SINUMERIK System 3
Basic Version 4C

Installation Guide

SINUMERIK

Edition 05.89

SINUMERIK®-Documentation

Key to Editions

The Editions listed below have been published prior to the current Edition.

The column headed "Amendments" lists the amended sections, at all times with reference to the previous Edition.

Edition	Order No.	Amendments
05.89	6ZB5 410-0CH02-0AA0	New edition

SINUMERIK System 3
Basic Version 4C

Installation Guide

Edition 05.89

Contents

0 Preliminary Notes

This Installation Guide and the check lists cover the following numerical controls:

- SINUMERIK 3M (Milling)
- SINUMERIK 3T (Turning)

This Installation Guide is valid for:

- Basic model 4A up to software version C08
- Basic model 4B up to software version D06
- Basic model 4C up to software version E02

Remark:
The basic models 0 to 3 of SYSTEM 3 are covered by Commissioning Instructions, "Part 1".

Chapter 1

-Commissioning checklists-

Contents

Serial No.

SINUMERIK SYSTEM 3

SINUMERIK 3T ☐ 3TT ☐ 3M ☐

Basic model ☐

Number of NCs ☐

Checklist valid for NC-No. ☐

1.1 Checklist

Pay attention to the MOS-precaution instructions given on page 3-1!
This check list or a copy of it should be filled in and left with the log book of the control.
Tick the appropriate "yes" after each section has been completed.
Enter all required values where stated.
Further explanations to each section of the check list can be found in the Commissioning Instructions.

First commissioning:			Second commissioning:		
Name:	Siemens department:	Date: from	Name:	Siemens department:	Date: from
Customer:	Location:	to	Customer:	Location:	to

Checks to be carried out:

1. Are the prerequisites for commissioning fulfilled ? yes ☐

2. Visual checks: Mains supply, EMERGENCY OFF, earthing, position encoders, cabling, screening, operator panel, overall machine and control condition. yes ☐

3. a) NC system software identification
   b) PLC basic interface program

4. Input voltage checks:

   Input voltage to internal power supply unit: 03500 — V.D.C.
   Input voltage to operator panel: 03780/03730 — V.D.C.

   Input voltage to load power supply: — Single phase V.D.C. / Three phase V.A.C.

5. Are all vital machine data entered ? yes ☐
   (e.g. axis travel limits, feedrates, rapid traverse speeds, spindle speed)

6. Are the position control loops for the axes commissioned ? yes ☐
Axis speed, tacho adjustment, multgain factor, closed-loop gain factor (kV factor), acceleration ramp, position control monitoring. analog spindle speed.
Are all these settings adjusted and checked ? yes ☐

Optimization of the servo drives:

Axis	3TT	X1	Z1	X2	Z2
	3T/M	X	Y	Z	4th
Max. axis speed Vmax (mm/min or inch/min)					
Tacho adjustment Umax (V) at above Vmax					
kV factor (m/min/mm)					

7. Have all manual mode functions been tested ? yes ☐
Has a function check with a test tape (supplied by the customer) been carried out ? yes ☐

8. Generation of a punched tape or floppy disk and a printout in plaintext of the machine data yes ☐
Has a tape or floppy disk been left with the control ? yes ☐
Has a machine data printout been left inside the log book? yes ☐
Has the option list been completed as per delivery note and options entered in the log book ? yes ☐
Have any special hardware settings jumperings been made and entered in the list provided and left in the log book? yes ☐
Has the customer been instructed on how to carry out the following tasks ?
Drift compensation
Adjustments of reference points
Backlash compensation
and how to enter these modified values into the machine data store and how to produce an updated tape/ floppy disk and printout yes ☐
Has the commissioning report been signed by the customer ? yes ☐
Has a copy of this check list been left inside the log book ? yes ☐

Signatures: First commissioning............................

Second commissioning........................

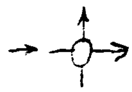
1.2 NC-machine data

This sheet should be completed even when a tape or floppy and on printout of the machine data are present at the machine.

MACHINE DATA SYSTEM 3T/3TT: basic model 4

In case of a 3TT fill in a separate list for NC1 and NC2.

No. *)	S.......	Description	Max. value +)	Dimension +)
100 101		Stop-position tolerance 1	32000	μm +)
110 111		Clamping tolerance	32000	μm +)
120 121		Acceleration	6000	0.01m/ s2 +)
130 131		Max. axis speed	24000	mm/min +)
140 141		Max. command value	2048/8192	Velo 1
150 151	1	kV factor	10000	0.01 s^{-1}
160 161		Positive software travel limit	± 99999999	μm
170 171		Negative software travel limit	± 99999999	μm
180 181		Reference point coordinates	± 99999999	μm
190 191		Backlash compensation	± 255	μm +)
200 201		Tool measurement reference coordinates	± 99999999	μm
210 211		Reference point shift	± 9999	μm +)
220 221		Multgain	32000	C x min/m
230 231		Drift compensation	± 500/2000	Velo 1 +)
240 241		Stop-position tolerance 2	32000	μm +)
250 251		Pitch error compensation value	99	μm +)
260 261		Reference pointer for p.e.comp.	1023	
270 271		Grid value for p.e. comp.	0.01	1 mm b. 320 mm +)
280 to 309		PLC machine data ref. to Section 1.3		
310		Lower limit for background memory input	99	
311		Upper limit for background memory input	99	
312		Subroutine no. for measuring value storage	999	



När maskinen ej söker ref-punkt korrekt
S

No.	S.......	Description	Max. value +)	Dimension +)
317		Distances of the tool tracks 1 to 8	± 9999999	µm
318				
319				
320				
321				
322				
323				
324				
325		Angle of inclination coordinate rotation	9000000	10^{-5} / degrees
326		Distance from machine zero point to transformation center	9999999	µm
327		Distance from fictitious zero point to transformation center	9999999	µm
328		Turret radius of the tool changer	9999999	µm
329		Turret radius of the C2-axis	9999999	µm
330		Assignment of the feed override values switch position 2 to 16	130	%
331				
332				
333				
334				
335				
336				
337				
338				
339				
340				
341				
342				
343				
344				
345		Software pre-limit switch	± 99999999	µm +)
346		Speed behind pre-limit switch	24000	mm/min
347		Reduced block and speed at G62	24000	mm/min
348		Feedrate jog-gauging	24000	mm/min
349		Cutoff speed rotary axes	24000	mm/min +)
350		Cutoff speed liniear axes	24000	mm/min +)

No.	S.......	Description	Max. value +)	Dimension +)
351		Speed threshold for contour monitoring	24000	mm/min +)
352		Tolerance band for contour monitoring	32000	mm · Test 850 125 1000
353		Delay time for position monitoring	16000	ms
354		Command value fault threshold	3000/12000	Velo 1
355		Circle end point tolerance band	32000	µm +)
356		Threshold for CRC block insertion at corners	32000	µm +)
357		Spindle drift	± 500	Velo 2
358		Dynamic smoothing exponent for thread cutting	5	
359		Max. spindle speed in the eight gear ranges	9999	1/min
360				
361				
362				
363				
364				
365				
366				
367		Tolerance band spindle speed	99	%
368		Tolerance band max. spindle speed	99 (100)	%
369		Tolerance band spindle speed at standstill	125	0,01 %
370		Max. spindle speed	9999	1/min
371		Jog feedrate	24000	mm/min +)
372		Jog rapid traverse speed	24000	mm/min +)
373		Speed reference point approach	24000	mm/min +)
374		Incremental feedrate	24000	mm/min +)
375		Dry run feedrate	24000	mm/min +)
376		Delay time for spindle drive inhibit	16000	ms

No.	S.......	Description	Max. value +)	Dimension +)
377		Minimum speed spindle motor	8192	Velo 2
378		Cutoff spindle speed at M19	9999	rev/min
379		Spindle position control loop gain at M19	10000	rev/min 360°
380		Spindle stop tolerance at M19	1000	1/11 degree
381		NC system software version	32000	
382		Limit for updated R parameter display	100	
383		Increase software sample period	30	1/2 ms
385		Second software limit in -X	± 99999999	

*) The 10°-decade of the machine data number 100 to 271 represents the axis number
..e.g..0 : X-axis
..   ..1.: Z-axis

+) See Section 7 for limits in degrees or inches.

The NC machine data lists must be filled in for each NC in the case of the 3TT.
In case of 3T/3TT with C-axis use the machine data lists of 3M.

No.	Bit 7	6	5	4	3	2	1	0
N 400S	0	0	0	0				
N 401S	0	0	0	0				
N 402S	0	0	0	0	0	0	0	0
N 403S								
N 404S								
N 405S	0	0	0	0	0	0	0	0
N 406S	0	0	0	0	0	0	0	0
N 407S								
N 408S								
N 409S	1	0		0	0		0	
N 410S								
N 411S								
N 412S								
N 413S								
N 414S		0	0	0	0		0	0
N 415S	1		1		1		1	
N 416S			0	1		1	1	1
N 417S								
N 418S	0	0	0	0	0	0	0	0
N 419S	0	0	0	0	0	0	0	0
N 420S								
N 421S								
N 422S	0	0	0	0	0	0	0	0
N 423S	0	0	0	0	0	0	0	0
N 424S								
N 425S								
N 426S								0
N 427S								
N 428S								
N 429S	0	0	0	0	0	0	0	0
N 430S	0							
N 431S	0							
N 432S	0	0	0	0	0	0	0	0
N 433S	0	0	0	0	0	0	0	0
N 434S	0	0	0	0	0	0	0	0
N 435S	0	0	0	0	0	0	0	0
N 436S	0	0	0	0	0	0	0	0
N 437S	0	0	0	0	0	0	0	0
N 438S	0	0	0	0	0	0	0	0
N 439S	0	0	0	0	0	0	0	0
N 440S			0		0	0	0	
N 441S	0	0	0	0	0	0	0	0
N 442S								
N 443S								
N 444S								
N 445S								
N 446S	0	0	0	0	0			
N 447S	0	0	0	0	0			
N 448S	0	0	0	0	0			
N 449S	0	0	0	0	0	0	0	0
N 500S to N 755S		for	pitch	error	comp.	(p.e.c.)		

Do not alter the fixed values given in the table.

(Complete these lists even when a tape or floppy and a printout of the machine data are present at the machine.)

MASCHINE DATA SYSTEM 3M, 3T/TT with C-axis Basic model 4

No. *)	S.......	Description	Max. value +)	Dimension +)
100		Stop-position tolerance 1	32000	µm +)
101				
102				
103				
110		Clamping tolerance	32000	µm +)
111				
112				
113				
120		Acceleration	6000	$0.01 m/s^2$ +)
121				
122				
123				
130		Max. axis speed	24000	mm/min +)
131				
132				
133				
140		Max. command value	2048/8192	VELO 1
141				
142				
143				
150		Kv factor	10000	$0.01 s^{-1}$
151				
152				
153				
160		Positive software travel limit	± 99999999	µm
161				
162				
163				
170		Negative software travel limit	± 99999999	µm
171				
172				
173				
180		Reference point coordinates	± 99999999	µm
181				
182				
183				
190		Backlash compensation	± 255	µm +)
191				
192				
193				
200		Tool measurement reference coordinates	± 99999999	µm
201				
202				
203				

No. *)	S.......	Description	Max. Value +)	Dimension +)
210		Reference point shift	± 9999	µm +)
211				
212				
213				
220		Multgain	32000	C x min/m
221				
222				
223				
230		Drift compensation	± 500/2000	VELO 1 +)
231				
232				
233				
240		Stop-position tolerance 2	32000	µm +)
241				
242				
243				
250	1	Pitch error comp. value	99	µm +)
251				
252				
253				
260		Reference pointer for p.e.c.	1023	
261				
262				
263				
270		Grid value for p.e.c.	32000	10µ
271				
272				
273				
280 bis 309		PLC machine data ref. to Section 1.3		
310		Lower limit for background memory input	99	
311		Upper limit for background memory input	99	
312		Subroutine no. for measuring value storage	999	
317		Distances of the tool tracks 1 to 8	± 9999999	µm
318				
319				
320				
321				
322				
323				
324				
325		Angle of inclination coordinate rotation	9000000	10^{-5} degrees
326		Distance from machine zero point to transformation center	9999999	µm

No.	S.......	Description	Max. value +)	Dimension +)
327		Distance fictitious zero point to transf. center	9999999	µm
328		Turret radius of the tool changer	9999999	µm
329		Turret radius of the C2-axis	9999999	µm
330		Assignment of the feed override values switc h position 2 to 16	130	%
331				
332				
333				
334				
335				
336				
337				
338				
339				
340				
341				
342				
343				
344				
345		Software pre-limit switch	± 99999999	µm +)
346		Speed behind pre-limit switch	24000	mm/min
347		Reduced block end speed at G62	24000	mm/min
348		Feedrate jog-gauging	24000	mm/min
349		Cutoff speed rotary axes	24000	mm/min +)
350		Cutoff speed linear axes	24000	mm/min +)
351		Speed threshold for contour monitoring	24000	mm/min +)
352		Tolerance band for contour monitoring	24000	mm • Test 850 / 125 • 1000
353		Delay time for stop position tolerance monitoring	16000	ms
354		Command value fault threshold	3000/12000	VELO 1
355		Circle end point tolerance band	32000	µm +)
356		Threshold for CRC block insertion at corners	32000	µm +)

No.	S.......	Description	Max. value +)	Dimension +)
357		Spindle-drift	± 500	VELO 2
358		Dynamic smoothing exponent for thread cutting	5	
359		Max. spindle speed in the eight gear ranges	9999	rev/min
360				
361				
362				
363				
364				
365				
366				
367		Tolerance band spindle speed	99	%
368		Tolerance band max. spindle speed	99 (100)	%
369	5 1	Tolerance band spindle speed at standstill	125	0.01 %
370		Max. spindle speed	9999	rev/min
371		Jog feedrate	24000	mm/min +)
372		Jog rapid traverse speed	24000	mm/min +)
373		Speed reference point approach	24000	mm/min +)
374		Incremental feedrate	24000	mm/min +)
375		Dryrun feedrate	24000	mm/min +)
376		Delay time for spindle drive inhibit	16000	ms
377		Minimum speed spindle motor	8192	VELO 2
378		Cutoff spindle speed at M19		rev/min
379		Spindle position control loop gain at M19		rev/min/360°
380		Spindle stop tolerance at M 19		1/11 degree
381		NC system software release	32000	
382		Limit for updated R parameter display	100	

No.	Value S.......	Description	Max. value +)	Dimension +)
383		Increase software sample period	30	1/2 ms
386		Acceleration time for the eight gear ranges	32000	4 ms
387				
388				
389				
390				
391				
392				
393				

, The 10^{0}-decade of the machine data number 100 to 273 represents the axis number.

e.g. ..0 : X-axis
..1 : Y-axis
..2 : Z-axis
..3 : 4th axis

+) For limits in degrees or inches, refer to Section 7.

MACHINE DATA BITS: 3M or 3T/TT with C-axis

No.	Bit 7	6	5	4	3	2	1	0
N 400S	0	0	0	0				
N 401S	0	0	0	0				
N 402S	0	0	0	0				
N 403S								
N 404S								
N 405S								
N 406S								
N 407S								
N 408S								
N 409S	1	0		0	0	0		0
N 410S								
N 411S								
N 412S								
N 413S								
N 414S		0	0	0	0			
N 415S	1				1			
N 416S		0				1	1	1
N 417S								
N 418S	0	0	0	0	0	0	0	0
N 419S	0	0	0	0	0	0	0	0
N 420S								
N 421S								
N 422S								
N 423S								
N 424S								
N 425S								
N 426S								0
N 427S								
N 428S		0	0					
N 429S	0	0	0	0	0	0	0	
N 430S	0							
N 431S	0							
N 432S	0							
N 433S	0							
N 434S	0	0	0	0	0	0	0	0
N 435S	0	0	0	0	0	0	0	0
N 436S	0	0	0	0	0	0	0	0
N 437S	0	0	0	0	0	0	0	0
N 438S	0	0	0	0	0	0	0	0
N 439S	0	0	0	0	0	0	0	0
N 440S			0		0	0	0	
N 441S	0	0	0	0	0	0	0	0
N 442S								
N 443S								
N 444S								
N 445S								
N 446S	0	0	0	0	0			
N 447S	0	0	0	0	0			
N 448S	0	0	0	0	0			
N 449S	0	0	0	0	0	0	0	0
N 500S to N 755S		for	pitch	error	comp.	(p.e.c)		

Do not alter the fixed values given in the table.

1.3 PLC MACHINE DATA for 3T/TT/M

No.	S.......	Description	max. value	Dimension
280		Reserved for standard function		
281		blocks (FBs)		
282				
284				
285				
286				
287		User area		
288		"		
289		"		
290		"		
291		"		
292		"		
293		"		
294		"		
295		"		
296		"		
297		"		
298		"		
299		"		
300		"		
301		"		
302		Reserve		
303				
304				
305				
306				
307				
308				
309				

PLC -MACHINE DATA BITS

No.	Bit							
	7	6	5	4	3	2	1	0
N 450S								
N 451S								
N 452S								
N 453S								
N 454S								
N 455S								
N 456S								
N 457S								
N 458S								
N 459S								
N 460S								
N 461S								
N 462S								
N 463S								

PLC -MACHINE DATA BITS for the USER

No.	Bit							
	7	6	5	4	3	2	1	0
N 464S								
N 465S								
N 466S								
N 467S								
N 468S								
N 469S								
N 470S								
N 471S								
N 472S								
N 473S								
N 474S								
N 475S								
N 476S								
N 477S								
N 478S								
N 479S								

1.4 Optional settings:
To be entered only if special settings are made.

Device	on P.C.B.	Standard settings	Special adjustments	
				Yes
20 mA-serial interface (TTY)	03840	NC = active source	NC passive	
Type of measuring probe output	03315/03316 03350/03351	Relay output or open collector Jumpers: o-[ ]-o 1.5k A B o o open C D o o open E H	for other probe outputs ref. to Section 8 (interface)	
Servo ready feedback signal	03320 03325/03326 03350/03351	Feedback signal available o o open P N	Feedback signal not used o——o P N	
Command value output	03325/03326 03350/03351	Command value ground connected to NC ground	other adjustments ref. to schematics	

1.5 ADDRESS CODING of the I/O-BOARDS:

OPTION	Type of I/O P.C.B.	rack-no.	slot-no.	Address range Byte-No.	Coding links

1.6 BUILT-IN OPTIONS according to delivery note

Present		Order Code	Options	T	TT	M	Available from Software version		
yes	no						4A	4B	4C
		A03	Circular axis (C-axis)	X	X	-	02	01	S
		A04	Fourth axis	-	-	X	01	01	01
		A13	C-axis for NC 2	-	X	-	02	01	01
		A70	Loader axes up to 240 m/min	X	X	X	-	01	S
		B02	Tape reader without reels	X	X	X	01	01	01
		B03	Tape reader with reels	X	X	X	01	01	01
		B05	NC without operator panel	X	X	X	02	01	01
		B06	Operator panel changeover	X	X	X	01	01	01
		B07	RS232/TTY changeover	X	X	X	01	01	01
		B08	Serial interface fan out	X	X	X	01	01	01
		B09	Op. panel fan out (training units)	X	X	X	01	01	01
		B10	Op. panel fan out f. 4 saddle m/c.	X	X	X	01	01	01
		B41	Metric/inch changeover	X	X	X	01	01	01
		B52	Block search without calculation	X	X	X	-	02	S
		B55	Measuring values printout	X	X	X	-	-	02
		B61	3 D interpolation	X	X	X	01	01	01
		B62	Circle radius programming	X	X	X	02	01	01
		B63	Polar coordinates	X	X	X	02	01	01
		B65	Coordinate transf. (TRANSMIT)	X	X	-	-	01	S
		B67	Rotated coord. system	X	X	-	-	01	S
		B68	Double TRANSMIT	X	X	-	-	01	S
		B69	Progr. coord. system rotation	X	X	X	-	03	01
		B70	Fixed cycles (milling, drilling)	-	-	X	01	01	01
		B73	Cylindrical milling	X	X	X	02	01	01
		B75	Blueprint programming	X	X	X	-	01	01

- not available X available S standard function

Built-in options according to delivery note:

Present		Order code	Options	T	TT	M	Available from Software version		
yes	no						4A	4B	4C
		B76	Read/load of system data	X	X	X	01	01	01
		B78	In-process ganging cycles	X	X	X	01	01	01
		B79	Gauging in JOG mode	X	X	-	-	01	S
		B80	Fixed cycles stored on disk	-	-	X	01	01	01
		B88	Gauging cycles stored on disk	X	X	X	01	01	01
		B90	Fixed cycles stored in NC	-	-	X	01	01	01
		B98	Measuring cycles stored in NC	X	X	X	01	01	01
		C33	Insertion of chamfers and radii	X	X	X	01	01	01
		C40	NC without PP memory	X	X	X	01	01	01
		C43	Extension of PP memory 16k	X	X	X	01	01	S
		C44	Extension of PP memory 32k	X	X	X	01	01	S
		C45	Extension of PP memory 64k	X	X	X	-	01	01
		C46	Extension of PP memory 128k	X	X	X	-	01	01
		C80	Expansion R parameter memory (5 pages @ 100 parameter)	X	X	X	-	-	02
		D22	Drilling cycles on disk	-	-	X	01	01	01
		D23	Drilling cycles stored in NC	-	-	X	01	01	01
		D27	Removal/threading cycles on disk	X	X	-	01	01	01
		D28	Removal/threading cycles in NC	X	X	-	01	01	01
		D29	Mould cycles on tape	-	-	X	-	-	01
		D30	Mould cycles on disk	-	-	X	-	01	01
		D31	Mould cycles in NC	-	-	X	-	01	01
		E31	Thread cutting G33/G63	S	S	X	01	01	01
		E35	Level- up threading	X	X	X	-	-	01
		E42	Oriented spindle stop M19	X	X	X	01	01	S

- not available X available S Standard function

Built-in options according to delivery note

Present		Order Code	Options	T	TT	M	Available from Software version		
yes	no						4A	4B	4C
		E44	High resolution turning	X	X	-	01	01	S
		E45	Incr. spindle pos. via PLC	X	X	X	-	03	01
		E60	FMS functions	X	X	X	-	01	01
		E93	Spindle speed set by electronic gear	X	X	X	-	01	01
		F05	Analog spindle speed	S	S	X	01	01	01
		F71	External data transfer NC-PLC	X	X	X	01	01	01
		H08	Expansion tool offsets	X	X	X	02	01	01
		H56	Pitch error comp. (p.e.c.)	X	X	X	03	01	01
		H82	Expansion zero offsets (12)	X	X	X	-	01	S
		J02	Monochromatic graphics	X X X	- - X	- X X	03 05 -	01 01 01	01
		J03	Colour graphics	X X X	- - X	- X X	03 05 -	01 01 01	01
		J04	12 inch monochromatic CRT	X	X	X	01	01	01
		J11	Operator guidance	X	X	X	01	01	01
		J12	Auto ZO and TO evaluation	X X	X X	- X	01 -	01 03	01
		J21	Display texts in English (retrofit)	X	X	X	01	01	01
		J22	Display texts in German	X	X	X	01	01	01
		J23	Display texts in French	X	X	X	01	01	01
		J24	Display texts in Italian	X	X	X	01	01	01
		J25	Display texts in Spanish	X	X	X	01	01	01
		J26	Display texts in Dutch	X	X	X		01	01
		J27	Display texts in Russian	X	X	X		02	01

- not available X availabl S standard function

Built-in options according to delivery note

Present		Order Code	Options	T	TT	M	Available from Software version		
yes	no						4A	4B	4C
		J28	Display texts in Swedish	X	X	X	-	05	01
		J84/85	Machine control panel	X	X	X	01	01	01
		K09	NC without measuring circuits	X	X	X	05	01	01
		K11	Integrated pulse shaping circuit in X: 10-fold	X	X	X	01	01	01
		K12	Integrated pulse shaping circuit in Y/Z: 10-fold	X	X	X	01	01	01
		K13	Integrated pulse shaping circuit in X2: 10-fold	-	X	-	01	01	01
		K14	Integrated pulse shaping circuit in Z210-fold	-	X	-	01	01	01
		K51	Integrated pulse shaping circuit in X: 5-fold	X	X	X	01	01	01
		K52	Integrated pulse shaping circuit in Y/Z: 5-fold	X	X	X	01	01	01
		K53	Integrated pulse shaping circuit in X2/Z: 5-fold	-	X	X	01	01	01
		K54	Integrated pulse shaping circuit in 4th: 5-fold	-	X	X	01	01	01
		N30	Internal dual PLC	X	X	X	03	01	01
		N32	PLC memory expansion 8k	X	X	X	01	01	01
		N34	PLC memory expansion 16k	X	X	X	01	01	01
		N35	PLC II in NC rack	X	X	X	01	01	01
		N39	PLC RAM memory 32kB	X	X	X	01	01	01
		N41	External Dual PLC	X	X	X	03	01	01
		N42	PLC not fitted	X	X	X	01	01	01
		N43	PLC in NC tier	X	X	X	01	01	01
		N60	Digital input board (32I): -420-3	X	X	X	01	01	01
		N65	Digital output board (32O): -445-3	X	X	X	01	01	01
		N70	Digital output board (16 O): -444-3	X	X	X	01	01	01

- not available   X available   S   standard function

Built-in options according to delivery note

Present yes	Present no	Order Code	Options	T	TT	M	Available from Software version 4A	4B	4C
		N81	I/O board, 48I, 24 O,03400	X	X	X	01	01	01
		N82	Output board, 16 O, 03460	X	X	X	01	01	01
		N83	Input board, 96 I, 03410	X	X	X	01	01	01
		N84	Output board, 48 O, 03421	X	X	X	01	01	01
		N85	I/O board, 32 I, 32 O, 03450	X	X	X	01	01	01
		N87	PCL link with 03845	X	X	X	01	01	01
		N90 [1]	Input board, 16 I, -432-3	X	X	X	01	01	01
		N91	EU-interface, replaced by N98 03-800 B	X	X	X	01	01	01
		N92	EU-interface, replaced by N98 03-300-3	X	X	X	01	01	01
		N93	CU-interface, replaced by N98	X	X	X	01	01	01
		N94	EU-interface, replaced by N98	X	X	X	01	01	01
		N96	CU-EU-interface, replaced by N98	X	X	X	01	01	01
		N97	03845 as PLC link, ref. to N87	X	X	X	01	01	01
		N98	03845 as CU-EU-link	X	X	X	01	01	01
		P03	PLC expansion unit	X	X	X	01	01	01
		P23	Power supply for PLC-EU	X	X	X	01	01	01
		U01	NC systemset T on location 1	X	X	-	01	01	01
		U02	NC systemset M on location 1	-	-	X	01	01	01
		U10	No NC set fitted on location 2	X	-	X	01	01	01
		U11	NC system set on location 2	-	X	-	01	01	01

- not available X available S standard function

Built-in options according to delivery note

Present		Order Code	Options	T	TT	M	Available from Software version		
yes	no						4A	4B	4C
		U12	NC system set M on location 2	-	-	X	01	01	01
		U21	NC operator panel 3T	X	X	-	01	01	01
		U22	NC operator panel 3M	-	-	X	01	01	01
		U51	Machine control panel T	X	X	-	01	01	01
		U52	Machine control panel M	-	-	X	01	01	01

- not available X available S standard function

Chapter 2

-Lists and tables-

Contents

2.1 NC standard machine data bits:

These bits and the standard machine data (Section 2.2) as well can be set simultaneously by means of an input routine. (For the operation sequence, see Section 4).

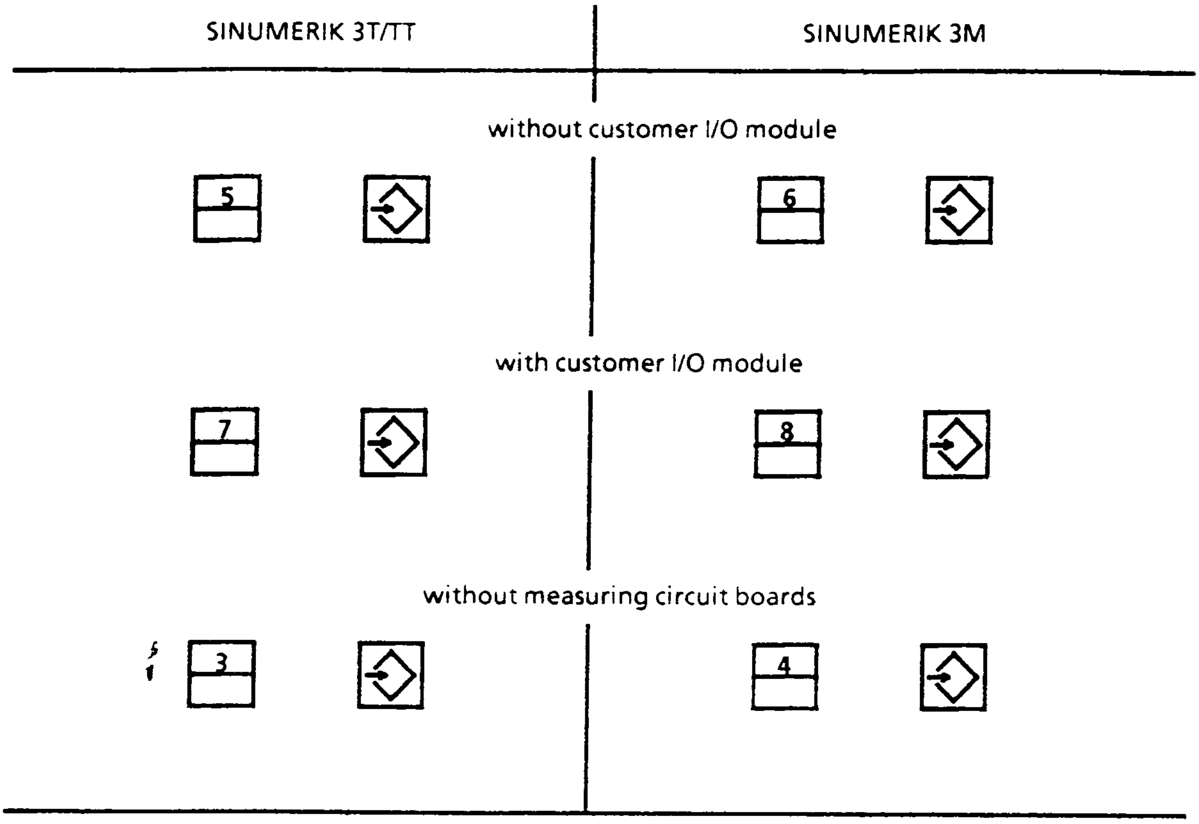
SINUMERIK3T/3TT

Machine data bits

Nr.	Bit							
	7	6	5	4	3	2	1	0
N 400S	0	0	0	0	0	1	0	0
N 401S	0	0	0	0	0	0	1	1
N 402S	0	0	0	0	0	0	0	0
N 403S	0	0	0	0	0	0	0	0
N 404S	0	0	0	0	0	0	0	0
N 405S	0	0	0	0	0	0	0	0
N 406S	0	0	0	0	0	0	0	0
N 407S	0	0	0	0	0	1	0	0
N 408S	0	0	0	0	1	0	0	1
N 409S	1	0	1	0	0	1	0	0
N 410S	1	1	1	1	1	1	1	1
N 411S	1	1	0	0	0	0	1	0
N 412S	1	1	0	0	0	0	1	0
N 413S	0	0	0	0	0	0	0	0
N 414S	0	0	0	0	0	0	0	0
N 415S	1	0	1	0	1	0	1	0
N 416S	0	0	0	0	0	1	1	1
N 417S	*	0	0	0	0	0	0	*)
N 418S	0	0	0	0	0	0	0	0
N 419S	0	0	0	0	0	0	0	0
N 420S	0	0	0	0	0	0	0	0
N 421S	0	0	0	0	0	0	0	0
N 422S	0	0	0	0	0	0	0	0
N 423S	0	0	0	0	0	0	0	0
N 424S	0	0	0	0	0	0	0	0
N 425S	0	0	0	0	0	0	**	0
N 426S	0**)	0	0	0	0	0	0	0
N 427S	0	0	0	0	0	0	0	0
N 428S	0**)	0	0	0	0	0	0	0
N 429S	0	0	0	0	0	0	0	0
N 430S	0	0	0	0	0	0	0	0
N 431S	0	0	0	0	0	0	0	0
N 432S	0	0	0	0	0	0	0	0
N 433S	0	0	0	0	0	0	0	0
N 440S	0	0	0	0	0	0	0	0
N 441S	0	0	0	0	0	0	0	0
N 442S	0	0	0	1	0	1	1	1
N 443S	0	0	1	1	0	1	1	0
N 444S	0	0	1	1	0	0	0	1
N 445S	0	1	1	0	0	0	1	1
N 446S	0	0	0	0	0	0	0	0
N 447S	0	0	0	0	0	0	0	0
N 448S	0	0	0	0	0	0	0	0
N 449S	0	0	0	0	0	0	0	0
N 500S to N 755S		for	opt.	p.e.c	only			

Machine data bits

Nr.	Bit 7	6	5	4	3	2	1	0
N 400S	0	0	0	0	1	0	1	1
N 401S	0	0	0	0	0	0	1	1
N 402S	0	0	0	0	0	1	1	0
N 403S	0	0	0	0	0	0	0	0
N 404S	0	0	0	0	0	0	0	0
N 405S	0	0	0	0	0	0	0	0
N 406S	0	0	0	0	0	0	0	0
N 407S	0	0	0	0	0	0	0	0
N 408S	0	0	0	0	1	0	0	1
N 409S	1	0	0	0	0	0	0	0
N 410S	1	1	1	1	1	1	1	1
N 411S	1	1	0	0	0	0	1	0
N 412S	1	1	0	0	0	0	1	0
N 413S	0	0	0	0	0	0	0	0
N 414S	0	0	0	0	0	0	0	0
N 415S	1	0	0	0	1	0	0	0
N 416S	0	0	0	0	0	1	1	1
N 417S	*	0	0	0	0	0	0	*)
N 418S	0	0	0	0	0	0	0	0
N 419S	0	0	0	0	0	0	0	0
N 420S	0	0	0	0	0	0	0	0
N 421S	0	0	0	0	0	0	0	0
N 422S	0	0	0	0	0	0	0	0
N 423S	0	0	0	0	0	0	0	0
N 424S	0	0	0	0	0	0	0	0
N 425S	0	0	0	0	0	0	**	0
N 426S	0**)	0	0	0	0	0	0	0
N 427S	0	0	0	0	0	0	0	0
N 428S	0**)	0	0	0	0	0	0	0
N 429S	0	0	0	0	0	0	0	0
N 430S	0	0	0	0	0	0	0	0
N 431S	0	0	0	0	0	0	0	0
N 432S	0	0	0	0	0	0	0	0
N 433S	0	0	0	0	0	0	0	0
N 440S	0	0	0	0	0	0	0	0
N 441S	0	0	0	0	0	0	0	0
N 442S	0	0	0	1	0	1	1	1
N 443S	0	0	1	1	0	1	1	0
N 444S	0	0	1	1	0	0	0	1
N 445S	0	1	1	0	0	0	1	1
N 446S	0	0	0	0	0	0	0	0
N 447S	0	0	0	0	0	0	0	0
N 448S	0	0	0	0	0	0	0	0
N 449S	0	0	0	0	0	0	0	0
N 500S to N 755S		for	p.e.c	opti.	only			



Both keys must be pushed simultaneously on switch-on (NC-ON)

* Bit has to be set to "1" if the machine control panel is connected via customer I/O module.
Bit has to be set to "0" without customer I/O module fitted.

*) From software C03, D01 or E01 on: Bit 417/0 is set automatically to "1" = 14 Bit DAC

** To be set to "1" if no measuring circuit boards are fitted in the NC.

**) Automatically set with basic version 4C from E01 on.

2.2 Cancel operations and definition of the type of control

Machine data clear	2
User program memory clear (PP and SP)	3
Setting data clear (TO, ZO and the background memory cleared"!)	4
3T/TT without change of machine data	1
3M without change of machine data	2
3T/TT with standard machine data and without measuring circuit boards (starting from C05/D01/E01 on)	3
3M with standard machine data and without measuring circuit boards (starting from C05/D01/E01 on)	4
3T/TT with standard machine data	5
3M with standard machine data	6
3T/TT with standard machine data and customer I/O module	7
3M with standard machine data and customer I/O module	8

Important note: The service switch S1 on the front plate of PCB 03830 must be set to the corresponding number of the NC concerned prior to any cancel or input operations.
For operation sequence, refer to Section 4.

2.3 NC machine data list with standard machine data

AXIS-SPECIFIC MACHINE DATA (TEST)

Manual input (with automatic. set standard Values)	Designation	Input-reference system	Max. input-values	Dimension
10 * S 50	Stop-position tolerance 1 +)	MS	32000	µm
11 * S 200	Clamping tolerance +)	MS	32000	µm
12 * S 50	Acceleration +)	IS	6000	$0{,}01 m/s^2$
13 * S 10000	Max. axis speed +)	IS	24000 3)	mm/min
14 * S 8192	Max. command value	-	2048/8192 2)	VELO
15 * S 1666	Kv-factor	MS	10000	$0{,}01 s^{-1}$
16 * S .. + 9999999	Pos. software travel limit +)	MS	± 99999999	µm
17 * S .. - 9999999	Neg. software travel limit +)	MS	± 99999999	µm
18 * S 0	Ref. point coordinates +)	MS	± 99999999	µm
19 * S 0	Backlash comensation +)	MS	± 255	µm
20 * S 0	Tool measurement reference coordinates +)	IS	± 999999999	µm
21 * S 0	Reference point shift +)	MS	± 9999	µm
22 * S 2400	Multgain +)	MS	32000	C x mm/min
23 * S 0	Drift compensation	-	± 500/2000 2)	VELO 1
24 * S................50	Stop position toler. 2 1) +)	MS	32000	µm
25 * S 0	Pitch error compensation value +)	MS	99	µm
26 * S 0	Reference pointer p.e.c.	1023	-	
27 * S 0	Grid value p.e.c. +)	MS	32000	10 µm

axis allocation:

*	3T	3M
0	X-Achse	X-Achse
1	Z-Achse	Y-Achse
2	-	Z-Achse
3	-	4.-Achse

+) For limits and dimensions in degree or inch see machine data description (Section 7)

1) From software version on C02

2) With 14 bit DAC

3) For max. speeds > 24m/min refer to section 7

MS Input units refer to measuring system

IS Input units refer to input system

VELO = Velocity unit (DAC unit)

General machine data (Test)

Manual input (with automatically set standard values)	Designation	Input reference system	Max. input value	Dimension
310 S..................0	Lower limit for background memory input 7)	-	99	-
311 S..................0	Upper limit for background memory input 7)	-	99	-
312 S..................0	Subroutine number for measuring value storage	-	999	-
317 S..................0	Distance tool track 1 Z'-axis	IS	± 9999999	µm
318 S..................0	Distance tool track 2 Z'-axis	IS	± 9999999	µm
319 S..................0	Distance tool track 3 Z'-axis	IS	± 9999999	µm
320 S..................0	Distance tool track 4 Z'-axis	IS	± 9999999	µm
321 S..................0	Distance tool track 5 Z'-axis	IS	± 9999999	µm
322 S..................0	Distance tool track 6 Z'-axis	IS	± 9999999	µm
323 S..................0	Distance tool track 7 Z'-axis	IS	± 9999999	µm
324 S..................0	Distance tool track 8 Z'-axis	IS	± 9999999	µm
325 S..................0	Inclination angle of coordinate system rotation	-	9000000	10^{-5} degrees
326 S..................0	Distance machine zero point to transf. center	IS	9999999	µm
327 S..................0	Distance fictions zero point to transf. center	IS	9999999	µm
328 S..................0	Turret radius of tool changer	IS	9999999	µm
329 S..................0	Turret radius of C2-axis	IS	9999999	µm

Manual input (with automatically set standard values)	Designation	Input reference system	max. input value	Dimension
330 S..................1	2nd swith position *)	-	130	%
331 S..................2	3rd switch position *)	-	130	%
332 S..................4	4th switch position *)	-	130	%
333 S..................6	5th switch position *)	-	130	%
334 S..................8	6th switch position *)	-	130	%
335 S................10	7th switch position *)	-	130	%
336 S................20	8th switch position *)	-	130	%
337 S................40	9th switch position *)	-	130	%
338 S................60	10th switch position *)	-	130	%
339 S................70	11th switch position *)	-	130	%
340 S................80	12th switch position *)	-	130	%
341 S................90	13th switch position *)	-	130	%
342 S.............100	14th switch position *)	-	130	%
343 S.............110	15th switch position *)	-	130	%
344 S.............120	16th switch position *)	-	130	%
345 S..................0	Softw. prelim. switch +) 1)	MS	99999999	µm
346 S..................0	Speed behind prelimit switch +) 1)	IS	24000	mm/min
347 S..................0	Red. block end speed at G62	IS	24000	mm/min
348 S..................0	Feedrate jog-gauging	IS	24000	mm/min
349 S..................0	Cutoff speed rotary axes +) 1)	IS	24000	degrees/min
350 S.............500	Cutoff speed linear axes +)	IS	24000	mm/min
351 S..................0	Speed threshold contour +) monitoring	IS	24000	mm/min
352 S..................0	Tolerance band for +) Contour monitoring	MS	32000	$\frac{\text{mm x Test x 850}}{\text{125x1000}}$
353 S.............500	Delaytime for position monitoring	-	16000	ms
354 S............2400 S............9600	Command value fault threshold	-	3000/ 12000 3)	VELO 1
355 S...............10	Circle end point +) tolerance band	IS	32000	µm

*) Feed override switch
Starting from C02, D01

Manual input (with automatically set standard values)	Designation	Input reference system	Max. input value	Dimension
356 S...............10	Threshold for CRC block insertion at corners +)	IS	32000	µm
357 S..................0	Spindle drift	-	± 500	VELO 2
358 S..................0	Dynamic smoothing exponent for thread cutting $(2^{x}-1)$ x Sample time	-	5	-
359 S.............500		-		
360 S...........1000		-		
361 S...........2000		-		
52 S...........4000	Max. spindle speed in	-	9999	1/min
363 S...........4000	the 8 gear ranges	-		
364 S...........4000		-		
365 S...........4000		-		
366 S...........4000		-		
367 S..................5	Tolerance band programmed spindle speed	-	99	%
368 S...............10	Tolerance band max. spindle speed	-	99 (100)	% (monitoring switch. off)
59 S...............50	Tolerance band spindle speed at standstill	-	125	0,01 %
370 S...........9999	max. spindle speed 1)	-	9999	1/min
71 S...........2000	Jog feedrate +)	IS	24000	mm/min
372 S..........10000	Jog rapid traverse speed +)	IS	24000	mm/min
373 S..........10000	Reference point approach speed +)	IS	24000	mm/min
374 S.............500	Incremental feedrate +)	IS	24000	mm/min
375 S...........2000	Dry run feedrate +)	IS	24000	mm/min

Manual input (with automatically set standard values)	Designation	Input reference system	Max. input value	Dimension
376 S............1000	Delay time for spindle drive inhibit	-	16000	ms
377 S..................0	Min. spindle motor speed	-	8192	VELO 2
378 S..................0	Cutoff spindle speed at M 19	-	9999	1/min
379 S..................0	Spindle position control loops gain at M 19	-	10000	1/min/360
380 S..................0	Spindle stop tolerance band at M19	-	1000	1/11 degrees
381 S....................	NC system software version [6]	-	(32000)	-
382 S................50	Limit for updated R parameter display	-	100	-
383 S..................0	Increase software sample period	-	30	1/2 ms
385 S-.....9999999	Second software limit in -X x) +)	MS	± 9999999[1]	µm
386 S..................0	Acceleration time for 1st gear	-	32000	4 ms
387 S..................0	Acceleration time for 2nd gear	-	32000	4 ms
388 S..................0	Acceleration time for 3rd gear	-	32000	4 ms
389 S..................0	Acceleration time for 4th gear	-	32000	4 ms
390 S..................0	Acceleration time for 5th gear	-	32000	4 ms
391 S..................0	Acceleration time for 6th gear	-	32000	4 ms
392 S..................0	Acceleration time for 7th gear	-	32000	4 ms
393 S..................0	Acceleration time for 8th gear	32000	4 ms	

VELO 1 = $\frac{10\,V}{2048}$ at 12 bit DAC

VELO 1 = $\frac{10\,V}{8192}$ at 14 bit DAC

VELO 2 = $\frac{10\,V}{8192}$ for spindle at both DAC types

1) Starting from software vers. C02
4) Starting from software vers.C03

3) At 12 bit DAC max. 3000
At 14 bit DAC max. 12000

The following machine data can be loaded via the PLC:

Nr. 120 - 123	
150 - 153	
160 - 163	
170 - 173	
180 - 183	1)
329	2)
370	1)
378	5)
379	5)
380	5)
386 - 393	5)
409 Bit 5	1)
410 Bit 3	8)
411 - 412	5)
420 - 423 Bit 4	9)
434 Bit 6	9)

1) Starting from software version C02
2) 4B only
5) 4B only starting from D03
7) 4B only starting from D06
8) 4C only starting from E01 on
9) 4C only starting from E02 on
x) 3T only
+) For limits and dimensions in degrees or inch refer to machine data descriptions (Section 7)

Valid software versions for	4A:	C01 to C08
" "	4B:	D01 to D06
" "	4C:	E01 to E02

6) Starting from D05 with 4B the value S.....33__(4B and software version) is displayed
For model 4C: S.....41__ (4C and software version) is displayed

2.4 NC-machine data bits (TEST)

◥ Active only after PORESET

No.		Bit 7	6	5	4	3	2	1	0
400S						Name of radius and chamfer etc. ①			
401S						Name of angle ①			
402S						Name of 4th axis ①			
403S	1st axis	Referencing not needed prior to start 1)	Part actual value times ten 1)	Rotary axis	Divide part actual value by 2	Part actual value times 2	Actual value sign change	Command value sign change	Ref. point approach in neg. direction
404S	2nd axis	Referencing not needed prior to start 1)	Part actual value times ten 1)	Rotary axis	Divide part actual value by 2	Part actual value times 2	Actual value sign change	Command value sign change	Ref. point approach in neg. direction
405S	3rd axis	Referencing not needed prior to start 1)	Part actual value times ten 1)	Rotary axis	Divide part actual value by 2	Part actual value times 2	Actual value sign change	Command value sign change	Ref. point approach in neg. direction
406S	4th axis	4th axis exists	Part actual value times ten 1)	Rotary axis	Divide part actual value by 2	Part actual value times 2	Actual value sign change	Command value sign change	Ref. point approach in neg. direction
407S		NC start enable without referencin				Spindle speed in 0.1 rev/min	Spindle encoder present	Spindle actual value sign change	Spindle actual value times two
408S		Fast stop at limit switches	input mode "Inch" (G70) setting ◥	◥	"Inch" measuring system ◥	Spindle control by NC	Aux. function output prior to move	Aux. function output at block search	
409S		NC machine data entered		Feedrate not related to contour			Diameter programming of x-axis at G90 (3T)		Axis move at tool comp. without being programmed
410S	Key switch locks	Data start in MDA	ZO data	TO data absolute value input	TO data wear value input	Program correction	Dry run feedrate	Block search	M, S, T, H editing
411S	V24 Input	Input device coding ⑤				Baudrate ⑥			
412S	V24 Output	Output device coding ⑤				Baudrate ⑥			
413S	@	Substitute EIA code for @							

No.		Bit 7	6	5	4	3	2	1	0
414S		RS 232 DC control signals without parity					Common NC ready reset 3TT	Name of axis parallel to 4th axis	
415S		CRC (3M) TNC (3T)		Analog spindle control		Teach-in Play back MDA		Threading and feed/rev.	
416S		Block end with CRLF	Display x-axis pos. in diameter (3T)		a29 Read/load of system par.		NC alarm texts display	Fixed cycles	Serial interface (RS232/TTY)
417S		Customer I/O module			Deceleratio to feed of next block	Spindle override effective at threading	Wear input in diameter (3T)	Measured Kv-factor	14 bit DAC
418S									
419S									
420S	1st axis	Rotary axis moduls 360 deg. 4)			No measuring circuit monitor-ing 1)	Rotary axis pos. display in 360 deg. 1)	Rotary axis pos. display in 256 times 360 deg. 1)	Rotary axis rounding to full degree 1)	Rotary axis rounding to half degree 1)
421S	2nd axis	Rotary axis moduls 360 deg 4)			No measuring circuit monitor-ing 1)	Rotary axis pos. display in 360 deg. 1)	Rotary axis pos. display in 256 times 360 deg. 1)	Rotary axis rounding to full degree 1)	Rotary axis rounding to half degree 1)
[illegible]2S	3rd axis	Rotary axis moduls 360 deg. 4)			No measuring circuit monitor-ing 1)	Rotary axis pos. display in 360 deg. 1)	Rotary axis pos. display in 256 times 360 deg. 1)	Rotary axis rounding to full degree 1)	Rotary axis rounding to half degree 1)
[illegible]3S	4th axis	Rotary axis moduls 360 deg. 4)			No measuring circuit monitor-ing 1)	Rotary axis pos display in 360 deg. 1)	Rotary axis pos. display in 256 times 360 deg. 1)	Rotary axis rounding to full degree 1)	Rotary axis rounding to half degree 1)
424S		Extended ZO memory 9)				Sign change of tool comp with G43/G44 1)			Simult. act. pos. display at 3TT 1)
425S					No text display "SIN 3" 2)	Progr. output without suffix 3)	Doubllle PLC 2)	Without measuring boards 3)	Without operator panel 1)

No.		Bit 7	6	5	4	3	2	1	0
426S		Block search without calculation 9)	Following error comp. 4)	No output of M17 4)					
427S		Diameter progr. not effective (3M Trainer) 6)			Contour feedrate only at inner circles 5)				
428S		Reduced servo sample time 8) 9)			No max. gear speed monitoring 8)	Exact stop at G64/G00 change-over 8)	Read. R par. out of display store 6)	M19 with cutoff spindle speed 6)	Tool track offsets effective 6)
429S		Double saddle display 9)			Fast auxilary function output 9) for T	for S	generally for M/S/T/H		
430S	1st axis		P.e. comp. in 0.5 μ	Time constant for command value at following error comp. 4)			Gain factor of the diff. part at following error comp. 4)		
431S	2nd axis		P.e. comp. in 0.5 μ 5)	Time constant for command value at following error comp. 4)			Gain factor of the diff. part at following error comp. 4)		
432S	3rd axis		P.e. comp. in 0.5 μ 5)	Time constant for command value at following error comp. 4)			Gain factor of the diff. part at following error comp. 4)		
433S	4th axis		P.e. comp. in 0.5 μ 5)	Time constant for command value at following error comp. 4)			Gain factor of the diff. part at following error comp. 4)		
434S		Clearing char. by char. of input line 10)	Inhibit spindle measuring circuit monitoring 10)			Data output without gaps between programs 9)	No NC-start enable at read in inhibit 9)	Data output without header (118 char.) 9)	No mirroring of tool length in X with 3T (as with 3M) 9)
435S									M19 acknowledge at trailing edge at spindle enable 10)
440S					Graphical simu. with aux. function output 2)				Coordinate system for vertical lathe 7)
441S									
442S		COLOUR DISPLAY AREA 2 2) 8				COLOUR DISPLAY AREA 1 2) 8			
443S		COLOUR DISPLAY AREA 4 2) 8				COLOUR DISPLAY AREA 3 2) 8			
444S		COLOUR DISPLAY AREA 6 2) 8				COLOUR DISPLAY AREA 5 2) 8			
445S		COLOUR DISPLAY AREA 8 2) 8				COLOUR DISPLAY AREA 7 2) 8			

No.		Bit 7	6	5	4	3	2	1	0
446S							Type of repr 5) XY (10)		
447S							Type of repr. 5) ZX (11)		
448S							Type of repr 5) YZ (12)		
500S		Comp. flag 3 2) (9)		Comp. flag 2 2) (9)		Comp. flag 1 2) (9)		Comp. flag 0 2) (9)	
bis									
755S		Comp flag 1023 2) (9)		Comp. flag 1022 2) (9)		Comp. flag 1021 2) (9)		Comp. flag 1020 2) (9)	

1) From C02 on
2) From C03 on
3) From C05 on
4) Model 4B only
5) Model 4B only, from D02 on
6) Model 4B only, from D03 on
7) Only with 4B, D01 and D02
8) Model 4B only, from D06 on
9) Model 4C only, from E01 on
10) Model 4C only, from E02 on

1 Address code for radius, chamber, tool radius, tool position and 4th axis

Bit 3	2	1	0	Name
0	0	1	1	A
0	1	0	0	B
0	1	0	1	C
0	1	1	0	U
0	1	1	1	V
1	0	0	0	W
1	0	1	1	P

3 Name of main axis parallel to 4th axis

Bit 1	0	Name
0	0	X
0	1	Y
1	0	Z

5 I/O device coding
Designation of the bits

Bit 7	6	Number of Stop bits
0	1	1 Stop-Bit
1	0	1 1/2 Stop-Bits
1	1	2 Stop-Bits

Bit 5	Parity
0	odd
1	even

Bit 4	Parity bit
0	no parity bit
1	with parity bit

Bit 3	'Device ready' check (DSR)
0	no
1	yes

6 Baud rate

Bit 2	1	0	Baud
0	0	0	110
0	0	1	150
0	1	0	300
0	1	1	600
1	0	0	1200
1	0	1	2400
1	1	0	4800
1	1	1	9600

7 Output of aux. functions at block search

1 Bit	0	Output
0	0	no output
0	1	after cycle start
1	0	during block search
1	1	-

8 Colour codes

0	0	0	black
0	0	1	red
0	1	0	green
0	1	1	yellow
1	0	0	dark-blue
1	0	1	violet
1	1	0	light-blue
1	1	1	white

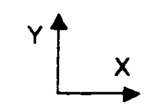
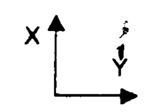
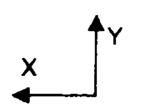
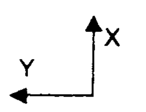
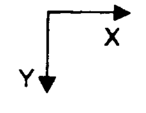
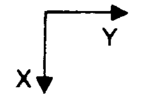
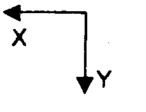
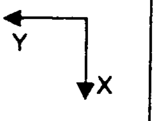
9 Pitch error comp. flags

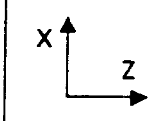
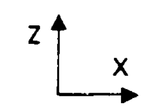
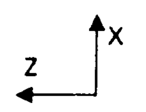
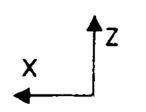
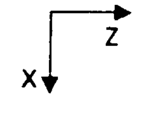
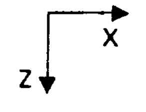
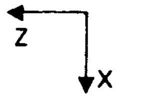
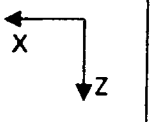
0	0	no comp.
1	1	pos. comp.
1	0	neg. comp.

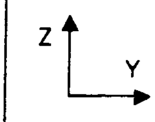
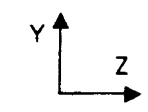
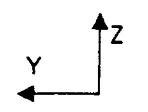
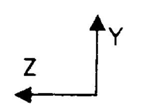
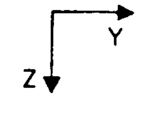
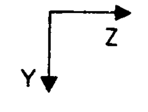
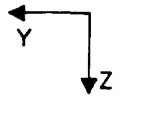
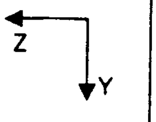
⑩ TYPE OF REPRESENTATION XY PLANE

⑪ TYPE OF REPRESENTATION ZX PLANE

⑫ TYPE OF REPRESENTATION YZ PLANE

BIT 210	Type of repr.
000	
001	
010	
011	
100	
101	
110	
111	

BIT 210	Type of repr.
000	
001	
010	
011	
100	
101	
110	
111	

BIT 210	Type of repr.
000	
001	
010	
011	
100	
101	
110	
111	

⑤ and ⑥: Selection of input/output device codings:

Machine data (Binary)								(HEX)	Devices
B7	B6	B5	B4	B3	B2	B1	B0		Universal devices
1	1	0	0	0	1	0	0	C4	FACIT 4040 with PI81 interface (1200 BAUD)
1	1	0	0	0	0	1	1	C3	FACIT 4070 with MI77 interface (600 BAUD) 54Ch/sec.
1	1	0	0	0	0	1	0	C2	PT80 Siemens Data Terminal Preset coding for STT104 interface (300 BAUD)
1	1	0	0	0	1	0	0	C4	SANYO M25020 Cassette Recorder with ZE601 interface (1200 BAUD)
1	1	0	0	0	1	0	0	C4	SME (1200 BAUD)
1	1	0	0	0	1	0	0	C4	NC <-----> NC link wire controlled (1200 BAUD)
1	1	0	0	0	1	0	0	C4	FACIT 4030 (1200 BAUD) 120 Ch/s
1	1	0	0	0	1	1	1	C7	Tape reader T40/T50
1	1	0	0	0	1	0	0	C4	PG 675/685
B7	B6	B5	B4	B3	B2	B1	B0		Special devices
0	0	0	0	0	0	0	0	00	Output: PT80 (300 BAUD) Input: Siemens tape reader
0	0	0	0	0	1	1	1	07	Siemens tape reader with or without reels (9600 BAUD)
0	0	0	0	1	1	1	1	OF	Siemens-Lochstreifenleser mit und ohne Wickler (9600 BAUD)
0	0	0	1	1	0	0	0	18	Teletype ASR-33 full duplex (110 BAUD) 10 Ch/sec.
0	0	1	0	0	1	1	0	26	FANUC- portable reader DC1/DC3 controlled (4800 BAUD)
0	0	1	1	0	1	1	0	36	FANUC programming work station (4800 BAUD)
0	0	1	0	0	1	0	0	24	NC <-----> NC link with control signals DC1 to DC4 (1200 BAUD)
0	0	1	0	0	1	1	1	27	FACIT 4040 with PI81 interface Control signals DC1 to DC4 (9600 BAUD)

2.5 Service parameter displays (Test)

Ident-No.	axis 3T	axis 3M	Display	Dimension metric	Dimension inch
800 S	X	X	Following error	µm	10^{-4} inch
801 S	Z	Y	"		
802 S	-	Z	"		
803 S	-	4.	"		
810 S	X	X	Actual pos. (meas. syst.)	µm	10^{-4} inch
811 S	Z	Y	" "		
812 S	-	Z	" "		
813 S	-	4.	" "		
820 S	X	X	Command value	VELO 1 2048/8192 VELO = 10 V	
821 S	Z	Y	"		
822 S	-	Z	"		
823 S	-	4.	"		
830 S	X	X	Part actual value	µm	10^{-4} inch
831 S	Z	Y	"	servo sample	
832 S	-	Z	"	time:	3T 8ms
833 S	-	4.	"	ser. sample time:	3M 9ms
840 S	X	X	Contour deviation	µm	10^{-4} Inch
841 S	Z	Y	"		
842 S	-	Z	"		
843 S	-	4.	"		
850 S	X	X	Measured Kv factor	0,001	0,001
851 S	Z	Y	"	m/min	inch/mi
852 S	-	Z	"	mm	n
853 S	-	4.	"		Zoll
860 S	-	-	Spindle command value	VELO 2	
861 S	-	-	Spindle position	$\frac{360°}{4096}$	

$$\text{VELO 1} = \frac{10\,\text{V}}{2048} \quad \text{with 12 bit DAC}$$

$$\text{VELO 1} = \frac{10\,\text{V}}{8192} \quad \text{with 14 bit DAC}$$

$$\text{VELO 2} = \frac{10\,\text{V}}{8192}$$

2.6 Setting data (user data)

2.6.1 Display and input of Zero Offset, Smax, M19, Setting Data Bits and R-Parameter

Input No.	Address	Display/Input		Sign	No. of decades		
1- 12 1)	X,Z Y,4.	Zero offset	X	±	8	μm	10^{-4} inch
13	X,Z Y,4.	Programmable zero offset G59	-	±	8	μm	10^{-4} inch
14	X,Z Y,4.	External zero offset (via PLC)	-	±	4	μm	10^{-4} inch
20	S	Spindle speed limitation G92	X	-	4	1/min	
22	S	Oriented spindle stop M19	X	+	4	0,5 degrees	
25	N	Setting data bits ref. to 2.6.2	X	-	8	-	
26 85	N	Setting data bits ref. to 2.6.3	X	-	8	-	
100 - 599	R	R-Parameter 3)	X	±	8	-	
600 - 699	H	Background memory 2) 3)	X	±	8	-	

1) Model 4A: 4 zero offsets only
Model 4B: up to 12 zero offsets

2) Model 4B from D06 on, model 4C from E01 on

3) Model 4C from E01 on:
VR- and H- parameters can be input and output via the RS 232 serial interface.
With model 4C only: optional 500 R-parameters (5 pages @ 100 R- parameters, page selection by @ 28 function)

2.6.2 Setting data bits no. 25 (user data)

Bit \ Input	0	1
7		
6	No block number prompting	Block number prompting on program input 3)
5	Punch tape in ISO code	Punch tape in EIA code
4	RS232 time monitoring active (Alarm 238)	RS232 time monitoring disabled 2)
3	Program start with %	Program start with LF
2	Tape block parity OFF	Tape block parity ON
1	Operator prompting OFF	Operator prompting ON
0	Actual pos. display with respect to machine zero ⊕ M	Actual pos. display with respect to workpiece zero *) ⊕ W

2.6.3 Setting data bits no. 26 (user data)

Bit \ Input	0	1
7		
6		
5		
4		
3	Display of fictitious actual pos. value 1)	Display of real actual pos. values 1)
2	Handwheel weighting increments per division 0	Handwheel weighting increments per division 100
1	Handwheel weighting increments per division 0	Handwheel weighting increments per division 10
0	Handwheel weighting increments per division 0	Handwheel weighting increments per division 1

From C02 on, the handwheel weighting can be edited via PLC.

*) With reference to work piece zero W, without zero offset and tool offset.
1) Model 4B and 4C only
2) Model 4C only, from E02 on
3) Model 4C only, from E01 on

Clear	Nr.: 3. decade / 1. + 2. decade	8	7	6	5	4	3	2	1
	00	Axis 1 Ref. value setting not possible 2)			Axis 1 Servo enable of an axis in motion removed			Axis 1 Limit switch -	Axis 1 Limit switch +
	01	2			2			2	2
	02	3			3			3	3
	03	4			4			4	4
	10	Axis 1 Pollution error measuring devices			Axis 1 Drift too high	Axix + s 1 Position control loop hardware *)	Axis 1 Contour monitor-ing	Axis 1 Command value too high	Axis 1 Stand still monitor-ing
	11	2			2	2	2	2	2
	12	3			3	3	3	3	3
	13	4			4	4	4	4	4
	22	Pollution error spindle encoder			Max. spindle speed too high 1)	Spindle pos. control loop hardware *)	Emergency stop	Servos not ready	
	23	Time monitor RS 232	Overflow 2 Reader hard-ware fault	Stop bit fault	Overflow	Parity	Control word overwritten	Overflow 1	Stop bit, Paritv fault
				← USART hardware fault	→	→	← READER hardware faults	→	→
	24							Temperature too high	

Clear	Nr.: 3. decade / 1. + 2. decade	8	7	6	5	4	3	2	1
	25		Block without LF or block >120 char.			Operator error RS232	Parity error in memory	Program not found in memory	Block not found in memory
	26						G35 F too large 4)		Block search: Block not found
	27	Memory overflow	Stored program ≠ prog. on tape	Wrong tape format	Tape input disabled	Block with more than 120 char.	Block parity error	Wrong EIA character	Char. parity error
	28	Subroutine fault	Wrong point of intersection						General decoding fault
	29		Wrong input parameters	Wrong block sequence	Wrong G02/G03	Wrong radius value	Wrong angle value	No intersection	Wrong input value
		← Faults originating from blueprint programming →							
	30	Circle end point error	No half or full degrees progr. with rotary axis 1).			Illegal ZO or TO values	Wrong progr. P-parameter at G92 1)	Option not available	Progr. circle not in selected plane
	31	Supplementary axis not possible 2)	Too many axes programmed	No F-word progr. or value too large		Wrong thread pitch progr.	Change of thread pitch too large 4)		
	32							Illegal program block with active CRC	
	33								
	34								
	35								NC start without referencing

Clear	Nr.: 3. decade / 1. + 2. decade	8	7	6	5	4	3	2	1
	50	Axis twice or too many axes programmed		CRC/TNC contour error	Fault up to blue print program	Wrong block structure	← Reparable program faults →	More than 6 geometry para	General operator error
	51	Software prelimit overrun 1)		Block cannot be displayed fully	Selected block no. not found	More than 120 char. in block	Memory overflow	Input disabled	Input only after reset
	52	Kv-factors not measured	Kv-factors not equal		Part program editing not permitted 5)		Stop at threading		Incorrect data transfer strobe signal
		Contour monitoring errors							
	53	General input error	Last program not terminated	In playback two axes only	Playback only at axes standstill	Playback only at MDA interrupt	Playback at 1st block not allowed	Program no. already existing	Block with more than 40 char.
		← MDA errors →							
	54								
	55							Wrong input parameter	Wrong input value
								Graphics errors	
System Restart	70							Wrong address code in MD	
	71								Battery alarm

*) to be cleared with PORESET only

** Input line (bottom line) must be cleared completely!

Alarms in the 70x group cannot be cleared with either CLEAR or RESET!
Alarms in the 71x group can be cleared with CLEAR key!

1) From C02 on
2) Model 4B only
3) From C03 on
4) Model 4B only, from D06 on
5) Model 4C only, from E01 on

NC Test No.	NC Test Byte	interface PLC-NC Data bit 7	6	5	4	3	2	1	0	PLC 3T DB20 / 3TT DB20/ ① DB22
7	0	Mode of operation switch D	C	B	A	Feed/rapid override switch D	C	B	A	DL 34
7	1	Key-operated switch	Dry run	Delete block	Single block	Block search	Spindle speed override C	B	A	DR 34
7	2	Override for rapid traverse effective	Rapid jog	Jog direction keys X +	X–	Z +	Z–	*Deceleration X	Servo enable X	DL 35
7	3		2nd software limit switch X-active	Data start	Reset	Handwheel X	NC start	*Deceleration Z	Servo enable Z	DR 35
8	4	Gear range coding C	B	A	Spindle clockwise	Spindle enable	Feed enable			DL 36
8	5	* Emergency stop	Read-in enable	Mirror image Z values	Mirror image X values	Axis inhibit	Operator panel inhibit			DR 36
8	6	Follow-up mode spindle2	Key board inhibit		Feed enable X 1)	Ref. value setting X 3)		Axis inhibit X 1)	Follow-up mode X 1)	DL 37
8	7	RS 232 inhibit	Key shift 1)	Fixed cycle lock	Feed enable Z 1)	Ref. value setting Z 3)		Axis inhibit Z 1)	Follow-up mode Z 1)	DR 37
9	8	Clear distance to go	Clear number of SR subroutine passes	In-process measuring						DL 38
9	9	Handwheel inhibit	NC type change over T/M 1)	Spindle re-referencing 2)						DR 38
9	10	ZO group coding 3) B	A	Tool track coding 3) C	B	A	G39 selection 3)		NC stop 5)	DL 44
9	11							Screen blanking 5)	Following error comp. 3)	DR 44

1) From C02 on
2) From C03 on
3) Model 4B only, from D01 on
4) Model 4C only, from E01 on
5) Model 4C only, from E02 on

① FOR NC1 DB20
NC2 DB22
NC3 DB24
NC4 DB26

NC		Interface NC-PLC								PLC
Test		Data bits								3T DB20 3TT DB20 ① DB22
No.	Byte	7	6	5	4	3	2	1	0	
10	0	Spindle Actual rotation clockwise	Speed above limits	Speed within limits	At standstill			Motion command Z	X	DL 39
10	1	Program running	NC alarm	NC ready 2	NC ready 1	Rapid traverse	Threading	Measuring probe actuated	Program halt M00	DR 39
10	2	Spindle position reached	G96 active	RS 232 running	NC type switched to T 1)			Reference point reached Z	X	DL 40
10	3					Spindle speed at limits 3)	G39 active 3)			DR 40
11	4	STROBE SIGNALS M	S	T	H			M02/M30 Reset		DL 41
11	5	BCD output D 10^1	C 10^1	B 10^1	A 10^1	D 10^0	C 10^0	B 10^0	A 10^0	DR 41
11	6	BCD output D 10^3	C 10^3	B 10^3	A 10^3	D 10^2	C 10^2	B 10^2	A 10^2	DL 42

1) From C02on
2) Model 4B only, from D01 on

① FOR NC1 DB20
NC2 DB22
NC3 DB24
NC4 DB26

NC Test No.	NC Test Byte	Interface PLC-NC Data bits 7	6	5	4	3	2	1	0	PLC 3M DB20 ①
7	0	Mode op operation switch D	C	B	A	Feed/rapid traverse override switch D	C	B	A	DL 34
7	1	Key-operated switch	Dry run	Delete block	Single block	Block search	Spindle speed override C	B	A	DR 34
7	2	Override for rapid traverse effective	Rapid jog	Direction keys +	–	Axes selector switch B	A	*Deceleration X	Servo enable X	DL 35
7	3	4^{th} axis = main axis		Data start	Reset		NC start	*Deceleration Y	Servo enable Y	DR 35
8	4	Gear stage coding C	B	A	Spindle rotation clockwise	Spindle enable	Feed enable	*Deceleration Z	Servo enable Z	DL 36
8	5	* Emergency stop	Read-in enable	Mirror image Y values	Mirror image X values	Axes inhibit	Operator panel inhibit	*Deceleration 4^{th} axis	Servo enable 4th axis	DR 36
8	6	Follow-up mode spindle 2	Key board inhibit	Mirror image Z values 1)	Feed enable X 1)	Ref. value setting X 3)		Axis inhibit X 1)	Follow-up mode X 1)	DL 37
8	7	RS 232 inhibit	Key shift 1)	Fixed cycle lock	Feed enable Y 1)	Ref. value setting Y 3)		Axis inhibit Y 1)	Follow-up mode Y 1)	DR 37
9	8	Clear distance to go	Clear number of subroutine passes	In-process measuring	Feed enable Z 1)	Ref. value setting Z 3)		Axis inhibit Z 1)	Follow-up mode Z 1)	DL 38
9	9	Handwheel inhibit		Spindle re-referencing 2)	Feed enable 4^{th} axis 1)	Ref. value setting 4^{th} axis 3)		Axis inhibit 4^{th} axis 1)	Follow-up mode 4th axis 1)	DR 38
9	10	ZO group coding 3) B	A						NC stop 5)	DL 44
9	11							Screen blanking 5)	Following error comp. 3)	DR 44

1) From C02 on
2) From C03 on
3) Model 4B only, from D01 on
4) Model 4C only, from E01 on
5) Model 4C only, from E02 on

① FOR NC1 DB20
NC2 DB22
NC3 DB24
NC4 DB26

NC Test No.	NC Test Byte	Interface NC-PLC: Data bits 7	6	5	4	3	2	1	0	PLC 3M DB20 ①
10	0	Spindle: Actual rotation clockwise	Speed above limits	Speed within limits	At stand-still	Motion command: 4th axis	Z	Y	X	DL 39
10	1	Program running	NC alarm	NC ready 2	NC ready 1	Rapid traverse	Threading	Measuring probe actuated	Program halt M00	DR 39
10	2	Spindle position reached		RS 232 running	Nc type switched to T 1)	Reference point reached: 4th axis	Z	Y	X	DL 40
10	3					Spindle speed at limits 3)		G38 active 3)	G37 active 3)	DR 40
11	4	STROBE SIGNALS: M	S	T	H			M02/M30 Reset		DL 41
11	5	BCD output: D 10^1	C 10^1	B 10^1	A 10^1	D 10^0	C 10^0	B 10^0	A 10^0	DR 41
11	6	BCD output: D 10^3	C 10^3	B 10^3	A 10^3	D 10^2	C 10^2	B 10^2	A 10^2	DL 42

1) From C02 on
2) Model 4B only, from D01 on

① FOR NC1 DB20
NC2 DB22
NC3 DB24
NC4 DB26

Group	Byte address NC1	NC2	NC3	NC4	Bit number 7	6	5	4	3	2	1	0
Ready signals	A64	A74	A84	A94	*Emergency stop	Operator panel inhibit	Key board inhibit	RS 232 inhibit	Fixed cycle lock	Handwheel inhibit	Reset	Data start
Influence on programs	A65	A75	A85	A95	NC start (ST)	Start enable (FRST)	Read-in enable		Cancel distance to go	Cancel no. of subroutine passes	Screen blanking 6)	Following error comp. 5)
Influence on feed rate	A66	A76	A86	A96	Feed enable							Handwheel X 1)
Influence on spindle	A67	A77	A87	A97	Gear stage coding C	B	A	Spindle rotation clockwise	Spindle enable	Spindle re-referencing 4)	Follow-up mode spindle 4)	
General axes signals	A68	A78	A88	A98	4th axis = main axis 2)	Mirror image 3) ③	②	①	NC type switch over to T 1)	In-process measuring	2.nd softw. limit switch active	General axis inhibit
Axis specific signals	A69	A79	A89	A99		Follow-up mode ① 3)	Axis inhibit ① 3)	*Deceleration ①	Feed enable ① 3)	Servo enable ①	Ref. value setting ① 5)	
	A70	A80	A90	A100		Follow-up mode ② 3)	Axis inhibit ② 3)	*Deceleration ②	Feed enable ② 3)	Servo enable ②	Ref. value setting ② 5)	
	A71	A81	A91	A101		Follow-up mode ③ 3)	Axis inhibit ③ 3)	*Deceleration ③	Feed enable ③ 3)	Servo enable ③	Ref. value setting ③ 5)	
	A72	A82	A92	A102		Follow-up mode ④ 3)	Axis inhibit ④ 3)	*Deceleration ④	Feed enable ④ 3)	Servo enable ④	Ref. value setting ④ 5)	
Influence on program	A73	A83	A93	A103	ZO group coding 5) B	A	Tool track coding 5) C	B	A	Selection G39 5)		NC stop 6)

		3T/TT	3M	3T + C
①	1st axis	X	X	X
②	2nd axis	Z	Y	Z
③	3rd axis	-	Z	-
④	4th axis	-	4.	C

1) With 3T/TT only
2) With 3M only
3) From C02 on: mirror image in Z axis possible (3M)
4) From C03 on
5) Model 4B only, from D01 on
6) Model 4C only, from E02 on

Group	Byte address				Bit number							
	NC1	NC2	NC3	NC4	7	6	5	4	3	2	1	0
Ready signals	E64	E74	E84	E94	Program running		NC-ready 2	NC-ready 1	RS 232 running			
	E65	E75	E85	E95			NC alarm					
Program commands	E66	E76	E86	E96	Measuring probe actuated	Threading G33 G63		Rapid traverse	v = constant G96 1)			
	E67	E77	E87	E97	Program halt M00	Prog. end M03/M30						
Spindle	E68	E78	E88	E98	Actual spindle rotation CW	above limits	Spindle within limits	Spindle position reached	Spindle at standstill			NC type switched to T
Axis-specific signals	E69	E79	E89	E99							Ref. point reached ①	Motion command ①
	E70	E80	E90	E100							Ref. point reached ②	Motion command ②
	E71	E81	E91	E101							Ref. point reached ③	Motion command ③
	E72	E82	E92	E102							Ref. point reached ④	Motion command ④
Program commands and spindle	E73	E83	E93	E103					Spindle speed at limits 2)	G39 active 2)	G38 active 2)	G37 active 2)

		3T/TT	3M	3T + C
①	1st axis	X	X	X
②	2nd axis	Z	Y	Z
③	3rd axis	-	Z	-
④	4th axis	-	4.	C

1) Only 3T/TT
2) Model 4B only

2.10 PLC machine data:

Ident-No.	Description	Max. input value (via NC)	
280	Standard-FB/s	+ 9999	
281		-"-	
282		-"-	
283		-"-	
284		-"-	
285		-"-	
286		-"-	
287	user	-"-	
288		-"-	
289		-"-	
290		-"-	
291		-"-	
292		-"-	
293		-"-	
294		-"-	
295		-"-	
296		-"-	
297		-"-	
298		-"-	
299		-"-	
300		-"-	
301		-"-	
302	Reserve	-"-	
303		-"-	
304		-"-	
305		-"-	
306		-"-	
307		-"-	
308		-"-	
309		-"-	

No.	Data bits								NC1	NC2	NC1	NC2
	7	6	5	4	3	2	1	0	DB 9		DB 20	DB 22
450											-	-*
451											-	-*
452		Reset-key at key inh. no active	T strobe acknowledge by user	M19 strobe expanded	M/S/T/H strobe ex- panded	Collective alarm PCB S5-432	Time alarms 10 s	2 s	DL 0	-	DL 95	-*
453	Time alarms 1 s	200 ms	100 ms	20 ms	10 ms	EGB service package 2)	No. of NCs ①		DR 0	-	DR 95	-*
454	No.	of	data block	for	Menu display		(binary coded)		DL 1	-	DL 96	-*
455		Ext. dual PLC	PLC key via flag O.1	Key assignment 3G	Menu for status progr. 1)	2nd I/O cus- tomer module	M.C.P. via I/O module Gray C, 5 bits	M.C.P. via I/O module I : 1, 4 bits	DR 1	-	DR 96	-*
456	PLC-MD entered 3)								DL 2	DL 36	DL 97	DL 97
457		Static M decoding	M.C.P. via flags	M.C.P. via inputs 1)			Standard S transfer 1)	Standard M decoding 1)	DR 2	DR 36	DR 97	DR 97
458									DL 3	DL 37	DL 98	DL 98
459								NC functions as ELG 2)	DR 3	DR 37	DR 98	DR 98
460		4)	4)	4)	4)	4)	4)	4)	DL 4	DL 38	DL 99	DL 99

No.	Data bits 7	6	5	4	3	2	1	0	NC1 DB 9	NC2 DB 9	NC1 DB 20	NC2 DB 22
461	4)	4)	4)	4)	4)	4)	4)	4)	DR 4	DR 38	DR 99	DR 99
462									DL 5	DL 39	DL 100	DL 100
463	4)	4)	4)	4)				4)	DR 5	DR 39	DR 100	DR 100
464	Machine data bits for user								DL 6	DL 40	DL 101	DL 101
465									DR 6	DR 40	DR 101	DR 101
466 bis 479	Machine data bits for user								DL 7 bis DR 13	DL 41 bis DR 47	DL 102 bis DR 108	DL 102 bis DR 108

MD = maschine data
M.C.P. = machine control panel
ELG = electronic gear

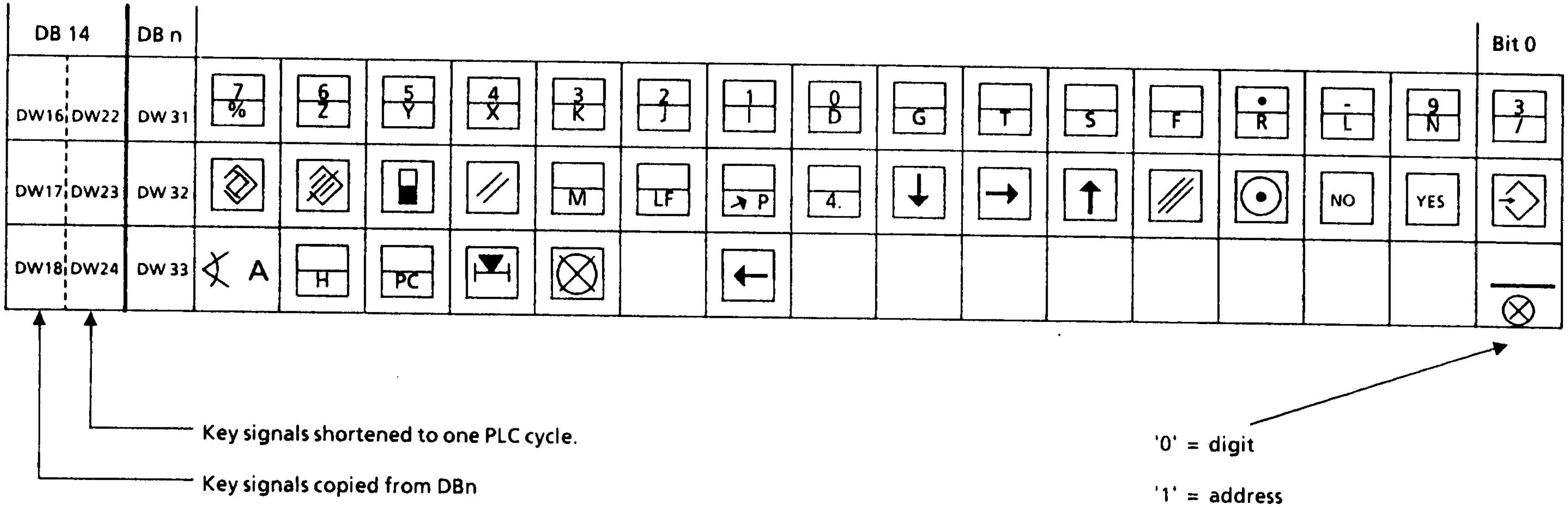
① 00 = 1 NC
01 = 2 NC
10 = 3 NC
11 = 4 NC

1) Presetting in the PLC by the basic interface program if no DB9 present or no MD in NC, automatically defaulted in NC with basic model 4C, from E01 on.
2) To be set in DB9 only
3) To be set in NC only
4) PLC-MD for computer coupling (refer to Interface Description, Part 2)

* Common machine data, in NC1 only DL/DR for NC3/NC4, refer to Section 7

2.12 Keyboard image

The key board image is updated every 50ms approx.



Chapter 3

-Commissioning prerequisites and visual inspections-

Contents

3.1 MOS precautions:

Materials such as carpets, rubber shoe soles etc. cause human beings to acquire a considerable static electrical charge of up to several thousand volts. Integrated circuits, especially the MOS-types, are very sensitive to such charges. For this reason, neither the integrated circuits nor the tracks on the P.C.B. should be touched before one has discharged oneself by touching some earthed metal parts of the machine.

The power must always be switched off before any printed-circuit boards or power supply lines are disconnected or connected.

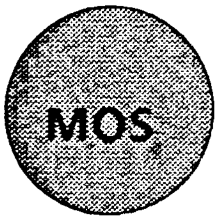
Even when the control is switched off VCCRAM is being supplied to certain RAM areas of memory from the backup battery and therefore care must be exercised when working on the control even when it is switched off. Do not short circuit the VCCRAM tracks, otherwise stored information in the CMOS memory e.g. Machine Data can be lost and the machine malfunctions.

MOS CAUTION! Pay attention to special MOS precautions!

MOS CAUTION! Pay attention to special MOS precautions!

Large-scale-integrated circuit manufacturing employs the MOS technology (Metal-Oxid-Semiconductor). The main advantages of the MoS-technology are:

- Simple realisation of transistor functions
- High density of circuits
- Extremely low power consumption



Identification label on the packaging

M O S Identification label on the P.C.B

ATTENTION!

Bs which carry the above label have MOS components fitted. To avoid damage of the MOS circuits, these P.C.Bs need to be handled with care. Prior to unpacking, the person must discharge himself by touching an earthed metal part of the machine. Store and carry the board without moving the conductive black rubber foam.

Do not wrap these boards in ordinary plastic sheeting.
Switch off power prior to fitting or removing boards.

3.2 Commissioning prerequisites

Before the control can be commissioned the customer should have attended to the following:

The relevant machine data must be available.

The electrical and mechanical installation of the machine should be completed.
The axes and the drives should be in a state for traversing (this should be confirmed by the customer) see note in Section 3.3.13. Have the drives been commissioned?

The interface controller and the user PLC program for the machine should be in working condition (in accordance with Interface Description) and connected to Machine and SINUMERIK (this should be conformed by the customer) see note in Section 3.3.13.

A visual check should ensure that the position measuring devices are mounted properly and the cables to SINUMERIK up correctly.

Cables to Interface controller and machine must be connected.
Special attention should be paid to the screening of the cables and its connection to the earth print of the control.

The flexible earth cables need to be the following size:(visual check)

from earthing bar of the interface to SINUMERIK	:	10 mm^2
from earthing bar of the interface to machine bed	:	10 mm^2
from SINUMERIK to operator panal	:	6 mm^2

A test program (test tape) should be supplied by the customer to check all machine-specific functions.

Customer's personnel should help with work at the Interface controller and machine, operation of the machine and the user PLC machine control program.

For safety reasons it is recommended to reduce the travel range by narrowing the mechanical limit switches.

If the encoder cables are split into sections by connecting plugs, check that all sections are properly connected and screened and that no part is under mechanical stress.

3.3 Supply voltages

3.3.1 Load power supply (when fitted)

Input: 3 phase 380/415 V/50/60 Hz

(Tolerance: + 10 % - 15 %)

Output: 24 V DC (Tolerance: 20 V to 30 V)

20 Amp. unit: Type 6EV 1350 - 5AK

40 Amp. unit: Type 6EV 1360 - 5AK

3.3.2 Control supply voltage

The NC logic, the PLC and the operator panel are designed to be supplied by an external 24 V DC power supply from the line voltage.

Current consumption of the internal power supply:

	3 T	3 M	3 T 4)	3 M 4)	3 TT
Input voltage rated value	24 V-	24 V-	24 V-	24 V-	24 V-
Input voltage range incl. ripple	20 to 30 V	20 to 30 V	20 to 30 V	20 to 30 V	20 to 30 V
Input capacitance	8100 µF	8100 µF	8100 µF	8100 µF	8100 µF
Current consumption NC-logic U_E = 20 V U_E = 24 V U_E = 30 V	1) I_E = 7.3 A I_E = 6.1 A I_E = 4.9 A	1) I_E = 7.7 A I_E = 6.4 A I_E = 5.2 A	I_E = 4.2 A I_E = 3.7 A I_E = 3.1 A	I_E = 4.7 A I_E = 3.9 A I_E = 3.4 A	I_E = 6.2 A I_E = 5.2 A I_E = 4.1 A
urrent consumption PLC-logic 3) U_E = 20 V U_E = 24 V $_E$ = 30 V	- - -	- - -	I_E = 3.3 A I_E = 2.9 A I_E = 2.3 A	I_E = 3.3 A I_E = 2.9 A I_E = 2.3 A	I_E = 3.3 A I_E = 2.9 A I_E = 2.3 A
Current consumption Operator panel 2) U_E = 20 V U_E = 24 V U_E = 30 V	$I_E \leq 2$ A	$I_E \leq 2$ A	$I_E \leq 2$A	$I_E \leq 2$ A	$I_E \leq 2$ A

1) Current consumption of the logic components NC + PLC without supply of the I/Os.

2) Without machine control panel

3) Current consumption of the PLC logic component without I/O boards

4) NC logic component with expansion subrack for additional I/O boards

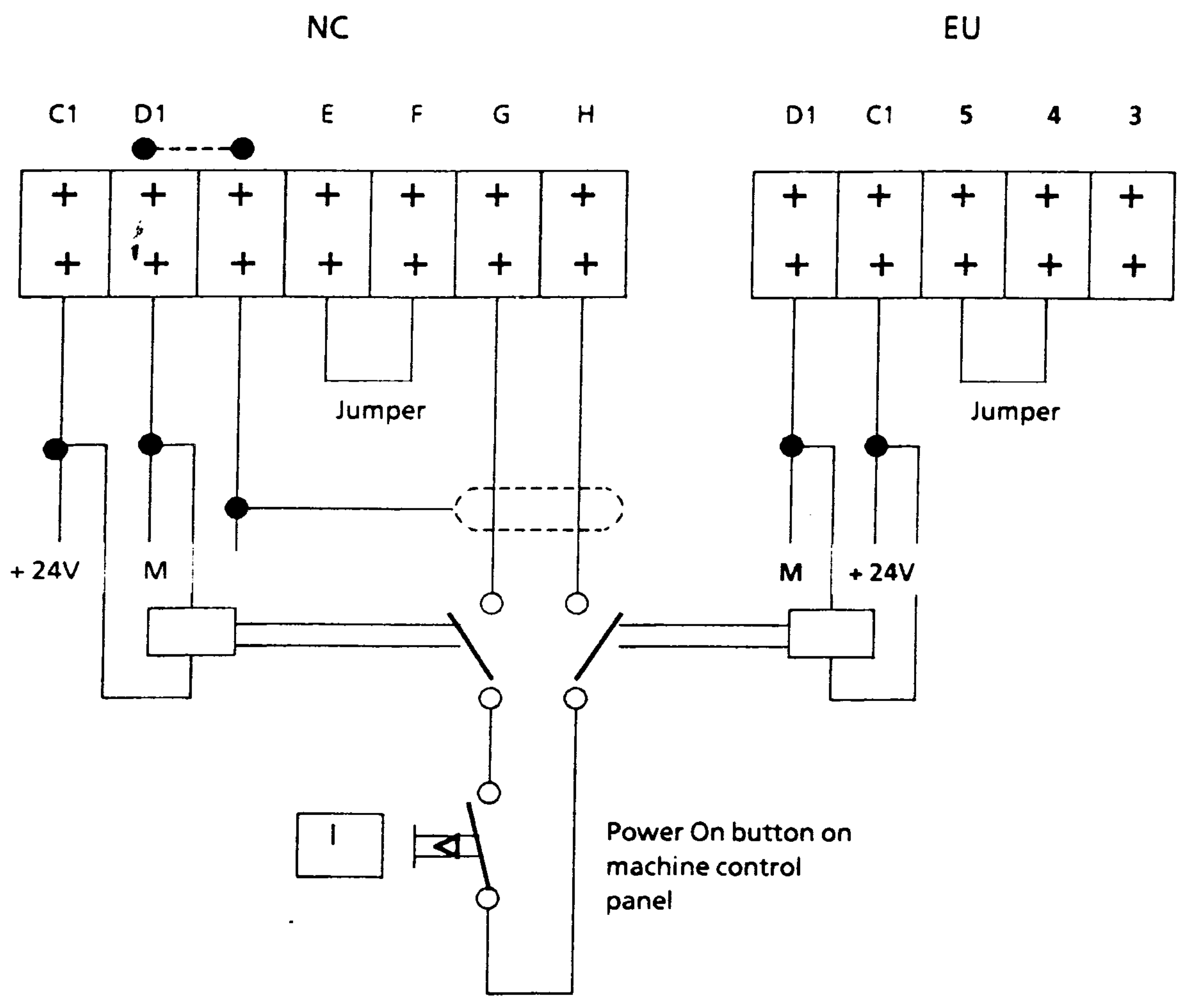
3.3.3 Power supply connections of the logic components

The external supply voltage is connected via terminal blocks on the front plate of the power supply 03500 in the NC.

Cable size : 1.5 mm² cross section for each wire.

If a multicore cable is used, all wires must be employed e.g. spare wires must be connected in parallel.

Cross section of the POWER ON line: 2x1 mm², shielded.



The input terminal D1 (0V) is connected internally with the chassis via the BUS.

<u>Note:</u>

When an external switching element is employed for POWER ON indead of the provided pushbutton on the control panel, it must <u>not</u> be a latching type of pushbutton or switch.

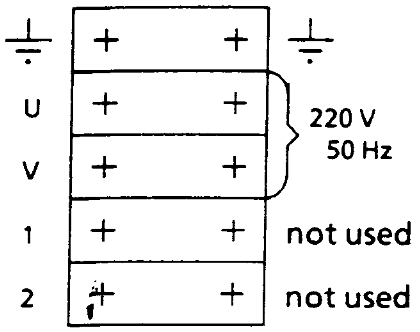
Terminal E-F may be used as an external ENABLE (e.g. floating contact of an auxiliary relay, fan monitoring etc.).

The terminals G or H must not be linked together in case of two or more logic racks (mutual influence !) (ref. to Interface Description, Part 2, Section 2).

3.3.4 Power supply for fan unit

Input voltage: 220 V. AC, 50 Hz.

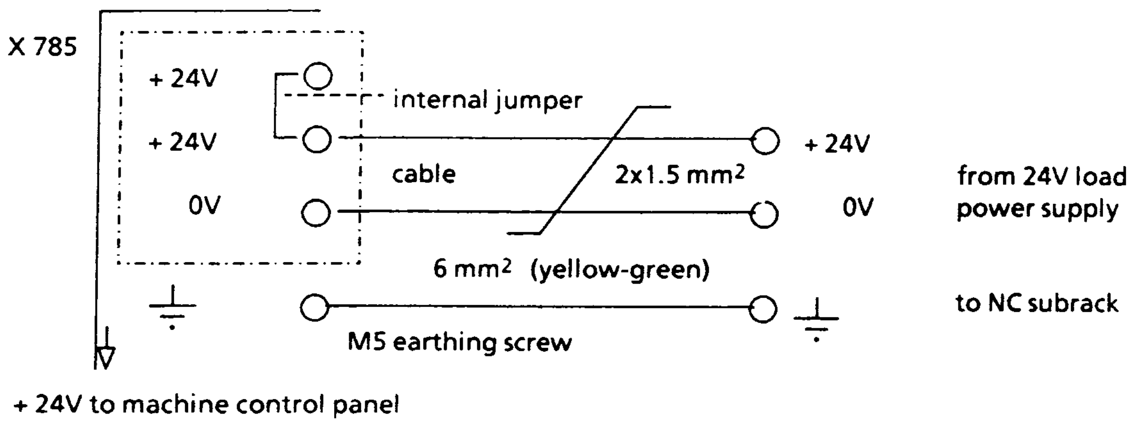
Terminal block X1



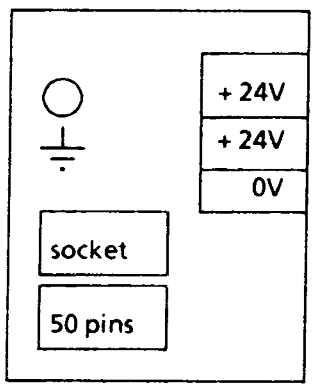
Note:
Terminal block X2 on the right hand side of the fan chassis is not used!

3.3.5 Power supply for operator panel

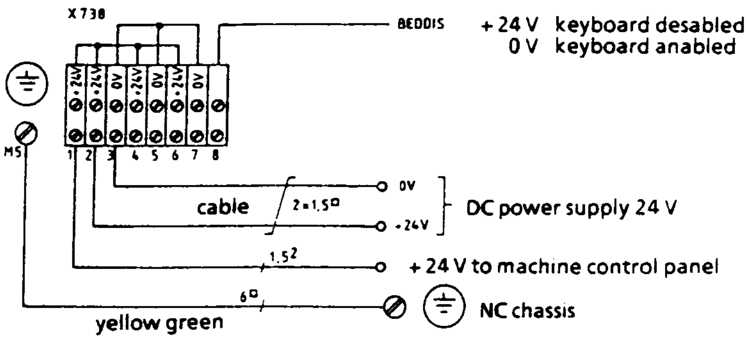
Connection of operator panel type 03780



Connection board on operator panel



Connection of operator panel type 03781:



Keyboard disable (BEDDIS) via terminal X738/8.

Attention!

Prior to switching on the power supply, the correct polarity of the supply voltage and the proper ground connection should be checked. Refer to Interface Description.

Wrong connection can damage ICs on operator panel and video interface board!

To avoid noise disturbances make sure the 6 mm^2 earth connection is made as per specifications (see above).

Connection of operator to NC logic:

Operator panel	PCB-Type	03731	03780
	24 V-plug	X738	X785
	50-pin plug	X781	X781
NC logic (video interface board)	PCB Type	03810	03810
	50-pin plug	X812	X812

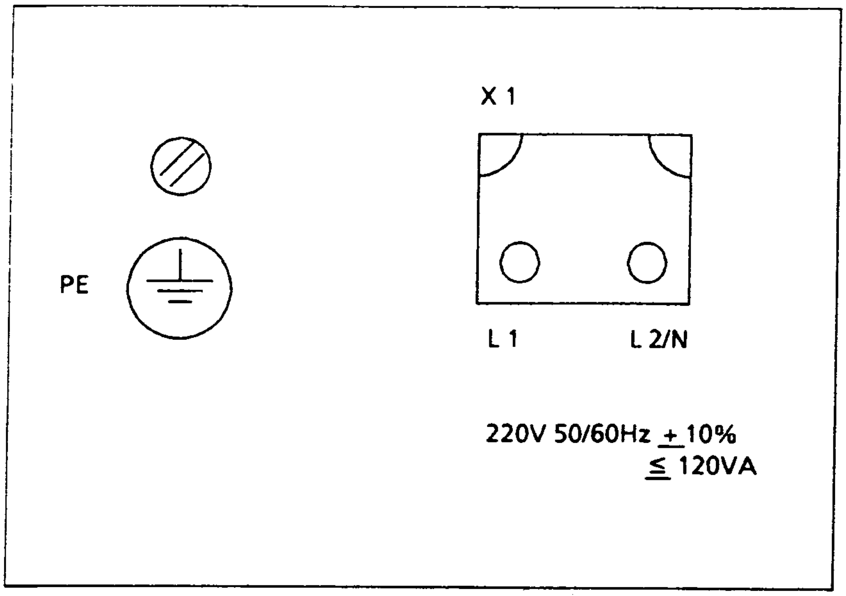
.3.6 <u>Machine control panel 03721:</u>

Supply voltage: 24 V DC. from operator panel via 6.3 mm faston connector.

.3.7 <u>Power supply for the colour monitor</u>

The operator panel logic PCB requires a 24 V DC supply.

The monitor needs an additional 220 V AC mains supply. The mains voltage is to be connected via the terminals L1/L2 located at the side of monitor housing.



3.4 Visual inspection

3.4.1 Earthing

Proper earthing to divert external noise is essential for trouble-free operation. It must be ensured that the earth wires are not kinked or looped and have the necessary cross-section (refer to Section 3.2).

3.4.2 Position encoders

Particular attention is to be paid to the specified installation of the sensitive linear scales (alignment etc.) and rotary encoders (coupling). Refer to Heidenhain Installation- and Calibration Instructions. Check for correct wiring and fixed location of the connectors. Other makes of position measuring devices may lead to problems in accuracy and surface finish beyond our control.

3.4.3 Cabling

Power and control cables should be separated. Do not produce earth loops ! Loops or non-correct earthing affect the speed command value in form of a hum. Smooth running of the servos at low speeds is then no longer possible.
Avoid kinks ! Proper running of the cables in the cable drags without mechanical stress must be observed.

3.4.4 Shielding

The overall shields of all cables running to or from the controller are to be earthed at the NC via the earth contacts in the connectors. Refer to Interface Description.

3.4.5 Operator panel

Check the function and condition of pushbuttons, keys, lamps, symbols, actual value and data displays etc.

3.4.6 Overall condition

Check the mounting of the modules, cover plates and connectors. Tighten screws of the module front plates and plugs. (earth connection).
Accessory pack:
Are the log book and the part list available ? (The part list comes with the delivery note and should be kept inside the log book).

When replacing modules or in the event of a fault, check all ICs in socket for correct location and fit.

Attention!

The 24 V DC power supply and the RAM memory board should only be taken out of the subrack in the event of a fault, otherwise stored data e.g. machine data, will be lost (battery is located in the power supply unit !)

3.4.7 Cables

Check all cables in correspondence with cable and equipment overview (to be found in the Interface Description). This applies particularly to cables produced by the customer. Random checks should be made on at least one connector (Pay particular attention to the conductive elastomer connections within the plug housings). If our specifications are not adhered to, inform the responsible sales department and instigate appropriate measures (refer to Interface Description).

3.5 Printed circuit board identification and rack assignment

3.5.1 General identification system

Machine-readable product designation (MLFB-No.)

Cross-reference key to MLFB-No. and GWE works internal drawing numbers.

e.g. CPU board 03161 for model 3GA4B

6 F X 1 1 2 5 - 8 A B 0 1

MLFB-No.

SINUMERIK PCB — 6FX11

sequential PCB-No. — 25-8

SINUMERIK Product "A"
GWE internal product groups — A

Assembly variant — B
A
B
C
.
.
.

sequential no.
of redesign — 01
00
01
02
.
.
.

Note:

Some of the earlier boards are still designated in the Commissioning Instructions according to the former type numbers.

For cross reference refer to Sections 9 and 12.

Former type designation

0	3	3	1	0		A	A

System-No.

Type of board a)

1 CPU

2 Memory

3 Measuring circuit

4 I/O module

5 Power supply

6 Back plane

7 Operator panel

8 Link module

9 -

0 Others

Sequence number for variations of a board 0...9 b)

Innovation No. 0...9

Assembly variants of a board A...Z

Level of redesign A...Z

a) If one board comprises a number of functions then the board will carry the identification number of the most significant function.

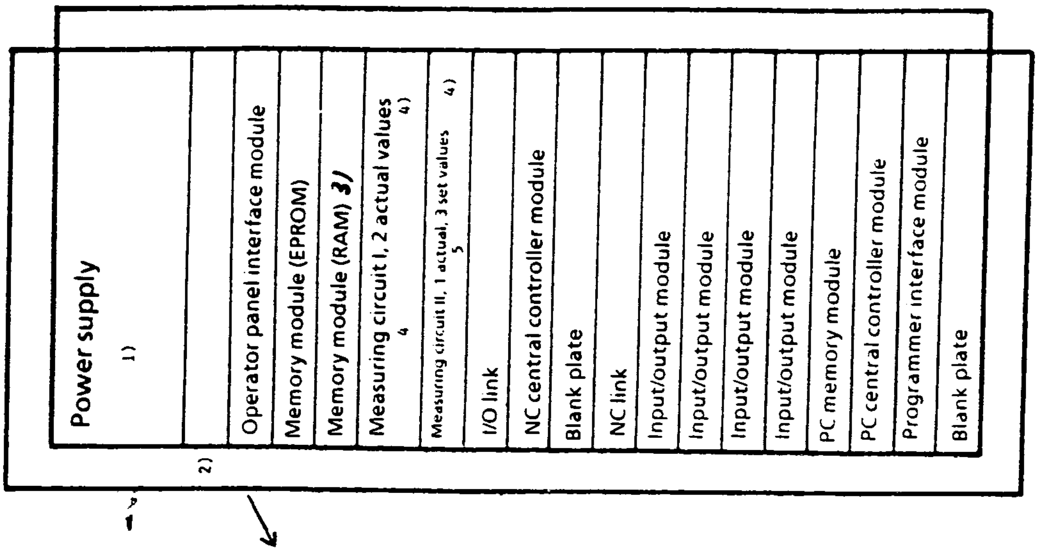
b) The innovation number is used additionally if the number of variants exceeds 10.

The example above demonstrates the identification system of the position control board 3 310 A. On the metal front plate generally the code 03 310 A/B is marked even when only the A-board is actually fitted. Then the two slots on the top right hand side are covered. This board can be employed for 3T or 3M without analog spindle. In the assembly variant 03 310 B, two boards are mounted piggyback to cater for a 3M with 4 axes and/or analog spindle.

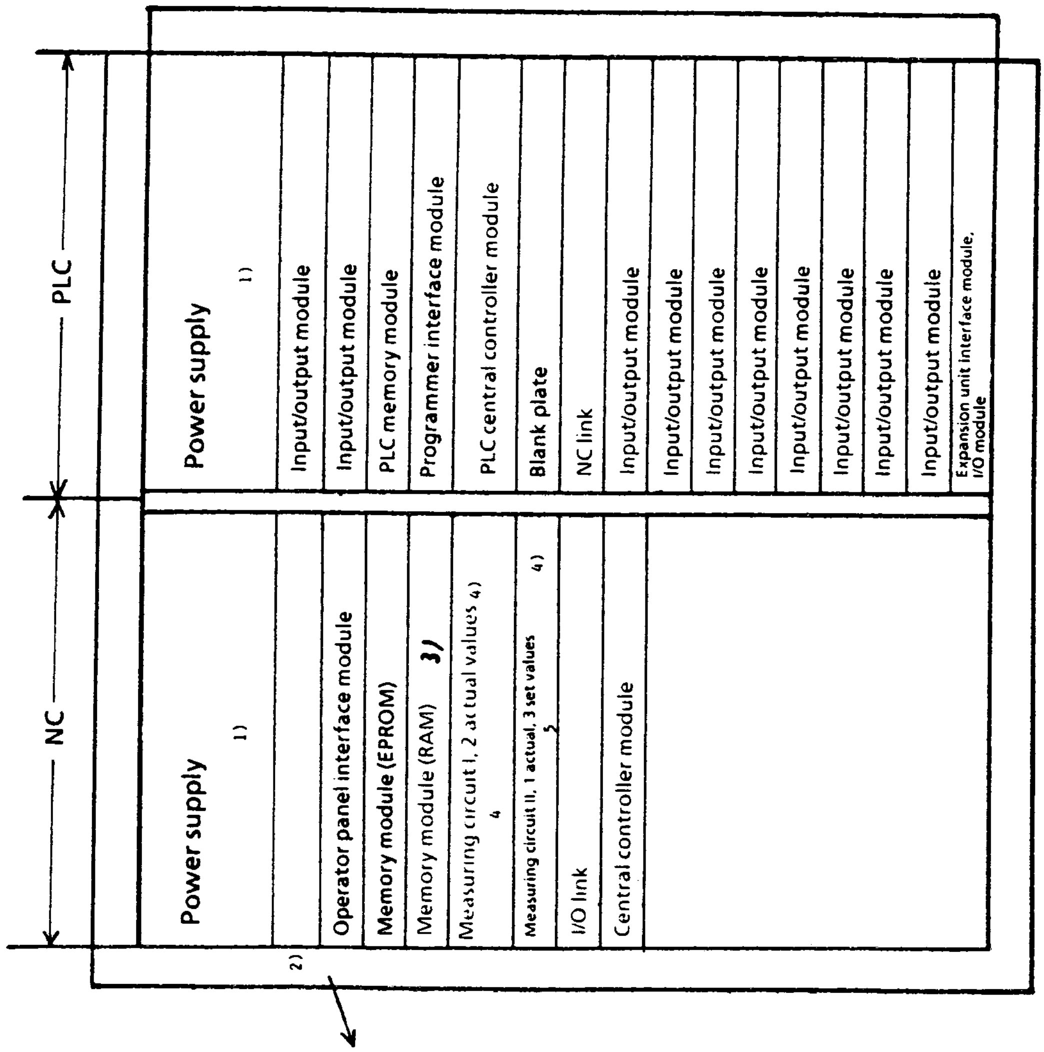
A labelling strip at the bottom of the rack shows the location of the boards.

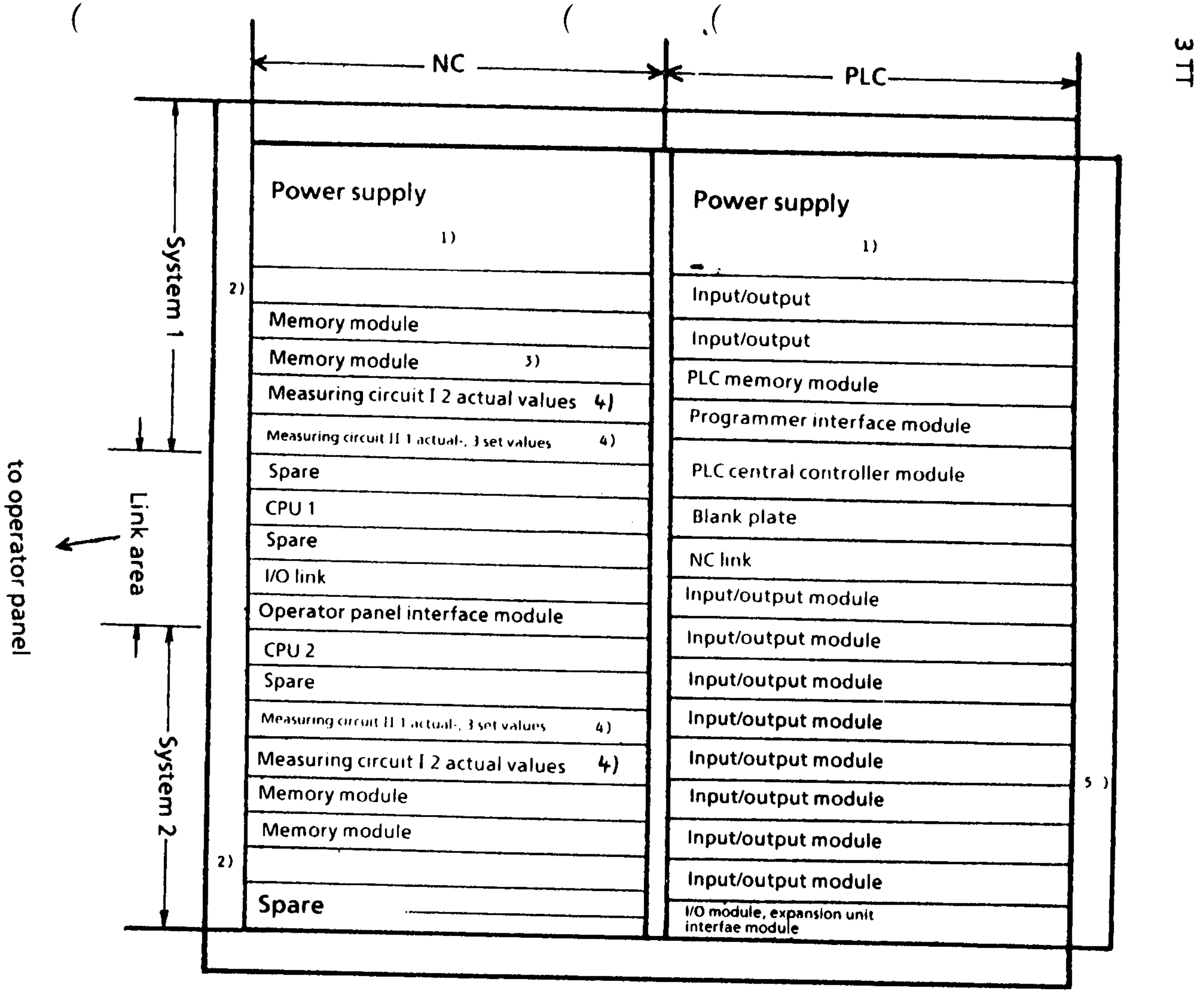
Hints for handling the boards are given in Section 3.1.

3.5.2 Rack assignment for model 4A 3T/M



3T/M with expanded I/O area (version -OHA)




NC
PLC
Power supply
1)
Power supply
1)
2)
Memory module
Memory module 3)
Measuring circuit I 2 actual values 4)
Measuring circuit II 1 actual-, 3 set values 4)
Spare
CPU 1
Spare
I/O link
Operator panel interface module
CPU 2
Spare
Measuring circuit II 1 actual-, 3 set values 4)
Measuring circuit I 2 actual values 4)
Memory module
Memory module
2)
Spare
Input/output
Input/output
PLC memory module
Programmer interface module
PLC central controller module
Blank plate
NC link
Input/output module
Input/output module
Input/output module
Input/output module
Input/output module
Input/output module
Input/output module
Input/output module
I/O module, expansion unit interfae module
5)
System 1
Link area
System 2
to operator panel

Remarks:

1) Power upply 03501 : two fault LEDs provided (input and output voltage fault)

03502 : one fault LED (only output voltage fault)

2) Engineering panel (test board) : to be ordered optionally.

3) RAM memory PCB 03260 :

Memory capacity 8000 characters = 03260 E

" 16000 characters = 03260 F

" 32000 characters = 03260 G

Two sockets are available on the front plate of the 03260 board for external back-up battery connection (connection not permitted during operation).

This allows board removal without data loss.

The 03210 board can be used instead of the 03260

4) Allocation of the sockets on the position control modules:

Module:	03 310 A		03 310 B				03 320 set value		
Encoded axis: Socket:	Act. 1 X312	Act 2 X313	Act 1 X312	Act 2 X313	Act 4 X314	Act 5 X315	axis 1 X322	axis 2 X232	Act 3 X324
3T	X	Z	not used with 3T				X,Z,S	-	S analog
3M X,Y,Z	X	Y	not used with 3M with 3 axes only and without spindle encoder				X,Y,Z	4th.,S	Z
3M X,Y,Z and 4th and/or spindle encoder	not used with 3M with 4 axes- and/or spindle encoder		X	Y	4th	S	X,Y,Z	4th, S	Z

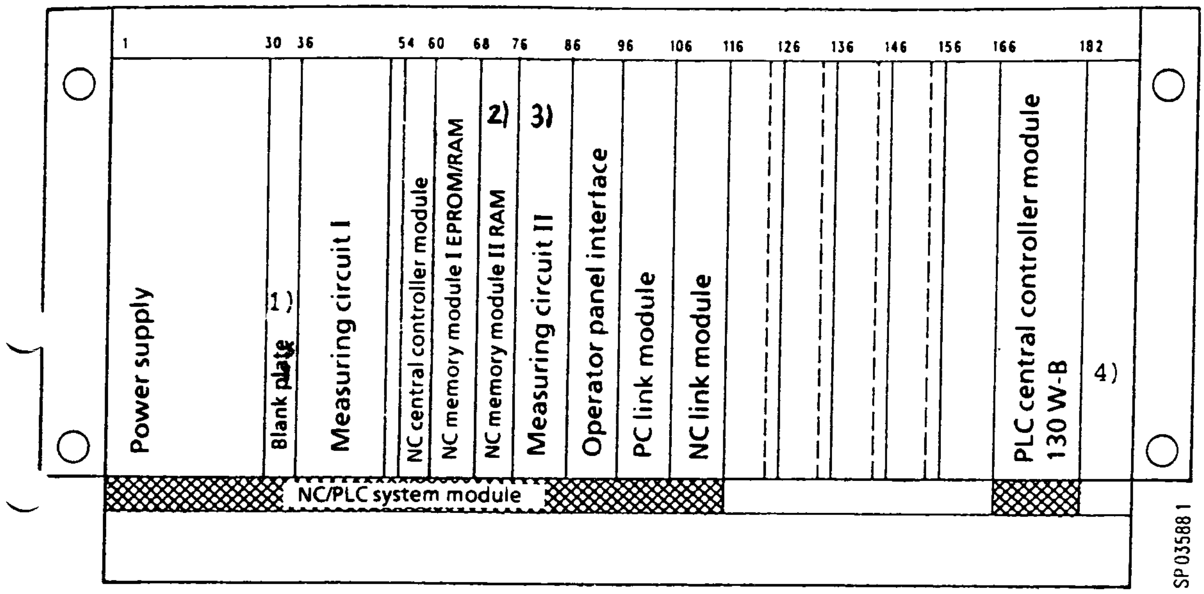
For axis allocation of the new measuring circuit modules, refer to Section 3.5.3.

3.5.3 4B configuration

SINUMERIK 3T/3M

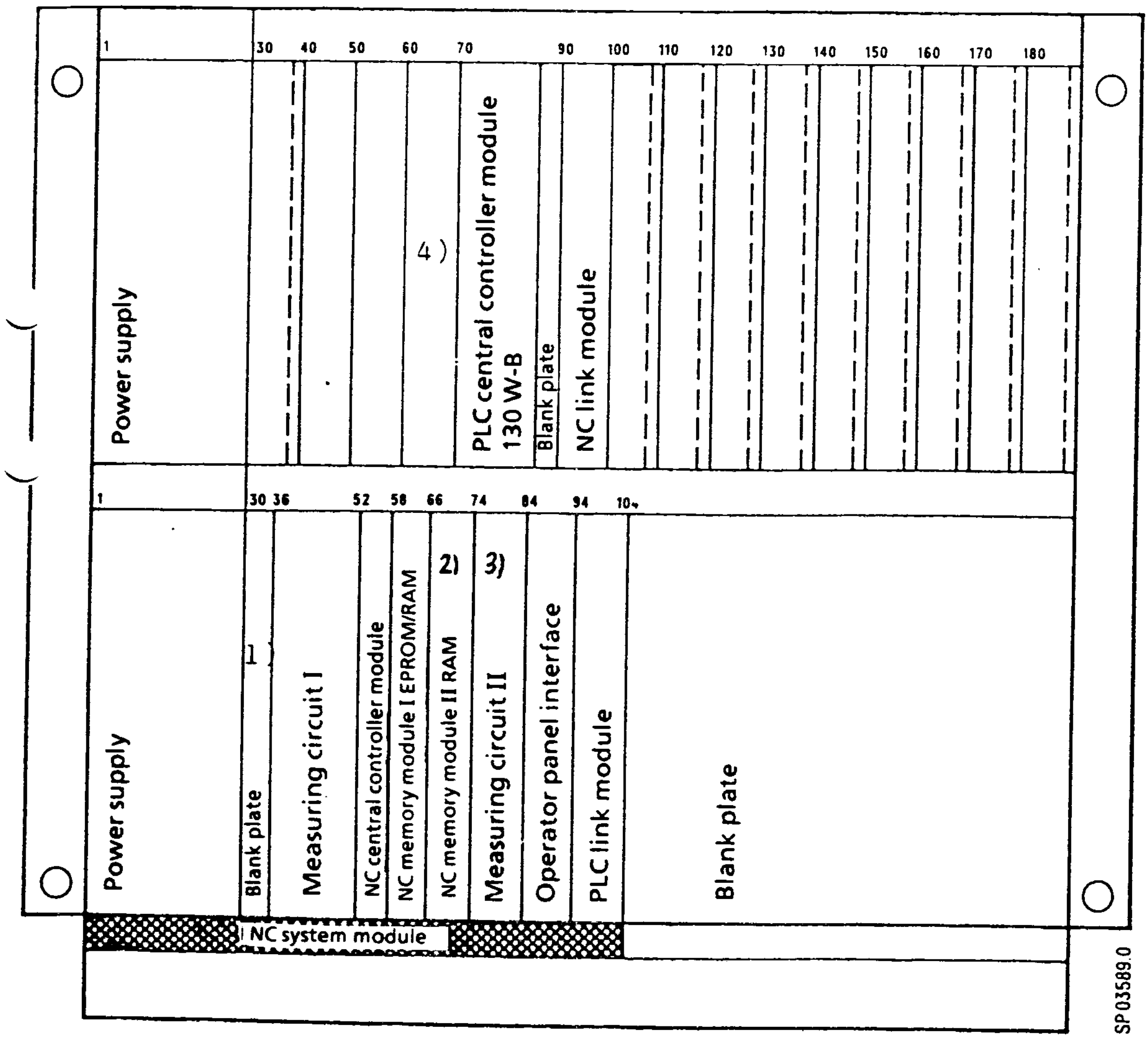
Single-tier rack 6FC3...-0FA

Logics component assignments



SP 03588 1

SINUMERIK 3T/3M two-tier rack 6FC3 . . OHA

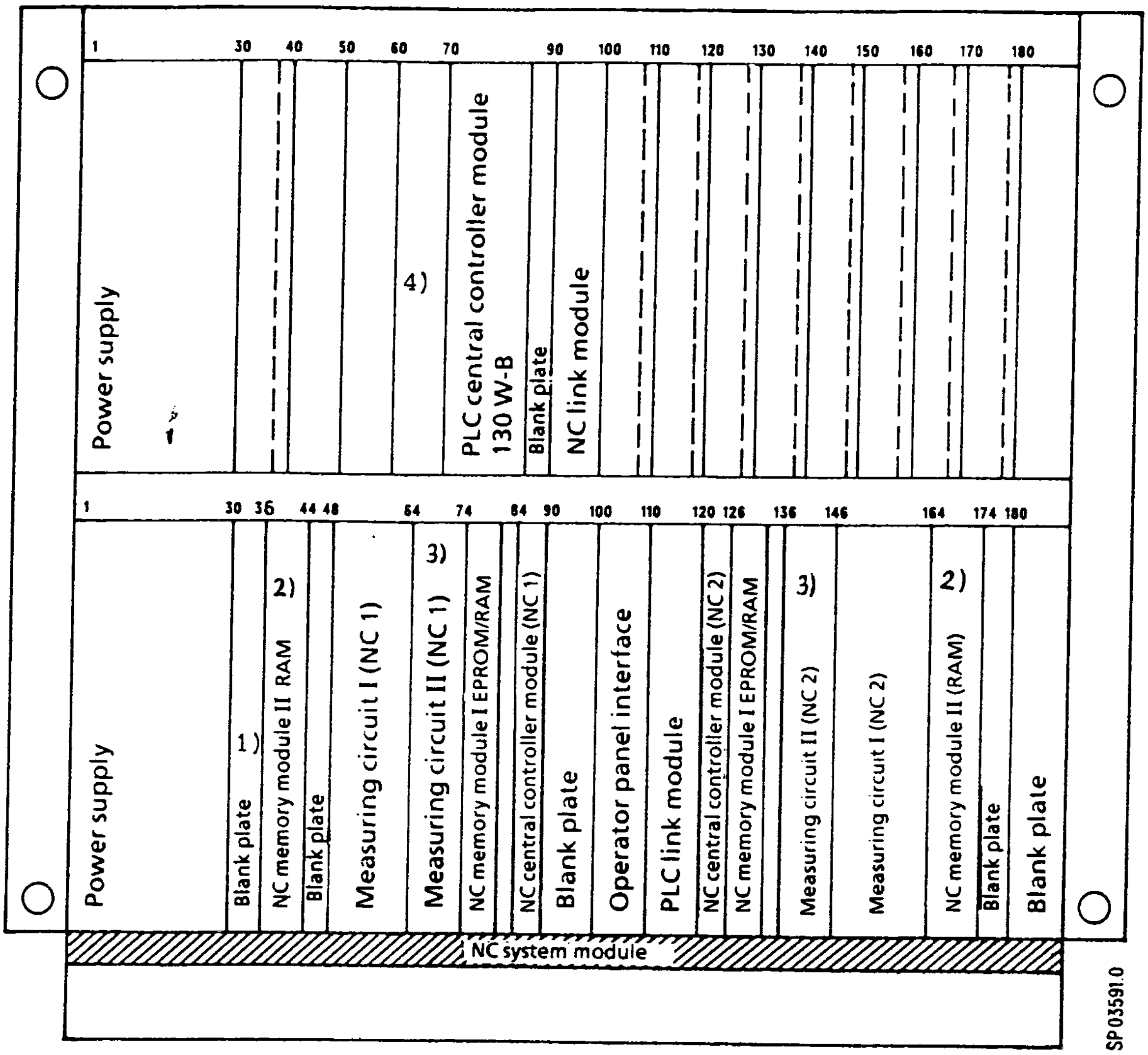


SP 03589.0

SINUMERIK 3TT

Two-tier rack 6FC373.-0FA

Logics component assignments

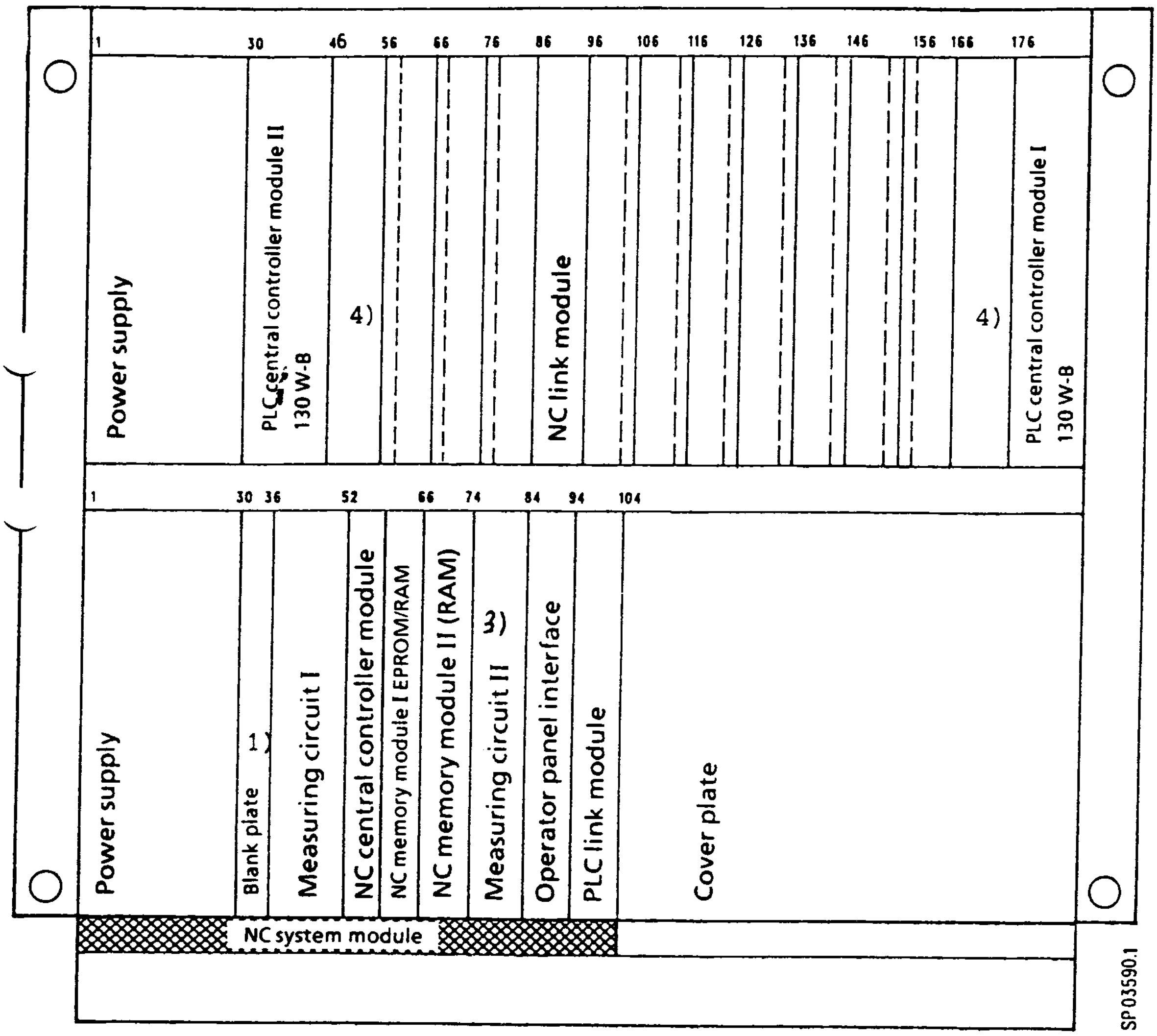


SP03591.0

SINUMERIK 3T/3M

Two-tier rack for DUAL PLC

Logics component assignments.



Remarks:

1) Slot for the test module, to be ordered separately.

2) Module to be fitted only with "Memory expansion" option.

3) Measuring circuit module II fitted only with 3M or 3T with C-axis.

4) Slot for programmer interface S5-511-5.

For assignment of additional modules in the PLC section, e.g. computer link S5-512-5, WF 625, WF 725, PLC memory board, I/0 modules, refer to Interface Description.
For detailed explanation of other system configurations, 3FA-systems rack assignments etc. refer to Interface Description Part 2, Section 1.

Measuring circuit assignments:

	03350/03351 3T		03315/03316 3M/3T with c-axis			03325/03326 3M/3T with c-axis		
				Axis			Axis	
	Socket	Axis	Socket	3M	3T with C-axis		3M	3T with C-axis
ENCODERS ACT. VALUES	X353 X355 X354	X Z Sp	X318 X320 X319 X317	X Y Z 4th	X Z - C1	X329	Sp	Sp
SET VALUES	X352 X352 X352	X Z Sp				X327 X327 X327 X328 X328	X Y Z 4th Sp	X Z - C1 Sp

Sp = spindle

C1 = C-axis

3.5.4 Jumper assignment and adjustments

The modules are delivered ex works with standard jumpering. No alterations are necessary for standard commissioning.

The following adjustments can be made to suit special requirements:

1. Simulation of the external signal "Servo Ready" (alarm 222)
2. Reference ground for command value.
3. 20 mA serial interface (TTY active-passive)
4. Measuring probe outputs

Attention: The TTY serial interface does not allow both, the NC and the peripheral device, to be set "active" simultaneously!

3.5.5 SINUMERIK I/O modules

The following I/O modules are available at present:

Type	Inputs	Outputs	Order code
03400	48	24, 100 mA floating	N83
03410	96	-	N83
03 402	-	48, 0.5 A	N84
03 450	32	32, 0.1 floating	N85
03 460	-	16, 2 A	N82

The width of these boards is 1 2/3 standard plug-in stations (SPS).

3.5.6 SIMATIC S5 I/O modules

SIMATIC S5 modules (6ES5 4...-3, Order Code N60, 65, 70, 90) can be fitted in the PLC section..

3.5.7 Logic module: refer to Interface Description.

3.6 Softwaresystem

3.6.1 NC system program

Check that the installed system program is valid.

The software version can be checked by visual inspection of the EPROM labels or by reading the machine data TEST N 381S.

To prevent damage to the EPROM chips, an appropriate tool should be used to extract them from the sockets. Damaged EPROMs and EPROMs without the original GEW label will not be refunded by the GEW works. Observe the MOS precautions when handling EPROMs.

A special EPROM extractor for 24 to 40 pin ICs can be obtained from the central stores in FÜRTH (Order No. L30460-X281-X).

3.6.2 SINUMERIK System 3 - Software identification

General guidelines to the understanding of the software identification system for EPROMs.

Starting with System 3 the current identification system came into use based on a key with 12 digits, it caters for the needs of the GEW works, the R & D, the sales and service.

The identification of EPROMs/PROMs is based on the following key:

	1	2	3	4	5	6	7	8	9	10	•	11	12
Position	1	2	3	4	5	6	7	8	9	10	•	11	12
GE	5	4	8	8	x	x	x	x	x	x		x	x

GWE-product group (fixed)

Software

System-family 00...99

System-Type 0...2

Modification of the system type 0...9

PROM/EPROM Location 1...32

Software version 00...99

Explanation of the key:

Position 1to 4:	These numbers are always 548 and 8 to denote software produced by the GWE works.
Position 5to 6:	These numbers identify the basic models: 11 for basic model 0 to 2 15 for basic model 3 17 for basic model 4A 19 for basic model 4B
Position 7:	This number gives the system type 0 General system 3 (common to all types)
Position 8:	This number specifies the language type of the system: 0 English 1 German 2 French 3 Italian 4 Spanish 5 Dutch 6 Russian/Test software 7 Swedish
Position 9 to 10:	The PROM locations are numbered in consecutive sequence. Each PROM location has its unambiguous number.
Position 1 to 12:	These numbers denote the software version and correspond with the last two digits of the number of the service bulletin. If the software system does not need completely recompiling on revision, the system can contain PROMs of different versions.
General remarks:	To identify an EPROM/PROM in practice, it is sufficient to specify the last eight digits of the full key. The two digits in front and the two digits behind the "decimal point" are the most significant and specify the PROM location and the software version. Information about the number of EPROMs, software version and allocation can be obtained from the service bulletin.
Example:	Order code for System 3 software for 3T/TT and 3M, basic model 4B, software version 04, English language: 548 819.00XX.04 XX = EPROM location

3.6.3 Software system for model 4A

Current software version and check sum of the individual PROMs.

EPROM designation: GE 548 817 0X XX.XX

Software version: 01 to 04

Function	PCB	Prom location	Prom type	Software version and check sum					
				01	Check sum	02	Check sum	03	04
Basic model 4A 3T/TT, 3M with options	03202	01	2532	01	5D24	02	600A	51C0	5238
		02			4EE8		4C88	62C5	62C5
		03			E5A4		5A03	5341	5341
		04			06CD		23B1	2C01	2C01
		05			354D		50AC	1867	1867
		06			1738		3B53	1655	1655
		07			F0B3		EA6B	23AC	23AC
		08			C7DE		183C	4B95	4B95
		09			4483		33ED	1B81	1B81
		10			F20D		EB1A	ED52	ED52
		11			4A19		6CC7	F938	F938
		12			3A3F		24E8	E305	E305
		13			07D		0067	84FD	84FD
		14			025A		EC8F	7F8C	7F8C
		15			47C3		5847	BB26	BB26
		16			6FEC		586D	CBE6	CBE6
		17			9CF7		734C	C76C	C76C
		18			7EB2		4841	8B8F	8B8F
		19			EAAD		4E15	797F	797F
		20			F571		9738	4B5C	4B5C
		21			-		B458	596A	596A
		22			-		B512	A024	A024
		23			-		-	89DB	89DB
		24			-		-	8AAA	8AAA
	*	25			*		*	*	*
	*	26			*		*	*	*
	*	27			*		*	*	*
	*	28			*		*	*	*
		29			-		-	B559	B559
		30			-		-	DD8B	DD8B
		31			65D8		3F4D	4D7F	4D7F
		32	2532	01	6525	02	4648	58AB	58AB

* Language EPROMs, optionally fitted

Total number of EPROMs:	Software version 01	26 chips
	Software version 02	28 chips
	Software version 03	32 chips
	Software version 04	32 chips

Software versions 05 to 08 of basic model 4A

EPROM designation 548 817.0 0 XX.XX

- 817 — System version 3 GA4A
- .0 — System type
- 0 — System language
- XX. — EPROM location
- .XX — Software version

Function	PCB	Prom location	Prom type		Software stand 05	Software stand 06	Software stand 07	Software stand 81	Software stand 08	Check sum 08
Basic model 4A 3T/TT/M + Options without text EPROMs	03202	01	2532		05	06	07	81	08	6902
		02	2532		05	06	07	81	08	580E
		03	2532		05	06	07	81	08	6645
		04	2532		05	06	07	81	08	4F51
		05	2532		05	06	07	07	08	1B3F
		06	2532		05	06	07	07	08	1AA6
		07	2532		05	06	07	07	08	3B73
		08	2532		05	06	07	07	08	4CBA
		09	2532		05	06	07	07	08	F3D3
		10	2532		05	06	07	07	08	01A7
		11	2532		05	06	07	07	08	C03D
		12	2532		05	06	07	07	08	E2DF
		13	2532		05	06	07	07	08	A962
		14	2532		05	06	07	07	08	6E5E
		15	2532		05	06	07	07	08	4EF2
		16	2532		05	06	07	07	08	5BEA
		17	2532		05	06	07	07	08	A62B
		18	2532		05	06	07	07	08	1DB1
		19	2532		05	06	07	07	08	4D3A
		20	2532		05	06	07	07	08	3A46
		21	2532		05	06	07	07	08	BDC0
		22	2532		05	06	07	07	08	DD7D
		23	2532		05	06	07	07	08	FF38
		24	2532		05	06	07	07	08	C8D7
4 language EPROMs		29	2532		05	06	07	07	08	E1A3
		30	2532		05	06	07	07	08	BEA1
		31	2532		05	06	07	81	08	0CF7
		32	2532		05	06	07	81	08	142B

A full set of software comprises 28 EPROMs and 4 text EPROMs.

Language EPROMs for model 4A

EPROM designation 548 817.0 0 XX.XX

- 817 — System version 3 GA4A
- .0 — System type
- 0 — System language
- XX — EPROM location
- .XX — Software version

Function	PCB	Prom location	Prom type	System language	Software stand					Check sum 06
Texts in various languages:	03202									
English:										
		25	2532	0	02	03	04	05	06	B411
		26	2532	0	02	03	04	05	06	9997
		27	2532	0	02	03	04	05	06	856D
		28	2532	0	02	03	04	05	06	82D0
German:										
		25	2532	1	02	03	04	05	06	B701
		26	2532	1	02	03	04	05	06	A4C7
		27	2532	1	02	03	04	05	06	1E62
		28	2532	1	02	03	04	05	06	1779
French:										
		25	2532	2	02	03	04	-	-	
		26	2532	2	02	03	04	-	-	
		27	2532	2	02	03	04	-	-	
		28	2532	2	02	03	04	-	-	
Italian:										
		25	2532	3	02	03	04	-	-	
		26	2532	3	02	03	04	-	-	
		27	2532	3	02	03	04	-	-	
		28	2532	3	02	03	04	-	-	
Spanish:										
		25	2532	4	02	03	04	-	-	
		26	2532	4	02	03	04	-	-	
		27	2532	4	02	03	04	-	-	
		28	2532	4	02	03	04	-	-	

The software for one language comprises a set of 4 EPROMs which have to be added to the basic system software.

For system software versions 07 and 08 use the language EPROMs of software version 06.

From software version 05 on, only English and German are available.

Second EPROM board for "Graphics" option Model 4A

EPROM designation 548 817.0 0 XX.XX

- XX (last) — Software version
- XX (first) — EPROM location
- 0 — System language
- .0 — System type
- 817 — System version 3 GA4A

Function	PCB	Prom location	Prom type		Software stand						Check sum
					03	04	05	06	07	08	08
Graphics option	03202	01	2532		03	04	05	06	07	08	AB10
		02	2532		03	04	05	06	07	08	CE1A
		03	2532		03	04	05	06	07	08	1CD4
		04	2532		03	04	05	06	07	08	5944
		05	2532		03	04	05	06	07	08	DF0C
		06	2532		03	04	05	06	07	08	ED04
		07	2532		03	04	05	06	07	08	26CC
		08	2532		03	04	05	06	07	08	5F27
		09	2532		03	04	05	06	07	08	B0D4
		10	2532		03	04	05	06	07	08	A0F2
		11	2532		03	04	05	06	07	08	E243
		12	2532		03	04	05	06	07	08	A362
		13	2532		-	-	05	06	07	08	0874
		14	2532		-	-	05	06	07	08	F914
		15	2532		-	-	05	06	07	08	6334
		16	2532		-	-	05	06	07	08	823B
		17	2532		-	-	05	06	07	08	22DC
		18	2532		-	-	05	06	07	08	624F
		19	2532		-	-	05	06	07	08	FFA2
		20	2532		-	-	05	06	07	08	DCCE
		21	2532		-	-	05	06	07	08	F9BC
		22	2532		-	-	05	06	07	08	3368

The graphics software comprises a set of 22 EPROMs installed on a second EPROM-PCB.

In software versions 03 and 04, graphics are available for the 3T model only.

This software comprises 12 EPROMs.

3.6.4 Diagnostics software for model 4A

EPROM designation GE 548 817 06 XX.XX

Function	PCB	Prom location	Prom type	Software stand	
				02	Check sum 02
Engineering panel and test software	03202	71	2532	02	IEFE
		72	2532	02	1158
		73	-	-	-
		74	-	-	-
		75	-	-	-
		76	-	-	-
		77	-	-	-
		78	-	-	-
		79	-	-	-
		80	-	-	-

Remark: Scope of the test software:

- Display and alteration of memory contents
- System stop at break points
- Reading of addresses etc.
- Detailed information about the use and function of the engineering panel and test software can be obtained from Commissioning Instructions Part 1, Section 10.

3.6.5 System software for basic model 4B

EPROM designation 548 819.XX X X.XX

- XX (last) — Software version
- X (after the point) — EPROM location on the submodule
- X — Module number
- XX — System language
- 819 — System version 3 GA4B

Function	PCB	Module No.	Prom loca-tion	System langua-ge	Software stand						
					01	81	02	03	04	05	06
Basic system	6FX1120-2CA00	1	1	00	01	81	02	03	04	05	06
		1	2	00	01	81	02	03	04	05	06
		1	3	00	01	01	02	03	04	05	06
		1	4	00	01	01	02	03	04	05	06
Standard language ENGLISH		2	1	00	01	01	02	03	04	05	06
		2	2	00	01	01	02	03	04	05	06
		2	3	00	01	01	02	03	04	05	06
		2	4	00	01	01	02	03	04	05	06
Optional language GERMAN		2	1	01	01	01	02	03	04	05	06
		2	2	01	01	01	02	03	04	05	06
		2	3	01	01	01	02	03	04	05	06
		2	4	01	01	01	02	03	04	05	06
Optional language FRENCH		2	1	02	01	01	02	03	04	05	06
		2	2	02	01	01	02	03	04	05	06
		2	3	02	01	01	02	03	04	05	06
		2	4	02	01	01	02	03	04	05	06
Optional language ITALIAN		2	1	03	01	01	02	03	04	05	06
		2	2	03	01	01	02	03	04	05	06
		2	3	03	01	01	02	03	04	05	06
		2	4	03	01	01	02	03	04	05	06
Optional language SPANISH		2	1	04	01	01	02	03	04	05	06
		2	2	04	01	01	02	03	04	05	06
		2	3	04	01	01	02	03	04	05	06
		2	4	04	01	01	02	03	04	05	06
Optional language DUTCH		2	1	05	01	01	02	03	04	05	06
		2	2	05	01	01	02	03	04	05	06
		2	3	05	01	01	02	03	04	05	06
		2	4	05	01	01	02	03	04	05	06
Optional language RUSSIAN		2	1	06	-	-	02	03	04	05	06
		2	2	06	-	-	02	03	04	05	06
		2	3	06	-	-	02	03	04	05	06
		2	4	06	-	-	02	03	04	05	06
Optional language SWEDISH		2	1	07	-	-	-	-	-	05	06
		2	2	07	-	-	-	-	-	05	06
		2	3	07	-	-	-	-	-	05	06
		2	4	07	-	-	-	-	-	05	06

The software comprises a set of 8 EPROMs

List of EPROM check sums for model 4B

Software versions 01 to 81

Function	Module No.	Eprom loca-tions	System langua-ge	Check sum	
				01	81
Basic software	1	1	00	0036 238E	0036 13B4
	1	2	00	0036 74A0	0036 69E3
	1	3	00	0032 2441	0032 2441
	1	4	00	0032 6B0D	0032 6B0D
Standard language ENGLISH	2	1	00	0027 25DC	
	2	2	00	0027 97D2	
	2	3	00	003C A34E	
	2	4	00	003D 5889	
Optional language GERMAN	2	1	01	0027 2675	
	2	2	01	0027 97D2	
	2	3	01	003D C18D	
	2	4	01	003E A16A	
Optional language FRENCH	2	1	02	0027 2708	
	2	2	02	0027 97D2	
	2	3	02	003C BFB3	
	2	4	02	003D 99D3	
Optional language ITALIAN	2	1	03	0027 25AE	
	2	2	03	0027 97D2	
	2	3	03	003C 5968	
	2	4	03	003D 466D	
Optional language SPANISH	2	1	04	0027 258F	
	2	2	04	0027 97D2	
	2	3	04	003D 010F	
	2	4	04	003D 6EC6	
Optional language DUTCH	2	1	05	0027 2602	
	2	2	05	0027 97D2	
	2	3	05	003D 2E22	
	2	4	05	003D D087	

The check sum of the language EPROMs is identical for both software versions 01 and 81.

List of the EPROM check sums for model 4B

Software version 02 to 04

Function	Module No.	Eprom loca-tion	System langua-ge	Check sum		
				02	03	04
Basic software	1	3	00	0035 EAE3	0036 1647	0036 1886
	1	1	00	0035 9B1E	0035 C08F	0035 C15C
	1	4	00	0031 ADB1	0032 5C2B	0032 5693
	1	2	00	0032 37C5	0032 B625	0032 B0CF
Standard language ENGLISH	2	3	00	0026 F442	0029 C405	0029 B02B
	2	1	00	0027 618D	0029 D5EA	0029 E6D3
	2	4	00	003B 2678	0030 EA61	0030 EA63
	2	2	00	003B FC85	0032 3FD2	0032 3FD2
Optional language GERMAN	2	3	01	0026 F2F6	0029 C46D	0029 B093
	2	1	01	0027 618D	0029 D5EA	0029 E6D3
	2	4	01	003C 2C11	0031 9CEC	0031 9CEE
	2	2	01	003D 5E25	0032 FB30	0032 FB30
Optional language FRENCH	2	3	02	0026 F3EB	0029 C3E2	0029 B008
	2	1	02	0027 618D	0029 D5EA	0029 E6D3
	2	4	02	003B 1A4C	0030 591F	0030 5921
	2	2	02	003C 62DF	0031 BAE8	0031 BAE8
Optional language ITALIAN	2	3	03	0026 F54B	0029 C408	0029 B02E
	2	1	03	0027 618D	0029 D5EA	0029 E6D3
	2	4	03	003A DCFF	002F 47EF	002F 47F1
	2	2	03	003B ED31	0030 A755	0030 A755
Optional language SPANISH	2	3	04	0026 F426	0029 C3C7	0029 AFED
	2	1	04	0027 618D	0029 D5EA	0029 E6D3
	2	4	04	003B 3668	0030 0865	0030 0867
	2	2	04	003C 5CC8	0031 95DD	0031 95DD
Optional language DUTCH	2	3	05	0026 F519	0029 C3FC	0029 B022
	2	1	05	0027 618D	0029 D5EA	0029 E6D3
	2	4	05	003B 87FF	0031 11FC	0031 11FE
	2	2	05	003C 9887	0032 9A5B	0032 9A5B
Optional language RUSSIAN	2	3	06	0026 F4a4	0029 C3C3	0029 AFE9
	2	1	06	0027 618D	0029 D5EA	0029 E6D3
	2	4	06	003A 8C2C	002E F965	002E F967
	2	2	06	003B 95D5	0030 0A56	0030 0A56

List of EPROM check sum for model 4B

Software version 05

Function	Module No.	Eprom location	System language	Check sum		
				05	06	
Basic software	1	3	00	0036 1848	refer to	
	1	1	00	0035 D9B8	Service Hand-	
	1	4	00	0032 OBC5	book for	
	1	2	00	0032 7DAD	check sums	
Standard language ENGLISH	2	3	00	0029 AFFE		
	2	1	00	0029 E72A		
	2	4	00	0030 EA83		
	2	2	00	0032 3FD6		
Optional language GERMAN	2	3	01	0029 AF67		
	2	1	01	0029 E72A		
	2	4	01	0031 9DOE		
	2	2	01	0032 FB34		
Optional language FRENCH	2	3	02	0029 AFDB		
	2	1	02	0029 E72A		
	2	4	02	0030 5941		
	2	2	02	0031 BAEC		
Optional language ITALIAN	2	3	03	0029 AF02		
	2	1	03	0029 E72A		
	2	4	03	002F 4811		
	2	2	03	0030 A759		
Optional language SPANISH	2	3	04	0029 AFC0		
	2	1	04	0029 E72A		
	2	4	04	0030 0887		
	2	2	04	0031 95E1		
Optional language UTCH	2	3	05	0029 AEF6		
	2	1	05	0029 E72A		
	2	4	05	0031 121E		
	2	2	05	0032 9A5F		
Optional language JSSIAN	2	3	06	0029 AFBC		
	2	1	06	0029 E72A		
	2	4	06	002E F987		
	2	2	06	0030 0A5A		
Optional language SWEDISH	2	3	07	0029 B05E		
	2	1	07	0029 E72A		
	2	4	07	0031 DEEC		
	2	2	07	0033 3175		

EPROM allocation for model 4B

EPROM designation		Software version						
		01	81	02	03	04	05	06
Basic software	548 819 9001.XX	-	-	-	-	-	-	-
comprises :	548 819 0011.XX	D3	D3	D1	D1	D1	D1	D1
	0012.XX	D1	D1	D2	D2	D2	D2	D2
	0013.XX	D4	D4	D3	D3	D3	D3	D3
	0014.XX	D2	D2	D4	D4	D4	D4	D4
Languages:								
ENGLISH	548 819 9002.XX	-	-	-	-	-	-	-
comprises:	548 819 0021.XX	D3	D3	D1	D1	D1	D1	D1
	0022.XX	D1	D1	D2	D2	D2	D2	D2
	0023.XX	D4	D4	D3	D3	D3	D3	D3
	0024.XX	D2	D2	D4	D4	D4	D4	D4
GERMAN	548 819 9012.XX	-	-	-	-	-	-	-
comprises:	548 819 0121.XX	D3	D3	D1	D1	D1	D1	D1
	0122.XX	D1	D1	D2	D2	D2	D2	D2
	0123.XX	D4	D4	D3	D3	D3	D3	D3
	0124.XX	D2	D2	D4	D4	D4	D4	D4
FRENCH	548 819 9022.XX	-	-	-	-	-	-	-
comprises:	548 819 0221.XX	D3	D3	D1	D1	D1	D1	D1
	0222.XX	D1	D1	D2	D2	D2	D2	D2
	0223.XX	D4	D4	D3	D3	D3	D3	D3
	0224.XX	D2	D2	D4	D4	D4	D4	D4
ITALIAN	548 819 9032.XX	-	-	-	-	-	-	-
comprises:	548 819 0321.XX	D3	D3	D1	D1	D1	D1	D1
	0322.XX	D1	D1	D2	D2	D2	D2	D2
	0323.XX	D4	D4	D3	D3	D3	D3	D3
	0324.XX	D2	D2	D4	D4	D4	D4	D4
SPANISH	548 819 9042.XX	-	-	-	-	-	-	-
comprises:	548 819 0421.XX	D3	D3	D1	D1	D1	D1	D1
	0422.XX	D1	D1	D2	D2	D2	D2	D2
	0423.XX	D4	D4	D3	D3	D3	D3	D3
	0424.XX	D2	D2	D4	D4	D4	D4	D4
DUTCH	548 819 9052.XX	-	-	-	-	-	-	-
comprises:	548 819 0521.XX	D3	D3	D1	D1	D1	D1	D1
	0522.XX	D1	D1	D2	D2	D2	D2	D2
	0523.XX	D4	D4	D3	D3	D3	D3	D3
	0524.XX	D2	D2	D4	D4	D4	D4	D4
RUSSIAN	548 819 9062.XX	-	-	-	-	-	-	-
comprises:	548 819 0621.XX	-	-	D1	D1	D1	D1	D1
	0622.XX	-	-	D2	D2	D2	D2	D2
	0623.XX	-	-	D3	D3	D3	D3	D3
	0624.XX	-	-	D4	D4	D4	D4	D4
SWEDISH	548 819 9072.XX	-	-	-	-	-	-	-
comprises:	548 819 0721.XX	-	-	-	-	-	D1	D1
	0722.XX	-	-	-	-	-	D2	D2
	0723.XX	-	-	-	-	-	D3	D3
	0724.XX	-	-	-	-	-	D4	D4

Example: 548 819 0011.XX

XX — Software version

Basic software fitted on submodule 1, to be plugged in the top receptacle. Language software fitted on submodule 2, to be plugged in the middle receptacle.

3.6.6 Diagnostics software for model 4B

EPROM designation GE.548 819.0 6 XX.XX

- Software version
- EPROM location
- System language
- System type
- System version 3 GA4B

Function	PCB	Prom location	Prom type	CHECK sum	Software version				
					01				
Engineering and test software	6FX1118-6AB00 (03202)	71 72	2532 2532	0F54 0D3D	01 01				

3.6.7 Export versions

The 3TE, 3TTE, 3ME controls have a different software system fitted.

Designation of the export software version:

Model 4A: 548 817 07 XX.XX

Model 4B: 548 817 07 XX.XX

Retrofitting can only be done in the GWE works.

3.6.8 System software for basic version 4 C

EPROM designation: 548 821.XX X X . XX

- XX (last) — Software version
- X — EPROM location on the submodule
- X — Module number
- XX — System modification (e.g. language)
- 548 821 — Version System 3/4C

Function	Order No. for sub-module and software	sub-module number	EPROM location	System modi-fication	Software version				
					01	02			
Basic system	6FX1821- 0AX02	2 2 2 2	1 2 3 4	00 00 00 00	01 01 01 01	02 02 02 02			
Standard language ENGLISH	6FX1821- 0AX03	3 3	1 3	00 00	01 01	02 02			
Option J22 GERMAN	6FX1821- 0AX13	3 3	1 3	01 01	01 01	02 02			
Option J23 FRENCH	6FX1821- 0AX23	3 3	1 3	02 02	01 01	02 02			
Option J24 ITALIAN	6FX1821- 0AX33	3 3	1 3	03 03	01 01	02 02			
Option J25 SPANISH	6FX1821- 0AX43	3 3	1 3	04 04	01 01	02 02			
Option J26 DUTCH	6FX1821- 0AX53	3 3	1 3	05 05	01 01	02 02			
Option J27 RUSSIAN	6FX1821- 0AX63	3 3	1 3	06 06	01 01	02 02			
Option J28 SWEDISH	6FX1821- 0AX73	3 3	1 3	07 07	01 01	02 02			

The software set comprises a set of 6 EPROMs: type 27512

The submodules are plugged into memory module 6FX 1120-2CA01

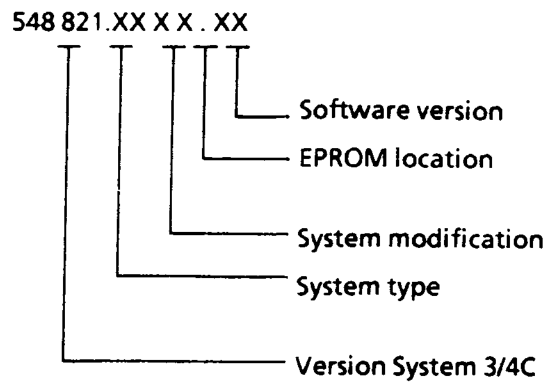
List of EPROM check sums for model 4:

Software versions E 01 and E 02

Function	Submodule number	EPROM location	Sytem modification	Check sum 01	02
Basic system	2	3 1 4 2	00 00 00 00	67 4E67 67 5147 A8 A21A A9 697E	
Standard language ENGLISH	3	3 1 - -	00 00	A2 8737 A0 C3E8	
Option J22 GERMAN	3	3 1 - -	01 01	A1 EE46 9F C69E	
Option J23 FRENCH	3	3 1 - -	02 02	A0 3C4D 9E 6EAF	
Option J24 ITALIAN	3	3 1 - -	03 03	9F 1F2D 9D 5896	
Option J25 SPANISH	3	3 1 - -	04 04	A0 0160 9E 1B13	
Option J26 DUTCH	3	3 1 - -	05 05	A1 7246 9F 6604	
Option J27 RUSSIAN	3	3 1 - -	06 06	9E BD2D 9C D641	
Option J28 SWEDISH	3	3 1 - -	07 07	A1 FF4D A0 0C5E	

3.6.9 Diagnostics software for model 4C

EPROM designation:



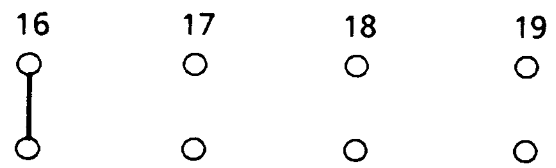
Function	Module	EPROM location	EPROM type	Check sum	Software version	
					01	
Engineering and test software	6FX1118-6AB00	71 72	2532 2532	0A F37E 0B 0796	01 01	

The software comprises: a set of 2 EPROMs of type 2532.

The test module 6FX1118-GAB00 (03 221B) is not part of the standard scope of delivery of System 3.

As a service- and engineering aid it has to be ordered separately or in conjunction with a spare part kit.

Addressing: Address 10 000 H



3.7 Back-up battery in the power supply unit

The back-up battery for NC and PLC is located in the internal power pack 03 500. It can be replaced without removing the power supply unit. The insulated top connector is the positive pole and must not be short-circuited to ground.

The battery should be replaced only under power so that the stored data are not lost. The battery voltage is checked at PORESET. Alarm 711 is displayed if the voltage drops below approx. 2.7 V.

Battery type: 3.4 V / 5 Ah
TL 2200
IEC-R-14 (Baby cell)

Attention !

In the event of a battery alarm, the integrated PLC reacts with a stop. This causes the NC to stop as well and the system monitoring LED (red LED on PCB 03 840) flashes at a rate of 4 Hz.

Back-up current and back-up time with SINUMERIK System 3 GA4

Back-up currents:

The following table shows the worst-case back-up currents for the PCBs used in System 3.

Board designation	MLFB-No.	Memory capacity in K Byte	Back-up current in mA max
Power supply	6EV 3054	-	0.03
NC-CPU	6FX1111-0...	16	0.1
EPROM/RAM	6FX1120-2...	32	0.2
RAM-SUBMODULE (NC)	6 FX1126-0...	32	0.2
PLC-CPU	6ES5 921-WB.	10	0.31
RAM-SUBMODULE (PLC)	6FX1123-6...	32	0.2
MEMORY EXPANSION PLC	6ES5 340...	32	1.0

Back-up times:

The available back-up time of a SINUMERIK depends upon the required back-up currents of the fitted modules as shown in the previous table.

The capacity of a Lithium battery amounts to approx. 5200 mAh at low back-up currents.

Therefore the back-up time can be calculated as follows:

$$t\ (\text{days}) = \frac{Q\ (\text{mAh})}{I_{total}\ (\text{mA}) \times 24\ (\text{hours/day})}$$

t	=	back-up time in days.
Q	=	battery capacity in mAh.
I_{total}	=	total back-up current of all fitted modules.

Example for a single tier NC/PLC rack

(Without NC memory expansion and without PLC-RAM board)

0.03 mA + 0.1 mA + 0.2 mA + 0.2 mA + 0.31 mA = 0.84 mA

$$t = \frac{5200}{0.84 \times 24} = 258\ \text{days}$$

In this case the NC can be switched off 258 days without data loss.

Attention:

A Lithium battery in new or unloaded (longer than approx. 5 weeks) condition can build up a so-called passivation layer. This layer increases the internal resistance of the battery. Therefore prior to installation, a new battery should be pre-loaded with an ohmic load of 30 to 50 Ohm for about 10 minutes.

Batteries fitted in the power supply unit do not need this treatment since the internal load of the power supply destroys this layer in a few days.

Chapter 4

-Voltage- and functional tests, clearing of memory areas, input of machine data-

Contents

4.1 Voltage check

4.1.1 Voltage supply

The power pack 03500 is supplied from 24 V DC.

Check this voltage prior to connection of the power pack.

Check the rated input voltage on the terminal block.

		Terminal
Supply voltage	24 V (20 V...30 V)	C1, D1
Ambient temperature range	0 to + 55° C	-
Temperature monitoring	63° C ± 2,8° C	-
Fan supply voltage	220 V AC 50 Hz	-
Fan monitoring	without monitoring: short-circuit E-F	E, F
NC-ON pushbutton		G, H

4.1.2 Switching on

The interface cables are still disconnected. Safeguard to prevent axis movements, disconnect the command value plug for the position control circuit.

For brief instructions: see Section 5

Switch on the control (operate the NC-ON pushbutton at least 2 seconds)

Is the control in running condition?

Is the basic display of the selected operating mode shown?

Checks, if the power pack does not remain locked in:

- Is link E-F closed?
- Fuses blown?
- 24 V as per specification?
- Overload? Remove power pack and switch on again. If the power pack locks in now, find the defective module or check the power consumption on the 5V side.

4.1.3 Fuses

NC:

Location	Designation	Rated current
Power pack (03500)	F 30 F 161	16 A very fast acting 0.8 A medium time-lag
I/O module (03400/03401)	F 1	1.6 A medium time-lag
Output module (03421)	F 1	16 A very fast acting (F type)
I/O module (03450)	F 1	1.6 A medium time-lag
Output module (03460)	F 1	1.6 A medium time-lag
Customer I/O module (02400/02401)	F 1	6.3 A medium time-lag
Operator panel (03731)	F 1	2.5 A medium time-lag
Operator panel (03780)	F 1	2.5 A medium time-lag

4.1.4 DC voltage

5 V voltage, to be measured on power pack 03500 (socket 5 V with respect to M). Adjustment of the set value >5.15V...5.25V by potentiometer R 145 behind the front plate (clockwise rotation = higher voltage). This ensures proper IC supply voltage (accounts for voltage drops caused by the tracks on back plane and printed-circuit boards). The 5 V voltage is adjusted correctly on the factory and does not need to be re-adjusted on commissioning in normal cases.

4.1.5 Fault storage on switch-off of the NC:

If power pack 03501 is fitted: Display via 2 LEDs whether the switch-off was caused by the input voltage or by the internal NC voltages. The reason for switch-off is stored and can be displayed by the "Fault Monitoring" pushbutton even with the control switched off. The reason for the switch-off remains stored until the next switch-off.
With power pack 03502 fitted: There is only one LED provided which lights up on actuating the "Fault Monitoring" pushbutton if one of the internal voltages was the reason for switch-off. If switch-off was caused by input voltage fault or defective power pack, the LED remains dark.

4.2 Functional test:

4.2.1 CPU cycle monitor on module 03841:

With one NC (3T/3M)

Lefthand LED is for monitoring

Righthand LED constantly bright

With two NCs (3TT):

Lefthand LED is for monitoring NC1

Righthand LED is for monitoring NC2

Significance of the LED on switch-on for 3T/TT, 3M:

LED flashes at approx. 1 Hz	EPROM check responded
LED flashes at approx. 2 Hz	PLC not operative
LED flashes at approx. 4 Hz	Battery alarm

For 3TT (2NCs) only:

Lefthand LED constantly bright Righthand LED flashes at approx. 2 Hz rate	2nd NC waits for completion of NC 1 restart.

LED constantly bright:

CPU fault

EPROM fault

Incorrect machine data

BUS system (backplane wiring) defective

Incorrect module jumpering (address, WAIT)

Measuring circuit-, EPROM-, RAM- or PLC interface module defective.

With more than 2 NCs, a second 03841 module is fitted in the second NC tier. The lefthand LED monitors NC 3 and the righthand LED monitors NC 4.

4.2.2 CPU monitoring during operation:

The LED lights up:

If there is a hardware fault

If the CPU runs in a loop and fails to re-trigger the monitoring time

If the CPU operates in cycle but the monitoring time has been exceeded once on account of a fault.

4.2.3 Sum check in the system program memory

Operating sequence: 1. Set service switch S1 on module 03831 into position 1
Position 1 for NC 1
Position 2 for NC 2
Position 3 for NC 3
Position 4 for NC 4
Service panel must not be activated.

2. Perform a system reset (e.g. by switch-on: PORESET)

The EPROM check is carried out automatically at every PORESET (mains switch-on). In the event of a deviation between set sum and actual sum, (EPROM missing or fitted on wrong location) the LED flashes at 1 Hz rate.
EPROM carrying the GWE label are automatically checked on "programming".

Basic model 4A:

The sum check is started as above. If a defective EPROM chip is found, the display shows

EPROM - ERROR - FOUND
EDITION _ (Software version)
CHIP_ ACT/SET-SUM __/__

(Chip number, Location number in decimal) (actual/set sum in hexadecimal)

No. 1 - 32 for system program EPROMs on the 1st EPROM submodule
No. 33 - 54 for graphics software EPROMs on the 2nd EPROM submodule

If no error is found, a jump into the regular system program is performed straight away.

3. By actuating the page key, further defective chips can be displayed. Consequently, if no defective chips are found anymore, a jump into the regular system program is performed.

All fitted system program chips are checked.

Basic model 4B:

The system software for system 3, basic version 4B is stored in two "EPROM submodules" (each comprising 4 EPROMs). The 1st EPROM of such an EPROM submodule contains a prefix (header) in which an identification number and the check sum list for the EPROMS of the submodule are stored.

The identification number is composed as follows:

548 819 9 00 1 77

- 77 — Software version
- 1 — Number of the EPROM submodule within the system
- 00 — Consecutive number (language identification)
- 9 — Identification of the software package
- 819 — Number of the software system (System 3, basic version 4B)
- 548 — Product group for SINUMERIK

In the course of an EPROM check (always after Power-on Reset) it is checked whether a valid identification number exists and then whether the actual check sum corresponds with the stored check sum.

In the event of a wrong identification number, the following display is shown:

M E M O R Y   E R R O R

EPROM MODULE NUMBER:

3GE.xxx.xxx.xxxx.xx (the identified wrong ident number)

WRONG EPROM MODULE

If an error is found on comparison of the check sums, the following display is shown:

M E M O R Y   E R R O R

EPROM MODULE NUMBER:

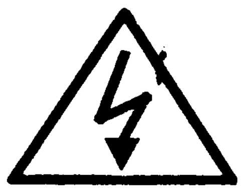
3GE.xxx.xxx.xxxx.xx (Ident number of the EPROM submodule which

CHECKSUM ERROR caused the check sum error)

It is not displayed which EPROM chip contains the wrong check sum.
If a memory error is detected, the EPROM check can be continued using the PAGE-key to evaluate further errors.
To clear a memory error the whole EPROM submodule must be exchanged (individual EPROM's are not to be exchanged).

4.2.4 <u>Adjustment of the brightness:</u>

The brightness can be adjusted by the potentiometer R18 (03780) or R36 (03731) on the operator panel interface module 03780 or 03731.



CAUTION!
There is high voltage in the monitor unit at the high voltage transformer, anode cable and anode terminal of the CRT (cathode ray tube)

15 KV - with monochrome monitor
25 KV - with colour monitor

4.2.5 <u>Notes on monitor</u>

Adjustment of contrast: Normally correctly adjusted at the works.
If re-adjustment necessary, proceed as follows:
Adjust optimum brightness R18 (03780) or R36 (03731) (Retrace beam just not visible)
Select inverted flashing character (e.g. by erroneous input)
Turn potentiometer R17 (03780), R10 (03731) to left dead-end stop.
Then turn R17/R10 to the right until an optimum of contrast and image quality is reached.
No shadow image of the displayed character should be seen and the righthand boundary of the character window should be a straight line (no blurring).

For colour monitor and adjustments on the visual display unit refer to Section 4.9.

Cleaning of the monitor: The monitor is not acid-resistant or scratch-resistant.
Magnetic interferences: The display on the monitor may oscillate if the visual display unit is exposed to electromagnetic fields. Devices which generate electromagnetic fields must be located at a distance greater than 300 mm form the visual display unit.

4.2.6 Test of emergency off and limit switches:

Replug the interface cables with the control switched off.

Functioning of emergency off and limit switches is checked without enabling the drives (command value cable disconnected)

The interface check (Section 8) can be used as an aid.

4.3 Clearing of memory areas (Cancel):

The cancel operations are to be carried out in conjunction with the following events:

- Replacement of power pack 03500
- Replacement of RAM memory 03210/03260 (model 4A only)
- Replacement of memory 6FX 1120-2CA00 (model 4B only)
- Exchange of system software on 03200 (model 4A only)
- If undefined displays appear on screen.
- If certain memory areas are to be cleared.

Attention: Cancel operations can be performed only if the service switch on module 03830 is set to the correct position.

For clearing, the cancel key  and the corresponding digit key are actuated simultaneously while a hardware reset (e.g. reset button on 03500 or power on) is performed on order to restart the control. The two keys must be kept actuated until a display appears on screen.

The following memory areas can be cleared:

Clearing of machine data		2
Clearing of user program (part program and subroutine)		3
Clearing of setting data (TO and ZO), background memory		4

Attention: Cancel 2 clears also the data for enabling the ordered options.

4.3.1. Cancel 2 (machine data)

If the standard machine data are loaded in accordance with Section 4.5, it is not necessary to perform a cancel 2 operation beforehand, since input 3 to 8 overwrites the entire machine data memory.

4.3.2. Cancel 3 (part program and subroutine)

Clearing of user programs with cancel 3 also cancels all standard and optional cycles.

4.3.3 <u>Cancel 4</u> (TO and ZO)

Clearing of tool offsets and setting data

with options B 76 and B 78, the basic models 4A and 4B have a background memory for 100 parameter values. With option B 78, this background memory contains the machine data for in-process gauging. These data are cleared with cancel 4.

Note: With basic model 4A and 4B, it is not possible to clear the PLC memory via the NC operating panel (previously cancel 0). For clearing the PLC memory, refer to Section 11.

4.4.1 <u>Loading standard machine data and establishing the type of control simultaneously</u>

This operation transfers machine data stored permanently in the EPROM area into the RAM machine data memory when the control is switched on.

The service switch on module 03830 must be in the correct position.

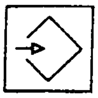
Attention: Input 3 to 8 also clears the data for enabling the ordered options.

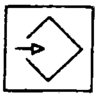
3T/3TT	Standard machine data without measuring circuit module (from C05, D01)	3 +	+ Power ON Reset (NC switch-on)
3M	Standard maschine data without measuring circuit modules (from C05, D01)	4 +	
3T/3TT	with standard machine data	5 +	
3M	with standard machine data	6 +	
3T/3TT	with standard machine data and customer I/O module	7 +	
3M	with standard machine data and customer I/O module	8 +	

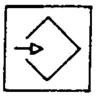
The keys must retain actuated simultaneously until a display appears. For stored standard machine data, refer to Section 2.1 and 2.2. For altering individual specific machine data, refer to Section 4.6.

4.4.2 Establishing the type of control without altering the machine data (for test purposes)

After clearing the RAM memory with cancel 2 (machine data, see Section 4.2) or after replacing the power pack or the RAM memory module, the type of control can be established without loading the standard machine data. The type of control is then stored in the RAM.

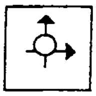
[1] +  + Power On Reset = 3T/3TT without loading the standard machine data

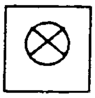
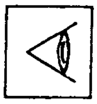
[2] +  + Power On Reset = 3M

Keys 1 and 2 and  must remain actuated until a display appears.

Application note: This operation allows changing from a 3T (turning) to a 3M (milling) and vice versa for training purposes without altering the machine data.
The type of control is automatically stored in loading operations with standard machine data.

4.5 General notes on machine data input

Mode of operation MDI-SE-TE 

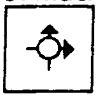
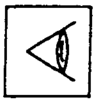
Switch display with  key to Test mode 

Progressing to the next display numbers or machine data numbers via:

the page keys ↓ ↑ and the cursor keys ← →

The cursor moves line by line. If it leaves the display, the next page is displayed

Manual alteration of machine data functions is possible in MDI-SE-TE mode only:

Operating mode  selected display (mode) 

There is no collective clearing of value blocks available. Any modification of values is furthermore protected by the data protection switch S3 on the front panel of module 03840.

Exception: Adjustment of the drift compensation is independent of the data protection switch. No machine data is entered with a decimal point, some values require a sign.

The smallest value to be entered is 0 or 1.

The greatest value tolerated, can be seen in the machine data list (refer to Section 2). Do not enter values, not even 0, into spare input numbers otherwise reading-in of tapes is blocked and an alarm appears. Spare numbers are blocked for manual entry.

The machine data can be displayed in all operating modes.

4.6 Structure and handling of the machine data tape

4.6.1 Structure of the maschine data type

A standard machine data type with already existing values of the machine is read-in.

Data structure on tape:

%TELF

N100S...LF

N101S...LF

.

.

.

.

.

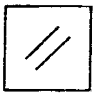
M02LF

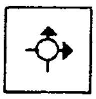
Note:

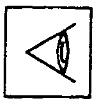
"N" for the ident number must exist on the machine data tape. The "N" does not appear on manual entry. In the Commissioning Instructions the ident number is occasionally referred to as "number" only.

4.6.2 Preparation for reading-in of machine data

Load standard machine data in accordance with Section 4.4, then switch machine data protection switch into "top" position (S3 on front panel of module 03840)

Reset 

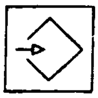
MDI-SE-TE  Operating mode for manual input of the required machine data

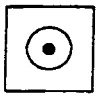
TEST 

Check the required machine data number 409, 411 and 416 (see below). If the standard machine data have not been loaded in accordance with Section 4.4 or if the input device does not match the entered values, entry or modification must be made manually.
Manual entry of the peripheral device designation and the bandrate into ident number 411 (see machine data list). Bit 7 of ident number 409 and bit of number 416 must be set to "1" in order to enable the operating mode switch.
After having entered the input device specification and the bandrate into the control, the machine data tape can be read in.
For reading-in with tape reader 40/T50 or PG675, refer to Section 10.

6.3 Reading-in the maschine data

Operating mode switch in position

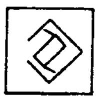
Data Input  followed by

Data Start key 

The bottom line of the display shows the message "Control in action" while the machine data are being read in.

Subsequently, the values can be modified by manual input. Furthermore, a drift compensation must be carried out:

Sequence: Select MDI-TE-SE and TEST, position cursor to the machine data number of the desired axis e.g.

> Nr. 230 S
... 233  (refer to Section 5.5)

After terminating these entries switch the data protection switch back into its normal position (switch on module 03840 in down position).
Other alarms (e.g. measuring circuit fault etc.) do not inhibit reading-in.

4.7 Machine data, example for standard machine data for 3T, software version 02 for model 4A

```
T E
N100 S+50
N101 S+50
N102 S+50
N103 S+50
N110 S+200
N111 S+200
N112 S+200
N113 S+200
N120 S+50
N121 S+50
N122 S+50
N123 S+50
N130 S+10000
N131 S+10000
N132 S+10000
N133 S+10000
N140 S+2048
N141 S+2048
N142 S+2048
N143 S+2048
N150 S+1666
N151 S+1666
N152 S+1666
N153 S+1666
N160 S+9999999
N161 S+9999999
N162 S+9999999
N163 S+9999999
N170 S+9999999
N171 S+9999999
N172 S+9999999
N173 S+9999999
N180 S+0
N181 S+0
N182 S+0
N183 S+0
N190 S+0
N191 S+0
N192 S+0
N193 S+0
N200 S+0
N201 S+0
N202 S+0
N203 S+0
N210 S+0
N211 S+0
N212 S+0
N213 S+0
N220 S+2400
N221 S+2400
N222 S+2400
N223 S+2400
N230 S+0
N231 S+0
N232 S+0
N233 S+0
N240 S+50
N241 S+50
N242 S+50
N243 S+50
N280 S+0
N281 S+0
N282 S+0
N283 S+0
N284 S+0
N285 S+0
N286 S+0
N287 S+0
N288 S+0
N289 S+0
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N301 S+0
N302 S+0
N303 S+0
N304 S+0
N305 S+0
N306 S+0
N307 S+0
N308 S+0
N309 S+0
N330 S+1
N331 S+2
N332 S+4
N333 S+6
N334 S+8
N335 S+10
N336 S+20
N337 S+40
N338 S+60
N339 S+70
N340 S+80
N341 S+90
N342 S+100
N343 S+110
N344 S+120
N345 S+0
N346 S+0
N349 S+0
N350 S+500
N351 S+0
N352 S+0
N353 S+500
N354 S+2400
N355 S+10
N356 S+10
N357 S+0
N358 S+0
N359 S+500
N360 S+1000
N361 S+2000
N362 S+4000
N363 S+4000
N364 S+4000
N365 S+4000
N366 S+4000
N367 S+5
N368 S+10
N369 S+50
N370 S+9999
N371 S+2000
N372 S+10000
N373 S+10000
N374 S+500
N375 S+2000
N376 S+1000
N377 S+0
N378 S+0
N379 S+0
N380 S+0
N381 S+
N382 S+50
N383 S+0
N385 S -9999999
N386 S+0
N387 S+0
N388 S+0
N389 S+0
N390 S+0
N391 S+0
N392 S+0
N393 S+0
N400 S 00000100
N401 S 00000011
N402 S 00000000
N403 S 00000000
N404 S 00000000
N405 S 00000000
N406 S 00000000
N407 S 00000100
N408 S 00001001
N409 S 10100100
N410 S 11111111
N411 S 11000010
N412 S 11000010
N413 S 00000000
N414 S 00000000
N415 S 10101010
N416 S 00000111
N417 S 00000000
N418 S 00000000
N419 S 00000000
N420 S 00000000
N421 S 00000000
N422 S 00000000
N423 S 00000000
N424 S 00000000
N425 S 00000000
N426 S 00000000
N427 S 00000000
N428 S 00000000
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N461 S 00000000
N462 S 00000000
N463 S 00000000
N464 S 00000000
N465 S 00000000
N466 S 00000000
N467 S 00000000
N468 S 00000000
N469 S 00000000
N470 S 00000000
N471 S 00000000
N472 S 00000000
N473 S 00000000
N474 S 00000000
N475 S 00000000
N476 S 00000000
N477 S 00000000
N478 S 00000000
N479 S 00000000
M02
```
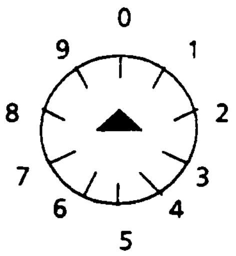
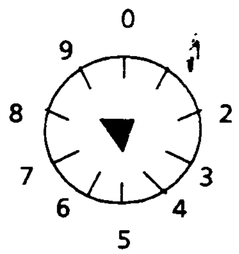

4.8 Service switch

The switch S1 is located on module 03830



Position 0:

The switch must be in this position for normal operation



Position 1:

For 3T/M, in case of a 3TT only NC1 is affected.

Cancel operations

Loading of machine data (Input 3 to 8)

EPROM check display

For controls with several NCs:

Position 1 for NC 1

Position 2 for NC 2

Position 3 for NC 3

Position 4 for NC 4

Each switch position becomes effective after Power on reset only.

The significance of each position is as described for position 1.

4.8.1 Display of the service switch positions:

From software version Co3 or Do1 on, the active position of the service switch is displayed on the right hand side in line 14 (alarm message line) of the screen.

Switch position	0 :	no display
	1 :	** 1 **
	2 :	** 2 **
	3 :	** 3 **
	4 :	** 4 **

Attention: If the service switch is in position 1-4, the "operator panel inhibit" (Q64.6) and "key lock" (Q64.5) interface signals are not effective.

4.9 Description of the monitor adjustment for Sinumerik 3 with 9 inch monochrom or 12 inch colour monitor.

4.9.1 General

Adjustments on the monitor should only be made in the event of severe display disturbances.

For tuning the various potentiometers use plastic screw drivers or similar.

Attention high voltage! (25 kV in colour monitor)

The potentiometers on the monitor printed circuit board are difficult to access.

Adjustment of colour monitor (Figure 1 to Figure 6)

The 3 basic colours (red, green, blue) must appear on screen. If a basic colour is missing, check first whether the thresholds of the video signals ON/OFF are adjusted correctly on the colour keyboard interface board 03781 (Potentiometer R8...red, R9...blue, R10...green).

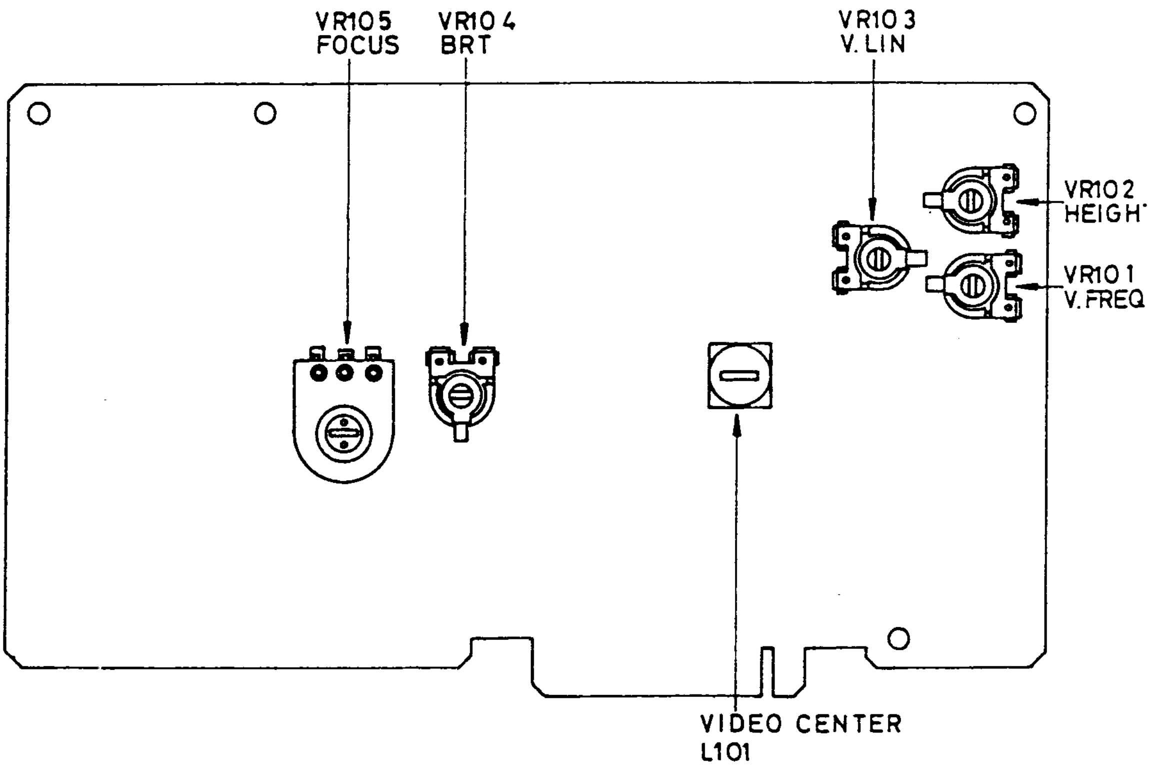
4.9.2 Adjustment of the 9 inch monochrome monitor

(Mitsui)

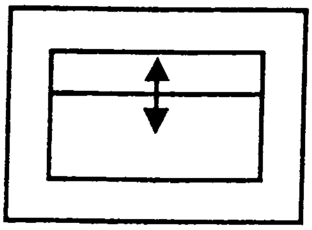
The monitors are adjusted correctly in the factory.

Therefore only the adjustment of the brightness should be made by means of the "brightness" potentiometer in order to adapt to the particular environmental lighting conditions. For information, the following overview shows the location and the function of the monitor potentiometers.

Please observe the high voltage of 15 kV on the CRT.

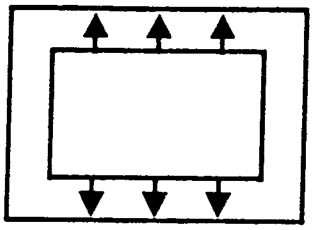


V-Frequency:
VR 101



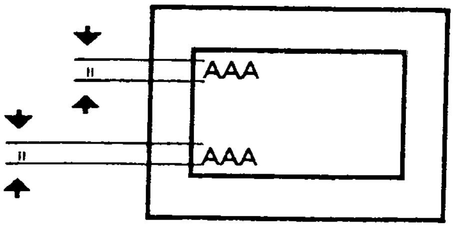
Frequency

Height:
VR 102



Magnitude

V-Lin:
VR 103



Distortion

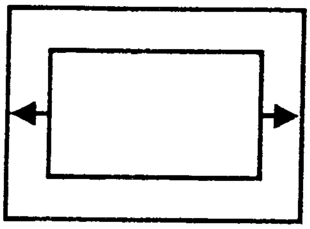
BRT:
VR 104

Brightness

Focus:
VR 105

Adjustment of focus of the display

Video Center:
L 101



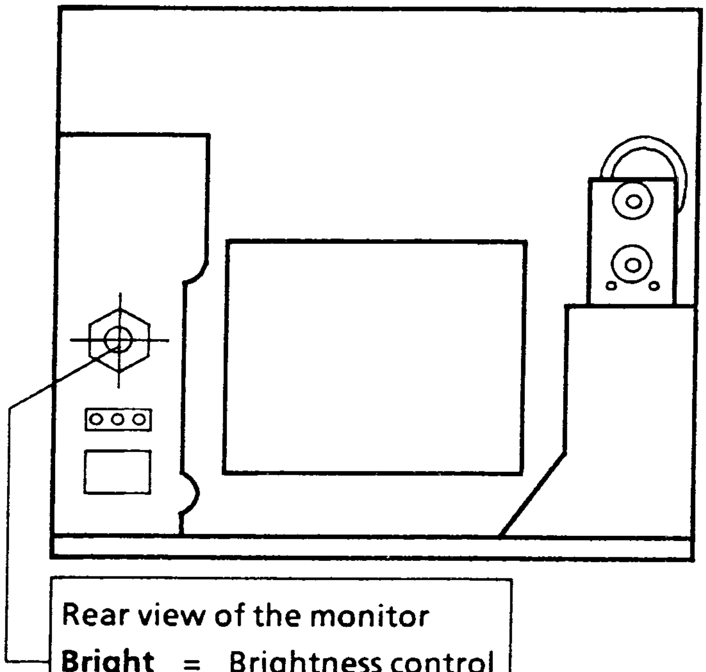
Adjustment of the centering

Note: A replacement of the monitor should only be performed by the factory since a number of basic adjustments have to be carried out.
For the final tuning of the monitor a TV tuning kit is essential.

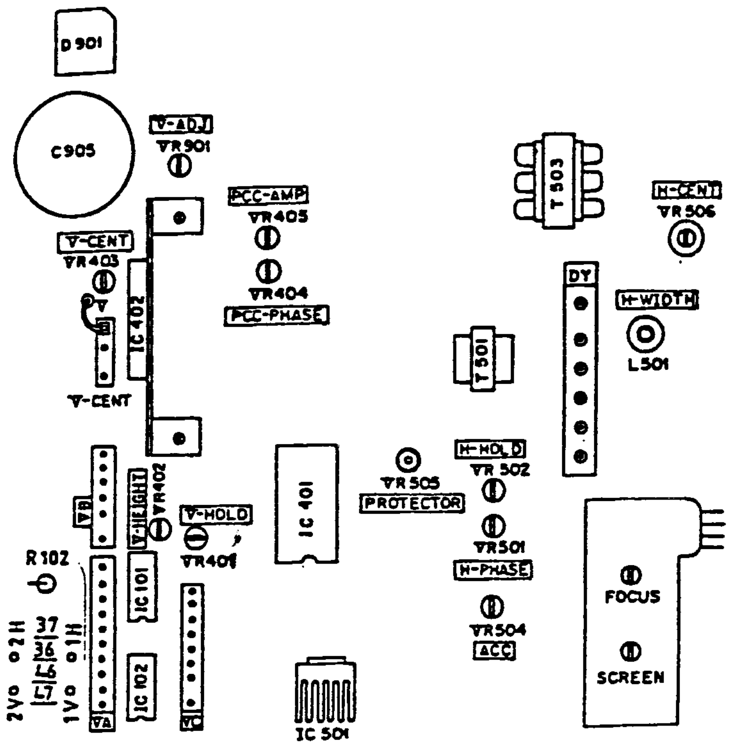
4.9.3 Adjustment of the 12 inch colour monitor (MITSUBISHI)

The monitor is adjusted correctly in the factory.

Therefore only the adjustment of the brightness should be made by means of the "Bright" potentiometer in order to adapt to the particular environmental lighting conditions.
For information, the following overview shows the location and the function of the monitor potentiometers.
Please observe the high voltage of 25 kV on the CRT.



Rear view of the monitor
Bright = Brightness control



View from above

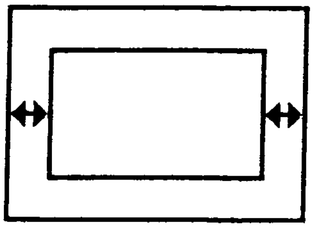
Focus = Focus adjustment of the display

Screen = Pre-adjustment of the brightness

Attention: Adjustments only in the factory.

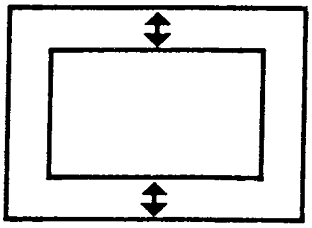
All potentiometers which are not marked by an X may only be adjusted in the factory.

H-Cent =
VR 506



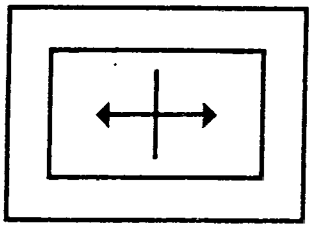
Adjustment of horizontal centering

V-Cent =
VR 403



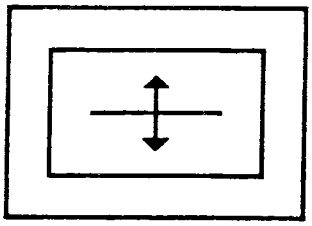
Adjustment of vertical centering

H-Hold =
VR 502



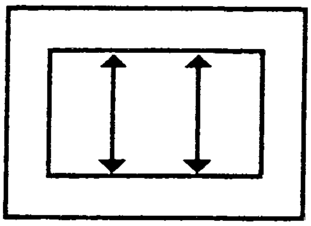
Horizontal hold

V-Hold =
VR 401



Vertical hold

V-Height =
VR 402

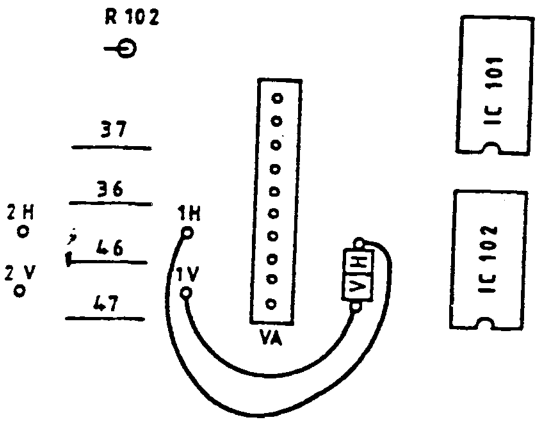


Magnification of the display

Note: If a monitor is replaced, make sure that jumpers 36, 37, 46, 47 and R102 are taken out.

Important! **Check in any case that the jumpers to 1V and 1H are soldered in (the jumpers must not be connected to 2V and 2H).**

Note: The monitor should only be replaced in the factory since numerous basic adjustments have to be carried out.

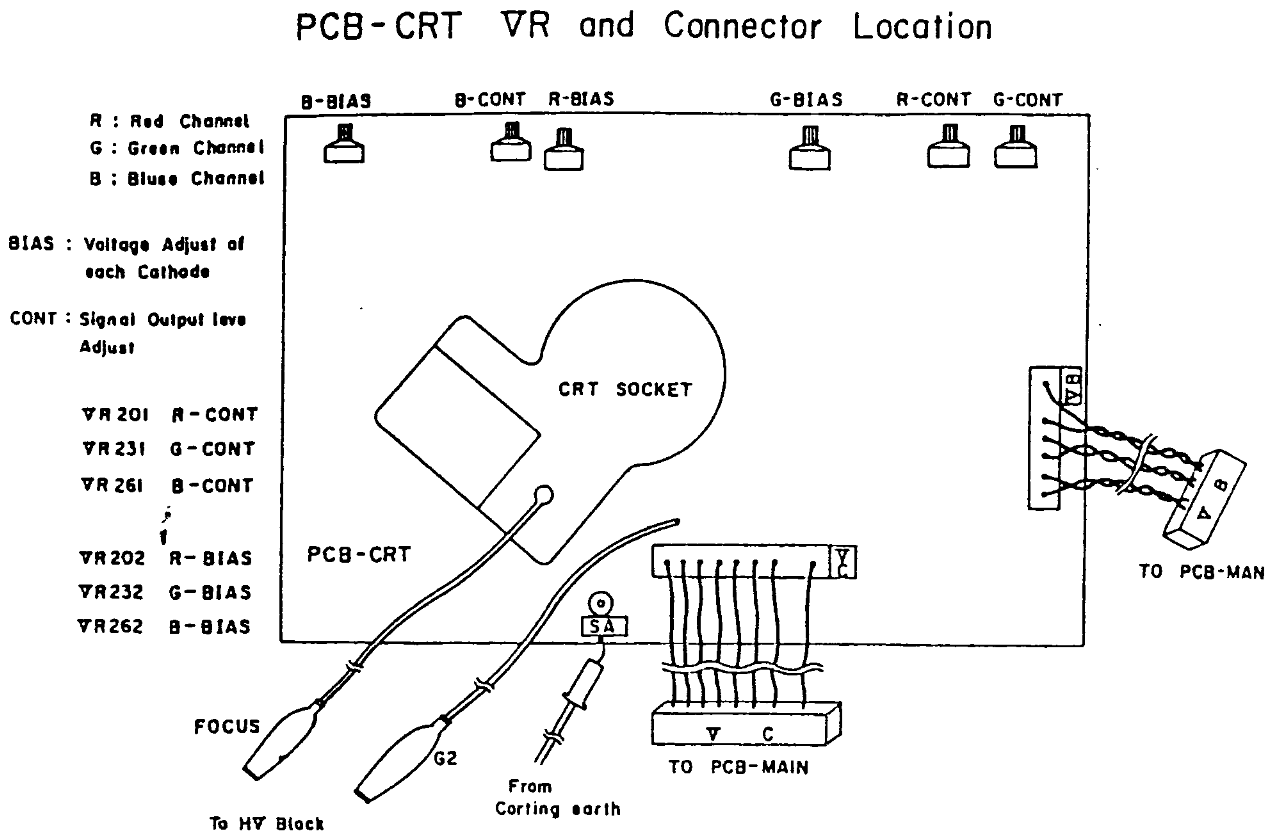


Adjustment of the display synchronization

The horizontal and the vertical synchronization of the display is performed by means of the H-HOLD or V-HOLD potentiometer. The display has to be checked in both monitor modes of operation (character mode 55 Hz, graphics mode 63 Hz).
In the event of difficulties on vertical hold adjustment (sensitive V-HOLD potentiometer, different behaviour in graphics and in character mode e.g. character mode display static, graphics mode display sweeps) the following adjustment must be checked:

Monitor type	Synchronization signals	Jumper H-K on 03731
R241 A120 L1	Low-active	in
R241 A120 H1	High-active	out

Potentiometer für colour adjustment

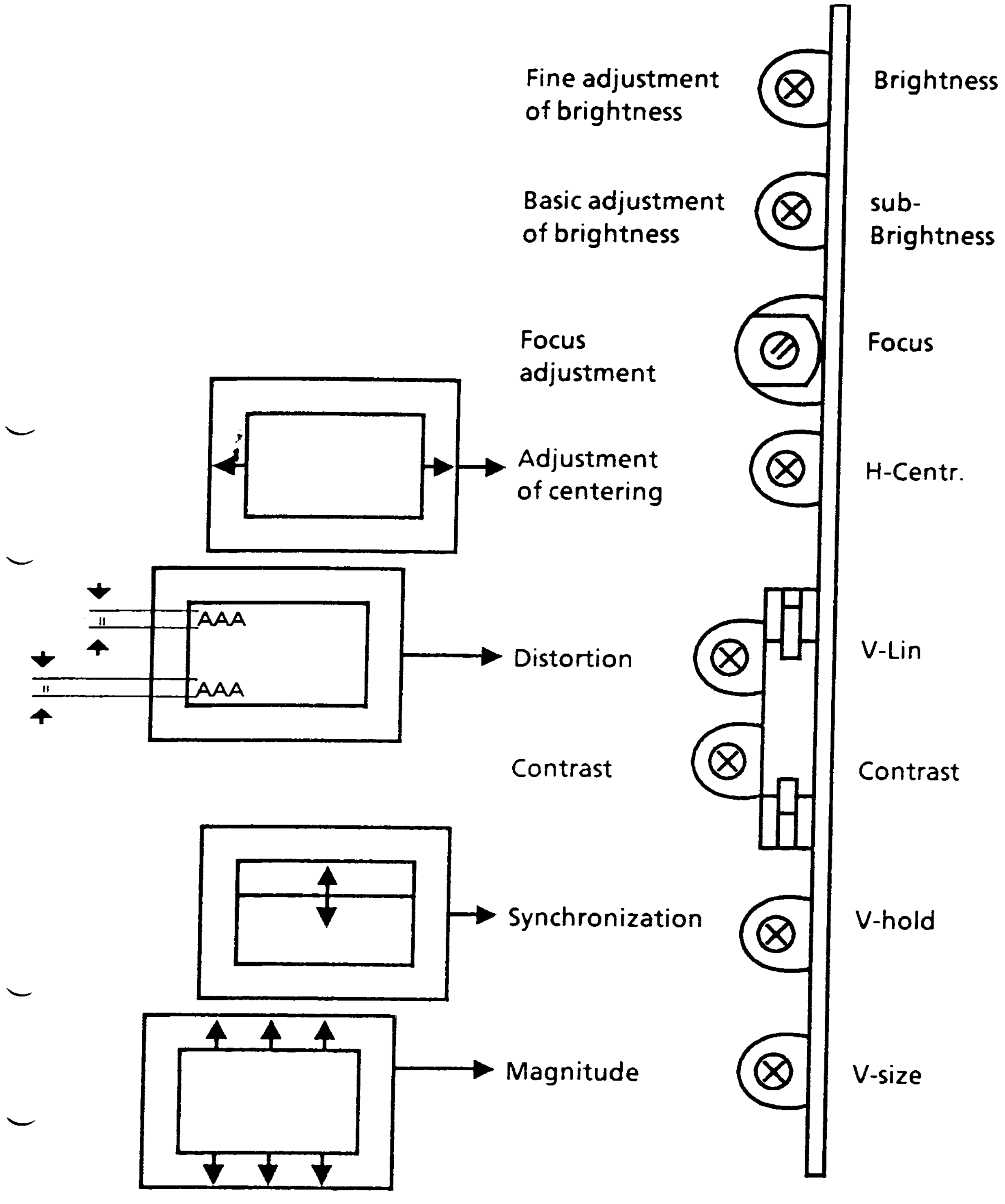


4.9.4 Adjustment of the 9 inch monochrome monitor (SAMPO)

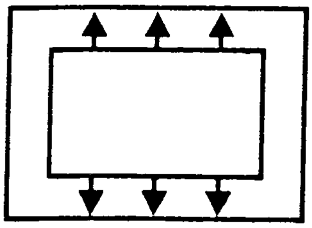
These monitors replace the former 9 inch monitors. Only this new monitor type can be supplied as a spare part. In the event of a breakdown there is an mechanical conversion kit available for replacement and mounting of the new monitor into the old chassis. The electrical connections are identical. The monitor is already correctly adjusted in the factory. Therefore only the adjustment of the brightness should be made by means of the "Brightness" potentiometer in order to adapt to the specific environmental lighting conditions.

For information, the following overview shows the location and the function of the monitor potentiometers.

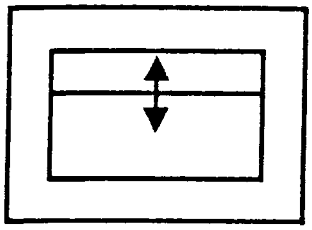
Please observe the high voltage of 15 kV on the CRT.


Fine adjustment of brightness
Brightness
Basic adjustment of brightness
sub-Brightness
Focus adjustment
Focus
Adjustment of centering
H-Centr.
AAA
AAA
Distortion
V-Lin
Contrast
Contrast
Synchronization
V-hold
Magnitude
V-size

V-size = Magnitude
Adjustment of the
display height

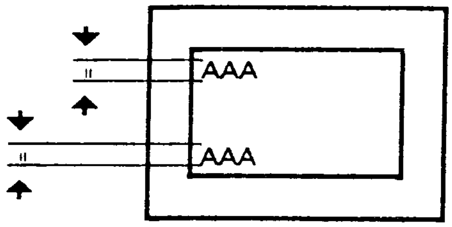


V-hold = Synchronization
Potentiometer for adjusting the
display sweep. Display should
lock-in from top towards bottom.

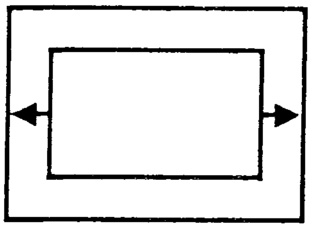


Kontrast = Adjustment of the
grey values

V-Lin = Even height
of the characters



H-Cent = Adjustment of the centering



Focus = Focus adjustment of the beam

sub-Brightness = Basic brightness adjustment
Attention! Setting should not be altered
since improper handling can
damage the CRT
(danger of screen burn).

Brightness = Fine adjustment of the brightness

Note: The monitor should be replaced only in the factory since
numerous basic adjustments need to be carried out.

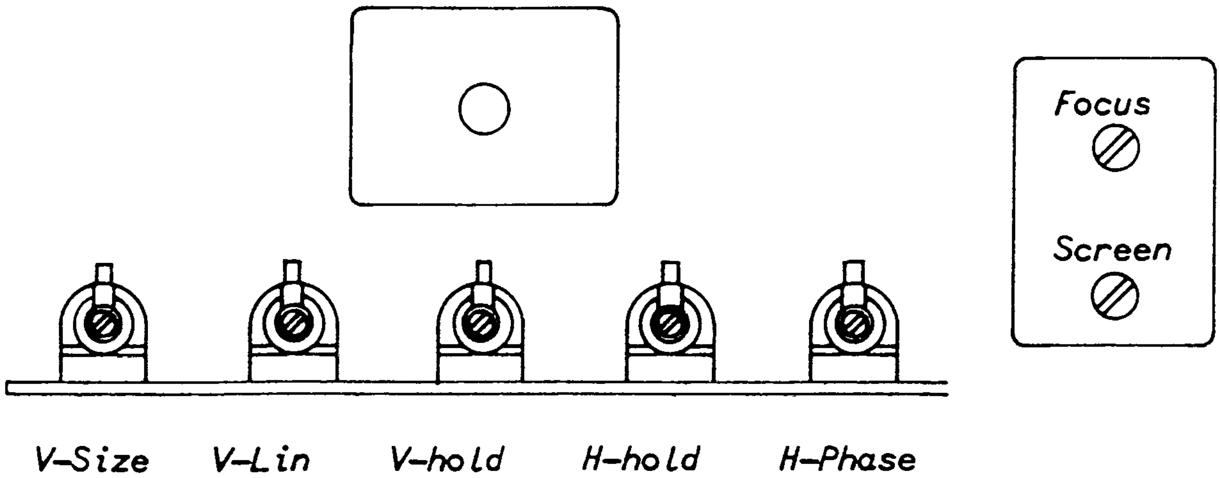
4.9.5 Adjustment of the 12 inch colour monitor (SAMPO)

This monitor replaces the previous 12 inch colour monitors.
In the event of a breakdown, there is a mechanical conversion kit available for replacement and mounting of the new monitor into the old chassis. The electrical connections are identical. The monitor is already correctly adjusted in the factory.

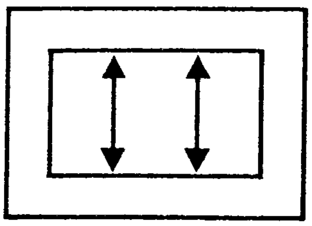
Therefore only the adjustment of the brightness should be performed by means of the "Bright" potentiometer in order to adapt to the specific environmental lighting conditions.,For information, the following overview shows the location and the function of the monitor potentiometers.

Please pay attention to the 25 kV high voltage on the CRT.

Rear view

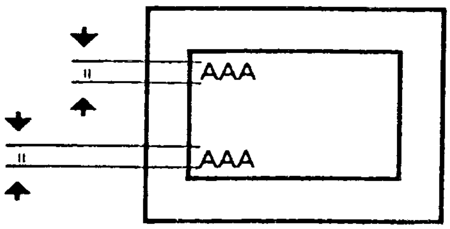


V-size =

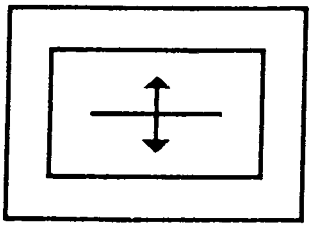


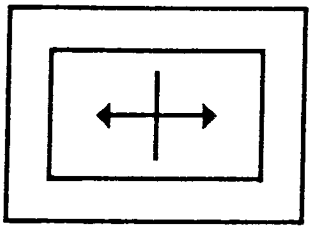
Magnification of the display

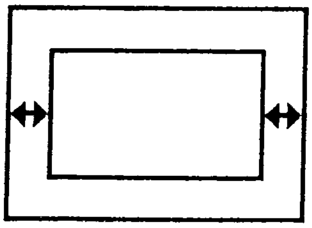
V-Lin =



Even heights of the characters

V-Hold =  Vertical hold

H-Hold =  Horizontal hold

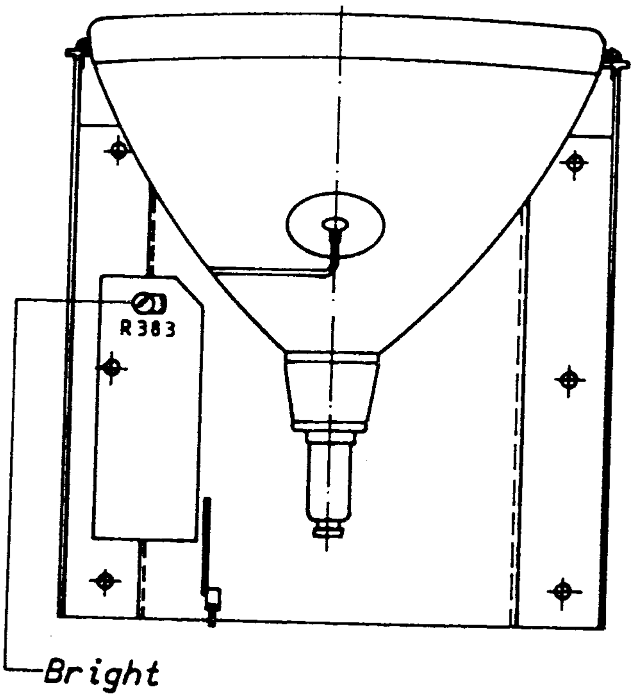
H-Phase =  Adjustment of the horizontal centering

Bright = Brightness control

Focus = Focus adjustment of the beam

Screen = Basic brightness adjustment

View from above



A TV tuning kit is essential for the final tunning of the monitor.

Note: The monitor should only be replaced in the factory since numerous basic adjustments have to be carried out.

4.9.6 12 inch monochrome monitor

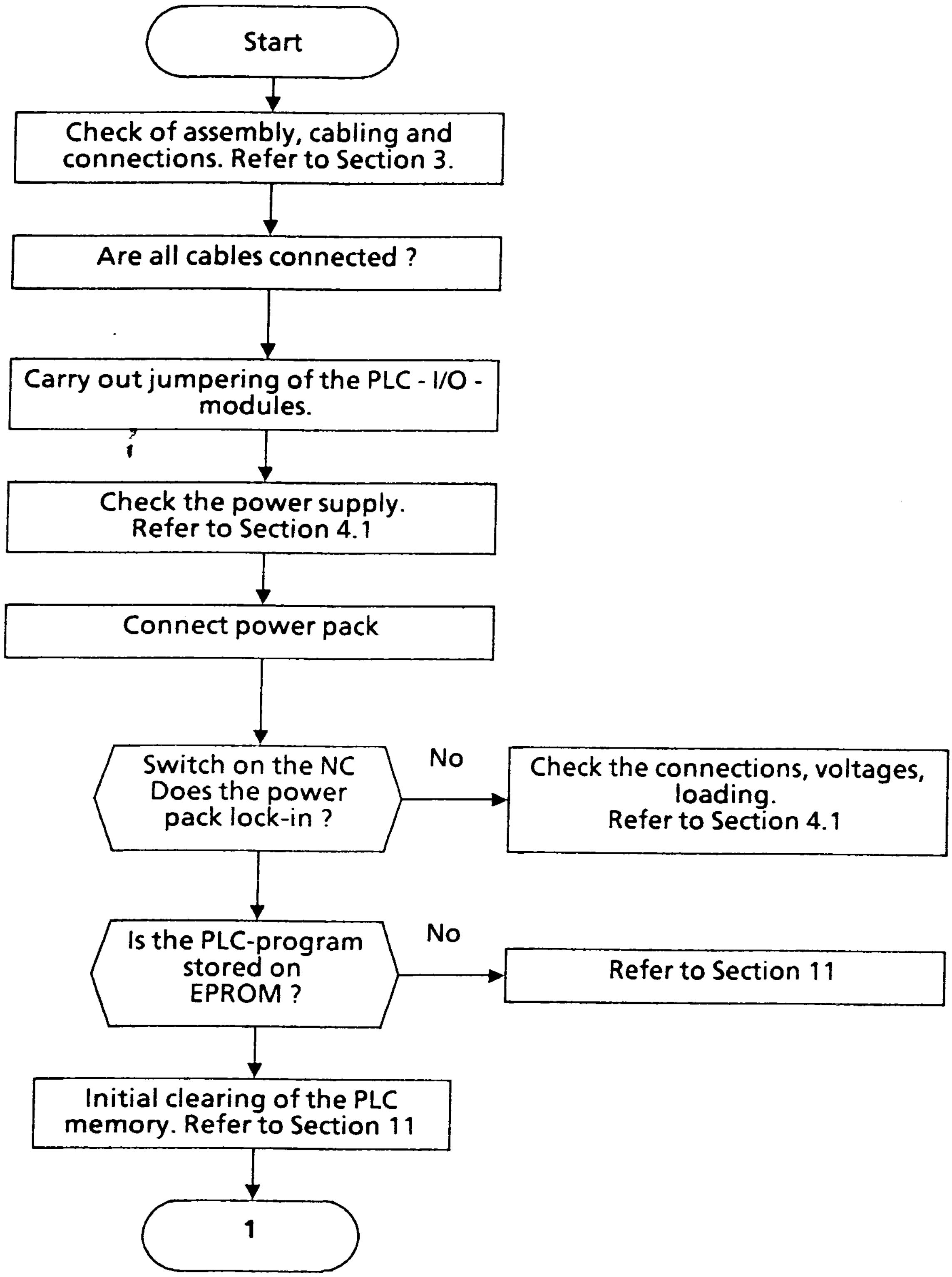
The adjustments and potentiometers are identical to those of the 9 inch monitor, see Section 4.9.2 and 4.9.4.
The Mitsui monitor is supplied from the 24 V of the operator panel.
The Sampo monitor has an additional 220 V connector.

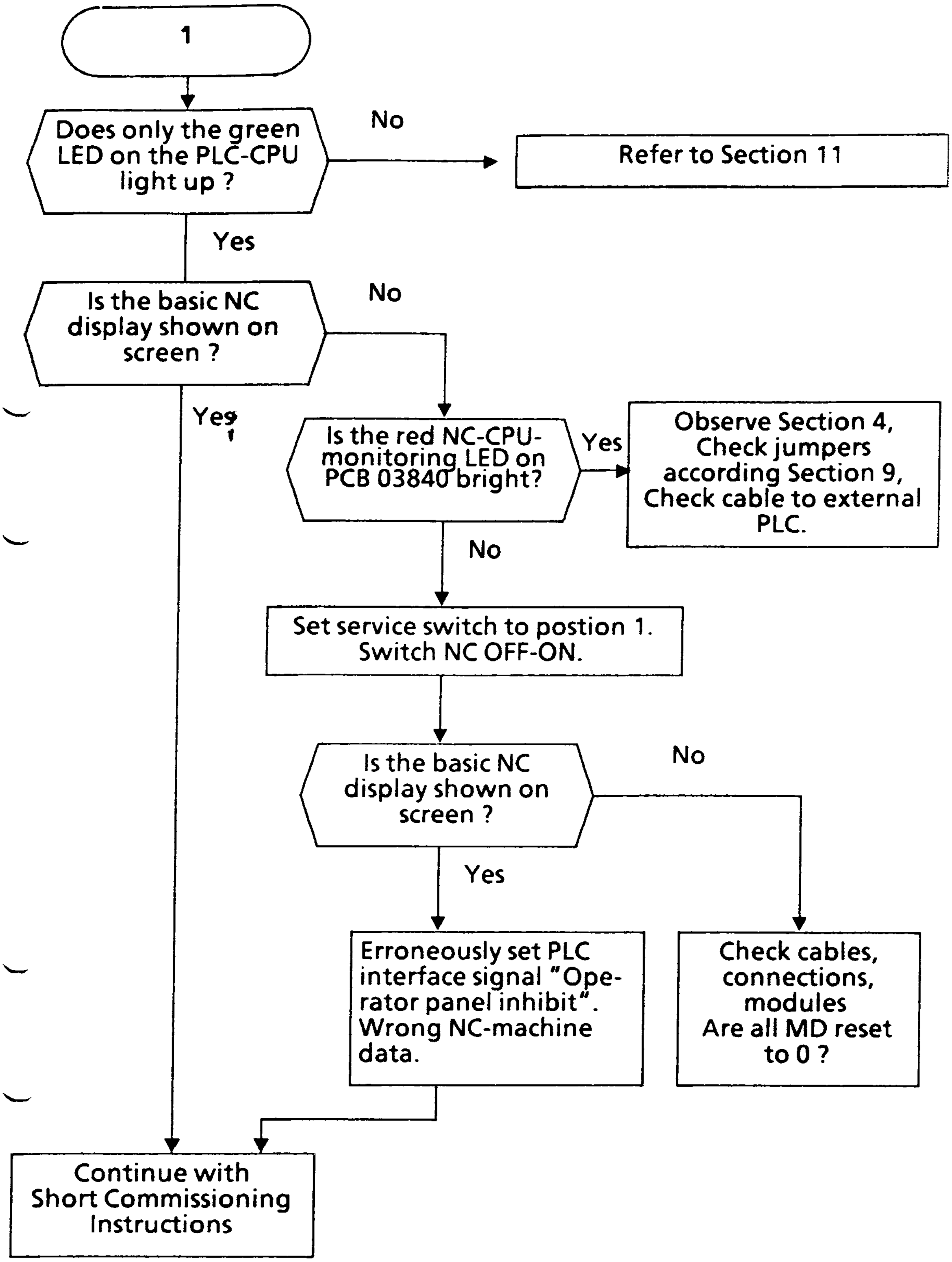
Chapter 5

-Short commissioning instructions for standard commissioning-

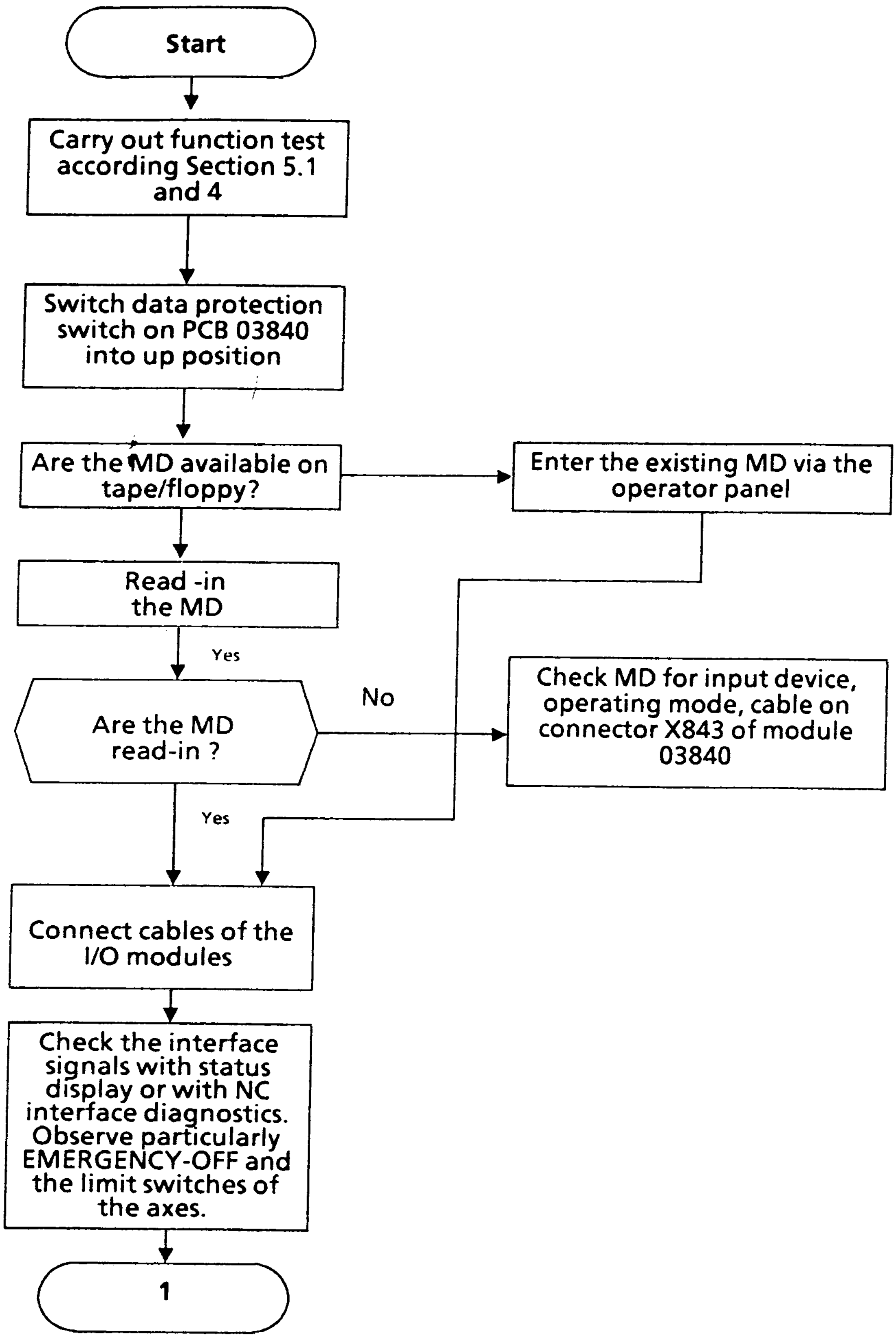
Contents

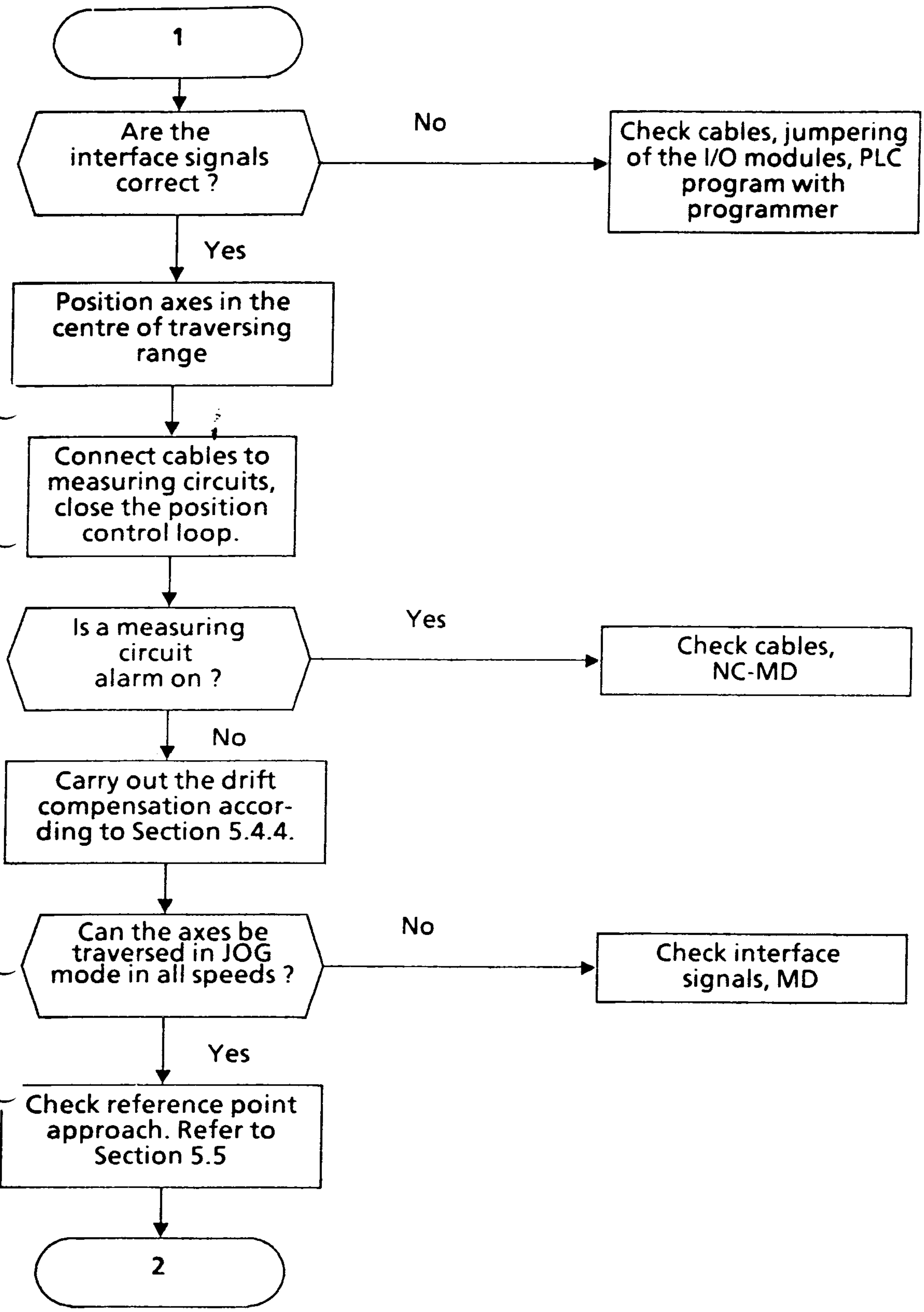
5.1 Short instructions for visual inspection and functional test

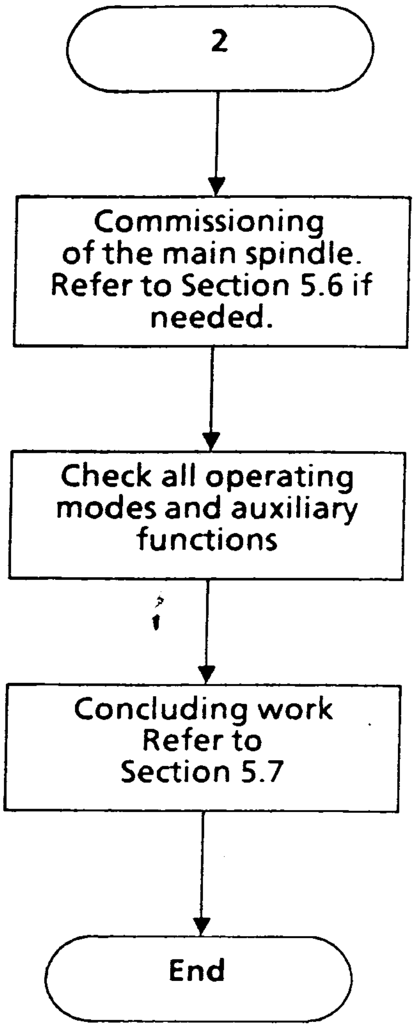



1
Does only the green LED on the PLC-CPU light up ?
No
Refer to Section 11
Yes
Is the basic NC display shown on screen ?
No
Yes
Is the red NC-CPU-monitoring LED on PCB 03840 bright?
Yes
Observe Section 4, Check jumpers according Section 9, Check cable to external PLC.
No
Set service switch to postion 1. Switch NC OFF-ON.
Is the basic NC display shown on screen ?
No
Yes
Erroneously set PLC interface signal "Operator panel inhibit". Wrong NC-machine data.
Check cables, connections, modules Are all MD reset to 0 ?
Continue with Short Commissioning Instructions

5.2. Short commissioning instructions with existing machine data (MD)




1
Are the interface signals correct ?
No
Check cables, jumpering of the I/O modules, PLC program with programmer
Yes
Position axes in the centre of traversing range
Connect cables to measuring circuits, close the position control loop.
Is a measuring circuit alarm on ?
Yes
Check cables, NC-MD
No
Carry out the drift compensation according to Section 5.4.4.
Can the axes be traversed in JOG mode in all speeds ?
No
Check interface signals, MD
Yes
Check reference point approach. Refer to Section 5.5
2


2
Commissioning of the main spindle. Refer to Section 5.6 if needed.
Check all operating modes and auxiliary functions
Concluding work Refer to Section 5.7
End

5.3 Commissioning flowchart with evaluation of the most important machine data.

Start

↓

Function test carried out ?

↓

Set the following MD according to the machine manufacturers specification
MD 130-133: maximum speed for each axis
MD 160-163, 170-173: values for the software limit switches, if used.
MD 180-183: Reference point coordinates.
These values are taken as actual position on reference approach.
MD 371-375: Speed for the various modes of operation
KV factor should be set to 1 m/min/mm.

↓

Speed-dependent multgain adaption: MD 220-223

Max.speed m/mm	15	12	10	8	6	5	4	3
Input value	1800	2250	2700	3375	4500	5400	6750	9000

Input values for inch or other maximum speeds: Refer to Section 7

↓

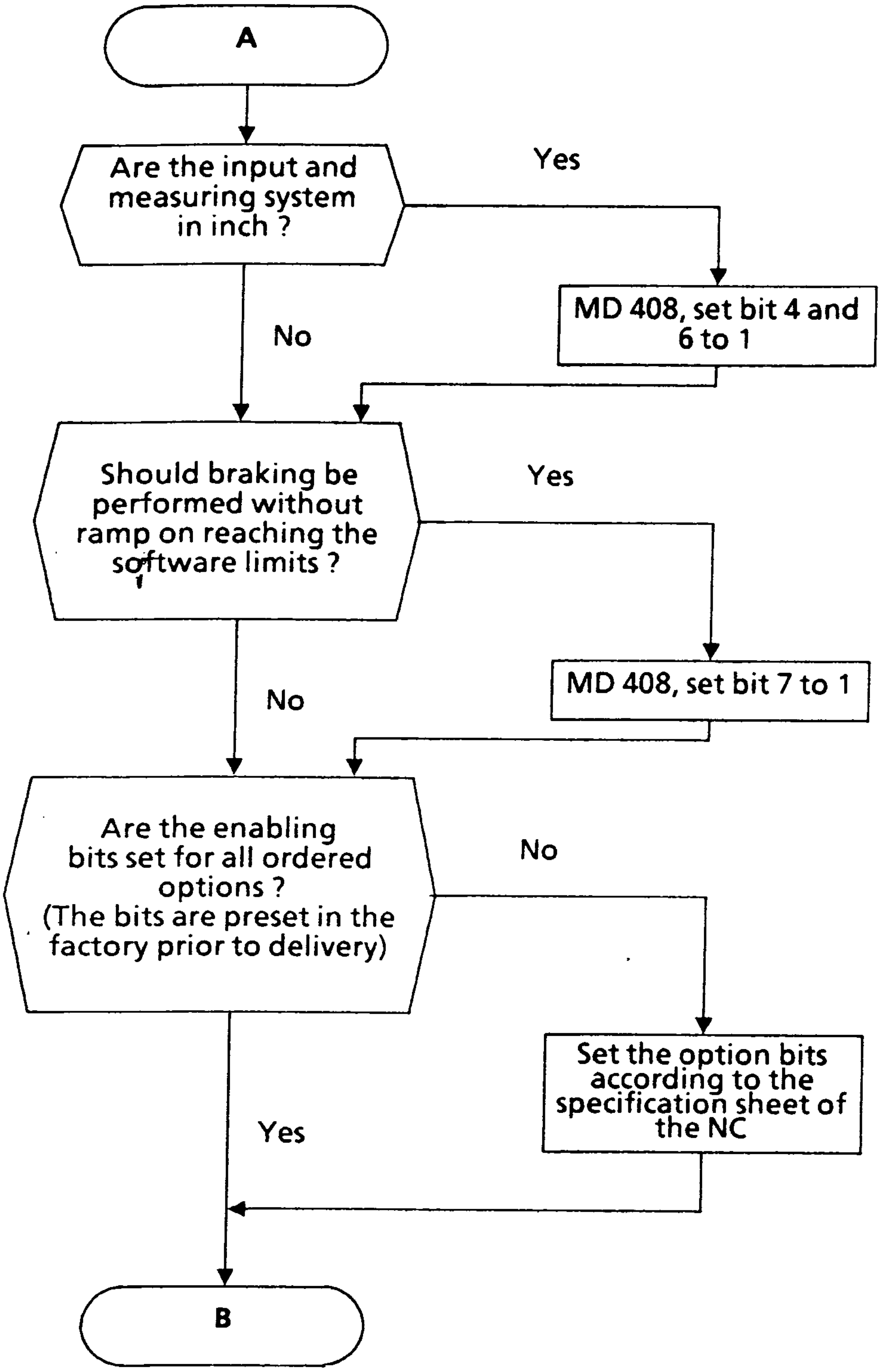
Does a rotary axis exist ?

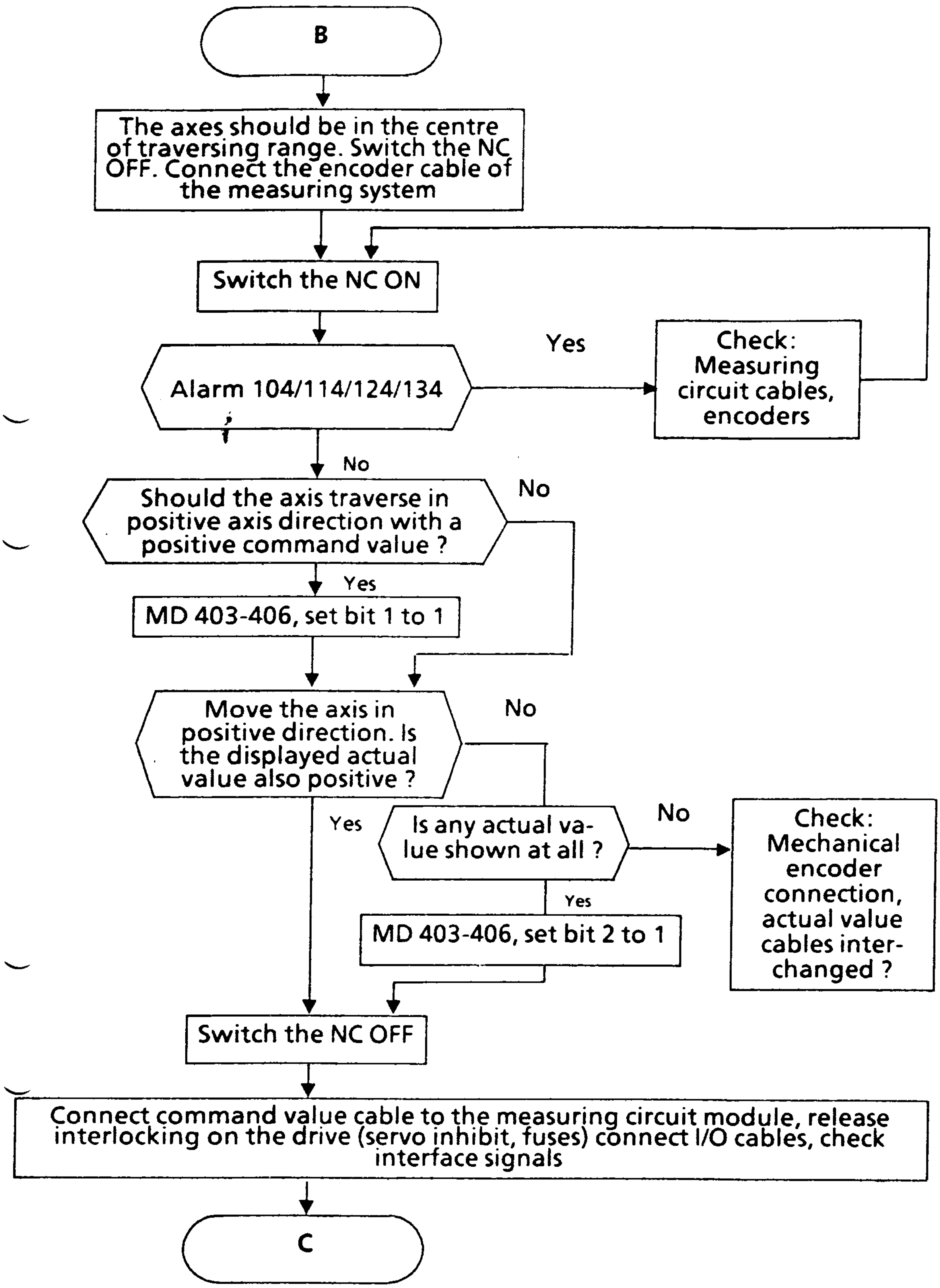
Yes → MD 403-406, set bit 5 to 1
MD 349: Enter value for the cutoff speed (100-400)
Observe MD 420-423.

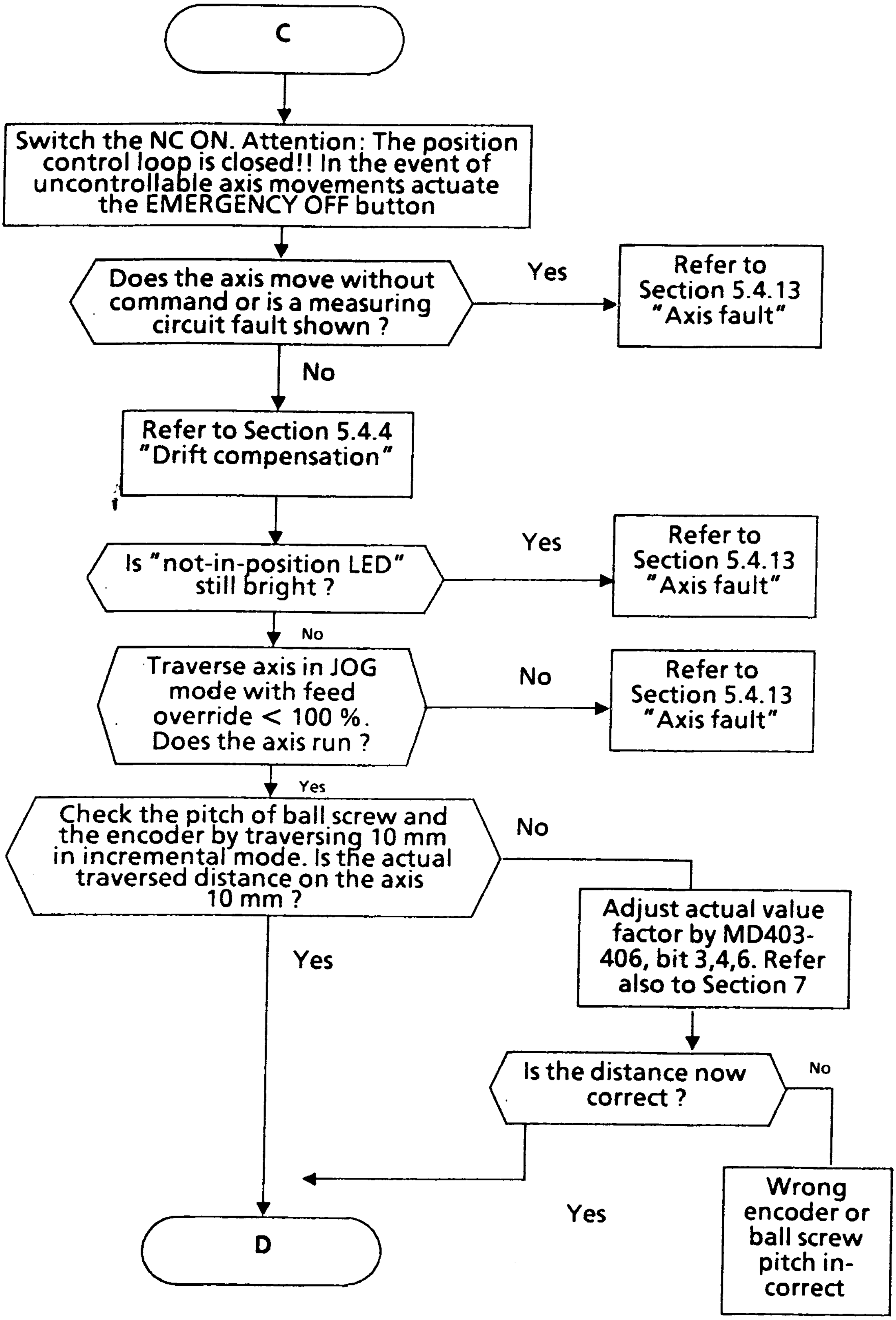
No

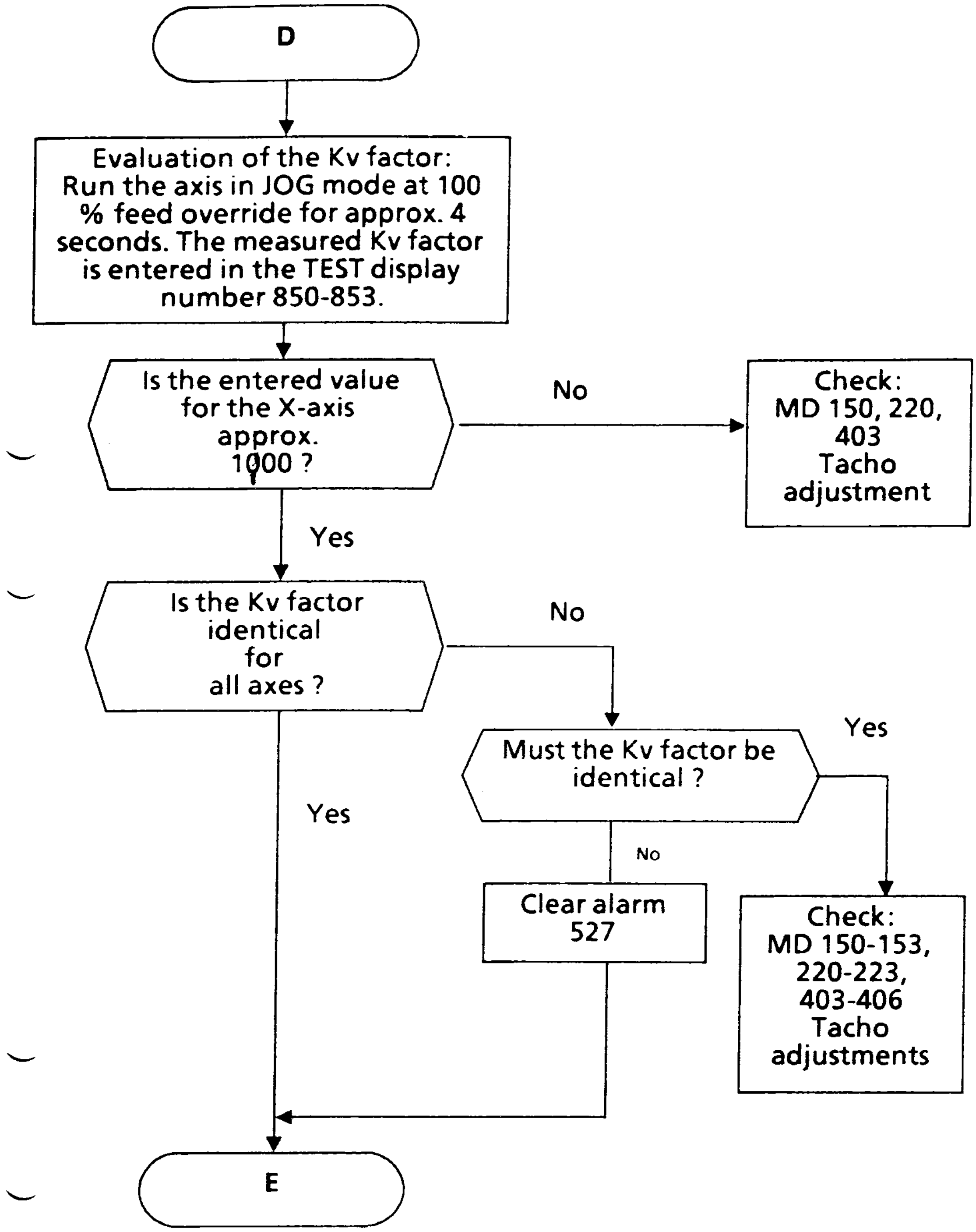
↓

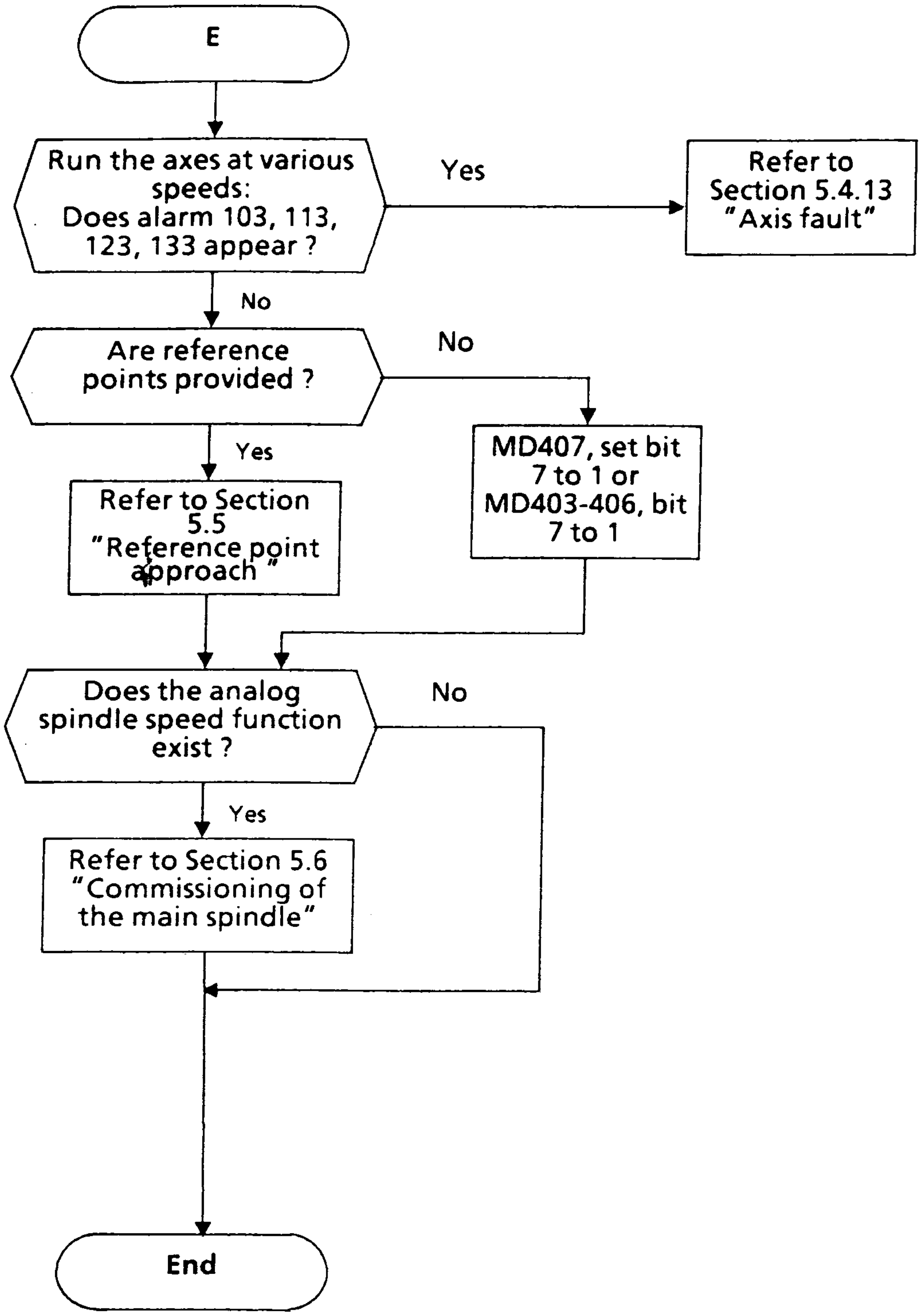
A


A
Are the input and measuring system in inch ?
Yes
MD 408, set bit 4 and 6 to 1
No
Should braking be performed without ramp on reaching the software limits ?
Yes
MD 408, set bit 7 to 1
No
Are the enabling bits set for all ordered options ? (The bits are preset in the factory prior to delivery)
No
Set the option bits according to the specification sheet of the NC
Yes
B


B
The axes should be in the centre of traversing range. Switch the NC OFF. Connect the encoder cable of the measuring system
Switch the NC ON
Alarm 104/114/124/134
Yes
Check: Measuring circuit cables, encoders
No
Should the axis traverse in positive axis direction with a positive command value ?
No
Yes
MD 403-406, set bit 1 to 1
Move the axis in positive direction. Is the displayed actual value also positive ?
No
Yes
Is any actual value shown at all ?
No
Check: Mechanical encoder connection, actual value cables interchanged ?
Yes
MD 403-406, set bit 2 to 1
Switch the NC OFF
Connect command value cable to the measuring circuit module, release interlocking on the drive (servo inhibit, fuses) connect I/O cables, check interface signals
C


C
Switch the NC ON. Attention: The position control loop is closed!! In the event of uncontrollable axis movements actuate the EMERGENCY OFF button
Does the axis move without command or is a measuring circuit fault shown ?
Yes
Refer to Section 5.4.13 "Axis fault"
No
Refer to Section 5.4.4 "Drift compensation"
Is "not-in-position LED" still bright ?
Yes
Refer to Section 5.4.13 "Axis fault"
No
Traverse axis in JOG mode with feed override < 100 %. Does the axis run ?
No
Refer to Section 5.4.13 "Axis fault"
Yes
Check the pitch of ball screw and the encoder by traversing 10 mm in incremental mode. Is the actual traversed distance on the axis 10 mm ?
No
Adjust actual value factor by MD403-406, bit 3,4,6. Refer also to Section 7
Yes
Is the distance now correct ?
No
Wrong encoder or ball screw pitch in-correct
Yes
D


D
Evaluation of the Kv factor: Run the axis in JOG mode at 100 % feed override for approx. 4 seconds. The measured Kv factor is entered in the TEST display number 850-853.
Is the entered value for the X-axis approx. 1000 ?
No
Check: MD 150, 220, 403 Tacho adjustment
Yes
Is the Kv factor identical for all axes ?
No
Must the Kv factor be identical ?
Yes
Yes
No
Clear alarm 527
Check: MD 150-153, 220-223, 403-406 Tacho adjustments
E


E
Run the axes at various speeds: Does alarm 103, 113, 123, 133 appear ?
Yes
Refer to Section 5.4.13 "Axis fault"
No
Are reference points provided ?
No
MD407, set bit 7 to 1 or MD403-406, bit 7 to 1
Yes
Refer to Section 5.5 "Reference point approach"
Does the analog spindle speed function exist ?
No
Yes
Refer to Section 5.6 "Commissioning of the main spindle"
End

5.4. Commissioning of axes:

Preconditions:

- PLC operative
- Interface signals checked
- Machine data entered
- Measuring circuit cables not connected

5.4.1 Sign of the feedback signal for the feed axes.

A wrongly adjusted sign of the feedback signal causes an uncontrollable axis movement at maximum speed. Therefore, always check the sign of the feedback signal for the position control and the speed control before closing the control loop.

Handling sequence:
The traversing direction of the feed axis must be known (Specified by the customer or according to ISO).

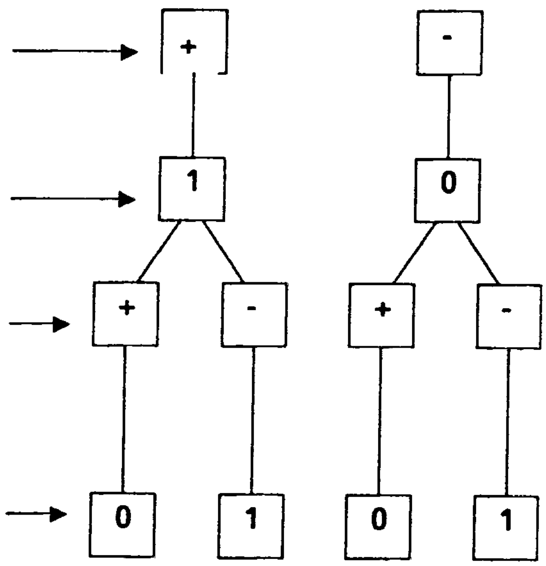
Example:
Axis movement in positive direction with a speed command value polarity of:

With which speed command value polarity on the servo drive does the axis move in positive direction ? (According to customer or check with battery box).

Set the machine data bits for the sign change of speed command value (MD No. 403...406, bit 1)

Check the sign of position control feedback: Move the feed axis manually in positive direction. Observe the sign of actual value change by means of the actual value display.

Sign change for part actual value (MD No. 403...406, bit 2)



5.4.2 Closing of the speed control loop:

Connect the command value plug and remove other interlockings for the axis (fuses, servo enabling) while the control is switched off. The other axes are still inhibited. Switch on the control.

Attention: Actuate EMERGENCY OFF, if the feed axis out of control.

Reasons for uncontrollable movements:

a) Wrong polarity of feedback sign of position control loop or speed control loop. Wrong setting of machine data bits.
Characteristic symptom: Axis runs off at maximum speed.

b) Position control loop not closed:
Characteristic symptom: Axis moves at constant low speed.
Reason: The measuring device (position encoder) does not follow the movement of the axis.

Short circuit to ground or interruption of the encoder cables triggers the measuring circuit monitoring.

c) Command value does not reach the speed controller:
Characteristic symptom: Axis moves at constant low speed (drifting)

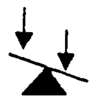
d) Errors in the control loops:

Characteristic symptom:	Vibrations and heavy oscillating of the axis.
Reasons:	Tacho feedback interrupted Wrong tacho feedback sign Kv factor too great.

5.4.3 Moving the axis in JOG mode

All command value cables are connected.
Sign of feedback signals is correct. Position control loop closed and gains correctly adjusted. Move the axes by means of the direction keys.

- In the event of alarms, refer to Section 5.4.13

- If the "not in position" - LED  remains bright, refer to drift

- If the red "feed halt"-LED lights up, check the interface signals (list contained in Section 2)

The following interface signals are needed:

Feed enablings
No axis lock
No follow-up mode
Servo enabling
Feed override not in position 0
Check with interface diagnostics
or status display according to
Section 8.

Check the weighting of the feedback pulses:

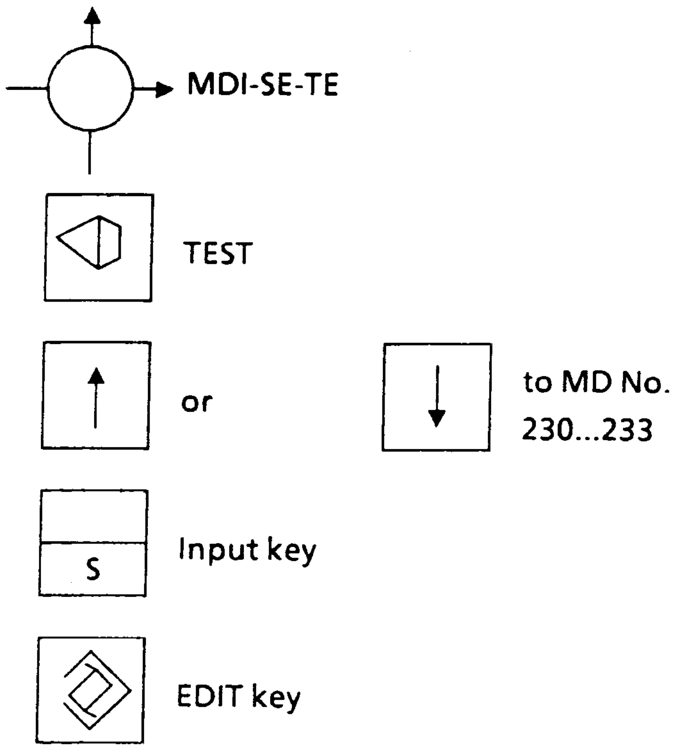
Move the axis 10 mm in incremental mode. Is the traversed distance correct ? If not, adjust the machine data bits for pulse weighting (MD 403, bit 3, 4, 6)

5.4.4 Drift compensation

The adjustment of the drift should be carried out when the control loops for all axes are closed and the drives are operative.

If the "not in position" LED remains bright, the axes can not be traversed.

Handling sequence:



Important: The drift compensation must be carried out individually for each axis. The data protection switch can remain in normal position (down). The axes must not be blocked and the drives must be operative.

5.4.5 Tacho adjustment and definition of the maximum command value.

The axis-specific maximum speeds (MD 130...133), specified by the customer must be reached at a certain tacho voltage. In this context it has to be observed that approx. 10 % control reserve is needed. The practical limits are determined either by the signal level of the measuring modules (10 V) or by the servo unit of the drive.

Case A:

Maximum permissible input voltage of the servo drive: 10 V. The value 8192 is entered in MD 140-143. (Command value output up to 120 V possible, 8192 VELO = 10V). However, the maximum axis speed must be reached at 9 V already (10 % control reserve)

Tacho adjustment

The adjustment should be carried out at low speed and with small speed command value.
Measuring point:
Check the speed command value on the servo unit of the drive while traversing the axis at a defined speed by the NC (e.g. in JOG mode). Adjustment by means of the "tacho"-potentiometer on the servo-drive unit.

Case B:

The servo-drive unit must be limited to speed command value lower than 10 V.
In MD 140...143, e.g. the value 4096 is entered (command value output up to 5 V).
The maximum axis speed must be reached at 4.5 V. (For tacho adjustment refer to case A).
The speed command value output voltage can be limited in the NC by means of machine datum MD 140...143.

Conversion: 10 V correspond to 8192 units (VELO).

The limitation, entered in MD 140...143, must not be reached in normal operation. Generally, case A should be employed if possible. Higher command value voltages give better control performance.

5.4.6 Multgain factor

MD 220...223. The NC needs a multgain factor in order to calculate the speed command value.

This allows control of axes using the full command value range despite different maximum speeds.

Axes which work together in continuous path control must have identical position control loop gains. This is the case, if the value for each axis is calculated according to the following formula:

$$\text{MULTGAIN} = \frac{3 \cdot 10^7}{V_{max.}\ \frac{mm}{min}} \bullet \frac{U_{max.}\ \ V}{10\ V}$$

With rotary axes:

$$\text{MULTGAIN} = \frac{3 \cdot 10^7}{V_{max.}\ \frac{degrees}{min}} \bullet \frac{U_{max.}\ \ V}{10\ V}$$

With inch measuring system:

$$\text{MULTGAIN} = \frac{3 \cdot 10^7}{V_{max.}\ \frac{inch}{Min}} \bullet \frac{U_{max.}\ \ V}{10\ V}$$

v_{max} = Maximum axis speed as entered in MD 130...133 as acceleration stop limit.

U_{max} = Speed command value voltage for V_{max} after tacho adjustment.

Overview table for multgain input value , refer to Section 7, MD 220.

Examples:

a) Kv factor for all axes	= (X, Z = 1m/min/mm)
Maximum speed of all axes	= (X, Z = 10 m/min)
Command value adjustment for all axes	= (U_{max} X, Z = 9 V)
results in a multgain value for all axes	= (X, Z = 2700)
b) Kv factor for all axes	= (X, Z = 1 m/min/mm)
Maximum speed of the axes	= (X = 10m/min, Z = 15m/min)
Command value adjustment for all axes	= (U_{max} X,Z = 9 V)
results in a multgain value of the axes	= (X = 2700, Z = 1800)
c) Kv factor for all axes	= (X, Z = 1 m/min/mm)
Maximum speed of the axes	= (X = 1 m/min, Z = 5m/min)
Command value adjustment for the axes	= (U_{max} for X = 4V, U_{max} for Z = 8 V)
results in a multgain value of the axes	= (X = 12000, Z = 1600)

5.4.7 Speed control gain: Kv factor

Definition:

$$Kv = \frac{\text{Speed} \qquad \text{m/min}}{\text{Following error} \qquad \text{mm}}$$

Unit of the Kv factor according to VDI standard

General

A high kV factor is essential to achieve small contour deviations in continuous path control. However, a high Kv factor leads to instability, overshooting and possibly to an impermissibly high stress of the machine.

The maximum admissible Kv factor depends upon:
Construction or dynamics of the drives (response time, acceleration and braking ability), quality of the machine.
In practice, standard values are known for serial machines, which in 80 % of the cases lie between 1 and 1.5 m/min/mm. In these cases, the standard value is set and a check for overshoots or instability is carried out.

Important: Precondition for an optimum Kv factor adjustment is a well optimized speed controller.

Procedure:

Reduce acceleration (MD 120...123).
The response performance (overshoots) is important for the evaluation of the optimum Kv factor.
Therefore, the acceleration must be set to such a value that the current limit of the drive is not reached.

If the drive should ultimately reach an acceleration of 1 m/sec^2, set provisionally half the value

$$\frac{0.5\ m}{sec^2} = \text{Input : 50}$$

<u>Kv-value adjustment</u>

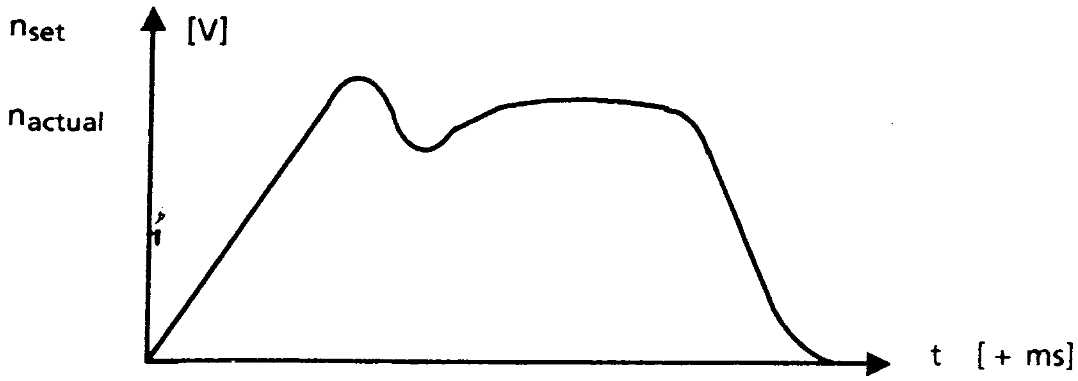
The loop gain is entered in MD 150...153 according to the equation:

$$\boxed{Kv\ (0.01\ S^{-1}) = \frac{1000}{60} \cdot 100 \cdot K_v \frac{m/min}{mm}}$$

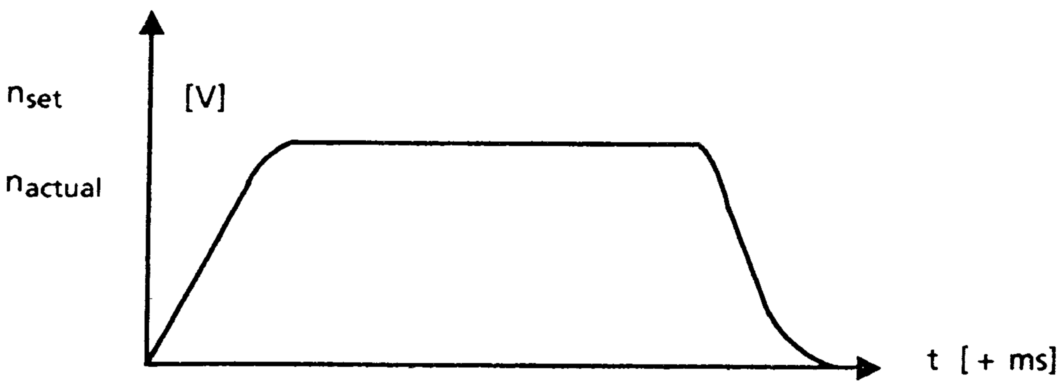
$$= 1666 \cdot K_v \frac{m/min}{mm}$$

For a Kv factor of 1, the value 1666 has to be entered.

The dynamically worst axis contributing to continuous path control should be selected for the evaluation of an acceptable positioning performance and the maximum value of the Kv factor.
The command value voltage n_{set} of the speed controller is measured at maximum feedrate by means of an ink recorder (Oszillomink®) or a storage oscilloscope.



The Kv factor is too high, which causes an overshoot. Overshooting can often be recognized by observing the following error (Test No. 800...803).



The Kv factor is so small that no overshoot appears.
Especially the braking at high gain has to be checked by means of an oscilloscope or ink recorder.
An overshoot can also be caused by the following events:

Acceleration too high (current limit is reached).
Response time of the speed controller too great.
Speed controller fault (re-optimization may be necessary).
Mechanical backlash, skewing of mechanical parts.
Load variations (vertical axes).

For safety reasons, choose the Kv factor 10 % below the maximum possible value.
Axes, which work together in continuous path control must have identical Kv factors.

Check of the Kv factor:

The value of the following error can be seen in TEST No. 800...No. 803. After drift compensation, the displayed value is identical at equal speed in positive and negative direction.
Finally the Kv factor entered for all axes has to be checked on traversing by means of the following-error display. A precise continuous-path control requires identical dynamical performance of the axes e.g. identical following errors at equal speed.
In the event of deviations, the differences must be compensated by means of multgain or the speed controller.

5.4.8 Acceleration: MD 120...123

The axes are accelerated and decelerated with the entered acceleration value

$$b\ [\ 10^{-2}\ m \cdot s^{-2}\ ]$$

The acceleration ramp allows a precise, quick speed-up with minimum wear of the machine and an accurate positioning.

The customer must specify the permissible permanent braking deceleration of the machine. This value, provided the drive is not overloaded, is entered in MD 120...123.
Customary values between

$$0.3\ m \cdot s^{-2} \text{ and } 2\ m \cdot s^{-2}$$

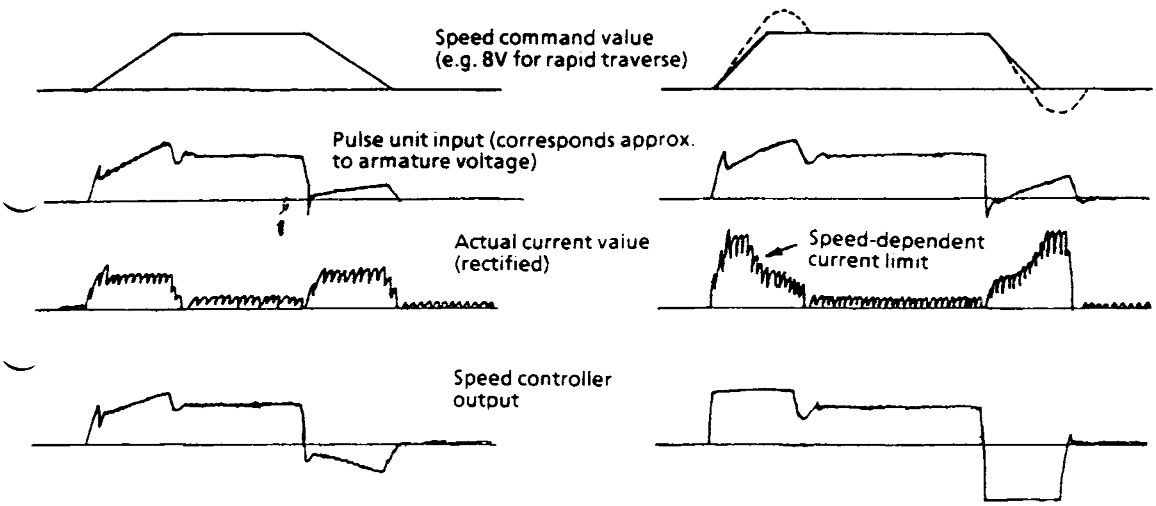
Check or evaluation of the acceleration value:
Criterion:
MD 120...123: Acceleration without overshoot to rapid traverse speed (acceleration stop limit) or positioning from rapid tra-verse speed under maximum load condition (e.g. heavy work-pieces on the table).

Measuring instruments:	Ink recorder or storage oscilloscope
Measuring point:	Speed command value and eventually actual current value and speed controller output

After adjustment of the acceleration value, the axes are traversed at rapid speed and the actual value of the current and, possibly, the speed controller output are recorded.

This shows whether or not the current limit has been reached. The drive can reach the current limit temporarily. However, this must only happen in the rapid traverse range.Some time prior to positioning, the drive must resume speed control again, otherwise the axis overshoots the position.

Examples with a 6-pulse circular current-free feed drive with current limitation control:



Example 1: Correctly acceleration

Example 2: Acceleration too high. Current limit is reached.
.....with engaged position control loop, an overshoot and undershoot of the command value results due to the accumulated following error.

Small load variations (tight running spots, lubrication influences) should not lead to reach current limit. Therefore, at least a 10 % lower acceleration value should be entered.
On customer's specification, the acceleration can be further reduced in order to reduce mechanical wear.

The axes can assume individual acceleration values.

5.4.9 Position monitoring

MD 100...103 Stop position tolerance 1
MD 240...243 Stop position tolerance 2

The programmed position is checked after the waiting time for the position monitoring in MD 353 is elapsed. If the following error at this point in time is larger than the value in MD 100...103 or in MD 240...243, then the "not-in-position" LED stays bright. Further traversing is inhibited.
Adjustment: The positioning accuracy depends upon the quality of the position control loop and the speed control loop. The normal deviation can be evaluated by observing the following error at standstill.
The value entered should lie between 10 µm and 50 µm according to customers specification and the positioning performance. However, at least the double maximum deviation of the following error at standstill should be entered. For the effect of stop position tolerance 1 and 2, refer to Section 7, MD 100...103.

5.4.10 Standstill monitoring

MD 110...113
Alarm 101, 111, 121, 131 appears if one of the axes is pushed out of position (e.g. by clamping and removing servo enable) at standstill after the time in MD 353 is elapsed. The position deviation must be checked in TEST No. 800...803 (following error). The machine manufacturer must try to keep it small, if possible below the stop position tolerance. Then, a value of the double size of that in MD 240...243 is entered in MD 110... 113 as standstill monitoring tolerance.

Customary value:
MD 110...113 contains values between 50 μm to 200 μm. This is valid even if none of the axes is clamped. In this case, the drive is stopped by means of servo inhibit if the position control loop is faulty (drifting off).

5.4.11 Waiting time for position monitoring MD 353.

This machine datum influences the evaluated clamping tolerance in MD 110...113 (refer to Machine Data Description in Section 7). If the clamping tolerance is checked out too early, e.g. the following error is not yet fully worked off or drive overshoots, then alarm 101, 111, 121, 131 can be triggered.
The time entered in MD 353 must be long enough to ensure that the drive is stationary when the clamping tolerance is checked.
MD 353 is entered in 1 ms units.
Usual input values between 160 and 1600. The standard value 500 has proved useful.

5.4.12 Checking the axes

- Check the hardware limit switches: Approach at low speed.
- Check the reference points: Approach deceleration can at low speed. If the "reference point reached" signal does not appear, refer to Section 5.
- Check the software limit switches after reference point approach.
- Evaluate the current Kv-factor. Traverse in JOG mode at 100 % override approx. 4 seconds. The current Kv-value is entered in the service display TEST No. 850...853. In the event of unequal Kv-values, check MD and tacho adjustment.

5.4.13 Problems which may occur on commissioning of the axes

The alarms used below prevent the axes traversing.

	Alarm		
	223	EMERGENCY OFF signal from PLC e.g. Q 64.7 with NC 1	
	222	Fault in the servo unit - Servo not ready. Observe jumper P-N on the measuring circuit module.	
1 2 3 4	001 011 021 031	Software limit switches reached in positive direction	Limits according to MD 160...163
1 2 3 4	002 012 022 032	Software limit switches reached in negative direction	Limits according to MD 170...173
1 2 3 4	005 015 025 035	Servo enabling of an axis in motion withdrawn by the interface control	
1 2 3 4	102 112 122 132	Speed command value too high Threshold for triggering the alarms in MD 354	
1 2 3 4	101 111 121 131	Standstill monitoring The axis is not in position. Threshold for triggering the alarms in MD 110...113.	
1 2 3 4	103 113 123 133	Contour monitoring Threshold triggering the alarms in MD 351 and 352.	
1 2 3 4	104 114 124 134	Position control loop hardware fault Monitor of the axis encoder signals responded.	
1 2 3 4	108 118 128 138	Measuring circuit fault "dirty scale". 24V input to measuring circuit module	

5.5 Reference point approach:

The following MD are to be observed:

MD 180 - 183	Reference point coordinates
MD 210 - 213	Reference point shift
MD 349/350	Cutoff speed. The zero mark is approached with this speed after deceleration.

MD 349	Cutoff speed for rotary axes,
MD 350	Cutoff speed for linear axes.
MD 373	Reference point approach speed
MD 403-406 bit 0	Reference point approach direction.

The following interface signals are to be observed:

Q 69.4...72.4	Deceleration
Q 69.1...72.1	Reference value setting. This signal transfers the content of MD 180...183 into the actual value store.

For reference approach principle, refer to Section 7, MD 210.

Commissioning:

- Check deceleration signal by means of status display or NC interface diagnostics
- Enter the correct MD values.
- Simulate reference approach with low speed in the centre area of the traversing range by actuating the deceleration cam manually. Axis must continue moving at cutoff speed.
- Does the "reference point reached" signal appear? If not, then the zero mark of the encoder or linear scale does not work properly. Check cable, encoder (refer to Section 8).

- The reference point can be shifted by the value stored in MD 210-213.
- Check reference approach with maximum speed first.

If the reference points is overrun then the maximum speed is too high or the deceleration cam too short.

- Check reference point approach several times. If the position of the reference point is not identical each time, reduce cutoff speed, or the deceleration signal from the PLC varies, or the encoder coupling slips; or the distance from deceleration cam to zero mark is too short.

A safe distance is 0.5 mm to 1.5 mm. This distance from the zero mark must always be observed.

- The distance between deceleration cam and zero mark can be checked by means of the NC interface diagnostics

For example:

- Content of MD 210 is set to zero
- Jog the axis with low speed back from the reference point and observe the deceleration interface signal.
- Stop axis as soon as the signal switches from 1 to 0.
- The traversed distance minus 2000 μm is the distance from zero mark to deceleration cam.

5.6 Commissioning of the main spindle:

Preconditions:

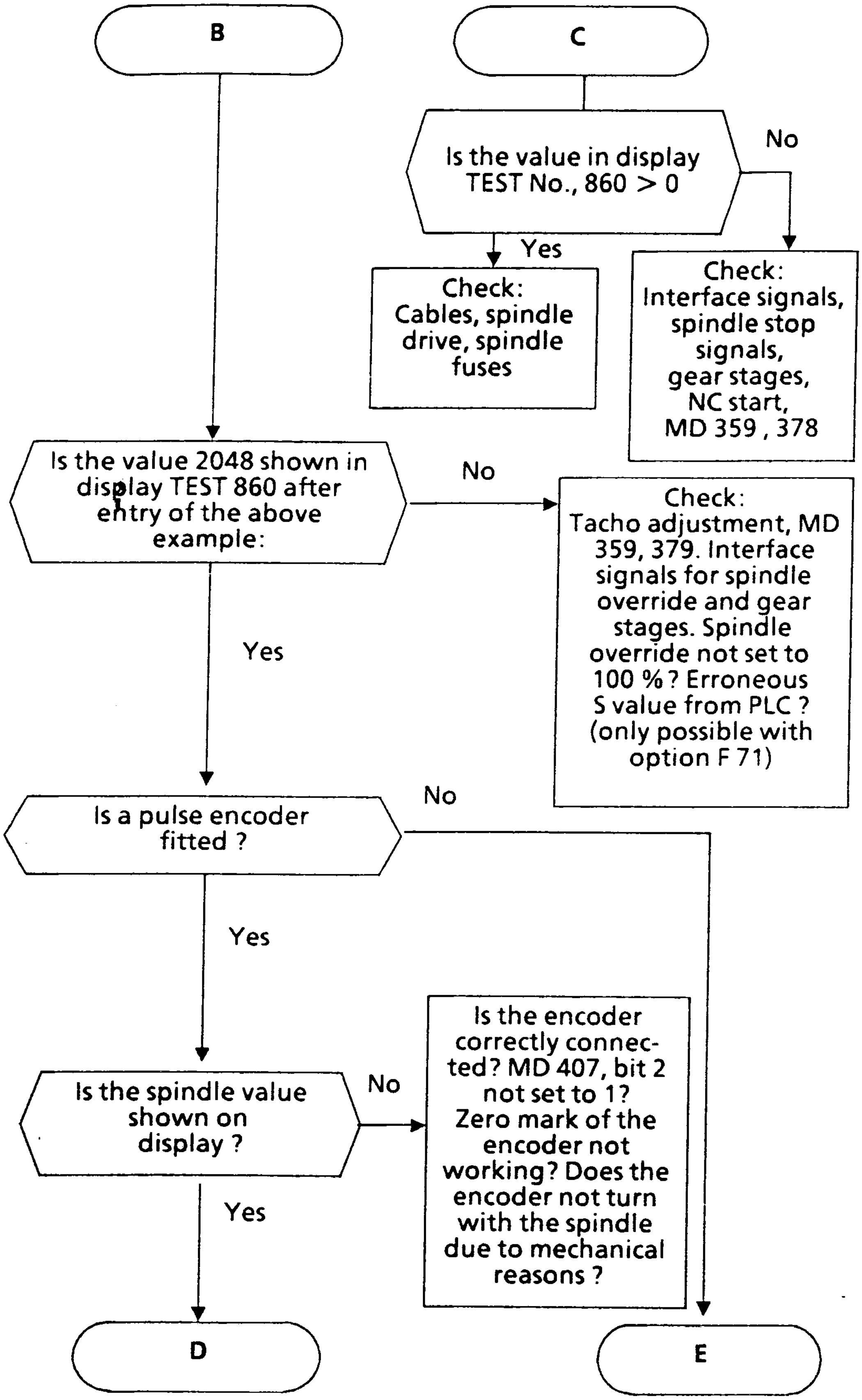
- 3T/M: The analog spindle value output of the NC must be used.
- 3M : Option F05 must be present
- Tacho adjustment: 10 V command value for max. speed.
- Standard MD are loaded (MD = machine data)

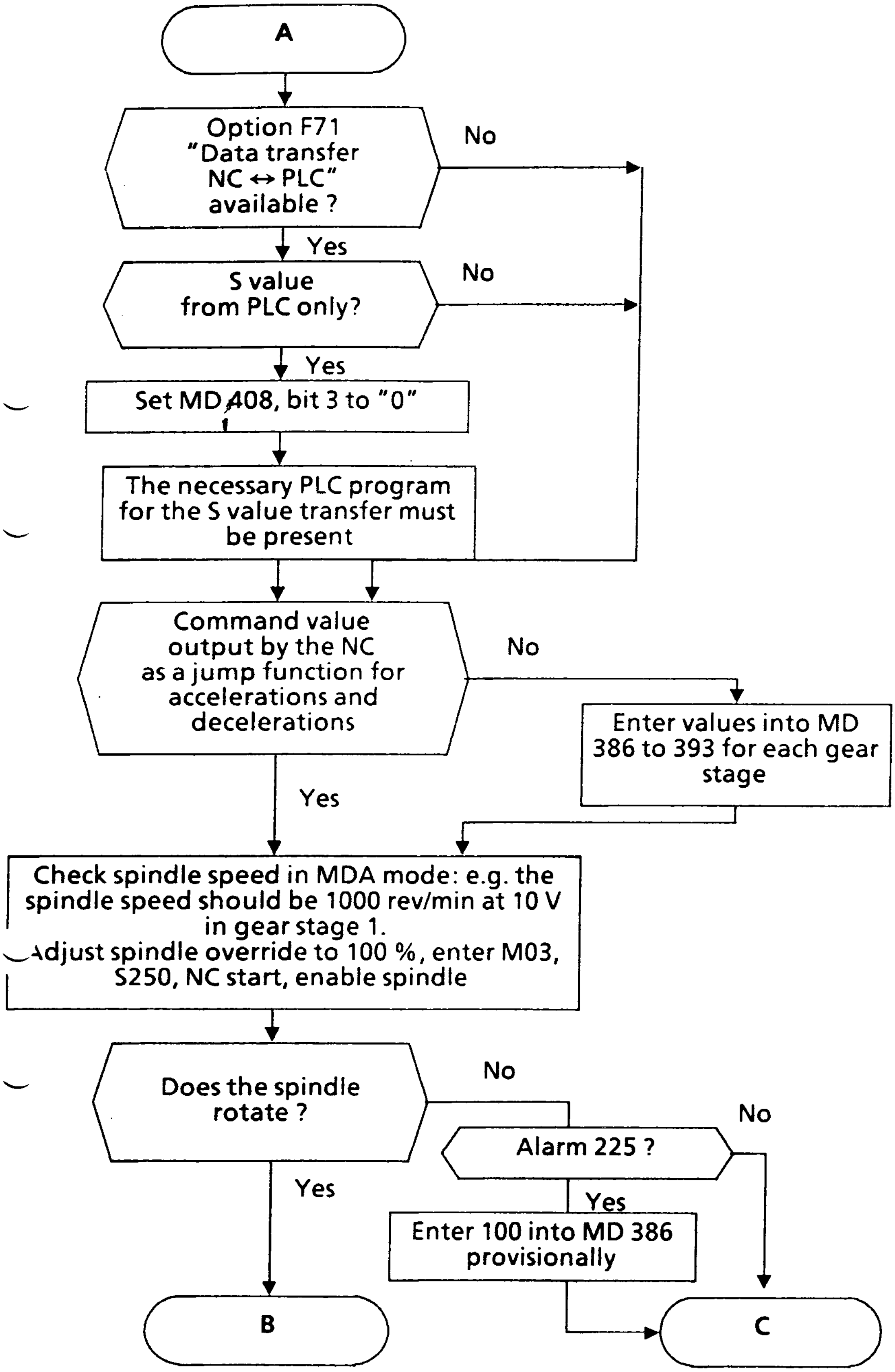
The following NC-MD are to be observed:

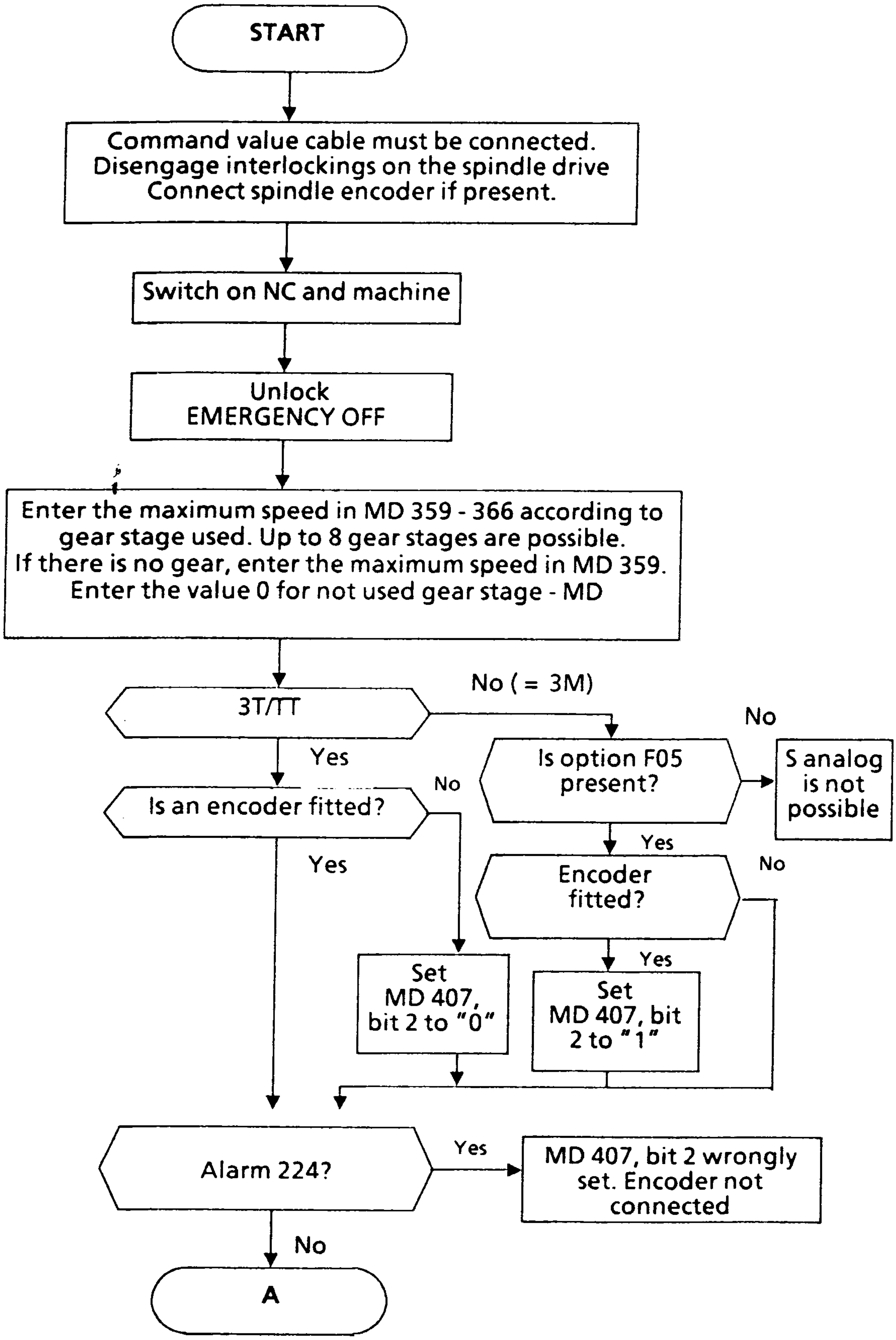
357	Spindle drift
359 - 366	Gear stages
367 - 369	Speed tolerances
370	Max. spindle speed (standard value 9999, can be overstored by the PLC)
376	Waiting time for servo inhibit
377	Lowest spindle speed
378 - 380	For Option E 42 (M19)
386 - 393	Acceleration ramps
407, bit 0,1,2,3	
408, bit 3	
415, bit 5	
417, bit 3	
428, bit 4	

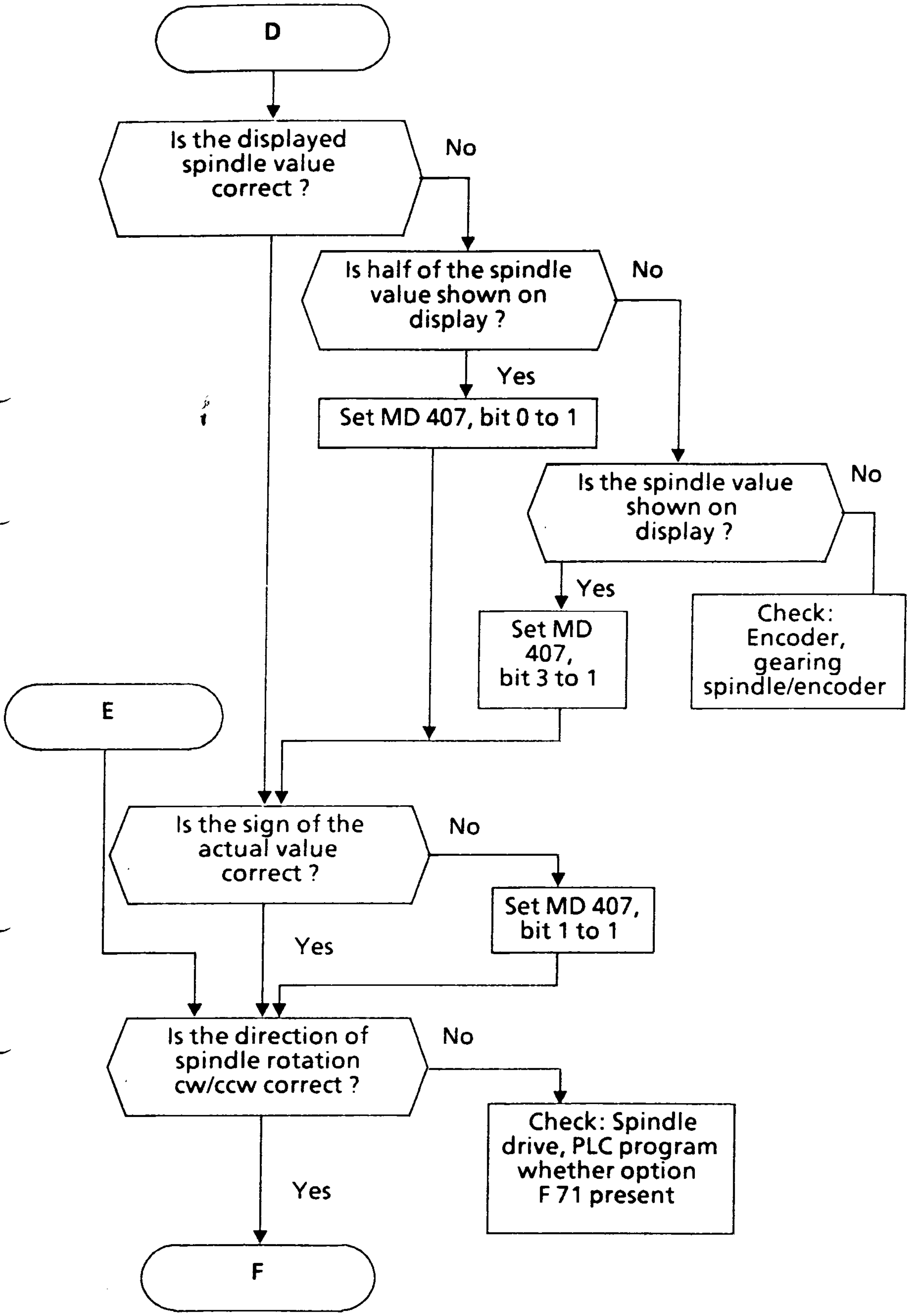
The following interface signals are to be observed:

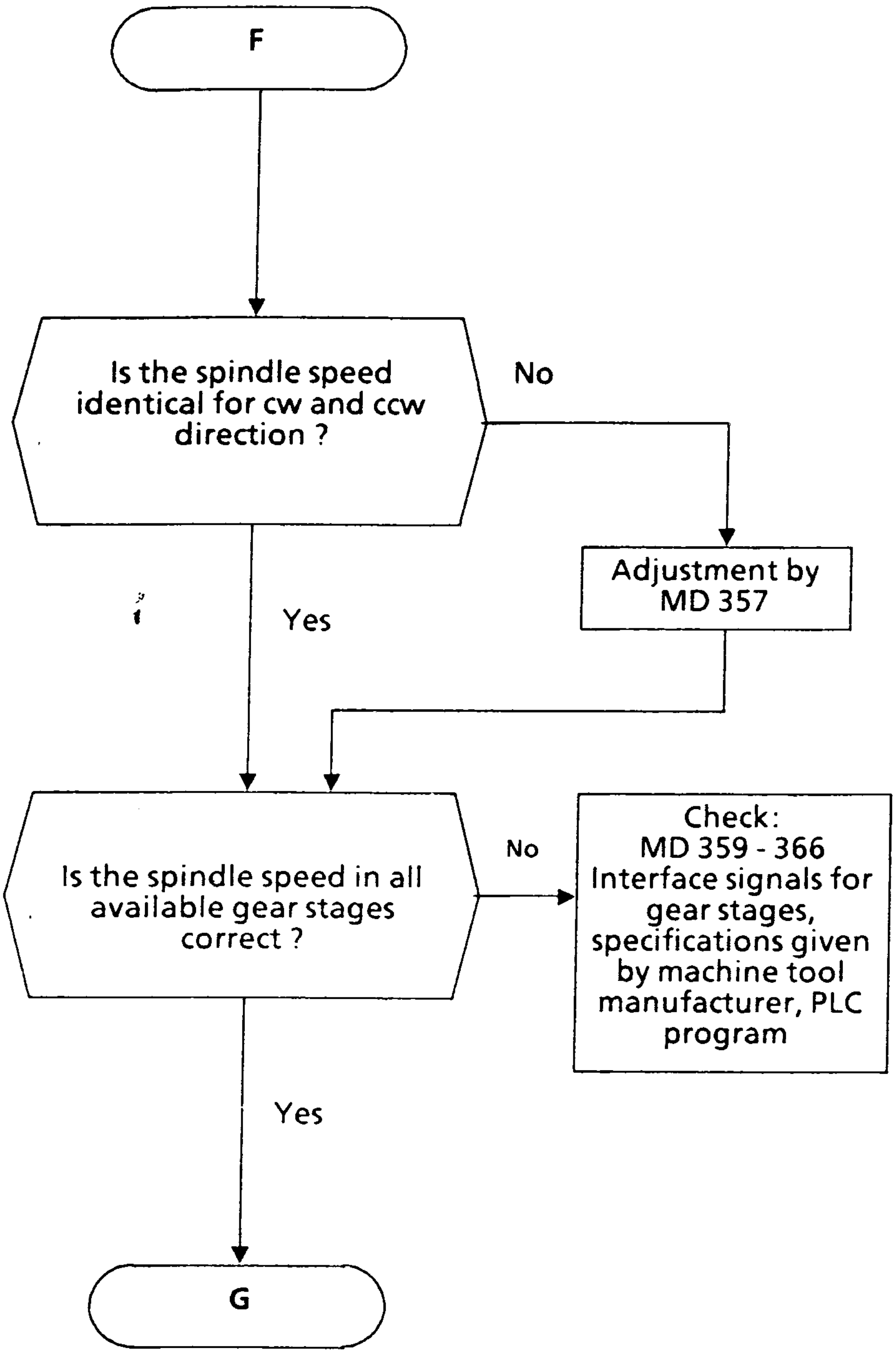
TEST-No.	7,	byte 1, bit 0-2	
"	8,	byte 4, bit 3-7	Q 67.3 - Q 67.7
"	8,	byte 6, bit 7	Q 67.1
"	9,	byte 9, bit 5	Q 67.2
"	10	byte 0, bit 4-7	I 68.3, I 68.5 - I 68.7
"	10,	byte 2, bit 7	I 68.4
"	10,	byte 3, bit 3	I 73.3

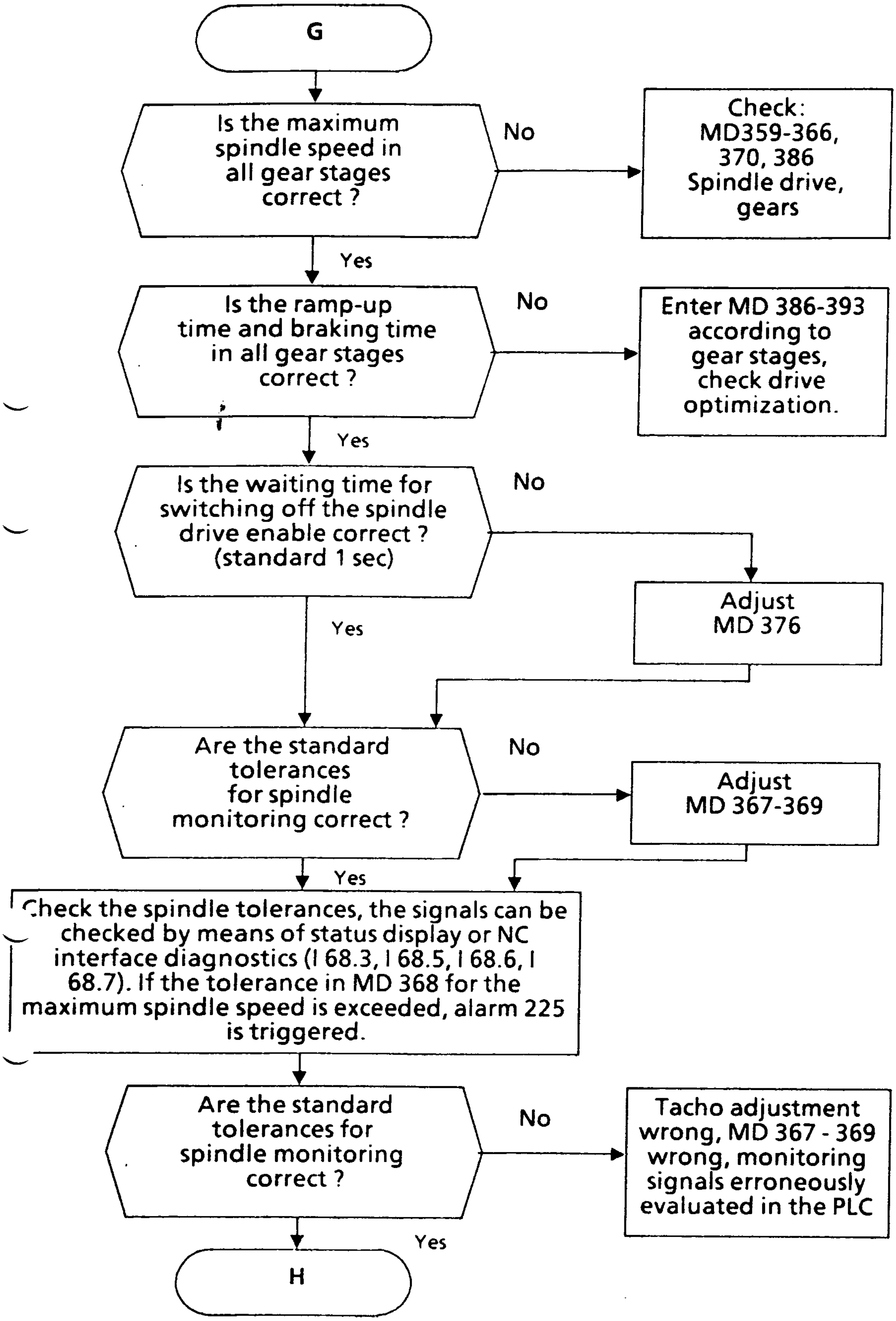

B
C
Is the value in display TEST No., 860 > 0
No
Yes
Check: Cables, spindle drive, spindle fuses
Check: Interface signals, spindle stop signals, gear stages, NC start, MD 359 , 378
Is the value 2048 shown in display TEST 860 after entry of the above example:
No
Check: Tacho adjustment, MD 359, 379. Interface signals for spindle override and gear stages. Spindle override not set to 100 %? Erroneous S value from PLC ? (only possible with option F 71)
Yes
Is a pulse encoder fitted ?
No
Yes
Is the spindle value shown on display ?
No
Is the encoder correctly connected? MD 407, bit 2 not set to 1? Zero mark of the encoder not working? Does the encoder not turn with the spindle due to mechanical reasons ?
Yes
D
E

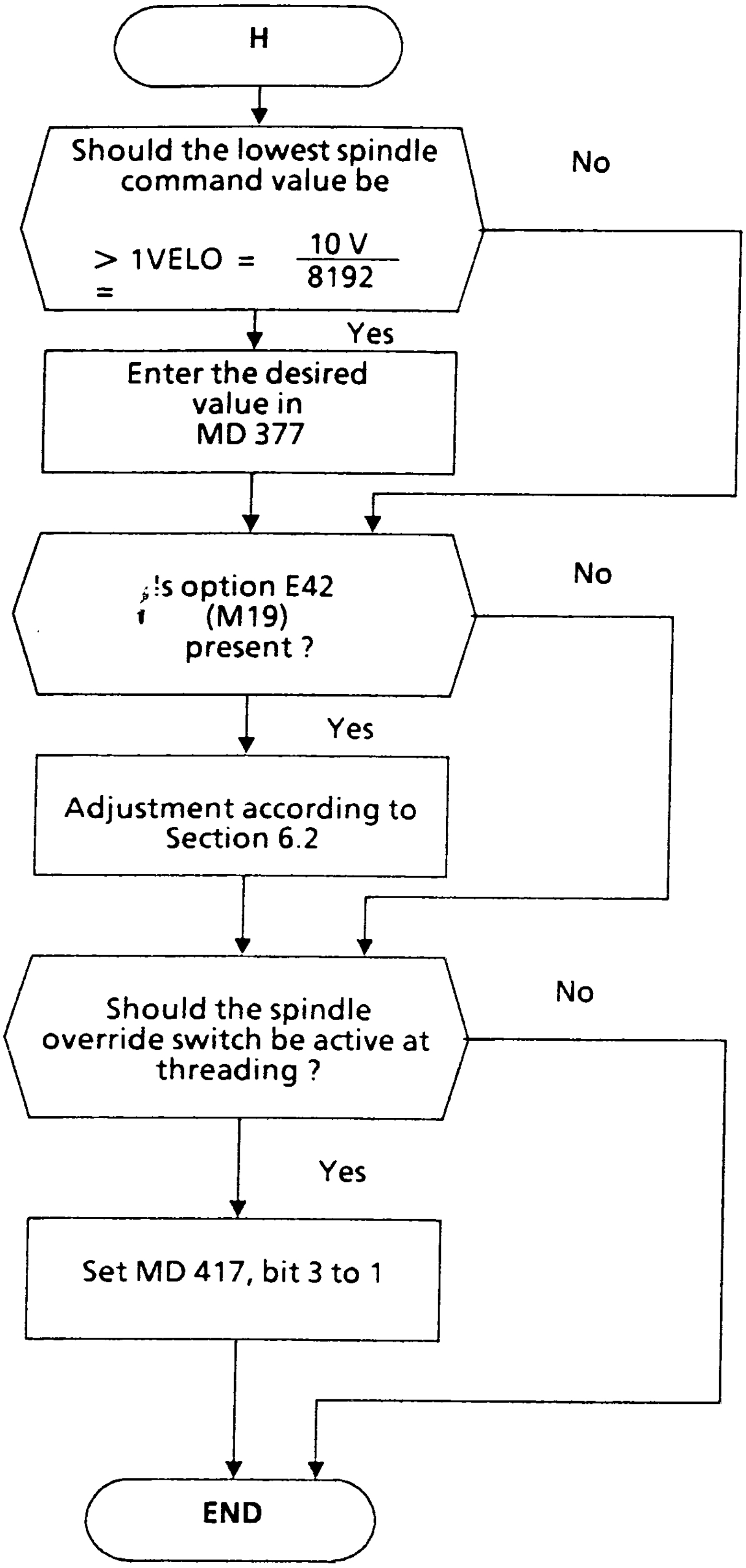

A
Option F71 "Data transfer NC ↔ PLC" available ?
No
Yes
S value from PLC only?
No
Yes
Set MD 408, bit 3 to "0"
The necessary PLC program for the S value transfer must be present
Command value output by the NC as a jump function for accelerations and decelerations
No
Enter values into MD 386 to 393 for each gear stage
Yes
Check spindle speed in MDA mode: e.g. the spindle speed should be 1000 rev/min at 10 V in gear stage 1.
Adjust spindle override to 100 %, enter M03, S250, NC start, enable spindle
Does the spindle rotate ?
No
Alarm 225 ?
No
Yes
Enter 100 into MD 386 provisionally
Yes
B
C


START
Command value cable must be connected.
Disengage interlockings on the spindle drive
Connect spindle encoder if present.
Switch on NC and machine
Unlock
EMERGENCY OFF
Enter the maximum speed in MD 359 - 366 according to gear stage used. Up to 8 gear stages are possible.
If there is no gear, enter the maximum speed in MD 359.
Enter the value 0 for not used gear stage - MD
3T/TT
No (= 3M)
Yes
Is an encoder fitted?
No
Yes
Is option F05 present?
No
S analog is not possible
Yes
Encoder fitted?
No
Yes
Set MD 407, bit 2 to "0"
Set MD 407, bit 2 to "1"
Alarm 224?
Yes
MD 407, bit 2 wrongly set. Encoder not connected
No
A


D
Is the displayed spindle value correct ?
No
Is half of the spindle value shown on display ?
No
Yes
Set MD 407, bit 0 to 1
Is the spindle value shown on display ?
No
Yes
Set MD 407, bit 3 to 1
Check: Encoder, gearing spindle/encoder
E
Is the sign of the actual value correct ?
No
Set MD 407, bit 1 to 1
Yes
Is the direction of spindle rotation cw/ccw correct ?
No
Check: Spindle drive, PLC program whether option F 71 present
Yes
F


F
Is the spindle speed identical for cw and ccw direction ?
No
Adjustment by MD 357
Yes
Is the spindle speed in all available gear stages correct ?
No
Check: MD 359 - 366 Interface signals for gear stages, specifications given by machine tool manufacturer, PLC program
Yes
G


G
Is the maximum spindle speed in all gear stages correct ?
No
Check: MD359-366, 370, 386 Spindle drive, gears
Yes
Is the ramp-up time and braking time in all gear stages correct ?
No
Enter MD 386-393 according to gear stages, check drive optimization.
Yes
Is the waiting time for switching off the spindle drive enable correct ? (standard 1 sec)
No
Adjust MD 376
Yes
Are the standard tolerances for spindle monitoring correct ?
No
Adjust MD 367-369
Yes
Check the spindle tolerances, the signals can be checked by means of status display or NC interface diagnostics (I 68.3, I 68.5, I 68.6, I 68.7). If the tolerance in MD 368 for the maximum spindle speed is exceeded, alarm 225 is triggered.
Are the standard tolerances for spindle monitoring correct ?
No
Tacho adjustment wrong, MD 367 - 369 wrong, monitoring signals erroneously evaluated in the PLC
Yes
H


H
Should the lowest spindle command value be
≥ 1VELO = 10 V / 8192
No
Yes
Enter the desired value in MD 377
Is option E42 (M19) present ?
No
Yes
Adjustment according to Section 6.2
Should the spindle override switch be active at threading ?
No
Yes
Set MD 417, bit 3 to 1
END

5.7 Concluding work

5.7.1 NC function check with an NC test program

for checking the following functions:
Actual value display
Data display
all S, T, H, M functions
Single block, skip block, program halt
Program memory
Tool offset compensation
Threading
Data input
Data output

The program and tape has to be supplied by the machine manufacturer.

5.7.2 Establishing a machine data tape

There are different possibilites:

a) Read the values entered on commissioning out of the TEST memory. For operating sequence refer to Operating Instructions.

b) The machine data can be written also on an external programmer.

The machine data tape is to be located near the control.
A printout of the machine data or a completed list according to Section 1 are to be located in the log book.

Afterwards, no alterations of machine data may be made without generating a new tape and printout.
The machine data protection switch has to be set into normal

position after completion of the commissioning in order to prevent unauthorized access to the machine data. (Switch S3 on front panel of module 03840 in <u>down</u> position = normal position).

For loading standard machine data, modification of ma-chine data and handling of the machine data tape refer to Section 4.

5.7.3 <u>Machine data tape with standard data of a machine:</u>

A machine data tape for each type of machine must be established, which should be used as a standard tape for similar machines. However, individual data, such as drift values, reference-point shift etc. must be evaluated and entered specifically for each machine.
Section 1 of the Commissioning Instructions contains blank lists for "collecting" these data. Short descriptions of the data are given in the lists. For detailed information refer to Section 7 (Machine Data Description).
Handling of the machine data tape input: Refer to Section 4.
After the machine data tape has been loaded, the drift compensation must be renewed as described in Section 5.

5.7.4 <u>Short customer instruction:</u>
Short instructions for the operator- and maintenance personnel on how to handle the numerical control should be given within the framework of commissioning.

The following work has to be carried out by the customer:
a) Adjustment of reference point
b) Evaluation of back lash
c) Input of these established values into the machine data memory. Generation of a corresponding tape or insertion into the existing machine data tape.

d)Drift compensation, refer to Section 5.

In order to carry out these tasks correctly without the service specialist on site, the customer must be instructed how to enter these machine data.

5.7.5 Commissioning report

The concluded commissioning has to be entered into the log book. The satisfactory function of the control after finishing the commissioning work should be confirmed by the customer on the commissioning report (form sheet).

5.7.6 Checklist for the log book

A copy of the completed check list according to Section 1 has to be deposited in the log book.

5.7.7 General

- The service switch on the front panel of module 03830 must be in position 0.
- The screws of all modules must be tightened.
- The standard- and option cycles must be loaded in the program memory.

Chapter 6

-Commissioning of special functions-

Contents

6.1 Contour monitoring

Principle of operation for the contour monitoring:

The following error remains constant after acceleration or deceleration is terminated. Load changes on the drive, e.g. caused by interrupted cut or varying cutting forces, are governed by the speed controller (PI characteristic). The following error changes drastically at constant set speed when the speed controller reaches its limits caused by an overload of the drive, e.g. tool breakage. The change of following error per interpolation cycle (eg. 18 ms) is used as a condition for triggering the contour monitoring. A tolerance band specifies the maximum permitted contour deviation in order to avoid unintentional response in the event of small speed changes e.g. caused by the slotting of the armature. Furthermore, a delay time has to expire after each speed change before the monitoring is activated. The width of the tolerance band and the duration of the delay time are inversely proportional to the loop gain of the position controller.

Precise machining on the contour is only possible if all axes involved in common interpolation are adjusted to identical loop gains. The loop gain depends not only on the KV factor set in the MD 150...153 and the Multgain set in MD 220..223 of the NC, but also on the tacho adjustment of the speed controller, actual value multiplication factors, gear ratios etc.

For this reason, contour monitoring has a Kv evaluation function. The actual loop gain is calculated from the set speed and the existing following error at that speed. The Kv evaluation has to be carried out at the speed (± 25 %) given in MD 371 (jog feedrate). The axis concerned must be traversed at constant speed for 3 seconds, at least. The measured Kv value is displayed in TEST No. 850. The dimension is 0.001 m/min/mm.

$$Kv = \frac{\text{traversing speed in m/min}}{\text{following error in mm}}$$

This dimension is customary and used by machine tool manufacturers. Customary values 500 to 2500. The once measured Kv factors remain stored when the control is switched off/on. The measured Kv factor is cleared on when machine data are altered unless MD 417, bit 1 is set. When the Kv factors of all axes present are evaluated, they are checked for equality. If the deviation is larger than 50, alarm 527 "Kv factors not equal" is displayed. In order to operate a machine with unequal Kv factors (e.g. rotary axes), alarm 527 must be cleared by means of reset (eventually via the PLC). If not all Kv factors have been measured, alarm 528 is displayed on power on.

Contour monitoring is optimized by MD 351 and 352.

The speed in mm/min, from which on the contour monitoring should be active, is entered in MD 351. The contour monitoring is not active at standstill, even not with input of 0. At standstill, the standstill monitoring checks inadmissible axis movements.

The tolerance band value for the permissible contour deviation is entered in MD 352. Here, the evaluated Kv factor is taken into account. This leads to the following equation for calculating the tolerance band:

$$\frac{\text{Value in MD 352} \cdot 125}{\text{Value in TEST No. 850..853}} = \text{Tolerance band in } \mu\text{m}$$

If 0 is entered, the software automatically defaults the value 2000 for tolerance band evaluation.

This leads to a tolerance band of 250 µm at Kv = 1 or 125 µm at Kv = 2. The actual contour deviations are displayed in TEST No. 840 ...843.

The contour deviation becomes ineffective if the position set value changes. This would mean no active monitoring for circular interpolation. To give some degree of machine protection, the sign of following error, position set value and actual position value are permanently compared with each other. In the event of irregularities the contour alarm 506 responds after the Kv-dependent safety time has elapsed.

6.2 Oriented spindle stop M 19

Option E 42, E 45

The following NC machine data are to be observed:

		Standard value
MD 357	Spindle drift	0
MD 378[1)]	Cutoff spindle speed M 19	200
MD 379[1)]	Gain factor M 19	200
MD 380[1)]	Position limits M 19	10
MD 386[1)] to MD 393[1)]	Acceleration ramps for each gear stage	0
MD 407, bit 1	Sign change actual value	0
MD 407, bit 2	Pulse encoder present	1
MD 428, bit 1	M19 carried out at cutoff speed	0

The MD for the spindle must be entered according to the spindle specifications. S analog and pulse encoder must be present.

1) These machine data can be modified via the PLC with basic model 4B from D03 on.

The following interface signals are to be observed:

Q 67.3 Spindle stop, terminates the positioning procedure

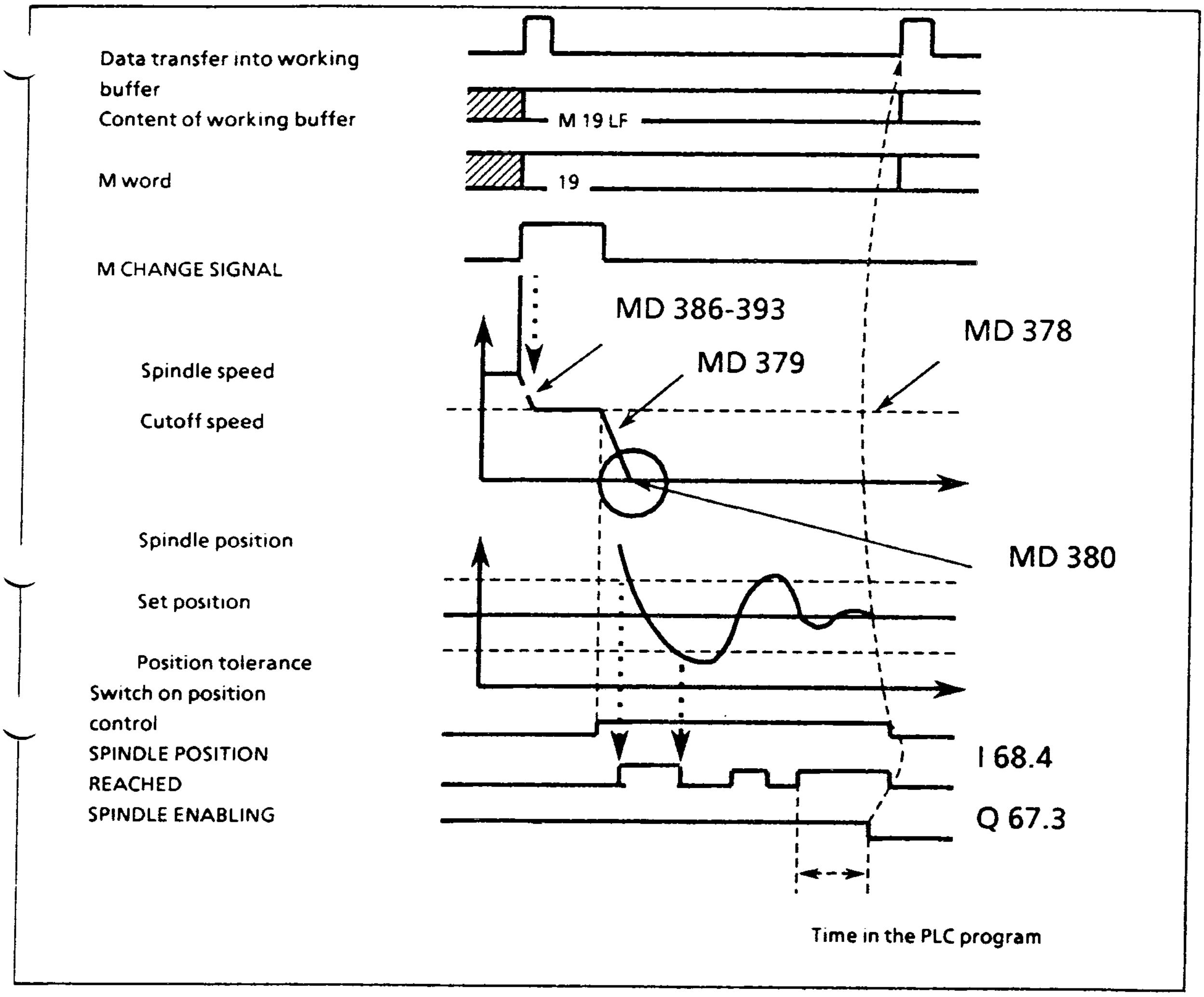
I 68.4 Position reached, signal from NC to PLC, spindle is within position limits.

The following PLC machine datum is to be observed:

M 19 change signal expanded (e.g. MD 452, bit 4)

This bit must be set to 1 if the spindle should be positioned from standstill.

M 19 principle:



The positioning procedure is started when the programmed M 19 S... is executed in the NC program. After the cutoff speed has been reached the spindle control switches to position control. MD 379 has a similar function as the MD for the Kv factors of the axes. The NC reports to the PLC "spindle position reached" when the spindle is within the tolerance limits. The spindle remains in position control until the PLC outputs the spindle stop signal. The spindle position can be viewed in the service display TEST No. 861 (0 to 360 degrees correspond to 0 to 4096 pulses. Resolution with an encoder of 1024 pulses per revolution: 1/11 degrees.)

Spindle stop must not be active on execution of M19 otherwise the positioning procedure is not started.
If the positioning should be carried out from standstill, the PLC machine datum "M 19 change signal expanded" must be set to 1 and the PLC program must cancel the "spindle stop" signal on output of M 19 in the same PLC cycle.
If the positioning performance differs in the individual gear stages, modify the acceleration by means of MD 386-393.
M 19 can be initiated from the PLC with basic model 4B from D03 on. Refer to Interface Description.

M 19 with axis movement:
There are 3 posibilities for M 19, with or without axis movement.

1. The following block is started only when the positioning procedure is terminated by spindle stop.
2. The following blocks are executed while the spindle positions.
3. The positioning procedure is not aborted even with M 30. Only effective if MD 408, bit 3 is set to 0 (spindle control by NC).

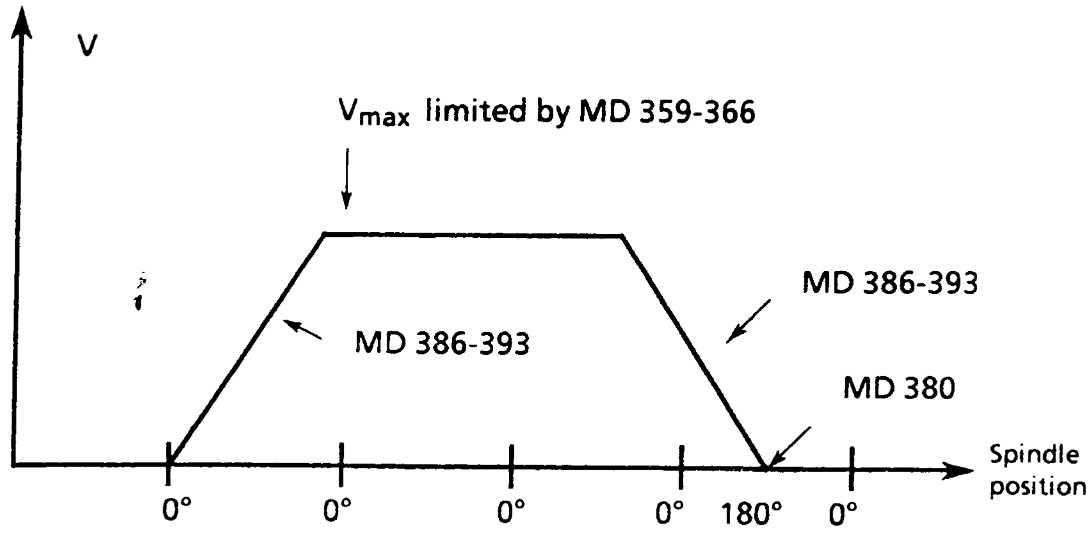
M 19 is terminated in all cases with spindle stop.

Incremental spindel positioning via the PLC : Option E 45:

The spindle can be positioned over several revolutions with this function. The set position and the speed are determined by the PLC.

The spindle is in position control during the entire positioning procedure.

Principle:



- MD 379 acts as Kv factor
- The actual position value can be viewed in the service display TEST No. 861
- The speed command value can be seen in the service display TEST No. 860

Refer also to Interface Description Part 2, Section 4.

3 C axis with 3T / 3TT

Option A 03, A 13 for turning-milling operations. The function is described in the Technical Description, Order Number E 80210-T101-X-A1-7600.

Relevant machine data:

- All axis-specific values for the 4th axis, like MD 103, 113..., must be entered for the C axis.
- MD 142 must not be set to 0
- MD 349 Cutoff speed rotary axis
- MD 383 Increase of sample time, observe with 3 TT only
- MD 402 bit 0 to 3 for axis name
- MD 405 bit 7 set to "1"
- MD 406 bit 3,4,6 Adaption of the encoder resolution to internal resolution
- MD 406 bit 5 set to "1" Rotary axis
- MD 406 bit 7 set to "1" 4th axis present
- MD 414 bit 0 set to "1" Y axis is parallel to 4th axis
- MD 422/423 bit 4 set to "1" Disable hardware monitoring
- MD 427 bit 7 set to "1" Diameter programming not effective with 3M
- MD for options

Interface signals:

- Measuring circuit connections (refer to Section 3.5)
- Interface signals of the 4th axis
- Set Q 68.7 permanently to "1" 4th axis is main axis
- Q 68.3 Changed over to T, signal from NC to PLC
- I 68.0 Change over to T. The PLC switches the NC from 3T to 3T.

Options:

The following options are possible with the C axis:

B 65	Transmit (G 37), basic version 4 B only
B 68	Double transmit (G 38), basic version 4 B only
B 73	Cylindrical milling
B 61	3D interpolation

The following options are included in the "C axis"option.

A 04	4th axis
A 08	Expanded tool compensation T 1 - T 16 for turning D 33 - D 64 for milling

Software changeover:
The control must function as a 3M on Power-On-Reset.
The changeover from turning to milling operation and vice versa is carried out via the NC-PLC interface by handshake control
The PLC sets the NC input signal Q 68.3 (changeover to 3T). The changeover is only accepted by the NC in the reset state.
The NC acknowledges the changeover by the output signal to the PLC : I 68.0 (changed over to 3T)

Commissioning:
Standard axis commissioning for the X and Z axes. The corresponding machine data for the 4th axis must be set for the C axis. The C axis must be commissioned as a rotary axis.

PLC:
The changeover to the desired type of NC is governed by the PLC. After each changeover from 3T to 3M, the reference point approach for the C axis must be renewed.

6.4 Precise turning: Option E 44 with 3T/ 3TT:

For turning operations with highest requirements regarding workpiece surface quality, the precise turning option can be supplied.
Output resolution: 0,2 µm or 0,00002 inch (with MD 408, bit 4 set).
The input resolution remains unchanged at 0.001 mm or 0.0001 inch.
The maximum rapid traverse/feedrate amounts to 4.8m/min with metrical machines or 5 m/min at machines with inch measuring system and a maximum encoder operating frequency of 100 kHz.[1] for both cases.
This function requires a pulse weighting of 0.8 µm per pulse on the output of the EXE. In conjunction with a Heidenhain linear scale with 20 µm grid constant, a 25-fold EXE has to be used.
In this case, MD 403/404, bit 3 and 4 must be set to 0. This means that the NC works internally with 0.2 µm units.

In the event of option E 44, the dimensions of the following MD and display values must be multiplied by factor 0.4:

MD 100 - 103, 110 - 113, 150 - 153, 160 - 163, 170 - 173, 190 - 193, 210 - 213, 220 - 223, 240 - 243, 345, 352 and 385.

Display values TEST No. 800 - 803, 810 - 813, 830 - 833, 840 - 843.

Example: A displayed following error of 2 mm = 2000 μm corresponds with precise turning to an actual following error of 2000 μm x 0,4 = 800 μm.

1) For higher speeds refer to Interface Description, Part 2, Section 10.

6.5 Loader axis : Option A 70

This function allows traversing speeds up to 240 m/min. However, it is necessary to employ a ten times coarser measuring circuit resolution as with normal axes (e.g. 10 μm instead of 1 μm). This results in traversing speeds, ten times higher than with normal axes (e.g. 240 m/min at 10 μm resolution).
The input format for loader axes is 5.2 (= input resolution 0.01 mm). The actual values and distance to go values are correctly displayed with two digits after the decimal point.
The dimensions of all machine data for loader axes increase by the factor 10. Feed values F assume the dimension cm/min. Zero offsets are entered with 2 digits after the decimal point.
The maximum traversing range amounts to 99 m.
Loader axes must not be programmed together with normal NC axes in an NC program block. Only linear interpolation is possible. Blueprint programming and CRC are not possible.

6.6 Following error compensation:

MD 426,	bit 6	following error compensation function
MD 430-433,	bit 0-2	Differential gain factor for following error compensation
MD 430-433	bit 3-5	Time constant for following error compensation

Function description:

The following error compensation becomes active if MD 426, bit 6 is set and the PLC interface signal Q 65.0 (following error compensation active) activated.

Then, a following error of approximately zero develops in the position control loop on constant traversing.
The following error compensation has a differential gain factor to be adjusted between 0 and 7 for each axis by the MD 430-433, bit 0-2.

Value 0 = no differential gain factor
Value 7 = high differential gain factor.

A high differential gain factor can cause a high overshooting of the actual speed value.
A delay time is available in the part set value channel which can be adjusted between 0 and 7 for each axis by MD 430-433, bit 3-5.

Value 0 = no delay time
Value 7 = largest delay time.

This delay time can reduce the overshoots of the actual speed value.
The following error compensation should only be activated or de-activated when the machine is at standstill (using dwell time etc.)
Implement following error compensation only for special cases.

Chapter 7

-Description of the machine data-

Contents

7.1 General introduction:

The machine data have to be entered into the Test data memory. Unintentional entry is prevented by a data protection switch S1 which has to be in the top position for input.

Overview:

100 - 273	Axis-specific NC machine data for programmed axes
280 ÷ 309	PLC machine data
310 - 393	General NC machine data applicable to all axes, spindle and others
400 - 449	NC machine data bits
450 - 479	PLC machine data bits
500 - 755	NC machine data bits for pitch error compensations

Software versions:

Model 4A: Software versions 01 to 08, corresponding designation: C01 to C08

Model 4B: Software versions 01 to 06, corresponding designation: D01 to D06.

7.2 Axis-specific NC machine data

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	100 101 102 103	S	+	Stop-position tolerance 1	

	Units of measuring system	min. and max. values		increment	units
metric,degrees	1/2x10^{-3}mm	0	32000	1	1µm,10^{-3}deg.
inch	1/2x10^{-4}inch	0	32000	1	10^{-4} inch

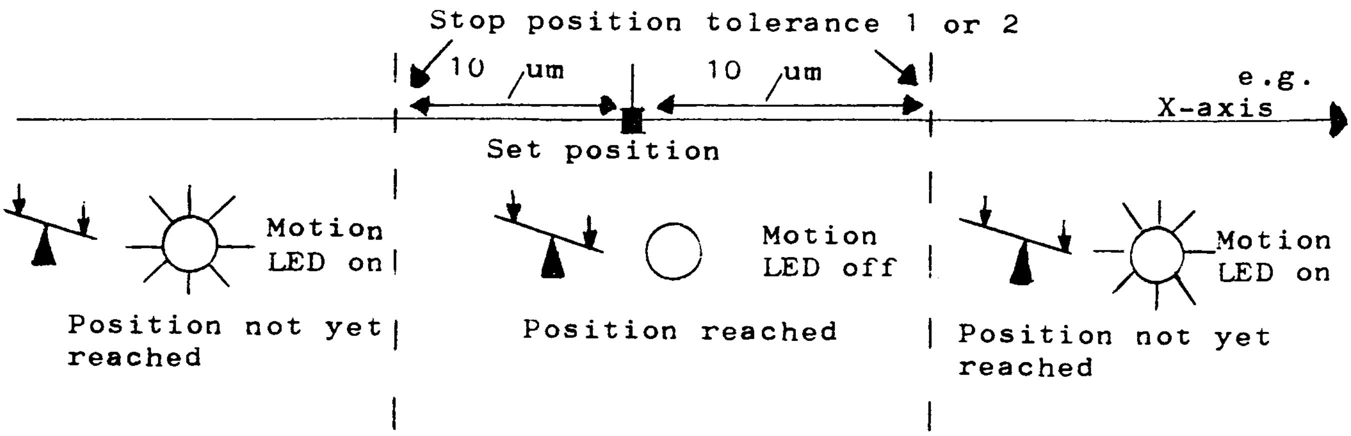
The position is considered to be reached when the axis has traversed to the programmed position ± the entered stop-position tolerance (Traversing into position).

Consequences from position monitoring

If the actual position is not within this range, the position control LED remains on and no further motion commands will be executed.

Corrective action: Drift compensation.

Example: N100 S10



The stop-position tolerance does not become effective in continuous path operation G64. No accumulative fault results from a number of consecutive positionings since the closed-loop control is not "shut off", but the next block starts already before the end position of the previous block is entirely reached. The actual travel distance is now: Remainder of previous block + programmed distance of next block etc.
If the axis remains stationary for a moment, e. g. because another axis is about to move or because of a program block without movements the axis reaches following error = 0 and stays exactly in position.

The stop-position tolerances are active at:

<u>Stop-position tolerance 1:</u>

(MD 100 - 103)
G 60 (3M)
G09 (3T)
Block ahead of G33

<u>Stop-position tolerance 2:</u>

(MD 240 - 243)
G00
Block ahead of G 04
Block ahead of setting data
Block ahead of a block containing auxiliary functions only
Single block without G60/G09
Jog mode
Incremental mode
End of program

In stop-position tolerance 2, a larger value than in stop-position tolerance 1 may be entered. This initiates an earlier block change. If this function is not desired, it can be disabled by inputting the same values in both machine data.

Stop-position tolerance 2 (MD240-243) is available with model 4A starting from C02. In software version C01, the stop-position tolerance in MD100 - 103 is effective for all positioning events.

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1	110	S	+	Clamping tolerance **and position monitoring**	
2	111				
3	112				
4	113				

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	32000	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	32000	1	10^{-4} inch

The NC monitors the position at standstill (holding of position).

The following events leading to faults may occur:

a) Removing of the servo enabling signal for an axis by the PLC means that the axis is no longer held in position by the NC. The PLC must now hold the axis in position by means of clamping. During clamping, the axis may be pushed out of position by mechanical influences.

b) High mechanical forces or drive faults may force the axis out of position.

The clamping tolerance entered must be larger than stop-position tolerance 1 and 2.

If the clamping tolerance range is exceeded and the position monitoring time in MD 353 has elapsed, alarm 101, 111, 121 or 131 is displayed. If the alarm appears in the last block, it is cancelled immediately with M30.

Axis no.	Ident. no.	Address	Sign	Name
1	120	S	+	Acceleration
2	121			
3	122			
4	123			

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	6000	1	10^{-2} ms^{-2} 10 degs^{-2}
inch	$1/2 \times 10^{-4}$ inch	0	2400	1	1 Inch s^{-2}

The acceleration value entered concerns each axis individually. The values also apply to deceleration (braking, refer to Section 7.3).

The axes do not need to be set to identical acceleration values. In case of common interpolation, the NC assumes the lowest acceleration value of the axes involved.

These machine data can be altered via the PLC.

Remarks: Values around 50 to 100 are used (0.5 to 1 m/s^2).

These values (MD 120 to 123) are not applicable for threading which works with MD 358 S....

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1	130	S	+	Maximum axis speed	
2	131				
3	132				
4	133				

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	24 000	1	1 mm/min
inch	$1/2 \times 10^{-4}$ inch	0	10 000	1	0.1 in/min

The value entered specifies the limit speed up to which the axis can be accelerated (rapid traverse speed limit). Traversing is performed at this speed when G00 (rapid traversing) is programmed.

<u>Example 1:</u> Maximum axis speed:

X axis 12 m/min
Y axis 12 m/min
Z axis 10 m/min
4th axis 4 m/min

If a feedrate of 10 m/min is programmed, the axes traverse at:

X axis 10 m/min
Y axis 10 m/min
Z axis 10 m/min at limit according to MD 132
4th axis 4 m/min with limitation according to MD 133

<u>Example 2:</u> Y and Z axes traverse along a 45 degrees slope with programmed G00. Both axes traverse with 10 m/min resulting in a contour speed of 14.142 m/min as the Z axis is limited to 10 m/min in MD 132.

Higher limit speeds than 24 m/min or 10.000 inch/min may be achieved dependent upon encoder and ball screw. (Refer to Interface Description, Part 2, Section 10.)

TEST Data memory

Axis No.	Ident-No.	Addr.	Sign	N a m e	
1 2 3 4	140 141 142 143	S	+	maximum command value (IPO Stop)	

Type of measuring module	min. and max. values		in-crement	units
03 320	0	2048	1	1 Velo = $\frac{10\ \text{Volt}}{2048}$
03 325/03 350 03 326/03 351	0	8192	1	1 Velo = $\frac{10\ \text{Volt}}{8192}$

Note: Exceeding this limit causes the interpolator to stop and the drive to oscillate.

This input specifies the maximum voltage value to be output as speed command value (output voltage limitation by IPO Stop).

This voltage value should be set approx. 10 % above the command voltage for max. speed to enable the speed controller to govern overshoots. At 9V command value for rapid traverse, it needs a setting of 2048 or 8192 (gives 10V with 10 % control reserve, refer also to Section 7.3, MD 354).

Important note:

Even when an axis is not present, a value ≠ 0 must be entered, otherwise no command value will be output for any axis! e. g. 3 T with C-axis: MD 142 must have a value > 0.

TEST Data memory

Axis No.	Ident-No.	Addr.	Sign	N a m e
1 2 3 4	150 151 152 153	S	+	kV factor, or position loop gain

min. and max. values		in-crement	units
0	10 000	1	0.01 s^{-1}

Conversions:

$$KV\ (0.01\ s^{-1}) = 1666.KV\ \left(\frac{m/min}{mm}\right)$$

or

$$KV\ (0.01\ s^{-1}) = 1666.\ KV\ \left(\frac{mm/min}{\mu m}\right)$$

The KV factor is axis-specific. Axes which never operate in continuous-path control can be set with a different KV factor. Axes to work together in continuous-path control must achieve the same position control loop gain (= same following errors at equal speeds. e.g. at 45 degrees traversing).

These MD can be altered via the PLC.

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1	160	S	±	positive software limit	
2	161				
3	162				
4	163				

	Units of measuring system	min. and max. values		increment	units
metric,degrees	1/2x10^{-3}mm	0	99999999	1	1μm,10^{-3}deg.
inch	1/2x10^{-4}inch	0	99999999	1	10^{-4} inch

The customary travel range limit switch can be supplemented by a software limit switch. The absolute position of the positive range limit for each axis has to be input. The software limits become active after the machine has been referenced.

Alarms 1, 11, 21 or 31 are displayed on reaching the software limits.

These MD can be set or altered via the PLC.
Refer also to MD 345 and 346 (Prelimit switch).

Note:

There are no NC interface signals for hardware limit switches provided. They may become effective indirectly by:

- Feed halt (slow, because of ramp down time)
- Servo disable (best, quick stopping with step function)
- Emergency off (also quick stopping with step function, but additional consequences, therefore unfavourable)

The software limits are overrun despite the automatic speed reduction (refer to Section 7.4).

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1	170	S	±	Negative software limit	
2	171				
3	172				
4	173				

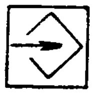
	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	99999999	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	99999999	1	10^{-4} inch

The customary travel range limit switch can be supplemented by a software limit switch. The absolute position of the negative range limit for each axis has to be input. The software limit witch becomes active after the machine has been referenced.

On reaching the negative software limits, the alarms 2, 12, 22 or 32 for each axis are displayed.

These MD can be set or altered via the PLC.
Refer also to MD 345 and 346 (Prelimit switch).

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	180 181 182 183	S	$\pm$	Reference point coordinates	

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2\times10^{-3}$mm	0	99999999	1	1µm,10^{-3}deg.
inch	$1/2\times10^{-4}$inch	0	99999999	1	10^{-4} inch

The distance between the absolute machine zero point and the fixed reference point has to be entered for the respective axis. These values are set as actual values on referencing.

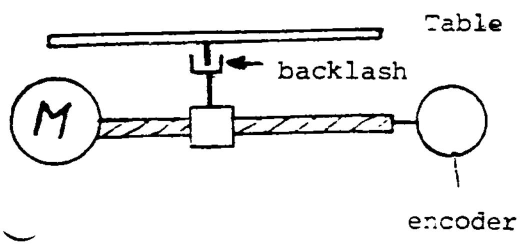
This machine datum can also be set or altered via the PLC. (With basic model 4A from C02 on.)

TEST Data memory

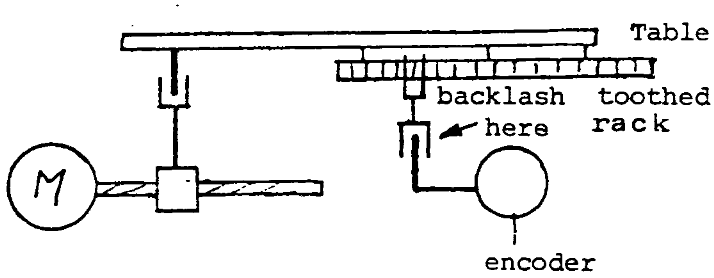
Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	190 191 192 193	S	±	backlash compensation	

	Units of measuring system	min. and max. values		increment	units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	255	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	255	1	10^{-4} inch

Positive backlash
(the usual case)



Negative backlash



. .tual encoder value ahead of actual axis value (Table)

Actual axis value (table) ahead of actual encoder value

The backlash can be positive or negative. A value up to ± 255 µm can be entered for each axis. The value must be positive for positive backlash and negative for negative backlash.

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1	200	S	±	Tool measurement reference coordinate	
2	201				
3	202				
4	203				

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	99999999	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	99999999	1	10^{-4} inch

Refer to the System 3 Operating Instructions for the automatic evaluation of geometrical tool data.
(Only with 3 T and option J12: Automatic evaluation of tool offsets.)

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	210 211 212 213	S	±	reference point shift	

	Units of measuring system	min. and max. values		increment	units
metric, degrees	$1/2x10^{-3}$mm	0	9999	1	$1\mu m, 10^{-3}$deg.
inch	$1/2x10^{-4}$inch	0	9999	1	10^{-4} inch

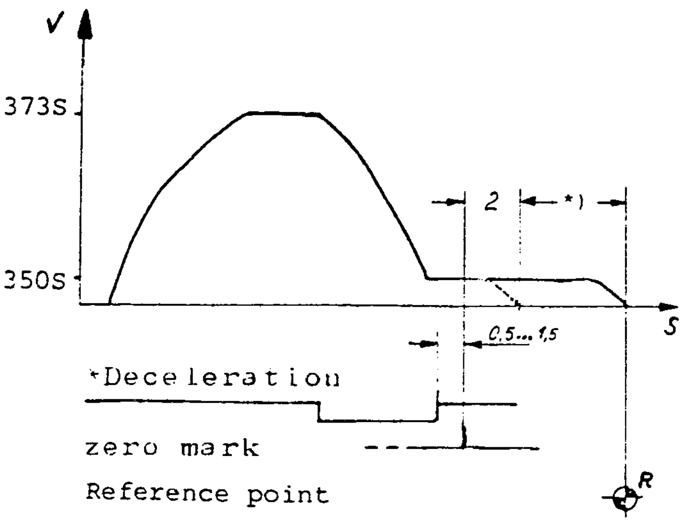
The reference points of the measuring system may be shifted using the reference point shift. Instead of mechanical shifting or rotating of the measuring device (and thus the * Deceleration cam), the reference point can be shifted electrically up to ± 9999 μm.

Note for reference approach in positive direction:

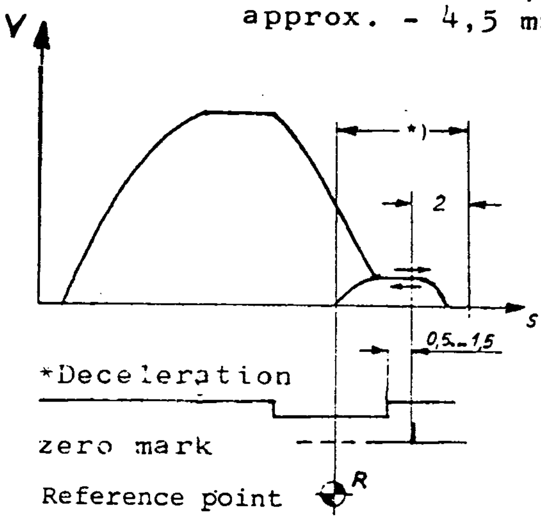
With positive value entry the axis travels in positive direction by the input value beyond the normal reference point (2000 μm behind zero mark).

With negative value entry the axis travels, after overrunning the zero mark, to the value resulting from the difference between [illegible]00 μm and the input value. With a reference point shift larger than approx. - 2000 μm the software realises the wrong direction after overrunning the zero mark and reverses the direction of travel.

Example 1: Positive shift,*)



Example 2: Negative shift, *) approx. - 4,5 mm



TEST Data memory

Axis no.	Ident. no.	Addr.	Sign	Name	
1 2 3 4	220 221 222 223	S	+	multgain factor	

min. and max. values		in-crement	units
1	32 000	1	$\frac{3 \cdot 10^7}{V_{max} [mm/min]}$
1	32 000	1	$\frac{3 \cdot 10^7}{V_{max} \times 0{,}1}$ inch/min

The multiplication factor for the position loop gain (Multgain for short) is used to match the axes despite individual axis speeds, tacho adjustments and equal KV factor inputs.
The KV factor is specified in MD 150 - 153.
The Multgain allows precise adjustment of the actual KV factor at different tacho adjustment.
The Multgain input value is calculated according to the formula:

$$\text{MULTGAIN} = \frac{3.10^{7} \cdot U_{max}\ (V)}{V_{max}\ (\frac{mm}{min}) \cdot 10\ (V)}$$

V max = max. axis speed as specified in MD 130 to 133.

U max = max. command value voltage at V max (Tacho adjustment)

Example:

Vmax = 10 000 mm/min, Umax = 9 V

$$MULTGAIN = \frac{3.10^7}{10\ 000 (\frac{mm}{min})} \cdot \frac{9\ (V)}{10\ (V)} = 2\ 700\ (\frac{min}{mm})$$

If the Multgain is entered in the described manner, the specified KV factor in MD 150 to 153 becomes effective according to its input dimension.

Table of Multgain input values:

V_{max} $\frac{n}{min}$ \ U_{max}	4 V	5 V	8 V	9 V
15		1000	1600	1800
14		1071	1714	1929
13		1154	1846	2077
12		1250	2000	2250
11		1364	2182	2455
10		1500	2400	2700
9		1667	2667	3000
8		1875	3000	3375
7		2143	3429	3857
6		2500	4000	4500
5		3000	4800	5400
4		3750	6000	6750
3		5000	8000	9000
2		7500	12000	13500
1	12000	15000	24000	27000
0.8	15000	18750	30000	32000
0.75	16000	20000	32000	
0.6	20000	25000		
0.5	24000	30000		
0.4	30000	32000		

Inch measuring system:

Max. axis speed in inch/min.	9V Command value for V_{max}
600	4 500
500	5 400
400	6 750
300	9 000
200	13 500
100	27 000

TEST Data memory

Axis no.	Ident no.	Addr.	Sign	Name
1	230	S	+	drift compensation
2	231			
3	232			
4	233			

Type of measuring board	min. and max. values		in-crements	units
03320	0	500	1	VELO 1 = $\frac{10V}{2048}$
03325/03350 03326/03351	0	2000	1	VELO 1 = $\frac{10V}{8192}$

This machine datum is used to compensate the drift of analog components and to bring the following error at standstill down to zero.

An automatic evaluation of the drift value can be performed as follows:

- Mode of operation: MDI - SE - TE
- Display mode: TEST
- Cursor positioned to the concerned axis: e.g. 230 for X axis
- $\boxed{S}$ key and followed by  key.

This drift compensation must be carried out for each axis individually.

If the automatic drift compensation gives values larger than 100 (03 320) or 400 (03 325/03 350), then the deviation can no longer be considered as drift and alarm 105, 115, 125 or 135 is output (see Section 4).

TEST Data memory

Axis-no.	Ident-no.	Addr.	Sign	Name	
1	240			--	
2	241	S	+	Stop-position tolerance 2	
3	242				
4	243				

	Units of measuring system	min. and max. values		in-crement	units
metric; degrees	$1/2 \cdot 10^{-3}$ mm	0	32 000	1	1 µm; 10^{-3} degr.
Inch	$1/2 \cdot 10^{-4}$ Zoll	0	32 000	1	10^{-4} inch

Refer to MD 100 to 103.

For basic model 4A from software version C02 on.

Axis no.	Ident. no.	Address	Sign	Name	
1	250	S	+	**Pitch error compensation value**	
2	251				
3	252				
4	253				

	Units of measuring system	min. and max. values		increment	units 1)
metric,degrees	1/2x10^{-3}mm	0	99	1	1µm,10^{-3}deg.
inch	1/2x10^{-4}inch	0	99	1	10^{-4} inch

For basic model 4A from software version C02 on.

1) If the MD bit 6 of MD 430 to 433 is set, the unit is reduced to 0.5 µm, 0.5.10^{-3} degrees or 0.5.10^{-4} inch.

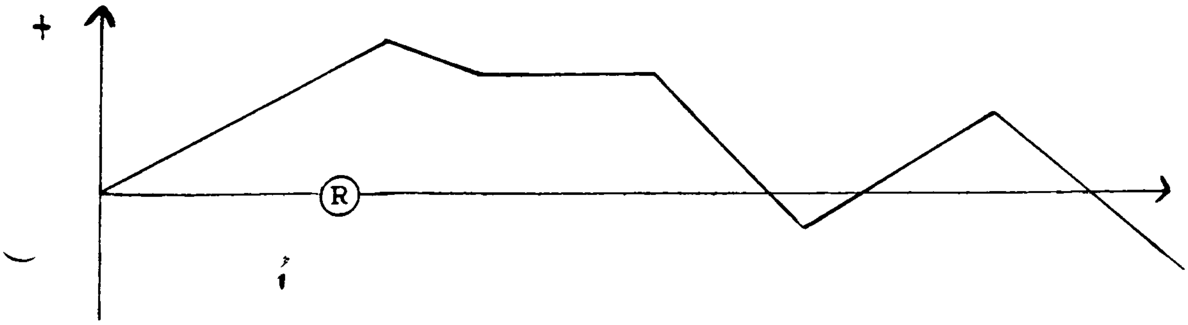
Pitch error compensation (p.e.c.)

The p.e.c. can be carried out for any number of axes. However, the full travel distance of an axis must be compensated. The travel range has to be divided in a number of compensation points of equal distance (p.e.c. grid: MD 270 to 273). Two compensation bits (= one flag, MD 500 to 755)are allocated to each compensation point. These compensation bits determine whether a positive or negative compensation or no compensation is made at this point.

The compensation value is stored in MD 250 to 253. The sign of compensation is determined as follows:
If an external measuring device (e.g. laser) measures in positive axis direction a greater value than the NC displays then a positive compensation must be made.
The compensation flags are addressed by a pointer. The pointer value increases in positive direction and decreases in negative direction. The reference point must always coincide with a compensation point. At this point there must not be any compensation (i.e. compensation flag set to 00). The pointer for the reference point flag must be stored as machine datum MD N26* .

Measuring of the p.e.c.:

First, the machine has to be referenced in order to synchronise the measuring system. Then the axis is traversed to the negative travel limit. Starting from here, the pitch error graph is recorded in positive direction by an external measuring device, e.g.:



en a suitable distance of the compensation points is chosen dependent on the given pitch error tolerance or the desired number of compensation flags. Then the compensation value is determined. The ideal value is chosen if the max. error difference between two compensation points can be compensated, e. g. for a max. error difference of 2 µm the compensation value must be set to 2 µm. Two compensation bits (= one flag) are allocated to each compensation point:

Most significant bit	Least significant bit	
0	0	no compensation
1	1	positive compensation
1	0	negative compensation

ur flags accounting for four compensation points are contained in one machine datum. The flags are stored in the machine data area MD N500 to MD N755. In total, 1024 compensation points are available. The pointer value rises with increasing significance of the MD bits e.g.:

Bit	7 ¦ 6	5 ¦ 4	3 ¦ 2	1 ¦ 0
No.500	Flag 3	Flag 2	Flag 1	Flag 0
No.501	7	6	5	4
No.502	11	10	9	8

The numbers in the table give the pointer values of the compensation flags.

The compensation flags of the individual axes must "butt-up" to each other. Make sure that the flag areas of the individual axes do not overlap and that the pointer never exceeds the maximum limits (0 to 1023).

Direction - dependent p. e. c.:

If direction-dependent compensation is needed the same procedure has to be applied for the negative traverse direction.

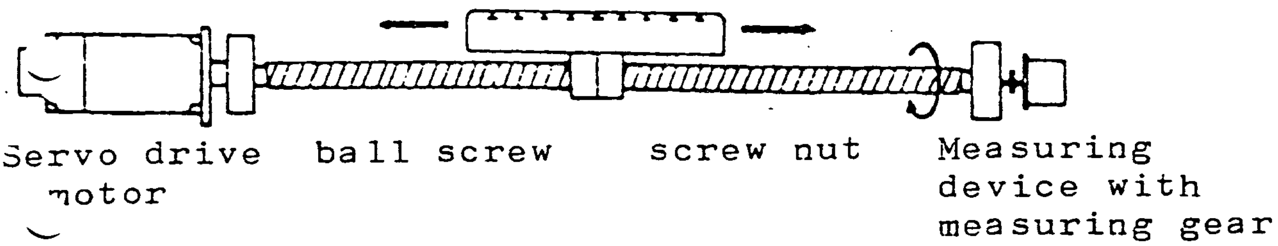
Attention: The grid value and the compensation value are valid for positive and negative traverse directions. The compensation flags for the negative traverse direction are located 100 bytes (= 400 flags) behind those of the positive traverse direction. Thus a maximum of 400 compensation points is possible for one axis.

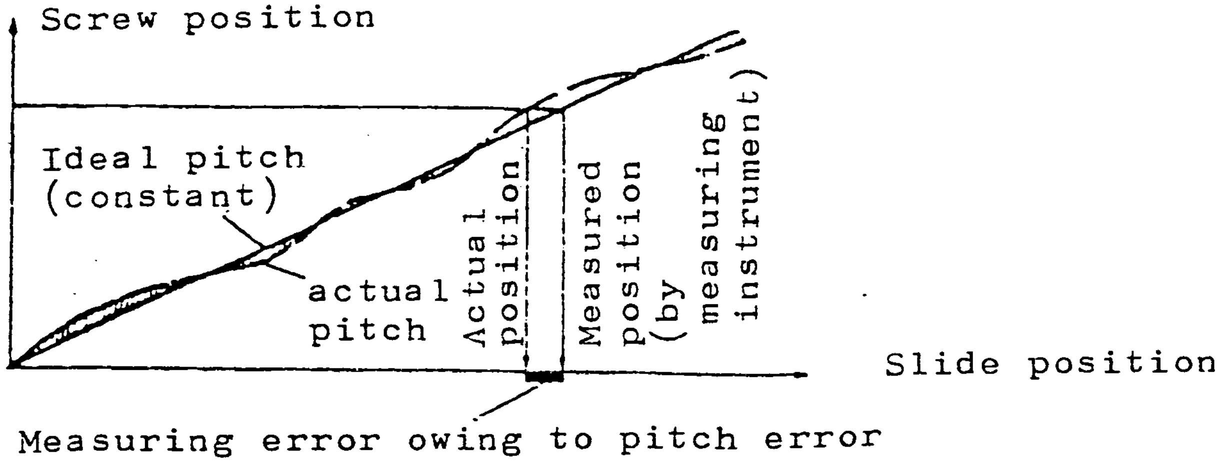
$$\sum 11 \text{ - flags (positive direction)} - \sum 10 \text{ - flags (positive direction)}$$

$$= \sum 11 \text{ - flags (negative direction)} - \sum 10 \text{ - flags (negative direction)}$$

Summary of pitch error compensation

The measuring principle of indirect measurement with NC controlled machines assumes a constant pitch of the ball screw at all locations within the travel range. Owing to manufacturing tolerances in the various quality classes of ball screws, more or less noticeable deviations are possible. Additionally, a comparatively small inherent error of the measuring device and a machine-dependent error may occur. The total error can be evaluated by recording the error graph over the entire travel range of the axis. As a reference device a highly precise measuring instrument is needed e.g. Laser-interferometer. The contour deviation on the workpiece owing to the sum of all errors can be reduced considerably by suitable compensation values entered when commissioning the control. The influences of errors can be compensated individually for all axes. 1024 compensation values are available in total for all axes. The grid value for the compensation points can be chosen for each axis within a range of 0.01 mm to 320 mm. The compensation value is common to all compensation points of an axis and can be set between 0.001 mm and 0.099 mm .





TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	260 261 262 263	S	+	Reference pointer for p. e. c.	

	Units of measuring system	min. and max. values		increment	units
metric,degrees		0	1023	1	-
inch		0	1023	1	-

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
1 2 3 4	270 271 272 273	S	+	**Grid value:** **Distance between pitch error compensation points**	

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	32 000	1	10 µm
inch	$1/2 \times 10^{-4}$ inch	0	32 000	1	10^{-3} inch

7.3 General NC machine data

TEST Data memory

	Ident No.	Addr.	Sign	Display/Input
	310	S	-	Min. input limit for background memory

Input limits		Increment
0	99	1

	Ident No.	Addr.	Sign	Display/Input
	311	S	-	Max. input limit for background memory

Input limits		Increment
0	99	1

In order to simplify the input of empirical values for the user, a new NC display has been incorporated. The new display appears after the R parameter display and shows the background memory and allows the input of values in the same way as with R parameters. Instead of "R" the letter "H" must be used. The input can be optionally enabled for a partial area of the memory. This area is specified by MD 310 and MD 311.

Example: MD 310 = 10
MD 311 = 20

This means that the background memory H 10 to H 19 can be entered.

The input is restricted to certain preconditions:

Data protection switch	MD 410, bit 6 ZO data	Key-operated switch	Input possible
on	x	x	in the entire memory
off	0	x	in the specified area
off	1	on	in the specified area
off	1	off	no input possible

x ... irrelevant

This option is only available with basic model 4B from D06 on.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	Display/Input	
	317 to 324	S	±	Distance of tool track 1 to 8, Z-axis	

	Units Measuring System	Input Limits		Increment	Units
Metric, degrees	1/2 · 10^{-3} mm	0	99999999	1	1 µm
Inch		-	-	-	-

Basic model 4B only. Not available for inch system.

Option B67.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	Display/Input	
	325	S	+	Angle of inclination of rotated coordinate system	

	Units Measuring System	Input Limits		Increment	Units
Metric, degrees	-	0	9000000	1	10^{-5} degrees
Inch	-	-	-	-	-

Basic model 4B only. Not available for inch system
Option B67.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	Display/Input	
	326 327	S	+	Distance machine zero and ficticious zero to transformation center at rotated coordination system	

	Units Measuring System	Input Limits		Increment	Units
Metric, degrees	$1/2 \times 10^{-3}$ mm	0	99999999	1	1 µm
Inch	-	-	-	-	-

Basic model 4B only. Not available in inch system.

Option B67.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	Display/Input	
	328	S	+	Turret radius tool changer	

	Units Measuring System	Input Limits		Increment	Units
Metric, degrees	$1/2.10^{-3}$ mm	0	99999999	1	1 µm
Inch	-	-	-	-	-

Basic model 4B only. Not available in inch system

Option B67.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	Display/Input	
	329	S	+	Turret radius C2-axis	

	Units Measuring System	Input Limits		Increment	Units
Metric, dégrees	$1/2.10^{-3}$ mm	0	99999999	1	1 µm
Inch	-	-	-	-	-

Basic model 4B only. Not available in inch system.

Option B68.

This machine datum can be altered via the PLC.

TEST Data memory

Axis No.	Ident. No.	Addr.	Sign	N a m e		
	330	S	+	feed override value in percent	2nd switch position	
	331	S	+		3rd " "	
	332	S	+		4th " "	
	333	S	+		5th " "	
	334	S	+		6th " "	
	335	S	+		7th " "	
	336	S	+		8th " "	
	337	S	+		9th " "	
	338	S	+		10th " "	
	339	S	+		11th " "	
	340	S	+		12th " "	
	341	S	+		13th " "	
	342	S	+		14th " "	
	343	S	+		15th " "	
	344	S	+		16th " "	

min. and max. value		increments	units
1	130	1	%

With basic model 4A from software version C02 on.

The percentage-values of the 15 positions of the feed override switch can be specified by these MD. Thus an adjustment in fine steps is possible in selected override ranges.

Starting from 1 % any % in steps of 1 % can be entered.
The first switch position (for left position) is specified as 0 %. If 0 % is allocated to any other position, the feed hold LED does not light up in contrast to the first position (= defined zero position). The upper limit is 130 %.

With automatic MD setting, the standard values of the machine control panel are entered.

Axis no.	Ident. no.	Address	Sign	Name	
	345	S	+	**Software** prelimit switch	

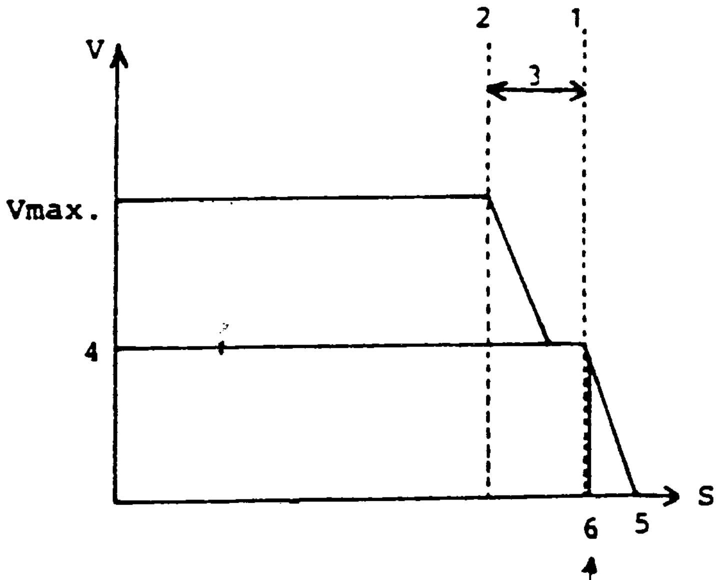
	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$mm	0	99999999	1	1µm, 10^{-3}deg.
inch	$1/2 \times 10^{-4}$inch	0	9999999	1	10^{-4} inch

With basic model 4A from software version C 02 on.

The software prelimit is defined as incremental value to be entered in MD 345. It ensures that the software switch is overrun by µm only, even at high traverse speeds. Above a defined traverse speed, braking is prematurely initiated by the incremental value of the prelimit switch. This prelimit switch is common for all axes in both directions.

If the software prelimit is reached at a speed greater than specified in MD 346, alarm 518 is displayed. If the software prelimit is reached at rapid traverse, the speed is reduced to the value given in MD 346 as well, but alarm 518 does not appear.

Principle of the prelimit switch:



Legend:

1 Software limit

2 Software prelimit

3 Incremental value of prelimit (Ident No. 345)

4 Speed limit for software prelimit (Ident No. 346)

5 Axis stop-point with ramp effective (Ident No. 408, Bit 7 = 0)

6 Axis stop-point without ramp (Ident No. 408, Bit 7 = 1)

The software limit will be overrun by µm dependent upon sample time and speed in MD 346.

The incremental value in MD 345 must be of such a size to allow braking down to the speed given in MD 346 without reaching the software limit switch. If the value 0 is entered in MD 345, MD 346 becomes ineffective.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
	346	S	+	Speed behind pre-limit

	Units of Measuring System	min. and max. values		Incre-ment	Units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	24 000	1	$1 \frac{mm}{min}; \frac{deg.}{min}$
inch	$1/2 \times 10^{-4}$ inch	0	10 000	1	$0.1 \frac{inch}{min}$

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name	
	347	S	+	Reduced block end speed at G62	

	Units of measuring system	min. and max. values		Incre- ment	Units
metric, degrees	$1/2 \times 10^{-3}$ mm	5	24 000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch	$1/2 \times 10^{-4}$ inch	2	10 000	1	0.1 $\frac{inch}{min}$

With basic model 4 A from software version C 05 on.

Programming of G62 reduces the speed at block end to the value given in MD 347.

This reduces wear on the machine at 90 ° or 270 ° corners traversed with high feedrates in continuous-path control.

Applicable to all machines with 3 M controls, but predominantly used with wood working machines.

TEST Data memory

Axis No.	Ident No.	Address	Sign	Name
	350	S	+	Cutoff speed for linear axes

	Units of measuring system	min. and max. values		increment	units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	24 000	1	$1\ \frac{mm}{min}$; $1\ \frac{deg.}{mm}$
inch	$1/2 \times 10^{-4}$ inch	0	10 000	1	$0.1\ \frac{inch}{mm}$

The speed specified in MD 350 is effective on reference point approach when the "deceleration at reference point approach" interface signal is active (refer also to MD 210 to MD 213).

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name	
	349	5	+	Cutoff speed for rotary axes	

	Units of measuring system	min. and max. values		Incre-ment	Units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	24 000	1	$1 \frac{mm}{min}$; $\frac{deg.}{min}$
inch	$1/2 \times 10^{-4}$ inch	0	10 000	1	$0.1 \frac{inch}{min}$

With basic model 4 A from software version C 02 on.

An individual cutoff speed for referencing can be specified for rotary axes.

This value applies to all rotary axes declared by MD 403 - 406.

The dynamic characteristics of rotary axes sometimes differ significantly from those of linear axes. To avoid reducing the cutoff speed of linear axes to the low values of rotary axes, a separately adjustable cutoff speed for rotary axes is available.

If the value '0' is entered in MD 349, the axis stops on the deceleration cam on reference point approach.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name	
	348	S	+	Feedrate for gauging in jog mode	

	Units of measuring system	min. and max. values		Incre-ment	Units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	24000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch	$1/2 \times 10^{-4}$ inch	0	10000	1	0.1 $\frac{inch}{min}$

Available with basic model 4 B only. Option B79 required.

The tool to be measured approaches the measuring probe at this speed.

351 S: Speed threshold for contour monitoring

TEST Data memory

	Units of Measuring System	Input Limits	Increment	Units
Metric, degrees	$1/2 \times 10^{-3}$ mm	0 - 24 000	1	mm/min
Inch	$1/2 \times 10^{-4}$ inch	0 - 000	1	0.1 inch/min

352 S: Tolerance band for contour monitoring

TEST Data memory

	Units of Measuring System	Input Limits	Increment	Units
Metric, degrees	$1/2 \times 10^{-3}$ mm	0...32 000	1	$\frac{\text{mm Test 850}}{125 \cdot 1000}$
Inch	$1/2 \times 10^{-4}$ inch	0...32 000	1	$\frac{\text{0.1inch Test 850}}{125 \cdot 1000}$

The actual KV factor is automatically evaluated when the axis is traversed at least 3 seconds with constant speed (display in TEST 850....853 in 0.001 m/min/mm, customary values between 500 and 1800). The measured KV factor remains stored until any MD is altered. After evaluation of all KV factors (otherwise alarm 528) they are compared for equality. A deviation greater than 50 is indicated by alarm 527.

Evaluation of the tolerance band: $\dfrac{\text{MD 352} \times 125}{\text{Measured KV factor} \times 1000}$ (μm)

For a detailed description of contour monitoring, refer to Section 6.

If the value 0 is entered as tolerance band, the control assumes automatically the standard value 2000. Entered values between 1 and 32 000 become effective according to the above equation.

e.g. Value 1000 is entered in MD 352, KV = 1 m/min/mm.

Tolerance band: $\dfrac{1000 \times 125}{1 \times 1000} = 125\ \mu\text{m}$

TEST Data memory

Axis no.	Ident. no.	Addr.	Sign	Name	
	353	S	+	Position monitoring delay time	

Note:
Standard value is 500

min. and max. values		in-crement	units
0	16000	1	1 ms

The entered delay time is effective at:

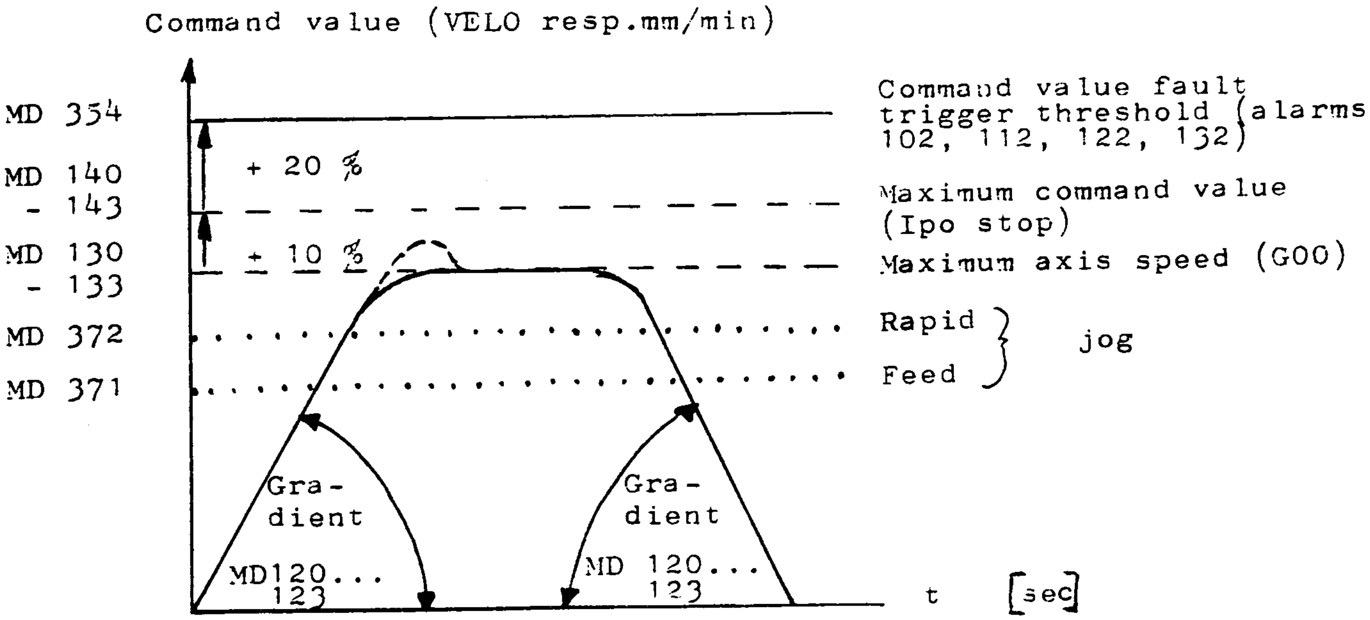
1. On positioning at digital zero the clamping tolerance monitoring (MD 110 - 113) is activated after this delay has expired. The delay selected should be as such that the max. following error can be worked off without triggering the alarms 101, 111, 121 or 131.
2. Delay for the output of the "servo inhibit" signal after emergency off or other faults which result in immediate shut down of the axes.
3. Delay for the output of the "servo inhibit" signal if the servo enable for a moving axis is cancelled by the interface control.
4. Delay for triggering the alarms 101 ... 131 (standstill monitoring) when the max. command value (MD 140 ... MD 143) is exceeded.

TEST Data memory

Axis No.	Ident-No.	Addr.	Sign	Name	
	354	S	+	Command value fault trigger threshold	⇨

Type of measuring circuit board	min. and max. values		in-crement	units
03320	0	3000	1	1Velo = $\frac{10V}{2048}$
03325/03350 03326/03351	0	12000	1	1Velo = $\frac{10V}{8192}$

The monitor triggers alarm 102, 112, 122, 132 if the command value rises too high owing to measuring circuit- or drive faults. The input value must be greater than the largest max. command value defined in MD 140 - 143.
Recommended value: Approx. 20 % greater than MD 140 - 143.

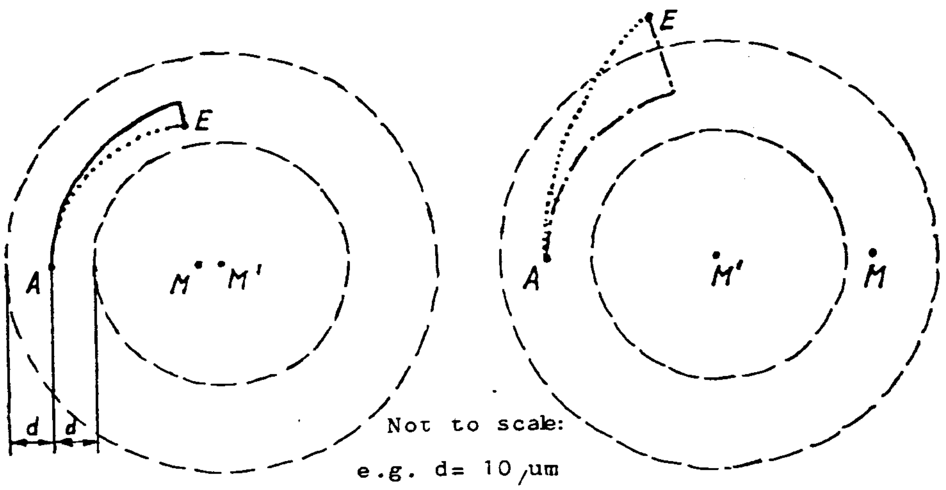


TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name	
	355	S	+	Circle end point tolerance band	

	Units of measuring system	min.and max. values		increment	units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	32 000	1	1 µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	32 000	1	10^{-4} inch

The input value defines an annulus (tolerance ring) equidistant to the programmed arc and independent of the programmed circle end point. If the programmed end point lies within the tolerance ring, then the erroneously programmed circle is executed until the end point can be reached on a radial path. If the programmed end point lies outside of the tolerance ring, the block is not cleared for machining. This is already detected in the first buffer memory (block decoding) and alarm 308 is triggered. The same applies to correctly programmed radius (M=M') and erroneously programmed end point.



End point lies within the tolerance ring:
Machining, no alarm

End point lies outside the tolerance ring:
No machining, alarm 308

---- Limits of tolerance ring

.... Required arc (with M and E)

____ Machined path (with erroneous M')

d Tolerance value entered in MD 355

A Starting point

E End point (correctly programmed)

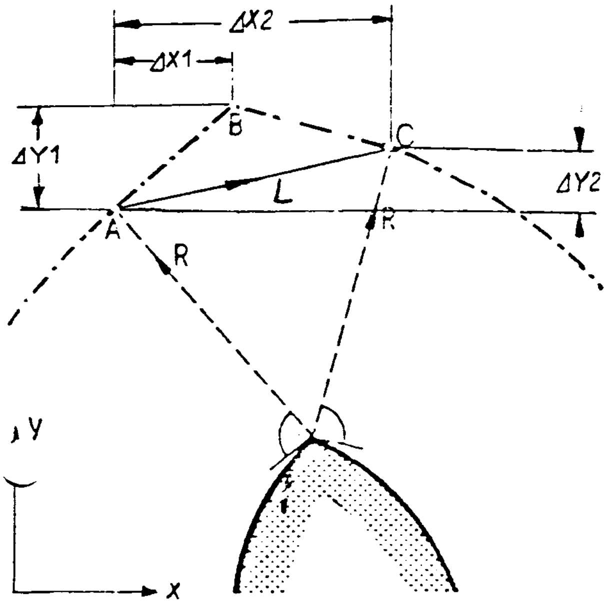
M Required centre point

M' Programmed centre point (erroneously programmed parameter or radius)

Axis no.	Ident. no.	Address	Sign	Name	
	356	S		Threshold for CRC block insertion at corners	

	Units of measuring system	min. and max. values		increment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	32000	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	32000	1	10^{-4} inch

One or more intermediate blocks for linear compensation movements are inserted for transistions from a circular contour to a linear or to another circular contour (refer to Programming Instructions). With these compensation movements the programmed feedrate is maintained along the cutter centre path, on machining, however, the feedrate is maintained with respect to the workpiece contour. This results in differences in feedrate. In order to avoid speed changes at small distances, the compensation movements beneath the threshold 'd' are simplified or omitted as follows:

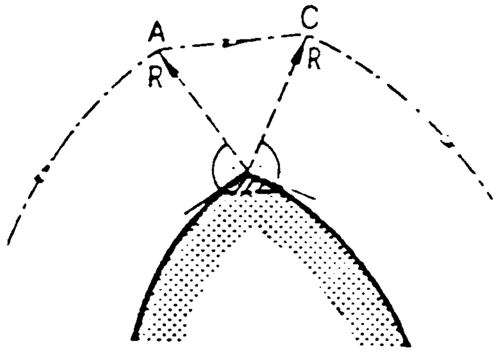


The threshold is not effective at transitions with linear interpolations only. The compensation movements are always carried out (refer to Programming Instructions)

-.-.- Cutter centre path

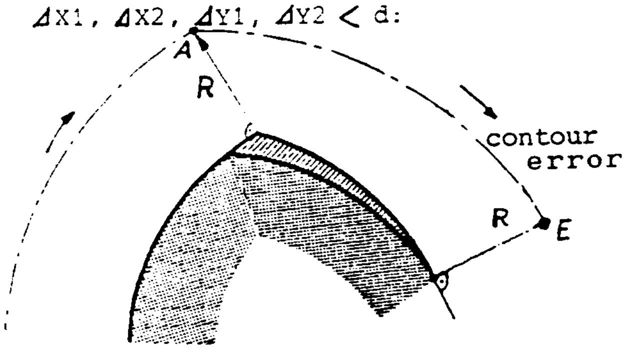
///// Contour error

$\Delta X1, \Delta Y1 < d$:



Simplified compensation movements A - C

$\Delta X1, \Delta X2, \Delta Y1, \Delta Y2 < d$:



No compensation movement. The correct compensation is ensured at the end (E) of block only.

TEST Data memory

Axis no.	Ident. no.	Addr.	Sign	Name	
	357	S	±	spindle drift	

min. and max. values		in- crement	units
0	500	1	$VELO2 = \frac{10 Volt}{8192}$

This machine datum specifies the value of drift compensation in the event of analog spindle command value output.

The input value must be evaluated at low speeds. It has to be altered in the appropriate sense until the spindle runs equal actual speeds in both directions of rotation.

Particularly with application of M 19 the drift compensation needs to be carried out accurately.

358 S Dynamic smoothing exponent for thread cutting

Input limits		Increment	Units
0	5	1	(2^x-1) x sample time

This machine datum specifies the ramp up time of the servos for threading. The MD 120 - 123 are not effective with G33. The actual value pulses of the spindle are smoothed for generating the axis speed.

The actual value sample time is used as a time constant according to the following formula:

(2^x-1) times sample time   x ... input value

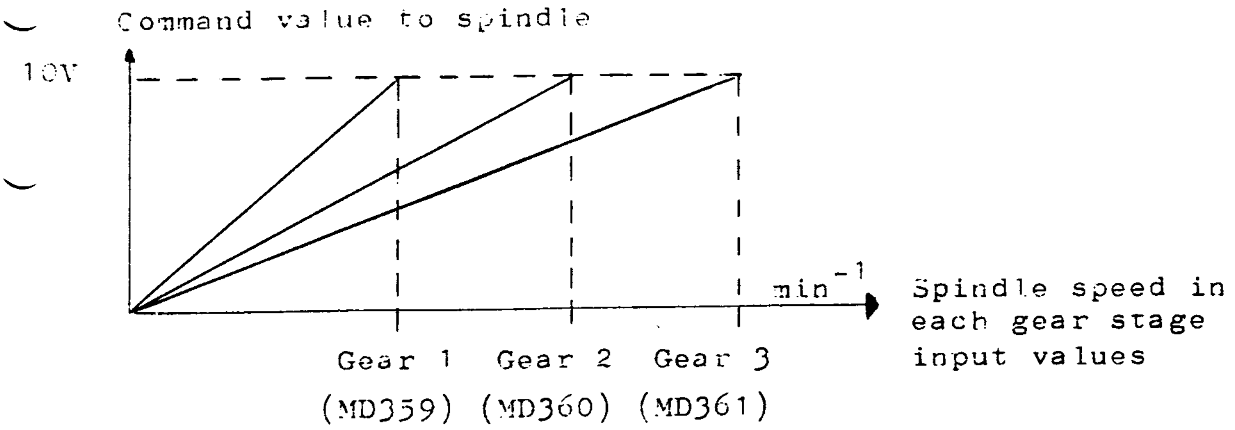
Table:

Input value	0	1	2	3	4	5
Sample time-factor	0	1	3	7	15	31
Ramp up function	jump	ramp				

Axis no.	Ident. no.	Addr.	Sign	Name	
	359 360 361 362 363 364 365 366	S	+	max. spindle speed in each of eight gear ranges	

spindle speed range	min. and max. values		in-crement	units
1 - 9999 min^{-1}	16	9999	1	rev./min
0.1 - 999 min^{-1}	16	9999	1	rev./0.1min

These MD determine the max. spindle speed reached in the individual gear ranges at a command value of 10 volts.
If there is no gear at all, the max. spindle speed is entered in MD 359. All other MD (360...366) are set to 0. For gears with less than 8 stages the value 0 should be entered into the MD of non-existing stages.



Correspondence of gear stages and MD number:

Gear stage	1	2	3	4	5	6	7	8
Input number	359	360	361	362	363	364	365	366

For the interface signals of the gear stages refer to Section 8 (Interface diagnostics of the input signals, 3 inputs for the coded gear stages).

Axis	Ident. no.	Address	Sign	Name
Spindle	367	S	+	Tolerance band for programmed spindle speed

Spindle speed range	min. and max. values		increment	units
1 - 9999 rev/min	0	99	1	%
0.1 - 999 rev/min	0	99	1	%

The deviation of actual speed from the set speed can be determined in systems with analog spindle control and fitted spindle encoder.

(Set speed - tolerance) $\leq$ actual speed $\leq$ (set speed + tolerance)

The actual speed is measured by means of a ROD-encoder.

Deviations outside the tolerance limits of the programmed spindle speed are signalled to the PLC via the input signal I 68.5 by cancelling the "Spindle within the set range" signal.

Axis No.	Ident No.	Address	Sign	Name
Spindle	368	S	+	Tolerance of maximum spindle speed

Spindle speed range	min. and max. values		Increment	Units
1 - 9999 rev/min	0	99 (100)	1	%
0.1 - 999 rev/min	0	99 (100)	1	%

In systems with analog spindle control and spindle encoder a deviation beyond the max. speed plus the tolerance limit results in setting of the input signal I 68.6 in the PLC "Spindle above speed limit" and the alarm 225. Consequently, the NC shuts off the spindle and the feed drives. The smallest of the following max. spindle speed limitations is active:

- Max. gear stage speed (MD 359 to 366)
- Max. spindle speed specified in MD 370
- With G96: Value in setting datum 20 (G92 S....)

The monitoring of the max. gear stage speed is not active if MD 428 bit 4 is set to '1'

An input of '100' disables the monitoring.

Note: An alteration of MD 368 becomes effective after hardware-reset or gear stage change only!

Axis no.	Ident. no.	Address	Sign	Name
Spindle	369	S	+	Tolerance spindle speed at standstill

Spindle speed range	min. and max. values		increments	units
1 - 9999 rev/min	0	125	1	0,01 %
0.1 - 999 rev/min	0	125	1	0,01 %

The actual speed is measured in systems with analog spindle control and spindle encoder. If the spindle speed drops below the "standstill speed" the NC reports via input I 68.3 the "Spindle stationary" signal to the PLC.

TEST Data memory

Axis No.	Ident.No.	Address	Sign	Name
Spindle	370	S	+	Maximum spindle speed

Spindle speed range	min. and max. values		Increments	Units
1 - 9999 rev/min	1	9999	1	1 rev/min
0.1 - 999 rev/min	1	9999	1	0.1 rev/min

With basic model 4 A from C02 on.

This machine datum limits the max. spindle speed.

It can be input or altered via the PLC.

Application:

The spindle speed can be limited depending on the chuck size via the "wide window" between the NC and the PLC.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
	371	S	+	Jog feed rate

	Units of measuring system	min. and max. values		Incre-ment	Units
metric, degrees	$1/2 x 10^{-3}$ mm	0	24000	1	$1 \frac{mm}{min}$; $\frac{degree}{min}$
inch	$1/2 x 10^{-4}$ inch	0	10000	1	$0.1 \frac{inch}{min}$

The entered value is applicable to all axes in jog mode with 100 % feedrate override, unless it is limited by values in MD 130 - 133.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name		
	372	S	+	Rapid jog speed		
		Units of measuring system	min. and max. values		Incre-ment	Units
metric, degrees		$1/2 x 10^{-3}$ mm	0	24000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch		$1/2 x 10^{-4}$ inch	0	10000	1	0.1 $\frac{inch}{min}$

The entered value applies to all axes in rapid jog mode with 100 % feedrate override and rapid traverse override "ON" unless limited by the values in MD 130-133.

The value entered in MD 372 is not used for programmed rapid traverse (G00). G00 is defined in MD 130 - 133 (acceleration speed limitation).

Axis No.	Ident. No.	Address	Sign	Name		
	373	S		Reference point approach speed		

	Units of measuring system	min. and max. values		Incre- ment	Units
metric, degrees	$1/2 \times 10^{-3}$ mm	0	24000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch	$1/2 \times 10^{-4}$ inch	0	10000	1	0.1 $\frac{inch}{min}$

The entered value applies to all axes in referencing mode with feedrate override at 100 % and rapid traverse over- ride "ON" unless limited by the values in MD 130 - 133.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name		
	374	S	+	Incremental feedrate		
		Units of measuring system	min. and max. values		Incre- ment	Units
metric, degrees		$1/2x10^{-3}$mm	0	24000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch		$1/2x10^{-4}$inch	0	10000	1	0.1 $\frac{inch}{min}$

The entered speed is effective in incremental mode only.

Customary values up to approx. 1000 mm/min.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name		
	375	S	+	Dry run feedrate		

	Units of measuring system	min. and max. values		Incre- ment	Units
metric, degrees	1/2x10^{-3}mm	0	24000	1	1 $\frac{mm}{min}$; $\frac{degree}{min}$
inch	1/2x10^{-4}inch	0	10000	1	0.1 $\frac{inch}{min}$

The entered value is effective with activated dry run switch instead of the programmed feedrate, if not limited axis-specifically by MD 130 - 133.

The feedrate override remains active in dry run mode.

The dry run switch can be locked with the key switch depending on MD 410 bit 2.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
	376	S	+	Delay time for *spindle inhibit

min. and max. values		Incre- ment	Units
0	16000	1	ms

To avoid drifting of the spindle after command value 0 output, the spindle drive enable (* drive inhibit) signal is cancelled after this delay time has elapsed.

The delay time is effective at:

- Cancelling of the interface signal "spindle enable"
- Spindle stop M05
- Emergency off
- In the event of position control monitoring alarms.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name	
Spindle	377	S	+	Minimum spindle motor speed	

min. and max. values		Incre- ment	Units
0	8192	1	$VEL02 = \frac{10V}{8192}$

This machine datum specifies the min. spindle motor speed which will be maintained even when, for instance, at constant cutting speed the turning diameter increases. Consequently, starting from this point the cutting speed is no longer constant but increases with the turning diameter.
A smooth running of the motor down to this speed is possible.

<u>Example for evaluation:</u>

Max. motor speed = 3500 rev/min, corresponds to max. spindle speed.
Min. motor speed e. g. 50 rev/min.

$$\text{Input value} = \frac{50 \text{ rev/min}}{3500 \text{ rev/min}} \times 8192 = 120$$

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
Spindle	378	S	+	Cutoff spindle speed for M 19 approach

Spindle speed range	min. and max. values		Increments	Units
1 - 9999 rev/min	1	9999	1	1 rev/min
0.1 - 999 rev/min	1	9999	1	0.1 rev/min

This machine datum specifies the spindle speed to which the speed is reduced at oriented spindle stop (M 19).
The spindle continues running at this speed until positioning can be accomplished along the position control characteristic set by means of gain.

With option E 42 only.

This MD can be set or altered via PLC with the basic model 4 B starting from D 03.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
Spindle	379	S	+	Gain factor for M19 closed loop control

Spindle speed	min. and max. values		In-crement	Units
1 - 9999 min^{-1}	0	10000	1	$\frac{min^{-1}}{360 \text{ degrees}}$
0.1 - 999 min^{-1}	0	10000	1	$\frac{0.1 \; min^{-1}}{360 \text{ degrees}}$

Recommended value: 200

In the event of oriented spindle stop (M19) the spindle operates in closed-loop position control. The gain factor is described by the positioning ramp to the end position. The slope is defined as the spindle speed (in rev/min) at a position 360° ahead of the programmed position.

With option E 42 only.

This machine datum can be set or altered via the PLC with basic model 4 B starting from DO 3.

TEST Data memory

Axis no.	Ident. no.	Addr.	Sign	Name	
Spindle	380	S	+	**Positioning tolerance for M19**	

min. and max. values		in-crement	units
0	1000	1	1/11 degrees

The position tolerance band is specified in encoder increments. One increment corresponds to 360/4096 degrees.

With oriented spindle stop (M19) the "Spindle position reached" message is output to the PLC via input I 68.4 as soon as the position deviation lies within this tolerance band.

With option E 42 only.

This machine datum can be set or altered via the PLC with basic model 4 B from D03 on.

TEST Data memory

Axis No.	Ident. No.	Address	Sign	Name
	381	S	+	NC system software version *)

The software version is stored in an EPROM and transferred into MD 381 on Power-ON-Reset (Input limits: 0....32000).
With basic model 4B from D05 on the following value will be entered: S.....33 uu.

33 signifies the software for basic model 4B
uu gives the software version

*) If any other value is input via the keyboard it will be changed on Power-ON-Reset to the value stored in the EPROM.

TEST Data memory

Axis No.	Input No.	Address	Sign	Display/Input
	382	S		Limit for updated R parameter display

Input limits		Incre-ment	Units
0	99	1	-

The actual contents of the locked R parameter are not displayed with active "Cycle inhibit" interface signal (Q 64.3) e.g. Entered value 50: The actual contents of the R parameters R 50 to R 99 will not be displayed. The limit must be set to ≤ 50, if the fixed cycle program L 95 or L 96 are used with a 3 M control.

Note: Calculation blocks programmed in cycle language are executed faster!

Refer also to MD 428, bit 2.

TEST Data memory

Axis No.	Ident. No.	address	Sign	Name
	383	S		Increase of software sample period

min. and max. value		Incre-ment	Units
0	30	1	1/2 ms

This machine datum is normally set to 0. The fixed standard sample period for the closed-loop position control is effective. However, by means of this machine datum the sample period can be increased.

The sample periods must be matched if two different types of NC are located in the same rack.

e. g. 3TT with one C-axis:

		MD 383
NC1	3T without C-axis	4
NC2	3T with C-axis	0

In all other cases the technical department (TN4) of the GWE works must be contacted before increasing the sample period if needed. Pay attention to MD 428, bit 7.

TEST Data memory

Axis no.	Ident. no.	Address	Sign	Name	
.	385	S	±	2nd software limit in minus X direction (only 3T)	

	Units of measuring system	min. and max. values		in-cre-ment	units
metric,degrees	$1/2 \times 10^{-3}$ mm	0	±99999999	1	1µm, 10^{-3} deg.
inch	$1/2 \times 10^{-4}$ inch	0	±99999999	1	10^{-4} inch

The second software limit switch in minus X direction is activated with PLC output Q 68.1 (3T only).

Axis No.	Ident. No.	Address	Sign	Name
Spindle	386 387 388 389 390 391 392 393	S	*	Acceleration time for eight gears (acceleration and deceleration ramp)

min. and max. values		Incre-ment	Units
0	32000	1	4 ms

The controller outputs the command value for spindle acceleration as a ramp specified by this machine datum. This machine datum acts as a variable ramp-function generator.

The adjustment is performed by measuring the time interval from speed 0 to max. speed.
The time converted to the stated units is entered into the MD.

<u>Example:</u>

Gear stage 1

Acceleration time: 400 ms ⟶ MD 386 S 100

Gear stage 2

Acceleration time: 580 ms ⟶ MD 387 S 145

These MD can be set or altered via the PLC with basic model 4B from D03 on.

7.4 Description of the Machine Data Bits:

The description of the individual machine data bits follows the sequence of the input numbers.

For MD 400 MD 401 MD 402	The name of a key is specified by a corresponding bit combination. The corresponding character appears on screen when the key is actuated. The same allocation must be adhered to in programming (punched tape or floppy). Coding of the addresses:

Bit				Name
3	2	1	0	
0	0	1	1	A
0	1	0	0	B
0	1	0	1	C
0	1	1	0	U
0	1	1	1	V
1	0	0	0	W
1	0	1	1	P

Refer also to the Programming- and Operating Instructions of System 3

	7	6	5	4	3 2 1 0
400					Name of radius of chamfer

Bit 7 to 4	Always to be set to '0'
Bit 3 to 0	Name of radius or chamfer for: 3M: - Address (name) for cutter radius - Address (name) polar coordinate programming - Address (name) for diameter ratio in cylindrical milling - Address (name) for insertion of radii and chamfers in blueprint programming (option C33, B75). - Address (name) for radius programming of circles (option B62). 3T: - Address (name) for tool nose radius - Address (name) for radius programming of circles (option B62).

Note: In the Programming Instructions the name P is used throughout for 3 M and B for 3 T. These letters should also be used in practice.

	7	6	5	4	3	2	1	0
401					Name of angle			

Bit 7 to 4	Always to be set to '0'
Bit 3 to 0	Name of angle, mostly the letter A is used (see Programming Instructions) With 3T: Address (name) for coding of the tool position (position of tool nose) Address (name) of angle in blueprint programming (option B75) With 3M: (from C02 on) Name of angle in polar coordinate programming Name of angle in blueprint programming (option B75). Refer also to MD400.

	7	6	5	4	3	2	1	0
402					Name of 4th axis, 3M only			

Bit 7 to 4	Always to be set to '0'
Bit 3 to 0	Address (name) of the 4th axis with option A 03, A04. Refer also to MD400.

403	1st axis, X with 3T and 3M
404	2nd axis, Z with 3T, Y with 3M
405	3rd axis, Z with 3M, C2-axis with option B68
406	4th axis, 3M only, C1-axis with option A03

	7	6	5	4	3	2	1	0
403 to 406	Referencing not needed prior to start	Part actual value times ten	Rotary axis	Divide part actual value by 2	Part actual value times 2	Actual value sign change	Command value sign change	Ref. point approach in negative direction

Bit 7	Bit set to '1': The NC start interlocking is not effective for this axis. Application: The NC start interlocking can be excluded for individual axis even without setting MD 407, bit 7. e. g. 3M with two axes only (X and Y). The non-existant Z axis requires an adaptor plug in order to short-circuit the open encoder input or MD 422 bit 4 has to be set to '1'. If bit 7 of MD 405 is set and bit 7 of MD 407 is not set then only the X and Y axis need to be referenced. Available with basic model 4A from C02 on. This bit has a different function in case of the 4^{th} axis. Refer to Data Specification Sheet of the control.
Bit 6	Bit set to '1': Part actual value multiplied by ten. This factor matches the increment resolution of the measuring device to the interpolation resolution of the control. Refer to table for measuring device selection in the Interface Descriptions. For encoders with other increment numbers than those given in the table or for other pitch values of the ball screw, the matching has to be made at the machine e.g. by adaptation gears.

403 to 406
Continued

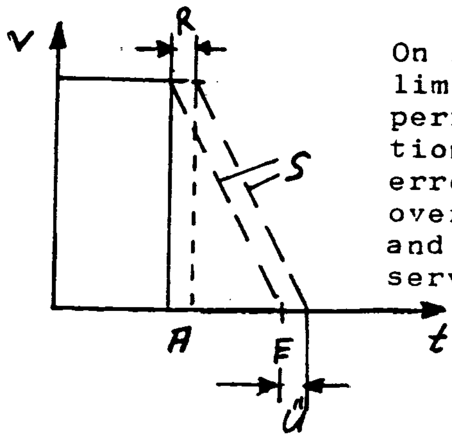
Bit 6 (continued)	<table><tr><th>Factor</th><th>Bit 6*</th><th>Bit 4</th><th>Bit 3</th></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0.5</td><td>0</td><td>1</td><td>0</td></tr><tr><td>2</td><td>0</td><td>0</td><td>1</td></tr><tr><td>5</td><td>1</td><td>1</td><td>0</td></tr><tr><td>10</td><td>1</td><td>0</td><td>0</td></tr><tr><td>20</td><td>1</td><td>0</td><td>1</td></tr></table>* With model 4A from C02 on. Refer also to table for measuring device selection in the Interface Descriptions.
Bit 5	Bit set to '1': Axis is declared as a rotary axis. If "modulo 256" bit (MD 420-423, bit 2) is set, the actual value overflows to 0 after 256 revolutions. With inch programming or inch measuring system and bit 5 set, the axis is taken as a rotary axis with programming in degrees.
Bit 4	Bit set to '1': Part actual value divided by two. For table refer to bit 6.
Bit 3	Bit set to '1': Part actual value multiplied by two. For table refer to bit 6.
Bit 2	Bit set to '0': Positive part actual value is taken as positive for calculation. Bit set to '1': Positive part actual value is taken as negative for calculation.
Bit 1	Bit set to '0': An axis command in positive direction leads to a negative set speed output. Bit set to '1': An axis command in positive direction leads to a positive speed output.
Bit 0	Bit set to '0': Reference point approach in positive direction. Bit set to '1': Reference point approach in negative direction.

	7	6	5	4	3	2	1	0
407	NC start enable w/out referencing				Spindle speed in 0.1 rev/min	Spindle encoder present	Spindle actual value sign change	Spindle actual value times two

Bit 7	Bit set to '0': After switching on the control all axes need to be referenced otherwise the NC start would be inhibited in the operating modes MDA and AUT (alarm 351). Refer also to MD 403, 404, 405, bit 7. Bit set to '1': The interlocking of the NC start is not active, but approaching the reference points is possible.
Bit 6 to 4	
Bit 3	Bit set to '1': Spindle speed S ranges from 0.1 to 999.9 rev/min. The desired set value multiplied by ten has to be programmed e. g. for 99 rev/min = S990 must be programmed. The actual value is displayed correctly (99 rev/min). The maximum spindle speed is 999.9 rev/min if the bit is set. Bit set to '0': Spindle speed S ranges from 1 to 9999 rev/min.
Bit 2	Bit set to '1': This activates the hardware monitoring for the spindle encoder (alarm 224) and the display of the actual spindle speed.
Bit 1	Bit set to '1': The sign of the measured actual spindle speed is changed e. g. a positive active value is taken as negative in calculations. This affects display, spindle monitoring and M19.
Bit 0	Bit set to '1': The actual value of the spindle is multiplied by two. Bit set to '0': In order to reach higher spindle speeds the ROD-encoder can be geared down by a reduction gear 2 : 1. Then the actual value of spindle must be multiplied by two. This makes it possible to double the admissible maximum spindle speed to a maximum of 9999 rev/min or 999.9 rev/min.

	7	6	5	4	3	2	1	0
408	Fast stop at limit switches	Input mode "Inch" (G70) setting		"Inch" measuring system	Spindle control by NC	Aux. function output prior to move	Aux. function output at block search	

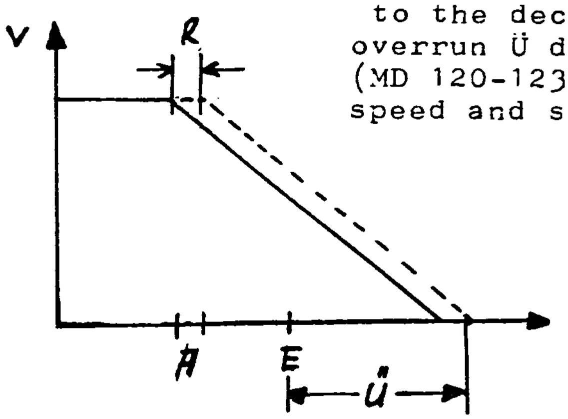
Bit 7	Bit set to '1':



On reaching the software limits, braking is not performed over the deceleration slope, only the following errors are worked off. The overrun Ü depends on instant A and braking performance of the servo drive.

Bit set to '0':

On reaching the software limits, braking is performed according to the deceleration slope. The overrun Ü depends on acceleration (MD 120-123), the instant A, the speed and servo drive.



A .... Instant in the sample time within which the software limit switch is recognized.

E .... Instant at which the software limit switch would be reached exactly.

Ü .... Time in the course of which the software limit switch will be overrun.

S .... Actual travel speed owing to following error.

Refer also to MD 345 and MD 346.

Bit 6	Bit set to '1': Input system is set to "Inch" Units: 10^{-4} inch G70 is reset state Bit set to '0': Metric input system Units: 10^{-3} mm G71 is reset state Refer also to bit 4.
Bit 5	
Bit 4	Bit set to '1': Inch measuring system, unit 10^{-4} inch. Bit set to '0': Metric measuring system, unit 10^{-3} mm. Both bits 4 and 6 will only become active after PORESET. If bit 4 and 6 are not set identically, Option B41 is required. Various machine data and units for operating and programming depend on these bit settings. The following machine data depend on bit 4 (measuring system): MD 100 ... 103 MD 180 ... 183 MD 250 ... 253 MD 110 ... 113 MD 190 ... 193 MD 270 ... 273 MD 150 ... 153 MD 210 ... 213 MD 345 MD 160 ... 163 MD 220 ... 223 MD 352 MD 170 ... 173 MD 240 ... 243 MD 385 The following display values depend on bit 4: 800 ... 803 810 ... 813 830 ... 833 840 ... 844 The following machine data depend on bit 6 (input system): MD 120 ... 123 MD 326 ... 329 MD 349 MD 130 ... 133 MD 346 MD 350 MD 200 ... 203 MD 347 MD 351 MD 317 ... 324 MD 348 MD 356 MD 371 ... 375

Bit 4	The following functions depend also on bit 6 (input system), but not on the programmed G70/G71. Actual value display All zero offsets (G54 to G57, external and G59) Constant cutting speed G96 Feedrate G94, G95 Tool offsets Increments in incremental mode.
Bit 3	Bit set to '0': The programmed speed and direction for analog spindle control is routed via the PLC. The interface control decodes the programmed BCD data of the spindle supplied by the NC and transfers it back to the NC via "external data input". This allows modification of the data by the interface control for special functions (gear change, chip breaking etc.). The NC-internal evaluation of programmed data has no effect on the spindle. Bit set to '1': The programmed spindle speed or cutting speed and M03, M04, M05 are evaluated NC-internally. Superimposition of S value and direction of rotation can be achieved via "external data input" from the interface control. The superimposed values remain effective until "RESET" or program end while the programmed data are suppressed. If the function blocks FB21 and FB22 are active in the PLC, the programmed S-values are always processed via the PLC as described above (with bit 3 = 0), even when bit 3 = 1.
Bit 2	Bit set to '0': Auxiliary function output prior to axis movement Bit set to '1': Auxiliary function output during axis movement
Bit 1,0	Auxiliary function output at block search: Bit 1 | Bit 0 0 | 0 — no output 0 | 1 — after NC start 1 | 0 — during block search The output of auxiliary functions at block search has to be specified according to machine manufacturer's stipulation

	7	6	5	4	3	2	1	0
409	NC machine data entered		Feedrate not related to contour			Diameter programming of x-axis at G90 (3T)		Tool length comp. carried out even if axis is not progr.

Bit 7	This machine data bit enables the interface to the PLC to work. The interface signals can be transferred when the bit is set. This bit must be always set to 1.
Bit 6	
Bit 5	Bit set to '1': The programmed feedrate is maintained on the path of the cutter or tool nose centre point and not at the workpiece contour in order to avoid inadmissible traverse speeds at small radii. Practical use for lathes with relatively large tool nose radius and where small radii are frequently programmed. This bit can be modified via the PLC. (With basic model 4A from C 02 on. Also pay attention to MD 427, bit 4.)
Bit 4 Bit 3	
Bit 2	Bit set to '0': Programmed travel distance for x axis in radius Bit set to '1': Programmed travel distance for x axis in diameter This bit has to be set according to the end-user's stipulation. 3T only.
Bit 1	
Bit 0	Bit set to '0': Length compensation is not carried out if axis is not programmed. Bit set to '1': The tool length compensation is carried out at selection, cancelling or changing of correction number, even if the axis is not programmed. (Refer to Programming Instructions for 3T)

	7	6	5	4	3	2	1	0
410	Data start in MDA	ZO data input	TO data absolute value input	TO data wear value input	Program correction	Dry run feedrate	Block search pointer	M, S, T, H editing

	The key switch can be made to lock certain functions dependent on customer specification. If a bit is set to 1 the corresponding function is locked by the key switch.
Bit 7	DATA start in MDA for Teach-in and Playback
Bit 6	ZO data input (Zero offsets and setting data)
Bit 5	TO data, absolute value input
Bit 4	TO data, wear value input, maximum 0.999 mm
Bit 3	Correction and deletion of part programs.
Bit 2	Dry run feedrate
Bit 1	Block search pointer input, input of part program numbers in Automatic mode.
Bit 0	Editing of auxiliary functions M, S, T, H.

	7	6	5	4	3	2	1	0
411	Device specification (input device)					Baudrate (input device)		
412	Device specification (output device)					Baudrate (output device)		

Bit 7 to 0	(Baudrate and coding for input and output devices) These machine data specify the input and output devices. MD 411 concerns the input, MD 412 concerns the output devices connected via the board 03840, connector X843. The serial interface can be operated in full duplex mode as RS232 or TTY interface. To activate the interface MD 415 Bit 0 must be set to '1'. With basic model 4B and option E60 the MD 411 and MD 412 can be set or altered from the PLC. For overall meaning of the eight bits refer to Section 2.

	7	6	5	4	3	2	1	0
413	Substitute EIA code for @ character							

Bit 7 to 0	There is no function key for the @ character in EIA code thus any other key must be chosen for substitution. The corresponding tape code (bit pattern) has to be entered.

	7	6	5	4	3	2	1	0
414	RS 232 DC control signals without parity					Common NC ready reset 3TT	Name of axis parallel to 4th axis	

Bit 7	Bit set to '0': DC control signal without parity DC1 = 11 H, DC2 = 12 H, DC3 = 13 H, DC4 = 14 H Bit set to '1': DC control signal with parity DC1 = 11 H, DC2 = 12 H, DC3 = 93 H, DC4 = 14 H Refer to Section 8, Part "RS232 interface".
Bit 6 to 3	
Bit 2	For 3TT only Bit set to '1': If an NC monitoring fault occurs in one NC the NC ready signal of the other NC is cancelled as well.
Bit 1 and 0	Only with 3M and 4th axis or 3T/TT with C-axis.

Bit 1	Bit 0	Name
0	0	X
0	1	Y
1	0	Z

	7	6	5	4	3	2	1	0
415	CRC (3M) TNC (3T)		Analog spindle control		Teach-in Play back MDA		Threading and feed/rev	

Bit 7	Bit must always be set to '1'. TNC (tool nose radius compensation with 3T) or CRC (cutter radius compensation with 3M) are included in the basic model
Bit 6	
Bit 5	Analog spindle speed (3T only) Bit has to be set to '1' for 3T
Bit 4	
Bit 3	Bit has to be set to '1' Teach-in, Playback and MDA are standard functions included in the basic model (refer to Operating Instructions)
Bit 2	
Bit 1	Bit has to be set to '1' for 3T Threading and feed per revolution are standard functions of the 3T and included in the basic model. An encoder **must** be fitted to the spindle
Bit 0	

	7	6	5	4	3	2	1	0
416	Block end with CRLF	Display x-axis pos. in diameter (3T)		a29 Read/load of system par.		NC alarm texts display	Fixed cycles	Serial interface (RS232/TTY)

Bit 7	Bit set to '0': The individual blocks are terminated with LF CR CR at program output. Bit set to '1': The individual blocks are terminated with CR LF at program output. The output of CRLF is essential with DNC control. This bit has also to be set to '1' for program output to PG 675/635 programmer. Refer also to MD 425, bit 3.
Bit 6	Bit set to '1': The actual values are displayed in diameter with 3T. MD 409, bit 2 must be set as well.
Bit 5, 3	
Bit 4	Reading and loading of system memory data: ⓐ 29 Bit 4 must be set with 3T/3TT if stock removal cycle L 94 is used.
Bit 2	Bit has to be set to '1'. Plaintext alarm displays in addition to the coded alarm numbers are included in the scope of the basic model.
Bit 1	Bit has to be set to '1'. Enables the machining cycles for drilling and milling according to Programming Instructions, Section 7. The cycle programs are delivered along with the control stored in the RAM memory (basic model).
Bit 0	Bit has to be set to '1'. Activates the serial interface to the peripheral devices (see Section 2) connected to connector X343 on PCB 03340. The serial interface is included in the basic model.

	7	6	5	4	3	2	1	0
417	Customer I/O module			Deceleratio to feed of next block	Spindle override effective at threading	Wear input in diameter (3T)	Measured Kv-factor	14 bit DAC

Bit 7

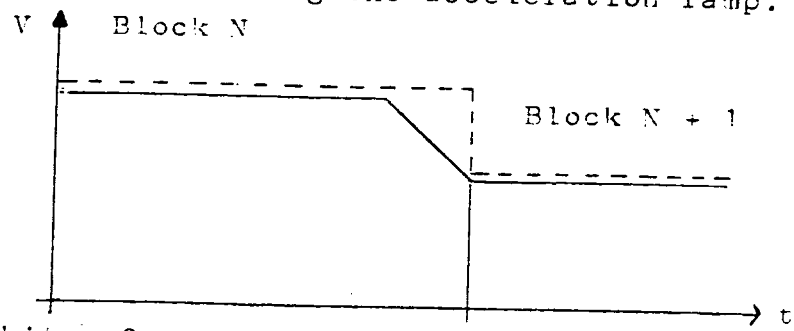
Bit has to be set if a customer I/O module (module 02401/02400) is used.

Bit 6,5

Bit 4

Bit set to '1':

In continuous - path control the speed at block end is reduced to the programmed speed of the next block using the deceleration ramp.



bit = 0 - - - - - - - - - -
bit = 1 ————————

Application for woodworking machines

Bit 3

Bit set to '1': The spindle override is also effective for blocks with G33 or G63 programming.

Bit 2

Bit set to '1': The entered wear value is halved and then stored in the tool offset memory. For the X-axis with 3T only.

Bit 1

Bit set to '0': The measured KV factor is cleared on MD modification.

Bit set to '1': The measured KV factor remains stored on MD modification. This is essential if MD are modified via the PLC.

Bit 0

Bit set to '0': The bit must not be set if measuring modules 03320-323, 03340 are fitted. 1 VELO = $\frac{10V}{2048}$

Bit set to '1': The bit must be set if measuring boards 03325, 03350 or 03326 and 03351 are fitted. 1 VELO = $\frac{10V}{8192}$

In this context, pay attention to the following MD: MD 140 - 143, MD 230 - 233 and MD 354.
With basic model 4A this bit is set automatically to '1' by the input functions 5 to 8 from C03 on.

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MD	7 6 5 4 3 2 1 0
418	Internal test bits, always to be set to 0
419	Internal display bits
420	1st axis, X with 3T, X with 3M
421	2nd axis, Z with 3T, Y with 3M
422	3rd axis, Z with 3M, C2-axis with option B68
423	4th axis, 3M only, C1-axis with option A03

For detailed description of the eight bits of MD 420 - 423 refer to next page.

420 to 423	7	6	5	4	3	2	1	0
	Rotary axis modulo 360 deg.			No measuring circuit monitor-ing	Rotary axis pos. display in 360 deg.	Rotary axis pos. display in 256 times 360 deg.	Rotary axis rounding to full degree	Rotary axis rounding to half degree

Bit 7

Available for basic model 4B ONLY.

Preconditions:

MD 403 to MD 406, bit 5 (rotary axis) must be set.

The "modulo 360 degrees" function can be activated via machine datum as an alternative to the "modulo 256 revolutions" function. This function is axis-specific.

The function can be selected simultaneously for one or several rotary axes (max. 4). The programmed sign determines the direction of rotation of the modulo-axis, also in absolute programming (G90).

The absolute value of the programmed G90-value is approached. The maximum travel distance at G90 amounts to ± 360 degrees. In case of value 0 at G90, the axis approaches position 0 in negative direction and remains stationary in position zero.

The programmed direction of rotation is resumed after Automatic mode interruption (maximum rotation 360 degrees). Cutter radius compensation or blueprint programming is restricted to one modulo range.

Programming of an absolute move (G90) greater than 360° triggers alarm 501.

Any number of revolutions can be programmed (max. 256 times 360 degrees).

Maximum one revolution is traversed after block search.

Up to maximum of 3 axes with this function can be programmed within one block.

420-423
continued

Bit 6,5	
Bit 4	The hardware monitoring can be disabled axis-specifically. Bit set to '1': The alarms 104, 114, 124, 134 are no longer activated. With basic model 4A from C02 on.
Bit 3	Bit set to '1': The actual value display of rotary axis overflows at 360 degrees to 0 degree. The actual value display of an axis in follow-up mode must be adjusted to modulo 360 degrees in conjunction with the function "actual value offset". With basic model 4A from C02 on.
Bit 2	Bit set to '1': The actual value display jumps after 256 revolutions = 256 x 360= 92160 degrees back to 0 degree. The maximum move to be programmed in one block amounts to 256 revolutions. This function allows continuously revolving rotary axes. Several axes can be declared simultaneously as continuously revolving rotary axes. With basic model from C02 on.
Bit 1 and 0	Bit1set to '1': Rounding to whole degrees. Bit0set to '1': Rounding to half degrees. Toothed rotary tables can only be lowered for engaging if positioned in half or whole degrees. The control monitors the programmed positions with respect to this grid. In the event of incorrect programming alarm 307 is displayed. In jog mode rounding to the next half or whole degrees is performed. This function does not permit incremental mode operation.

	7	6	5	4	3	2	1	0
424					Sign change of tool comp. with G43/G44			Simult. act. pos. display at 3TT

Bit 7 to 4	
Bit 3	For paraxial tool offset compensation of milling tools. G43: Tool offset compensation positive. G44: Tool offset compensation negative. With basic model 4A from C02 on.
Bit 0	Bit set to '1': 3TT only. The "actual-value" display of SINUMERIK 3TT shows the actual values of slide 1 and 2 simultaneously. To achieve an equivalent display from both NC's, the machine datum TE416, bit 6 ("Actual value display for X axis in diameter") must be set identically in both. With basic model 4A from software version C02 on.

425	7	6	5	4	3	2	1	0
	-			No text display "SIN 3"	Progr. output without suffix	Dual PLC	Without measuring boards	Without operator panel

Bit 7-5	
Bit 4	Bit set to '1': The NC screen does not display "SINUMERIK System 3" in line 14. however, occuring alarms are still displayed in line 14. With basic model 4A from C03 on.
Bit 3	Bit set to '1': The program is output without suffix (feeder holes). If the MD 416, bit 7 is set, a CRLF follows the block end. If both machine data bits are set then no further character is output after "M30" LF on program output via RS232. Explanation: Normal case: X100 LF CR CR M30 LF CR CR suffix. MD425, bit 3 set: X100 LF CR CR M30 LF CR CR MD416, bit 7 set: X100 CR LF M30 CR LF suffix Both MD -bits set: X100 CR LF M30 CR LF With basic model 4A from C05 on.
Bit 2	This bit must be set to "1" if a dual PLC is connected. Thus the mutual NC - PLC - monitoring is activated. With basic model 4A from C03 on.

Bit 1	Bit set to '1': The control can be operated without measuring modules. The control functions remain available in their entirety. Even reference point approach with actual value setting is possible if the PLC simulates the deceleration cam . The bit can be set on switch-on by: Input 3 (3T) Input 4 (3M) With basic model 4A from C05 on. Attention: Erroneous setting of the bit causes the control to stop. Application: Training units without plotter but with graphics. This bit can also be used for troubleshooting in the event of NC-stop to check whether the measuring modules are causing the stop.
Bit 0	If the bit is set the control can be run without operator panel. Application sequence: - Set bit to '1' - Set "operator panel inhibit" interface signal (Output 64.6) to '1' - Now the cable to the operator panel can be removed or the power supply for the operator panel can be switched off. For re-installing the operator panel follow the sequence in reverse order. The bit can remain set to '1'. With basic model 4A from D02 on.

	7	6	5	4	3	2	1	0
426	-	Following error comp.	No output of M17					

Bit 7	
Bit 6	If the bit is set to '1' and the PLC activates the corresponding interface signal (output Q 65.0 for NC1) then a following error of approximately 0 develops when traversing in closed-loop position control. With MD430 to MD433, bit 0 to 5 a gain factor for the differential part and a ramp time constant can be adjusted. Activation of the following error compensation for special applications only. For description refer to Section 6. If MD 428, bit 7 is set, activation of following error compensation is not possible. Following error compensation is only available with basic model 4B.
Bit 5	Bit set to '1': M17 (end of subroutine) is not output if the block does not contain any further information and when cycle lock is active. This speeds up processing of cycles and subroutines. With basic model 4B only.
Bit 4-0	

	7	6	5	4	3	2	1	0
427	Diameter progr. not effective (3M Trainer)			Contour feedrate only at inner circles				

Bit 7	Bit set to '1': The MD 409 bit 2 is set to '1' for 3T with input 1 and to '0' for 3M with input 2. Only with basic model 4B from D03 on. Application: In training units using System 3 and for 3T with C-axis.
Bit 6,5	
Bit 4	Bit set to '1': The programmed feed rate is related to contour along inner circles only. MD409, bit 5 must not be set to '1'. Only with basic model 4B from D02 on.
Bit 3-0	

	7	6	5	4	3	2	1	0
428	Reduced servo sample time			No max. gear speed monitoring	Exact stop at G64/G00 change-over	Read. R par. out of display store	M19 with cutoff spindle speed	Tool track offsets effective

Bit 7	Refer to page 7-82b
Bit 6,5	Always 0
Bit 4	Refer to page 7-82c
Bit 3	Refer to page 7-82d
Bit 2	Refer to page 7-82e
Bit 1	From software version D03 on, it is possible to carry out the positioning at M19 always at spindle cutoff speed, irrespective of the present speed or any previously programmed speed. This extended function is selected via machine datum 428 bit 1. If MD 428, bit 1 is set, the spindle is always positioned at cut-off speed. The spindle is accelerated if the speed at activation of M19 is lower than the cutoff speed (MD378).
Bit 0	Up to now, the tool track offsets were compensated in G39 mode only. From software version D03 on, the tool tracks can be utilised if MD 428, bit 0 is set. The value of the tool tracks (MD 317 - 324) is compensated for the X-axis like an additional zero offset. Programming of G53 de-selects these offsets. Interface signals select the active tool track. Attention: If MD 428, bit 0 is set, the selected tool track is always compensated. In order to de-enable the function a track with value 0 must be selected e. g. in a program not using the tool tracks.

428 continued

Bit 7	Dependent upon MD 428, bit 7 the sample time for closed-loop control with SINUMERIK System 3, basic model 4B/8 MHz is reduced to 5.25 ms (3M) or 4.5 ms (3T). Simultaneously the interpolation sample time is increased to 21 ms or 18 ms. Following error compensation is then no longer possible. After setting or resetting MD 428, bit 7, a power-on reset must be performed. If there are two different NC types within the same rack (e. g. 3M and 3T), the sample time for the 3T must be increased on commissioning (MD383 set to 6) to achieve identical sample times for both types of control. This function works only with the 8 MHz version. Only with basic model 4B from D06 on.

428 continued

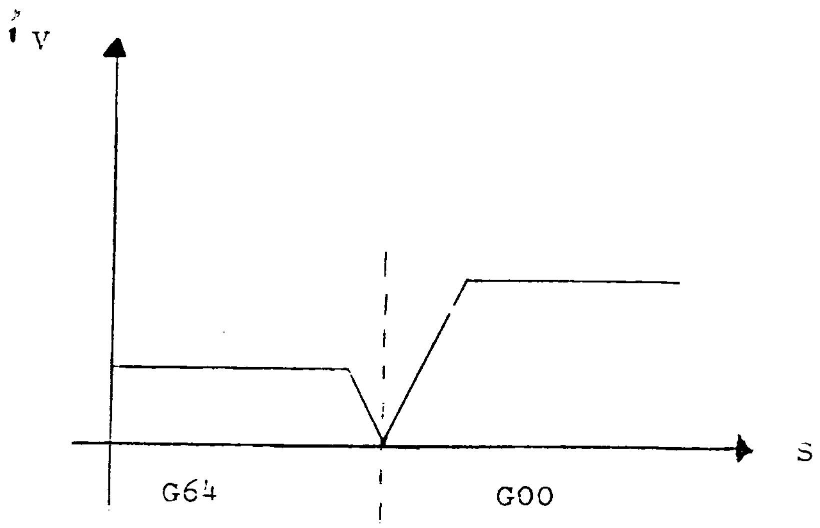
Bit 4	If the bit is set, the monitoring of the maximum gear stage no longer functions. Thus it is possible to change from a higher speed to a lower speed without stopping the spindle. The tolerance value in MD 368 for the maximum spindle speed applies only to the value in MD 370 and with G96 to the limitation by G92 S. Only with basic model 4B from D06 on.

428
continued

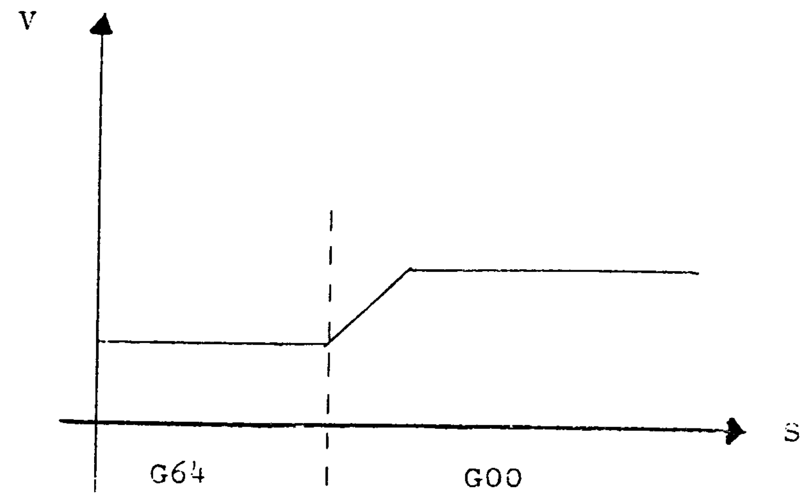
Bit 3	If the bit is set, an exact stop 2 is initiated automatically on transition from a block with G64 to the next block with G00.

Only with basic model 4B from D06 on.
Up to software version D06 a G09 must be programmed in order to initiate an exact stop on block change.

Bit is set to '1':



Bit is set to '0' or with software version D01-D06, C01-C03.



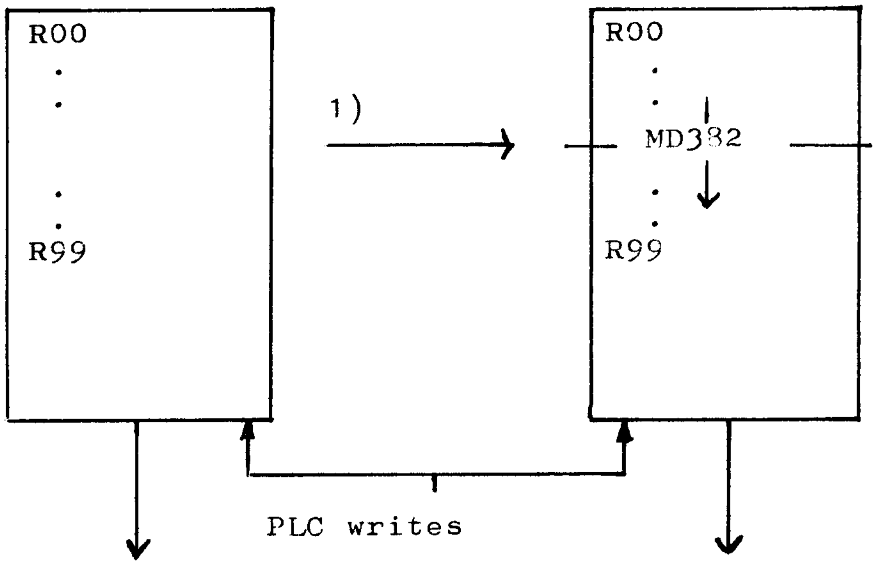
428
continued

Bit 2

R parameter memory.

Internal working memory: Display memory:

IWM DM



PLC reads
with software version:
D02 with basic model 4B
C08 with basic model 4A

from software version on:
D03 with basic model 4B
C09 with basic model 4A
if MD 428, bit 2 is set
to '1'

PLC reads
up to software version:
D01 with basic model 4B
C07 with basic model 4A

from software version on:
D03 with basic model 4B
C09 with basic model 4A
if MD 428, bit 2 is set
to '0'

1) The modified R parameters are transferred into the working memory and upto the limit for R parameter display (machine datum 382) into the display memory during program processing with activated "cycle inhibit".

430	1^{st} axis, X with 3T, X with 3M
431	2^{nd} axis, Z with 3T, Y with 3M
432	3^{rd} axis, Z with 3M, C2-axis with option B68
433	4^{th} axis, 3M only, C1-axis with option A03

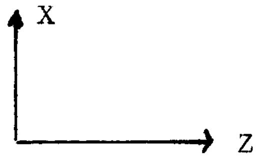
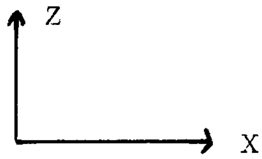
	7	6	5	4	3	2	1	0
430-433		P.e. comp. In 0.5 µ	Time constant for command value at following error compensation			Gain factor of the diff. part at following error compensation		

Bit 7	Always zero
Bit 6	Bit set to '1': The unit in MD 250 to MD 253 is modified from 1 µm to 0.5 µm for pitch error compensation (p.e.c.) In inch system from 0.0001 inch to 0.00005 inch. Only with basic model 4B from D02 on.
Bit 5-3	Time constant for following error compensation. Refer also to MD 426, bit 6.
Bit 2-0	Differential gain factor for following error compensation. Refer also to MD 426, bit 6.

	7	6	5	4	3	2	1	0
440	-			Graphical simu. with aux. function output				Coordinate system for vertical lathe

Bit 7, 6, 5	
Bit 4	Bit set to '1': During graphical simulation the following signals are additionally output via the NC-PLC interface in accordance with the program: Programmed halt M00 Threading Rapid traverse Program running G96 selected Auxiliary functions (M, S, T, H) along with the change signals No motion commands are output. Only with option J02 or J03.
Bit 3-1	
Bit 0	(see below)

Bit 0

Bit set to	0	1
Representation of the cycle displays for graphics		

Only with basic model 4B and D01, D02.

	7	6 5 4	3	2 1 0
442		Colour for the display area 2		Colour for the display area 1
443		" 4		" 3
444		" 6		" 5
445		" 8		" 7

Bit 7, 3	Irrelevant
Bit 6-4 and Bit 2-0	Individual determination of colours is possible by modifying these machine data within the framework of specified display formats of the control. Only with option J03. For the colour code table, refer to Section 2. With basic model 4A from software version C03 on. The colour areas are given in the following table:

Line		
01	Colour area 1	Colour area 2
02		
03		
04	Colour area 3	
05		
06		
07	dependent upon type of display	
08		
09		
10		
11	Colour area 4	
12		
13		
14	Colour area 5	
15	Colour area 6	
16	Colour area 7	Colour area 8

Defaults: Area 1 white, 2 red, 3 light/blue; area 4 yellow, 5 red, 6 yellow; area 7 yellow, 8 light/blue

	7	6	5	4	3	2 1 0
446						Type of representation X Y plane
447						Type of representation Z X plane
448						Type of representation Y Z plane

Bit 7-3	
Bit 2-0	The axis assignment of the simulation planes can be adapted to the real machine with the bits 0 to 2. For the table refer to Section 2. The displays for parameter entry in graphics are invariable. Applicable for options J02, J03 only. Only with basic model 4B from D02 on.

500 to 755	Compensation bits for pitch error compensation. Applicable for option H56. With basic model 4A from C03 on.

7.3 PLC-machine data bits:

For detailed description refer to Interface Description. The PLC-MD can be stored in the following areas:

- Stored in DB9 of the PLC user program: DB9 must be at least of the following length:

1 NCs	2 NCs	3 NCs	4 NCs	
35	69	103	137	DW

- PLC-MD stored in the NC: In this case the DB9 must not exist. This is possible from basic program version 08 on for single PLCs or from 02 on for dual PLCs. These PLC-MD are modified like the NC-MD by input or cancel functions, i. e. all PLC-MD are preset to 0. They also can be read-in or output like the NC-MD via the RS232 interface.

- No DB9 exists and no PLC-MD are stored in the NC: In this case the basic PLC program assumes setting of the following PLC-MD to 1 in the link RAM:

  Menu for status program.

  Machine control panel (MCP) from input image.

  Standard S data transfer.

  Standard M data decoding.

  The PLC-MD are defined according to the PLC user program!

  In the case of a dual PLC, DB9 with one data w rd (DW0) only must be available in PLC II.
  The PLC-MD for PLC I can be stored in DB9 of PLC I or in the NC.

DB9 DLO NC1 only MD 452	7	6	5	4	3	2	1	0
		Reset-key at key inhib. not active	T strobe acknowledge by user	M19 strobe expanded	M/S/T/H strobe expanded	Collective alarm PCB S5-432	Time alarms 10 s	2 s

General PLC-MD for all NCs

Bit 7	
Bit 6	Bit set to '1': The reset key on the operator panel is locked by the interface signal "key lock" (e. g. output Q 64.5 for NC1).
Bit 5	Bit set to '1': The basic PLC program does not acknowledge the T-change signal output from the NC. The user has to acknowledge.
Bit 4	Bit set to '1': The M-change signal is acknowledged by the basic PLC program 2 PLC-cycles after M19 has been output. The bit has to be set to '1' if the spindle starts positioning from standstill in order to allow the user program to enable the spindle in time.
Bit 3	Bit set to '1': The basic PLC program acknowledges the change signals after 2 PLC cycles.
Bit 2	Bit has to be set to '1' if the GE S5-432-3 module with group alarm signal is fitted.
Bit 1,0	Specification of the time grids for time-alarm processing.

DB9 DR0 NC1 only MD 453	7	6	5	4	3	2	1	0
	Time alarms					ELG service package	No. of NCs	
	1s	200 ms	100 ms	20 ms	10 ms			1

General PLC-MD for all NCs

Bit 7-3	Specification of the time grids for time-alarm processing.
Bit 2	Application in conjunction with the functionblock package for commissioning of the electronic gear only.
Bit 1,0	see below

Bit 1	Bit 0		
0	0	1 NC	With more than one
0	1	2 NCs	NC, DB9 must exist or the
1	0	3 NCs	PLC-MD must be stored in
1	1	4 NCs	the NC

DB9 DL1 NC1 only MD 454	7	6	5	4	3	2	1	0
	Number of data block for menu display (binary coded)							

General PLC-MD for all NCs

Bit 7-0	If the contents are 0, the menu from DB39 is displayed.
	If the contents are not 0: The contents of this byte are interpreted as the binary-coded DB number. The contents of this DB are shown as menu display initiated by the PLC key or flag F 0.1.

	7	6	5	4	3	2	1	0
DB9 DR1 NC1 only MD 455		Exter-nal dual PLC	PLC key via flag Fo.1	Key assign-ment 3G	Menu for status progr.	2nd I/O customer module	M.C.P. via I/O module gray coded 5 bits	M.C.P. via I/O module 1 : 1 4 bits

General PLC-MD for all NCs

Bit 7	
Bit 6	Bit must be set to '1' if an external dual PLC (option N41) is fitted. From basic PLC program version 02 for dual PLC on.
Bit 5	Bit set to '1': The PLC key on the operator panel can be simulated by any other key or input. From basic PLC program version 08 for single PLC or version 02 for dual PLC on.
Bit 4	Application for 3G (grinding)
Bit 3	Bit set to '1': Status display can be initiated with key 0 after menu selection. This bit is set to '1' by the basic PLC program if no DB9 exists or if the PLC-MD are stored in the NC.
Bit 2	The bit has to be set to '1' if two customer I/O modules are fitted.
Bit 1	The bit may only be set to '1' in conjunction with a special machine control panel with 5-track switches and customer I/O module (Pay attention to bit 0).
Bit 0	The bit has to be set to '1' if the standard machine control panel is connected via a customer I/O module. The PLC user program must contain FB8 and the NC-MD 416, bit 7 has to be set to '1' in the NC.

7	6	5	4	3	2	1	0
PLC-MD entered							

	NC 1	NC 2	NC 3	NC 4
MD	456	456	456	456
DB9	DL 2	DL 36	DL 70	DL 104

Bit 7	Bit set to '1': The PLC-MD are transferred into the link RAM during the start-up routine after NC-ON. The bit must not be set to 1 if DB9 is present. From basic PLC program version 08 with single PLC or version 02 with dual PLC on. If the bit is set to 1 and the remaining PLC-MD to 0, a PLC fault is indicated. Normal operation can then only be resumed by clearing all MD by the appropriate input function. This bit applies only for PLC-MD input via the NC.
Bit 6-0	

7	6	5	4	3	2	1	0
	Static M decoding	**M.C.P. via flags**	**M.C.P. via input image**			**Standard S transfer**	**Standard M decoding**

	NC 1	NC 2	NC 3	NC 4
MD	457	457	457	457
DB9	DR 2	DR 36	DR 70	DR 104

Bit 7	
Bit 6	Bit set to '1': The M-signals remain set in the allocated flag area after decoding and have to be cleared by the user program. Bit 0 has to be set to 1 as well.
Bit 5	Bit set to '1': The machine control panel signals are transferred to the link RAM from the corresponding flag area. The user program has to transfer the corresponding signals into the flag area. e.g. Flag byte FB 1 ...3 for NC 1 Flag byte FB 23 ...25 for NC 2.
Bit 4	Bit set to '1': The machine control panel signals are transferred into the link RAM from input byte 48 onwards. This bit is preset to 1 if no DB9 exists or if the PLC-MD are **not stored** in the NC. Attention: If both bit 4 and 5 are set to 0, a PLC fault is indicated.
Bit 3,2	Always to be set to '0'
Bit 1	Bit set to '1': The S-value of an NC is transferred back to the same NC. This bit is preset to 1 if no DB9 exists or if the PLC-MD are not stored in the NC.
Bit 0	Bit set to '1': The M-signals are decoded and the corresponding flags set. Dependent upon bit 6, the flag is set for one PLC cycle only or remains set. This bit is preset to 1 if no DB9 exists or if the PLC-MD are **not stored** in the NC.

	NC 1	NC 2	NC 3	NC 4
MD	458 - 463	458 - 463	458 - 463	458 - 463
DB 9	DL3-DR5	DL37-DR39	DL71-DR73	D1105-DR107

Bit 7-0	In conjunction with the electronic gear, bit 0 of DW3/DW37/DW71/DW105 is used. The computer coupling uses the PLC-MD of DW4/D5 etc. For application refer to Interface Description Part 2.

	NC 1	NC 2	NC 3	NC 4
MD	464 - 479	464 - 479	464 - 479	464 - 479
DB 9	DW6-DW13	DW40-DW47	DW74-DW81	DW108-DW115

Bit 7-0	This area can be used by the machine manufacturer for machine-specific MD.

	NC 1	NC 2	NC 3	NC 4
MD	280 - 291	280 - 291	280 - 291	280 - 291
DB 9	DW14-DW25	DW48-DW59	DW82-DW93	DW116-DW127

Occupied by standard FBs. Enter 0
in the NC or in DB 9.

	NC 1	NC 2	NC 3	NC 4
MD	292 - 301	292 - 301	292 - 301	292 - 301
DB 9	DW26-DW35	DW60-DW69	DW94-DW103	DW128-DW137

This area can be used by the machine manufacturer to specify MD for the machine.

Chapter 8

-Interface-

Contents

8.1 PLC status display

The control provides built-in diagnostic aids in order to check the status of all input- and output-signals exchanged between the PLC and the machine, and to display on screen the PLC-internal flags, timers, counters and data for service purposes.

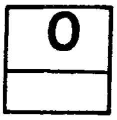
Input- and output signals, flags and data can be entered via the NC operator panel.

The function blocks for the status program are contained in the PLC basic interface program (from version 03 on).

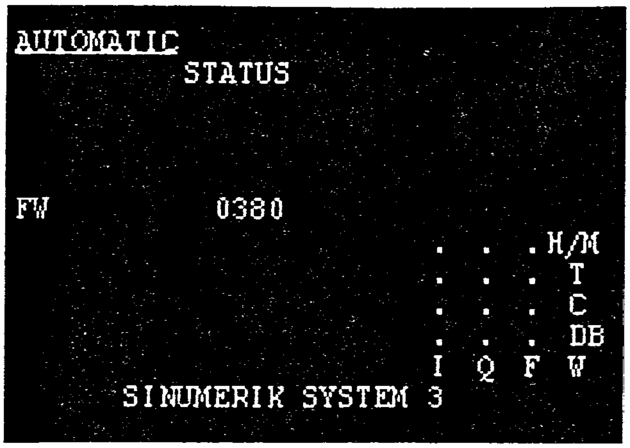
On selection of the menu display, further user texts, stored in data block DB 39, may appear beside the status line.
For a detailed description of the status display, refer to the Operating Instructions.

8.1.1 Selection of PLC status display

Menu selection by switchover to customer display



The status display is selected by entering the digit 0.



The contents of the word are shown in hexadecimal

After PLC status display selection, the key labelling of the NC address keys, changed for the status display, is shown in the bottom right hand corner of the screen.

I = Input signals	T = Timers	DB = Data block
Q = Output signals	C = Counters	H/M = Changeover hexa to binary bit pattern
F = Flags	W = Word	

Keys:   decrementing

 incrementing

8.1.2 Example for reading of individual input- and output signals and flags

[I] [0] [.] [4]

Selection of the input I 0.4
Selection range 0.0 to 127.7 for I
Selection range 0.0 to 127.7 for Q
Selection range 0.0 to 255.7 for F

Reading of input signal-, output signal- and flag words:

[F] [W] [3]

Selection of flag word FW 3
Selection range 0 to 254 for F
Selection range 0 to 126 for I
Selection range 0 to 126 for Q

Reading of timers and counters:

[T] [1] [0]

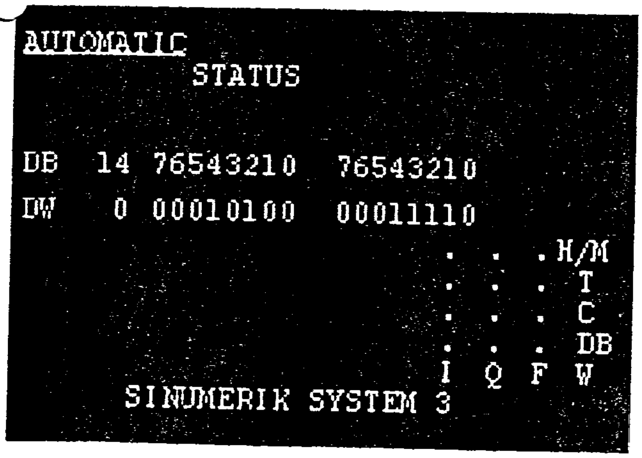
Selection of timer T 10
Selection range 0 to 127 for T
Selection range 0 to 127 for C

Reading of data words:

[DB] [1] [4] [W] [0]

Selection of data block DB 14, data word DW0

Selection range DB 1 to 255, DW0 to 255



The contents of the word are displayed as bit pattern.

8.1.3 Examples for writing of individual input- and output signals and flags

[Q] [1] [0] [0] [.] [0] — Selection of the output Q 100.0

[0] or [1] — Setting of the output to 0 or 1

Selection ranges as with reading

The input- and output signals and the flags written are set to 0 or 1 for one cycle time. The user program can alter the input- or output signal or the flag again during the consecutive cycle.

Writing of input signal- and output signal - and flag words.

[I] [W] [1] [2] [3] — Selection of input word IW 123

Selection ranges as with reading

[1] [5] [9] [8]

For hexadecimal entry use the keys .0 to .5 for A to F.

.0 = A	.2 = C	.4 = E
.1 = B	.3 = D	.5 = F

Writing of data words

[DB] [7] [2] [W] [1]

[H/M] — Changeover from bit pattern to hexadecimal display and vice versa

[2] [3] [2] [.] [0]

8.2 Interface diagnostics for signals exchanged between NC and PLC

The built-in interface diagnostics offer the possibility of displaying the input- and output signal status of the interface. No entry is possible.

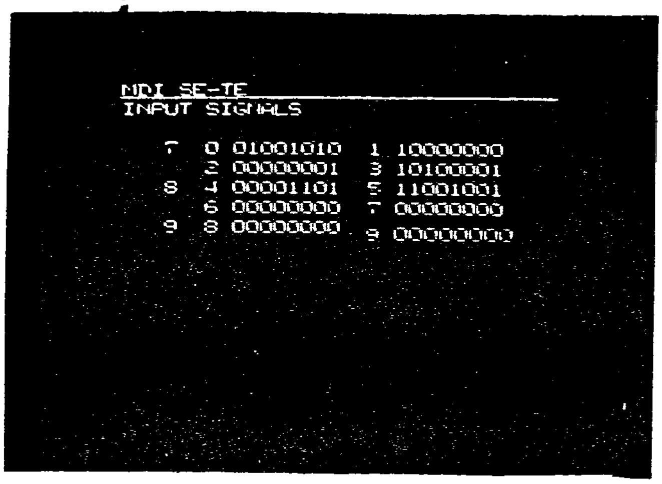
For significance of the signals, refer to Section 2.

Select test mode

Select input and output signals with page keys

↓ or ↑

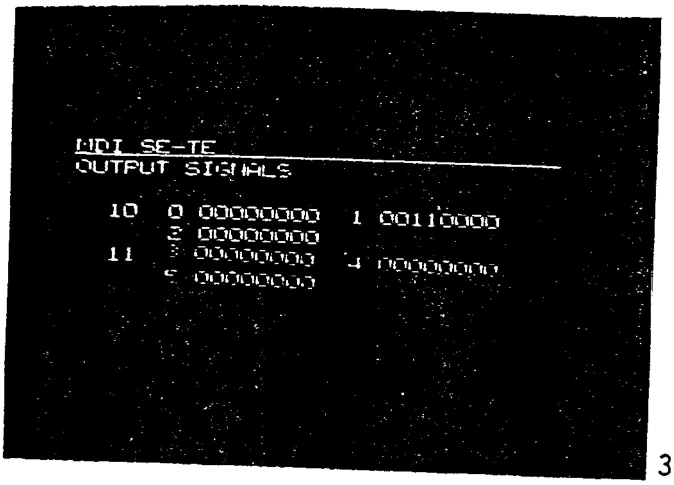
Input signals from PLC to NC:



36

10 bytes of input signals to the NC are displayed.

Output signals from NC to PLC:



36

6 bytes of output signals of the NC are displayed.

8.3 Measuring circuit actual value input

8.3.1 Modules and connectors:

The NC receives the actual value via a 15-pin-connector

PCB	Connector
03 310 A	X 312, X 313
03 310 B	X 314, X 315
03 320	X 324
03 315/03 316	X 317, X 318, X 319, X 320
03 325/03 326	X 329
03 350/03 351	X 353, X 354, X 355.

Incremental rotary position encoders (e. g. ROD 426) for linear and rotary axes and incremental linear scales with external pulse shaping electronics EXE for linear axes (e. g. linear scale LS 703 and EXE 603) can be connected. Both measuring devices provide the same input signals to the measuring circuit modules. The modules 03 315/316 or 03 325/326 or 03 350/351 can also be delivered with integrated EXE. In this case, the signals from the measuring head are directly connected to the measuring circuit module and converted into TTL signals on the module.

(Refer to Section 8.3)

For correspondence of lead screw pitch and machine data refer to Section 7.4.

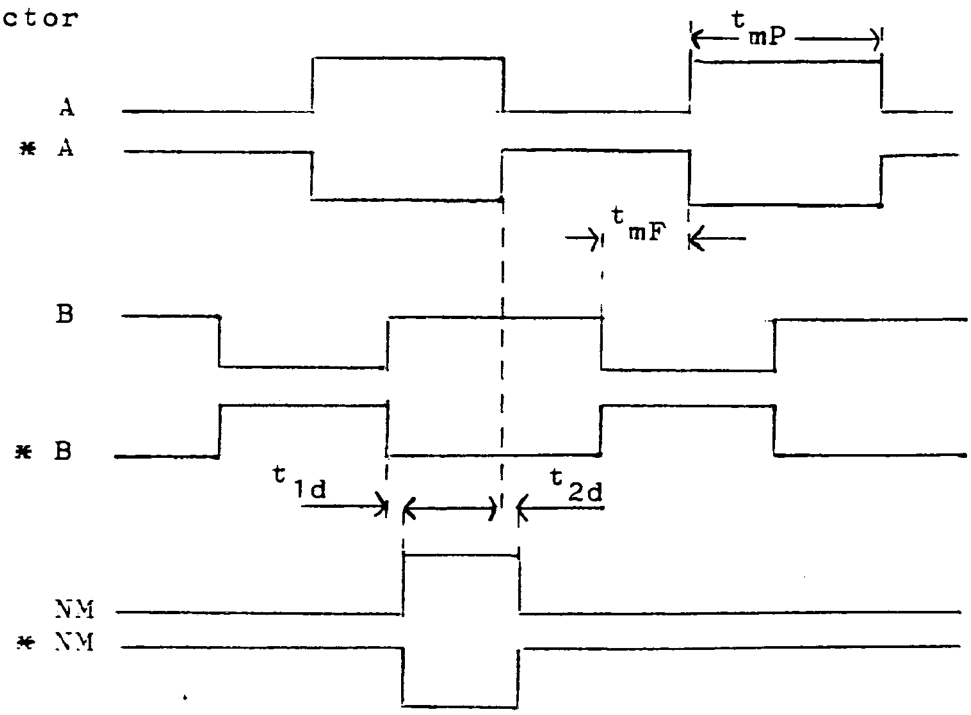
8.3.2 Input signals and characteristic values for the differential input

Pin on connector

1 track A
2 * A

4 track B
* B

9 zeromark NM
10 * NM



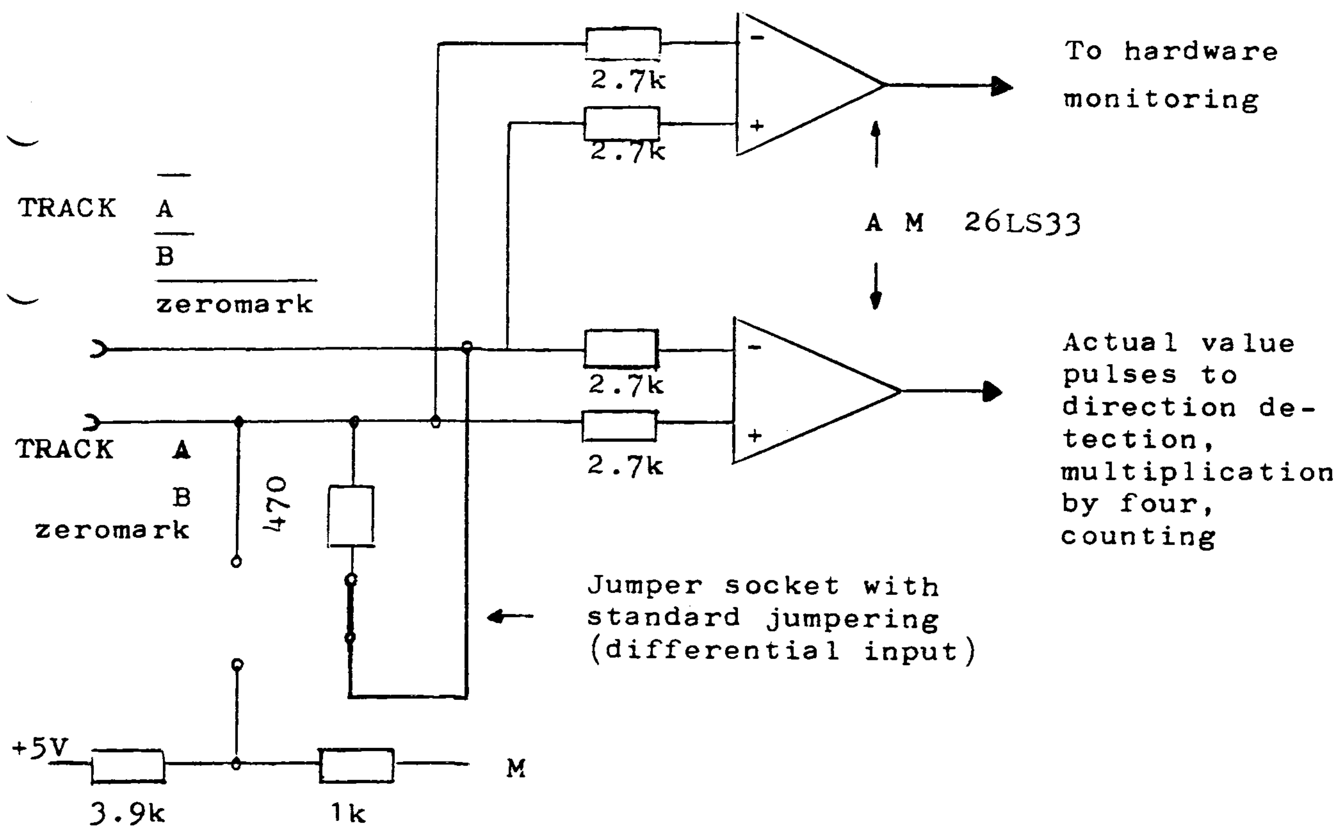
Some important characteristic values:

Measuring device supply voltage	5 V + 5 %
Current consumption per measuring unit	≤ 300 mA
Ohmic input resistance	470 Ohm
Differential input voltage e. g. between A and $\bar{A}$	≥ 1 V
Maximum differential input voltage	10 V
Maximum input frequency at 90° electrical phase shift between A and B pulses	500 kHz
Minimum pulse width tmp	1 µs
Minimum distance between two consecutive edges tmF	500 ns
t 1d and t 2d	≤ 200 ns

8.3.3 Schematic diagram for a differential input of module 03 310, 03 320:

Connector

X 312
X 313
X 314
X 315
X 316



8.3.4 Schematic diagram for a differential input of the module 03 315/316, 03 325/326, 03 350/351:

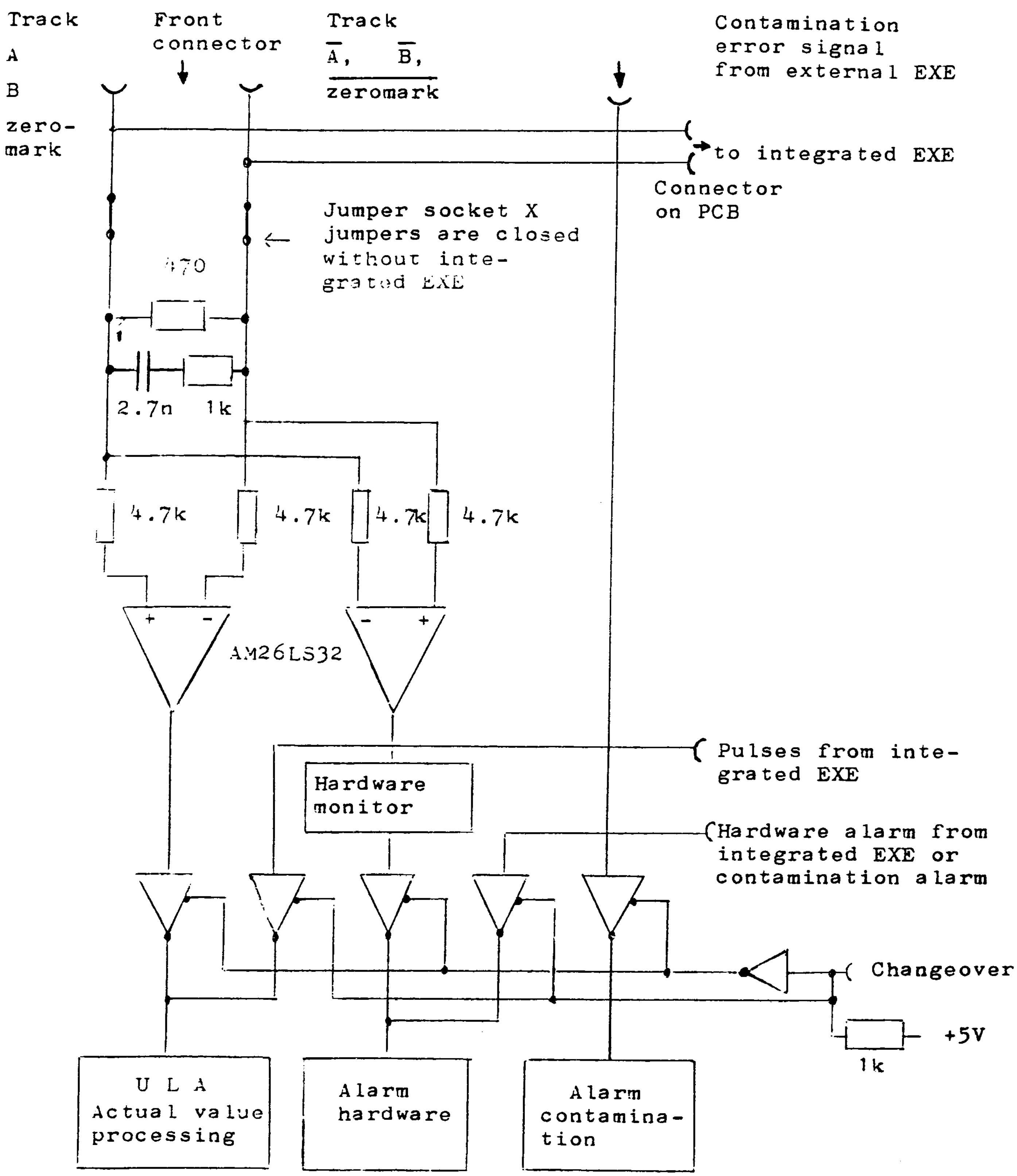
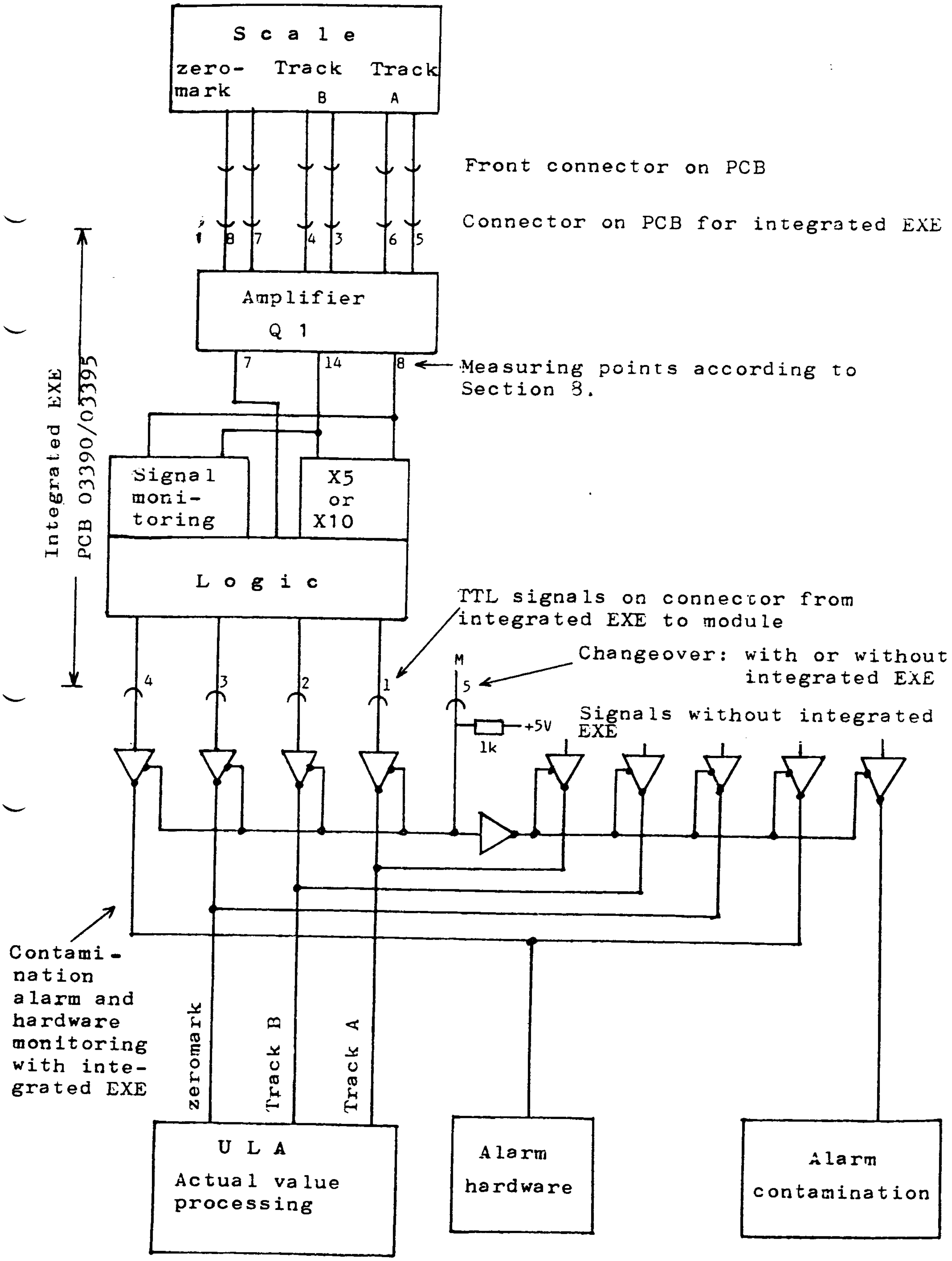


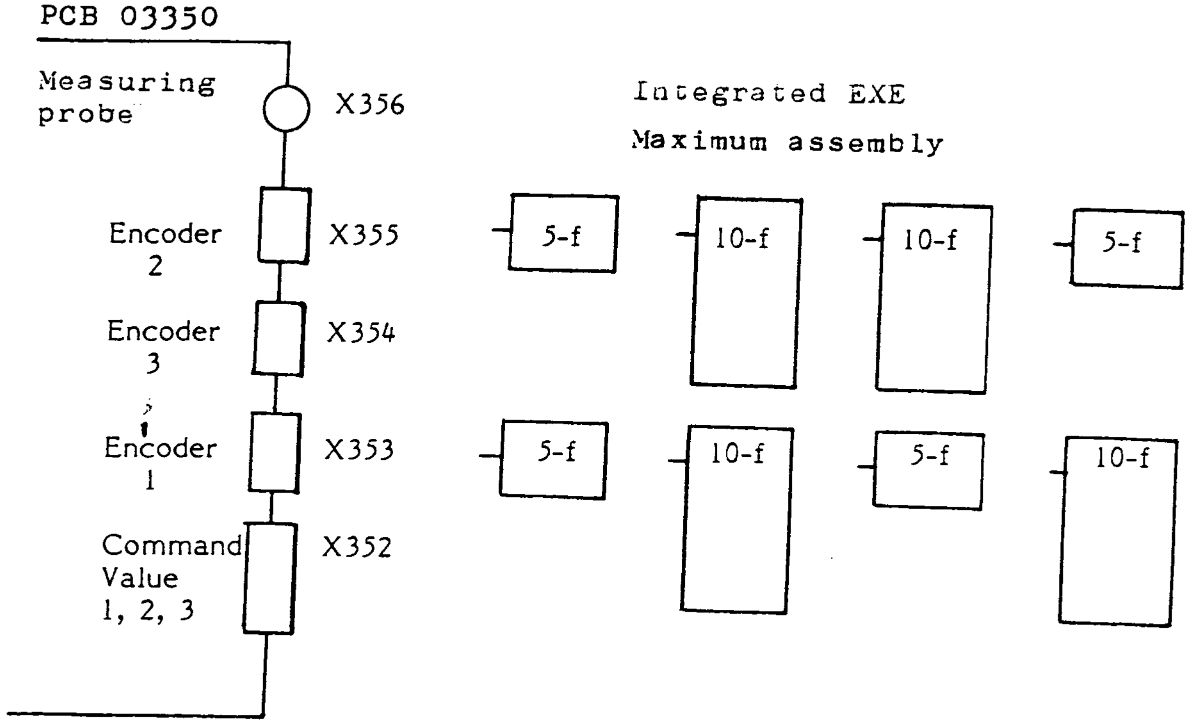
Diagram shows one track and the monitoring on module 03 325 without integrated EXE.

8.3.5 <u>Schematic diagram for actual value input for module 03 315/316 or 03 350/351 with integrated EXE</u>

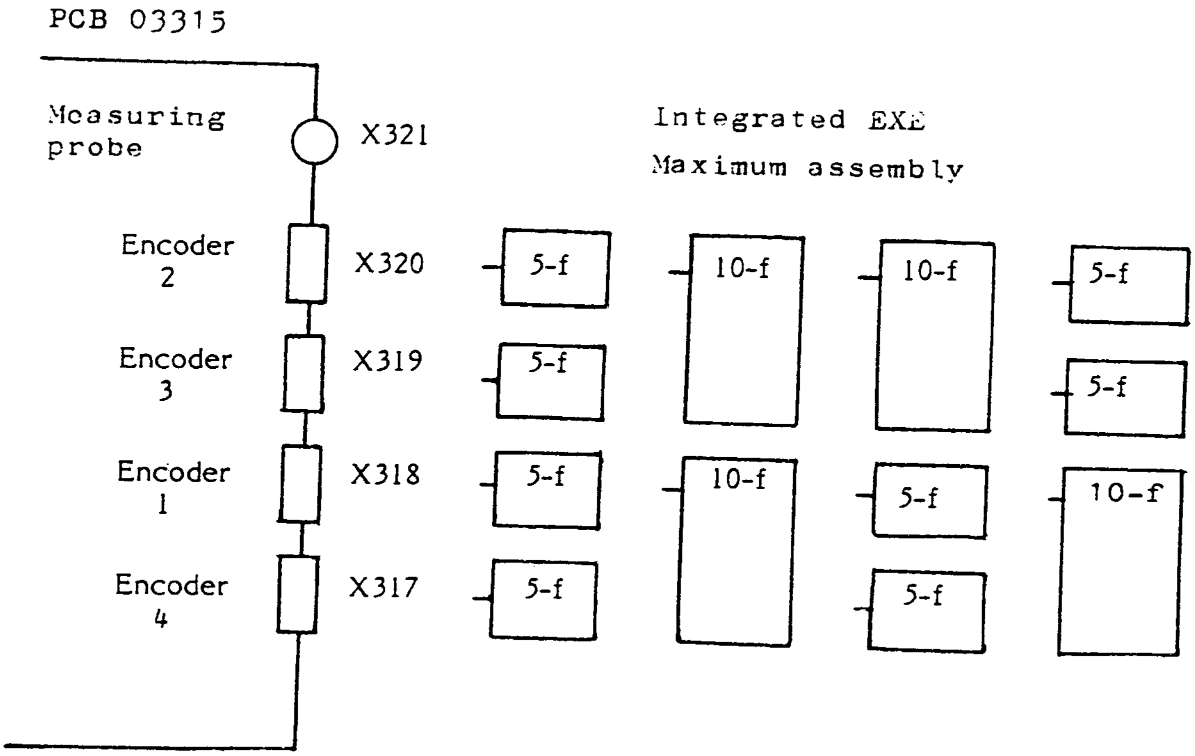


8.3.6 Possible assemblies with integrated EXE:

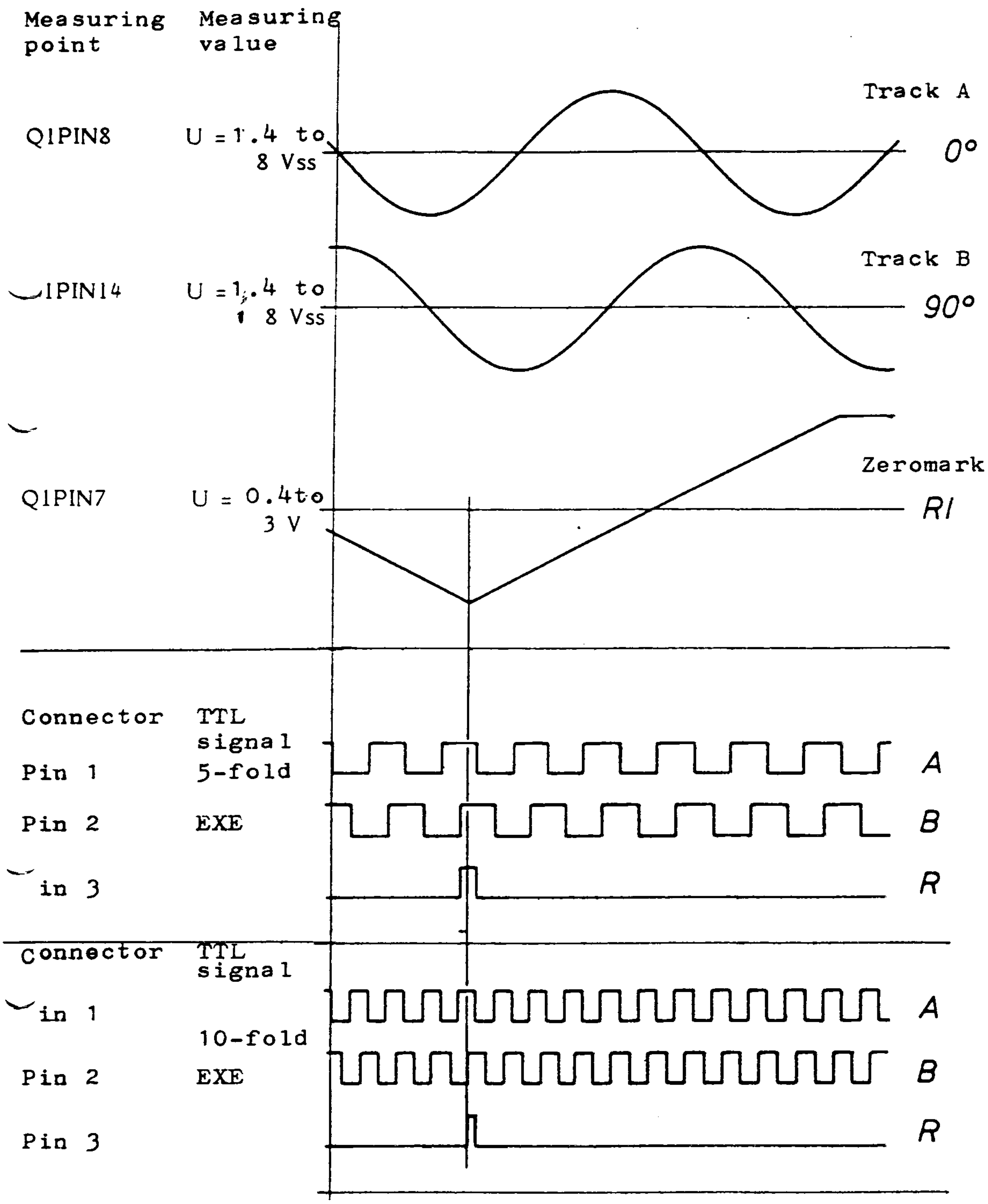
S I N U M E R I K 3T, 3TT



SINUMERIK 3M, 3T with C-axis, 3TT with C-axis



8.3.7 Input signals with integrated EXE



Further values:

Measuring of the Q1 signals with respect to measuring point U•, earth-free.
Phase angle 90° ± 12° with 0° /90° phase shift
Threshold for fault monitoring U = (0.7 ± 0.5) V_{ss} on output of amplifier Q1
Signal level for EXE input, track A and B approx. 11 µA,
zeromark approx. 3.5 µA

For characteristic values of the integrated EXE refer to Interface Description Part 2, Section 10.

8.4 Measuring circuit command value output

8.4.1 Modules and characteristic values

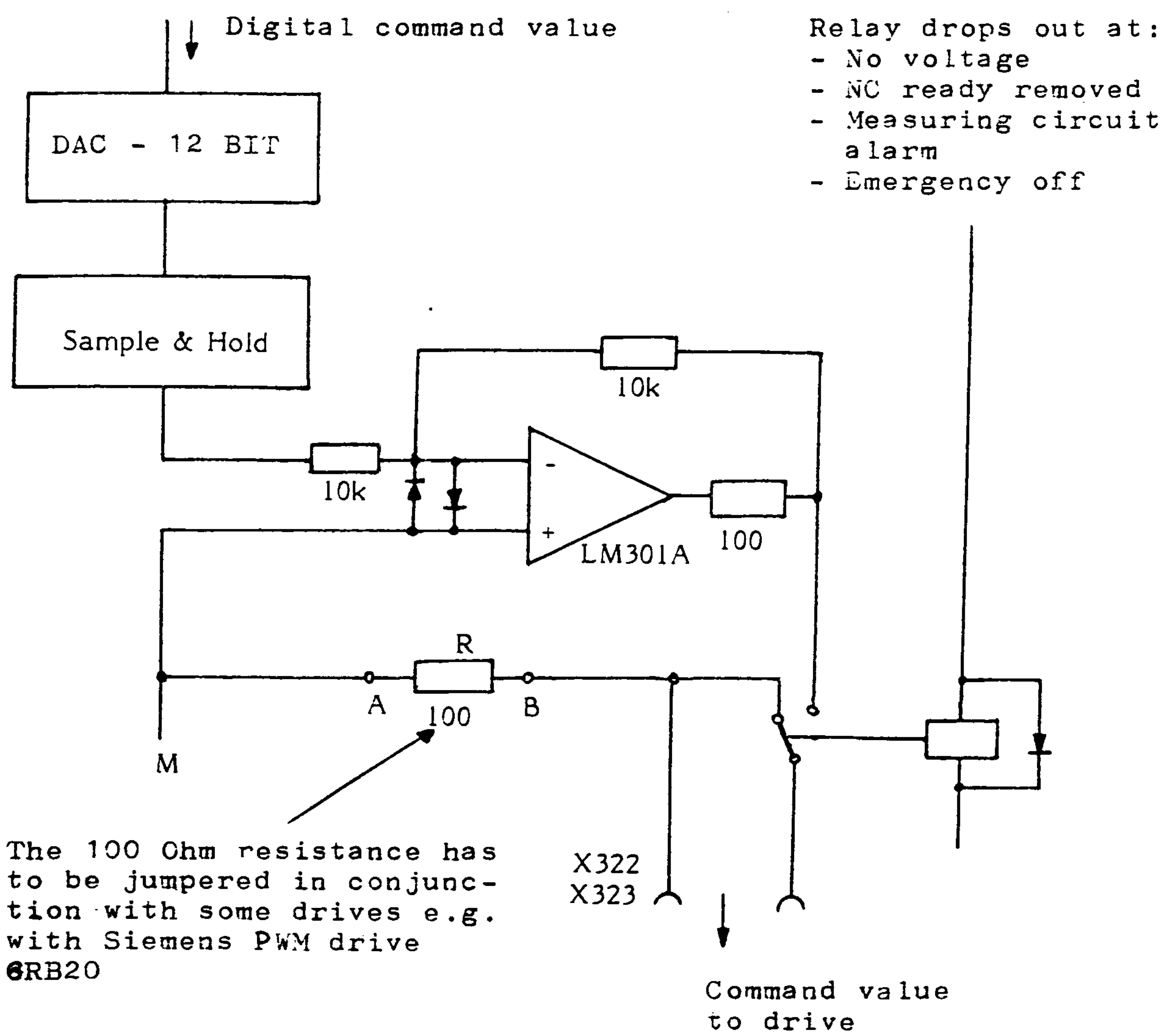
Module	Connector
03320	X322, X323
03325/326	X327, X328
03350/351	X352

Characteristic values:

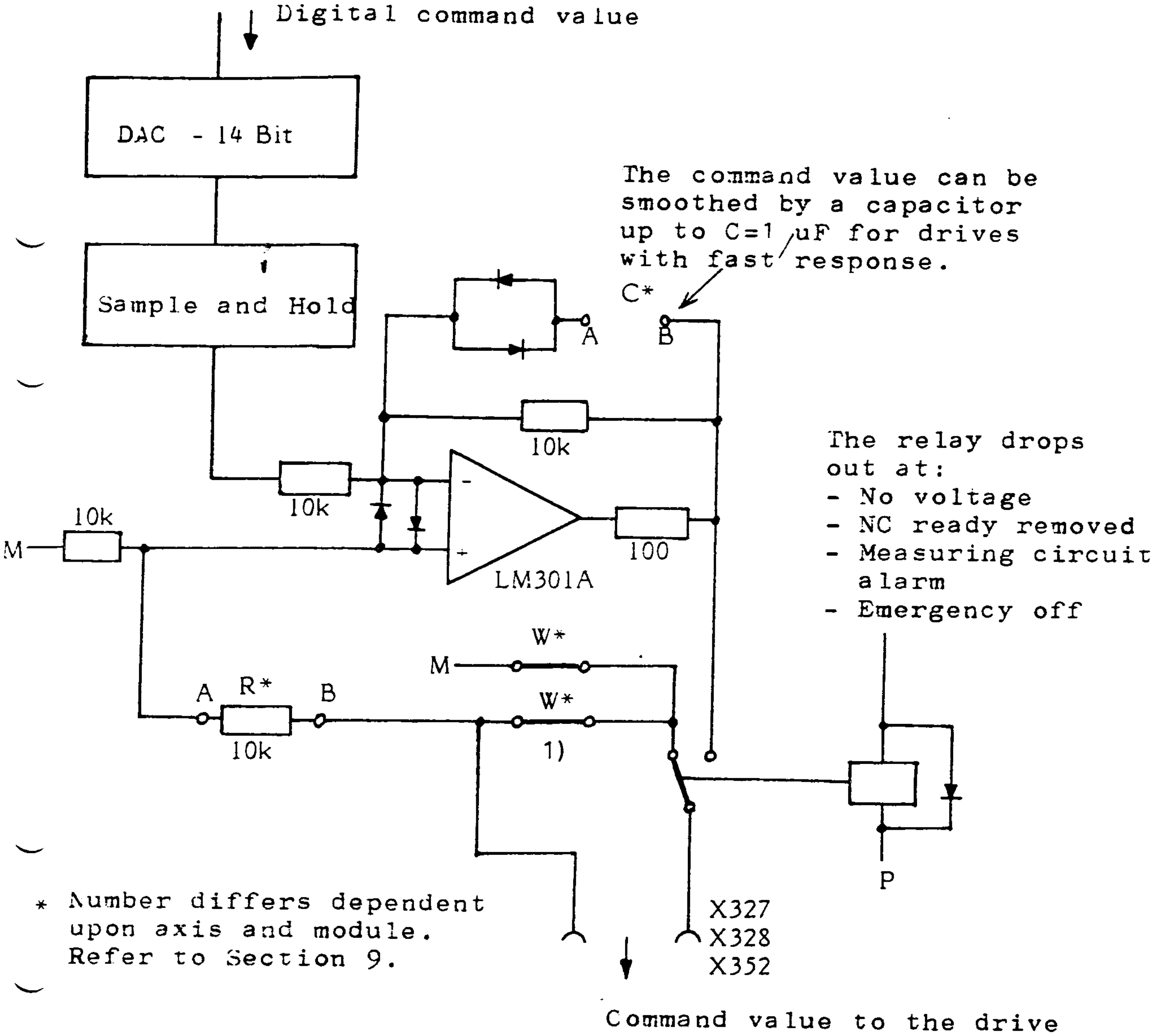
Command value voltage maximum $\pm$ 10 V

Current output 2 mA

8.4.2 Schematic diagram for command value output Module 03320



8.4.3 <u>Schematic diagram for command value output Modules 03325/326, 03350/351</u>



* Number differs dependent upon axis and module. Refer to Section 9.

Jumpers W* and R* can be altered if needed. The schematic diagram shows the standard jumpering (as delivered). The jumpers W* were not inserted in the first modules delivered.

<u>Attention:</u> The jumpers W* are not connected to solder pins and can easily be confused with the solder pins A and B of C*.

1) This jumper does not exist in modules 03326/03351.

8.5 Measuring circuit - Measuring probe input

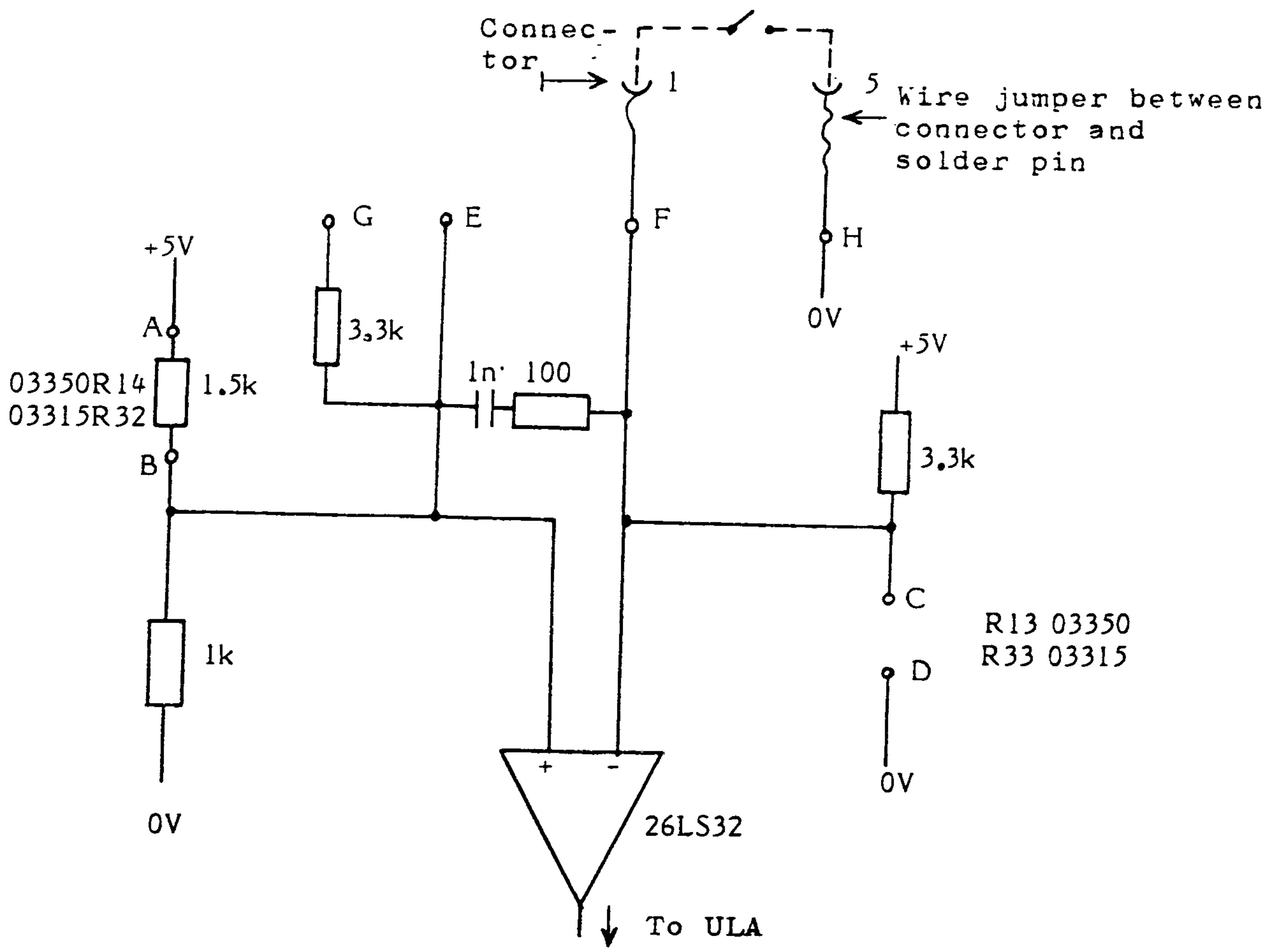
8.5.1 Modules:

PCB	Connector
03315/316	X321
03350/351	X356

The measuring probe signal is directly switched to the ULA via differential line receiver. This differential line receiver can be adjusted by jumpers in order to match different probe inputs. The measuring probe input connector X330 on the module 03325/03326 is not used.

8.5.2 Schematic diagram for measuring probe input:

For relay-contact or open collector probe outputs



The schematic diagram shows the standard jumpering (as delivered). It applies to relay-contact or open collector measuring probe outputs.

8.5.3 Jumpering for various measuring probe outputs

Probe input on module 03350, 03315

Type of probe output	Resistor jumpering	Wire connection to solder pins	
Open Collector Relay contact	A C 1.5k B D 0V	F 1 5 0V H	Standard jumpering
TTL positive	A C 1k 0V B D	E 1 5 0V H	
TTL negative	A C 3.3k 0V B D	F 1 5 0V H	
Differential drivers	A C 0V B D	E 1 5 F	
24 V input	A C 2.7k 0V B D	G 1 5 H	

03350 -- R14 R13

03315 -- R 32 R33

8.6 Serial interface

8.6.1 General

System 3 has one serial interface which can be operated full duplex as a RS-232 C interface (V.24) or as a 20mA current-loop interface (TTY).

The interface connection is located on module 03 840, connector X843.

With a 3TT, the interface can be allocated to the first or the second control system by the PLC program via the RS 232 inhibit signal.

The machine data need to be entered according to the specification of the device connected (Refer to Section 2). The interface data can be separately adjusted for data input and data output.

On clearing of programs via the interface, the termination with LF CR CR or CR LF according to MD 416, bit 7 has to be observed.

8.6.2 Machine data for the serial interface

No. 411		Device coding for input devices
No. 412		Device coding for output devices Refer to table in Section 2.
No. 413		Bit 0 to 7: Substitute EIA code for @ The entered character must have odd parity (Parity bit in the 5^{th} tape track = bit 4)
No. 414	1	DC control signal without parity. DC 1 = 11 H, DC 2 = 12 H, DC 3 = 13 H, DC 4 = 14 H
	0	DC control signal with even parity (ISO) DC 1 = 11 H, DC 2 = 12 H, DC 3 = 93 H, DC 4 = 14 H
No. 416 Bit 0		Must always be set to 1 (RS 232 present)
No. 416 Bit 7	1	Block end with CR LF, for output only
	0	Block end with LF CR CR
No. 425 Bit 3	1	Program output without trailer
	0	Program output with trailer
Bit 4	1	9 data bits
	0	8 data bits (7 data bits and parity bit)
Bit 5	1	Even parity with 9 data bits
	0	Odd parity with 9 data bits

The ISO/EIA code detection is independent of the 7^{th} data bit.

8.6.3 Setting data for the serial interface

No. 25, bit 2: Not set: no block parity check

set: block parity check effective

The block parity check checks each block for an even number of characters (valid for both ISO and EIA code). The NC supplements automatically for even block parity by inserting a blank (20 H) if the number of characters is odd.

No. 25, bit 3: Not set: start of program with %.

set: start of program with LF.

If the bit is set, the LF read first is taken as start of program. The program is stored in the memory under the number % 0. This permits, for instance, reading-in to start in the middle of a program.

No. 25, bit 5: Not set: program output in ISO code

set: program output in EIA code.

Remarks on EIA code:

Not all ISO characters can be represented in EIA code. Therefore, alarm 277 (read-in program ≠ stored program) can be triggered when comparing an ISO program in the NC with the transformed equivalent in EIA code.

Example:

Block in memory	Block output in EIA code
N10 ... (... ␣ = ...)*	N10 ... (...␣␣ ≠ .....)*

8.6.4 Alarms concerning the serial interface

Alarm no.	
231 232 233 237	These alarms appear only in conjunction with the Siemens tape reader. Fault causes: Reader logic module MS 600, especially with 232, 233. Reader especially with 231, 237. Machine datum, in the event of alarm 231.
234	Parity error This alarm responds only if MD 411, bit 4 or MD 412, bit 4 is set. The alarm is triggered if a data word (8 bit information and 1 parity bit) with wrong parity arrives from the reader. This error is not related to the parity errors of ISO or EIA characters from the tape (refer to alarm 271). Check MD setting and external device.
235	Overflow error This alarm is triggered if the next character is already transferred before the previous has been read (stored) by the control. - Check MD setting and external device - Fault in USART interface - Cable
236	Stop - bit error The alarm is triggered if the number of stop bits is set wrongly. Check MD setting and external device.
238	RS 232 interface time monitoring The alarm occurs if the NC does not send or receive a character within 20 seconds. Causes: - External device not operative - Wrong cable - The external device blocks the CTS signal for more than 20 seconds. - In the event of control signals (DC1-DC4) being used, if the NC does not receive the DC1 (11 H) within 20 seconds of data output.

Alarm no.	
254	<u>RS 232 interface operating error</u> - Data start from the PLC in the "Data Output" NC operating mode. - Data start from PLC or operator panel while RS 232 inhibit is active. - If the device code for the Siemens reader is entered in MD 412
271	<u>Character parity error</u> The control automatically recognizes and stores the ISO or EIA code on reading the character "%" or "EOR" dependent upon the definition of program start. All following characters are then checked that their parity conforms with the defined code. If not, alarm 271 is triggered.
272	<u>Inadmissible hole-combination of an EIA character</u> This alarm appears if, despite correct parity, the character read-in is not defined in EIA code.
273	<u>Block parity error</u> All characters of a block are counted if the block parity monitoring is activated by setting datum. If the number is not even, alarm 273 is triggered. Irrespective of the setting datum, the control always produces even block parity when punching out a tape. Blanks are inserted if necessary.
274	<u>Block with more than 120 characters</u> Alarm 274 is triggered if a block with more than 120 characters is read-in. Only those characters which are stored are counted e. g. CR, the feed hole and blanks, except in comments, are not counted. Remedy: Split into several blocks.
275	<u>Tape input inhibited</u> Alarm 275 occurs if: a) The key-operated switch is in "off"-position when reading in a partprogram or a subroutine and the setting datum "key switch active" is set.

b) The data protection switch S3 on the module 03 840 is not in "enable" position (top position) when reading-in machine data "TE".

c) The cycle lock is activated when reading-in subroutines (cycles) with the numbers L80 - L99 and L900 - L999.

276 Tape format error

Alarm 276 is displayed if:

a) The permissible number of decades following an address is incorrect.

b) The decimal point is in the wrong position.

c) Part programs or subroutines are not correctly defined or terminated.

d) The format of tapes is incorrect for clearing programs.

277 Stored program ≠ tape program

If a tape is read in more than once, the contents are compared block by block with the program stored on first reading. The control outputs alarm 277 if any discrepancy occurs. This alarm appears particularly if an attempt is made to store a program under a program number of an already existing program. The already existing program must be deleted prior to reading.

The "available memory" number displayed remains unchanged when this comparison is made, in contrast to when a program is stored. (Refer also to Section 8.6.3).

278 Memory overflow

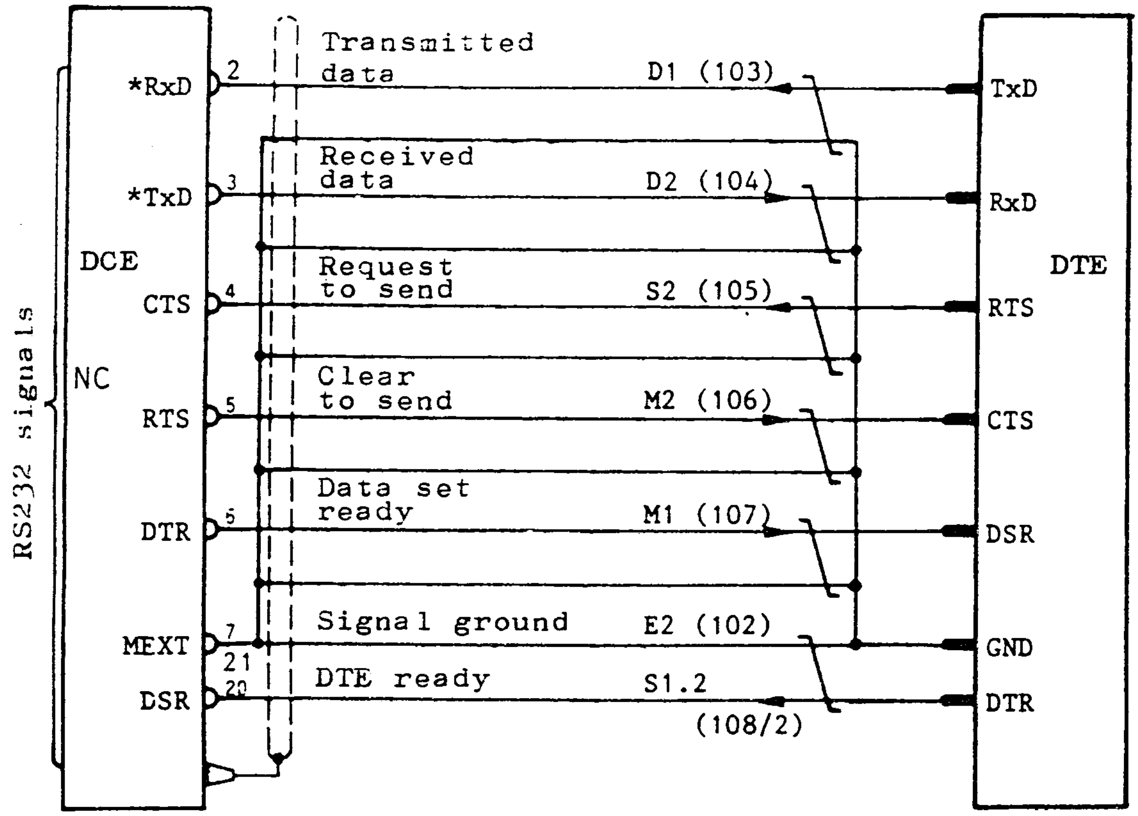
If the available memory is not sufficient when a program is stored, alarm 278 is triggered. The "available memory" display shows how much memory space is still available. In the event of alarm 278, programs not needed must be cleared and the desired program has to be read-in again.

8.6.5 RS 232 interface connection

A 25-pole pin connector (CANNON) on module 03 840 of the NC is provided as the serial interface connection. Pin allocation is in accordance with DIN 66020. The NC is considered as data control equipment (DCE) and the peripheral device as data terminal (DTE). This definition is to ensure proper connection of the NC inputs and outputs with the outputs and inputs of the peripheral device. The cables have to be crossed over if two DTEs are to be connected.

25-pole Cannon pin connector on NC X843 on module 03 840

The signal designations refer to data terminals (DTE)



e.g. tape reader
tape puncher
printer
(FACIT 4040, PT 80)

RS 232 interface signals

Which of the control- and monitoring signals provided are used depends upon the peripheral device.

For simple requirements the following signals are sufficient: Transmitted data (D1), received data (D2), ground signal (E2) for the input or output device. In this case, the control signals must not be connected to M (ground).

It is not permitted to connect an RS 232 transmitting device and a 20mA (TTY) transmitting device simultaneously to the same serial interface.

The pins 12, 13, 16, 21, 24 and 25 are always allocated to the 20mA interface by the control. Therefore, it has to be observed that in RS 232 operation none of these pins are connected to the peripheral device.

Whether the interface operates in RS 232 or 20mA (TTY) mode is decided by the pin allocation in the connector only and not by jumpers in the control.

8.6.6 Description of the signals:

Ground signals:

E1: Protective ground (101), pin 1 on NC

E2: Signal ground (102)
This is the common ground signal for all other interface signals (with the exception of E1), pin 7 on NC.

Data signals:

D1: Transmitted data (103)
This signal transmits data from DTE to DCE
Idle signal status: logical "one", pin 2 on NC

D2: Received data (104)
This signal transmits data from DCE to DTE
Idle signal status: logical "one", pin 3 on NC

Control signals:

S1.2: DTE operative (108/2 - Data terminal ready)
The DTE reports its readiness to transmit data to the DCE, pin 20 on NC

S2: Switch on transmitter (105 - Request to send)
DTE controls the transmitter of the DCE, pin 4 on NC

Monitoring signals:

M1: Ready to operate (107 - Data set ready)
The DCE reports to the DTE, that transmission is in progress.
Pin 6 on NC

M2: Ready to send (106 - Clear to send)
The DCE reports to the DTE, that it is ready to send data.
Pin 5 on NC

Pin designation according to DIN66020: E1/2, D1/2, S1.2, S2, M1/2.
Pin designation according to CCITT (RS232): 101 to 108.2.

8.6.7 20mA (TTY) interface connection:

This type of interface is not standardized. However, it is so widely used that it has practically become a standard (TTY interface).
The TELETYPE ASR 3320 printer can communicate with the control only via the 20mA interface.

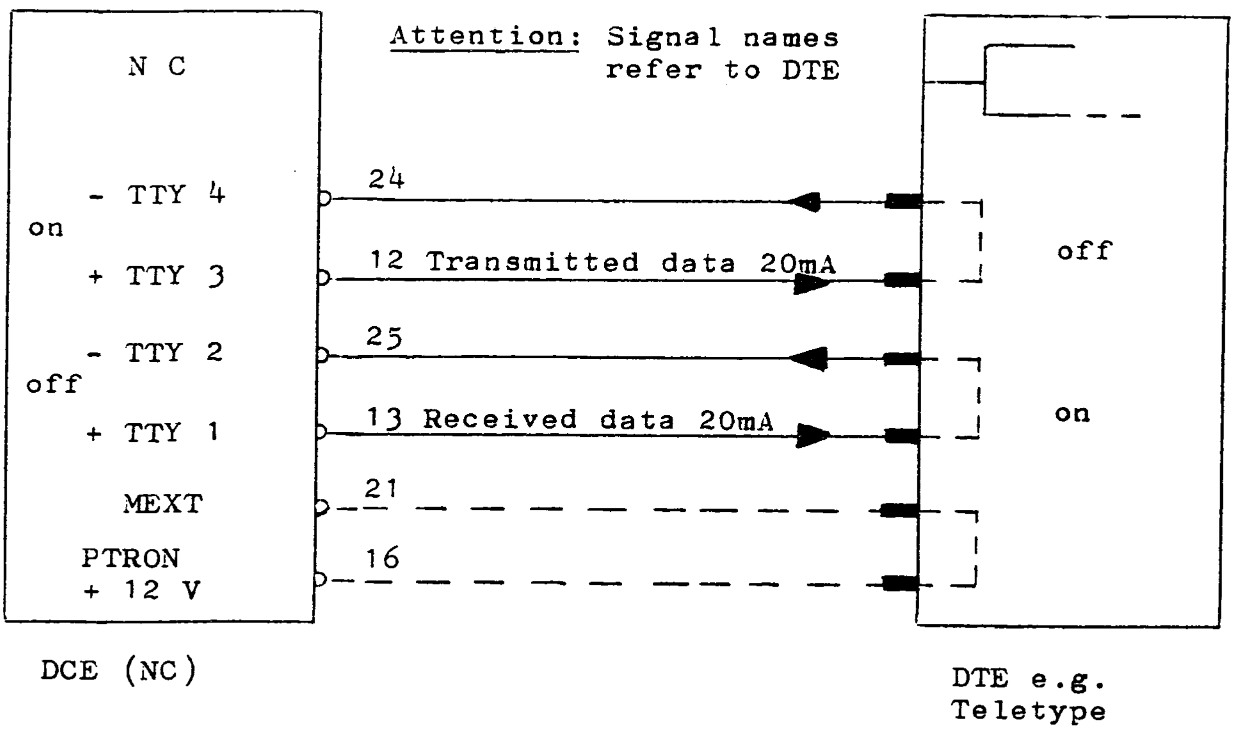
The following information (not the signal levels!) of the RS 232 and 20mA interface is identical:

Interface	RS 232	20 mA	
		+	-
Transmitted data D1 (103)	*RxD	TTY3	TTY4
Received data D2 (104)	*TxD	TTY1	TTY2

The standard jumpering of the 20mA interface is as active interface, that means, the NC supplies the 20mA loop current. The interface of the connected device has to be "passive". If this is not possible the NC can be adjusted to be "passive". In any case, the loop current should be checked in closed loop (approx. 20mA).

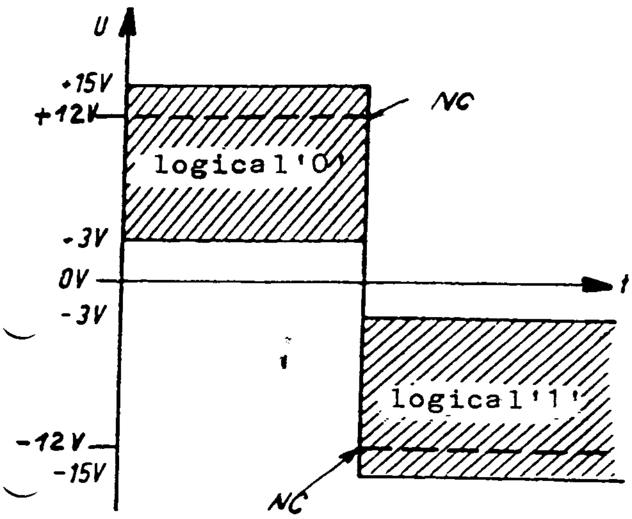
For modification of the jumpering refer to Section 9.

Connector X 843 on module 03 840

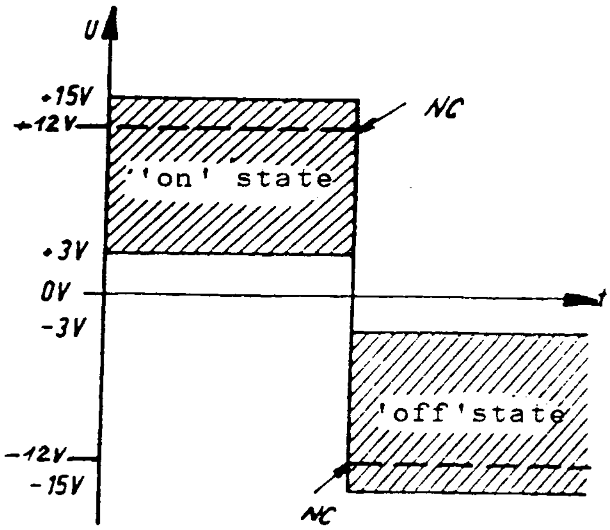


Remark: The signal PTRON is permanently connected to + 12 V via a 470 Ohm resistor.

8.6.8 Signal levels of the RS 232 interface signals



Data signals



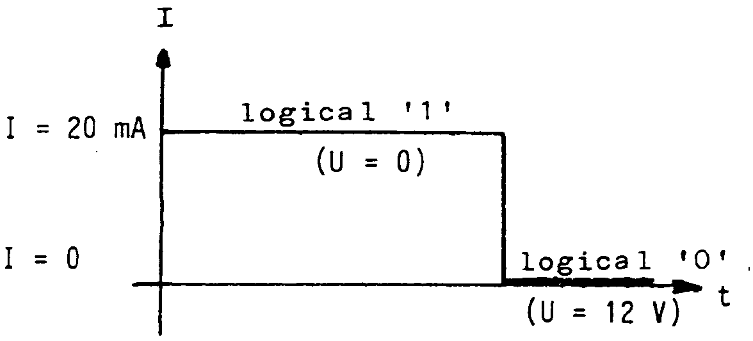
Control signals

All signal levels are specified with respect to signal ground E2 (102).

8.6.9 Signal levels of the 20mA interface

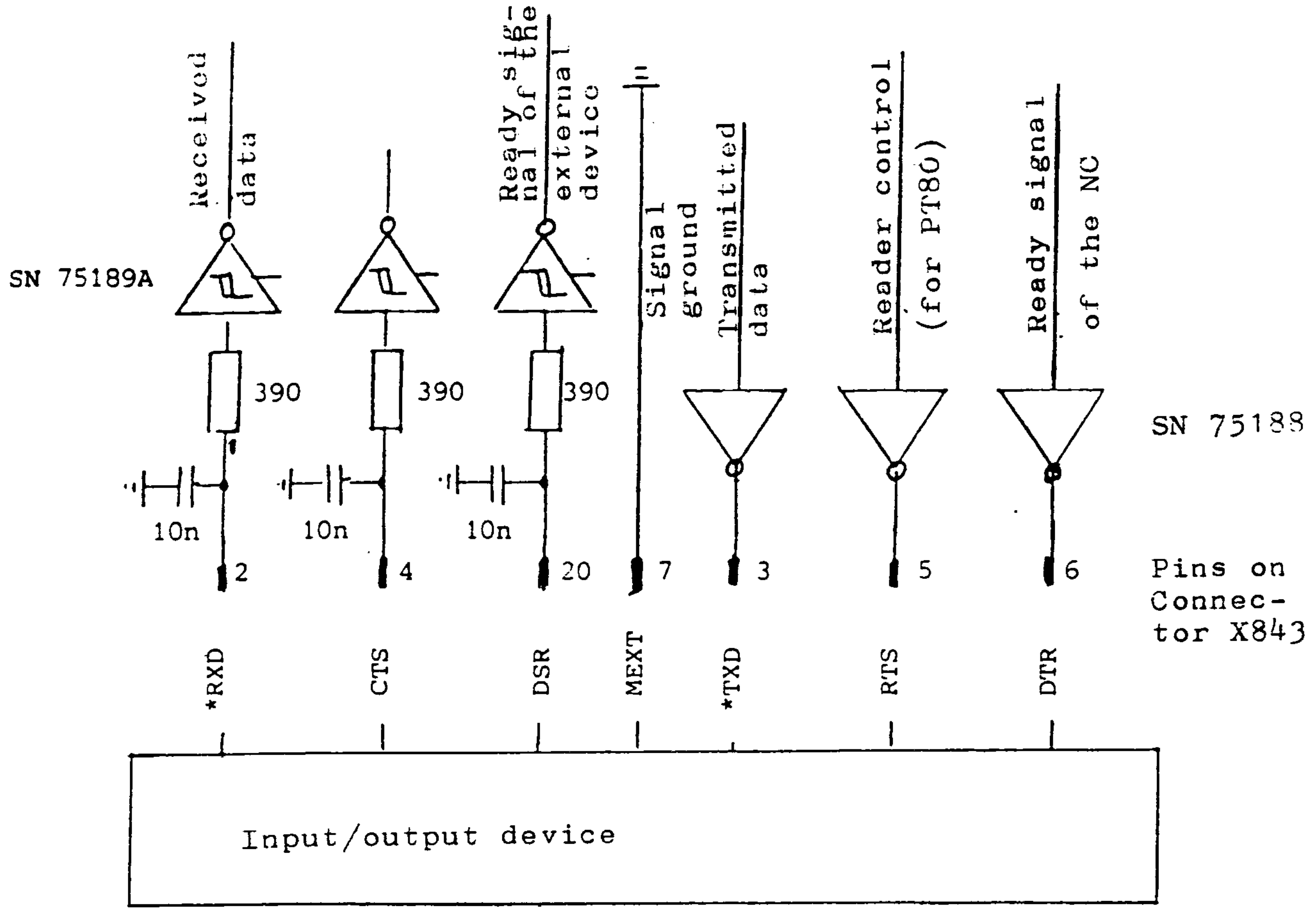
In contrast to the RS 232 interface, the information of the 20mA interface is not represented by the voltage level but by a load-independent loop current.

Data signals:



logical '0' ≙ I = 0
logical '1' ≙ I = 20mA (idle state)

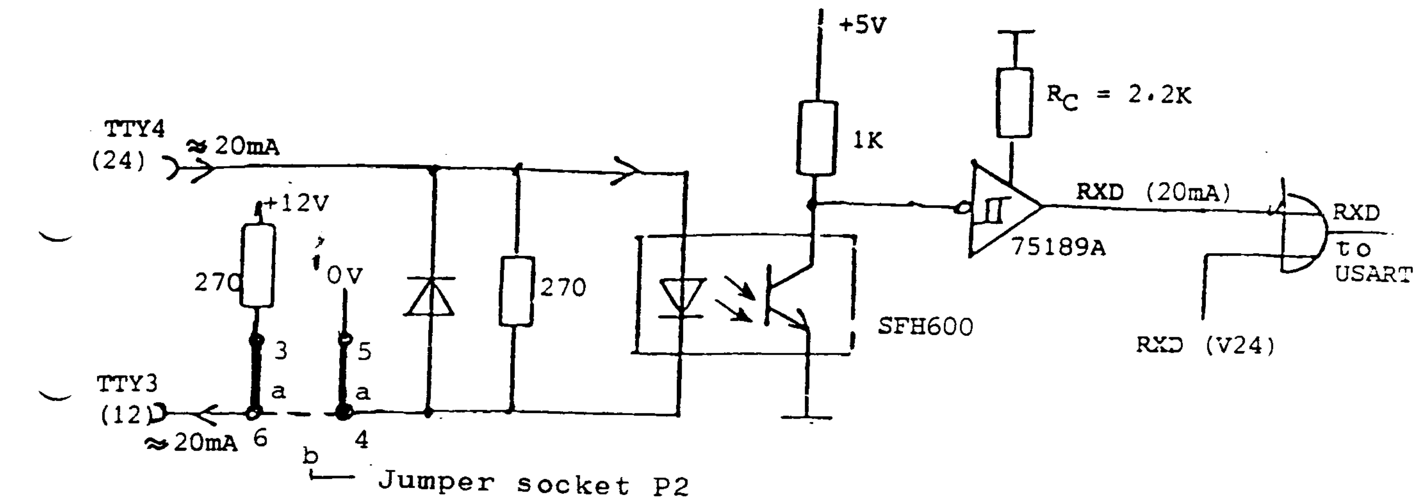
8.6.10 Schematic diagram of the RS 232 interface on module 03 840:



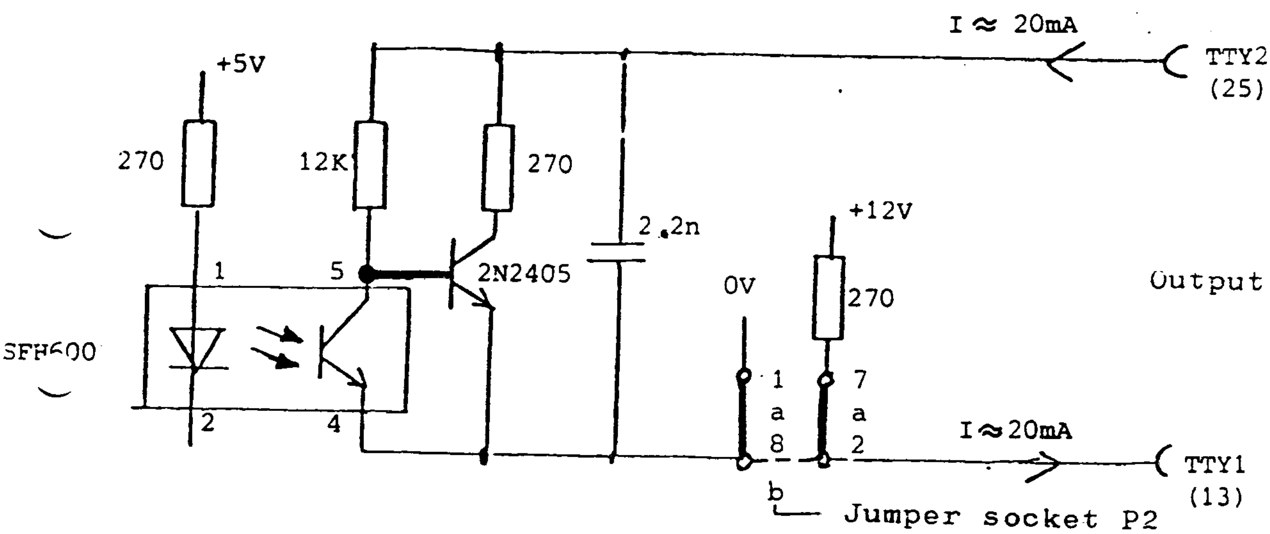
Here, the signal names refer to the NC (DCE).

8.6.11 Schematic diagram of the 20mA interface on module 03840

a) 20mA receiver circuit:

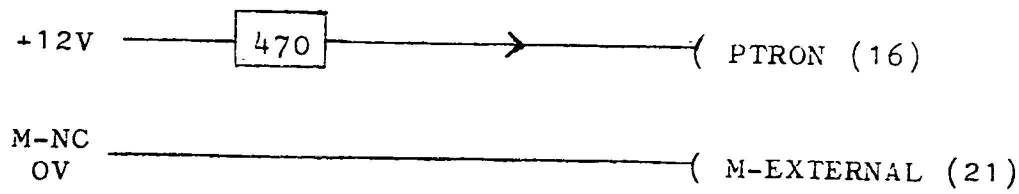


b) 20mA transmitter circuit:



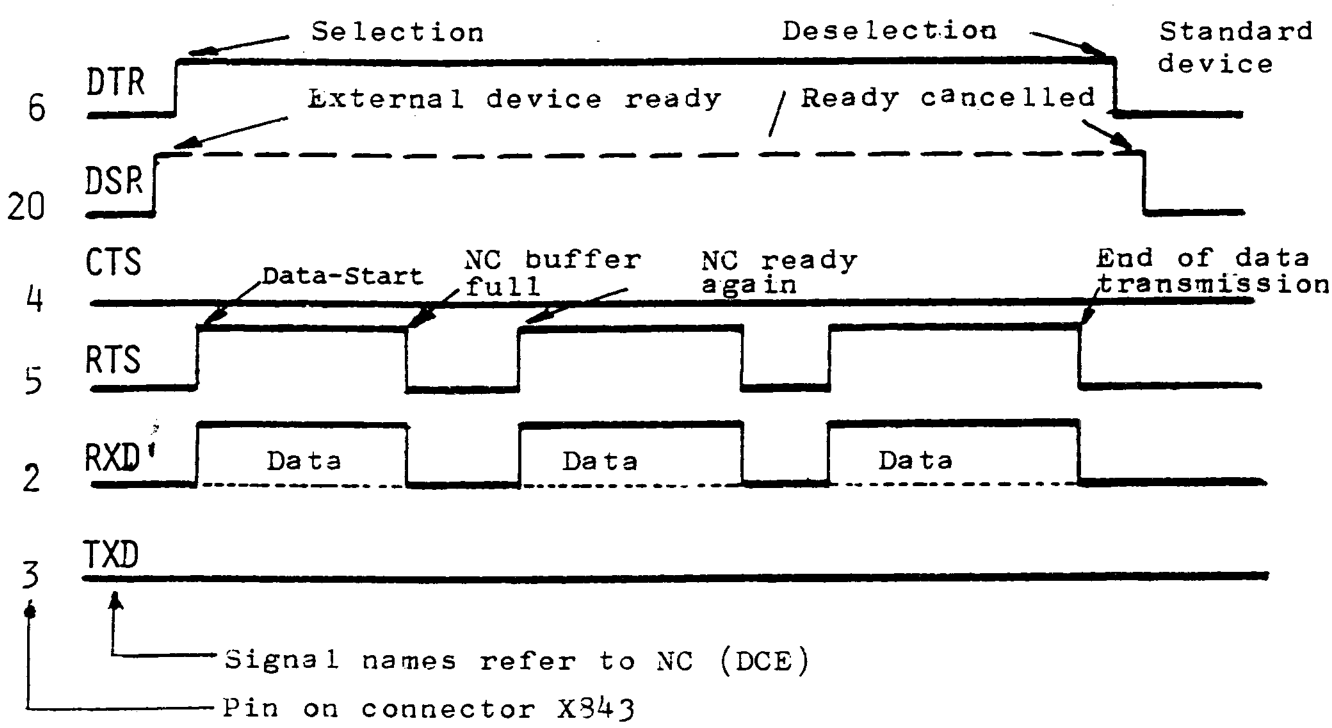
Jumpering a: active 20mA interface (standard jumpering)
b: passive 20mA interface

c) M and PTRON signal:



8.6.12 Signal diagrams for standard peripheral devices:

Data input (standard device ⟶ NC)

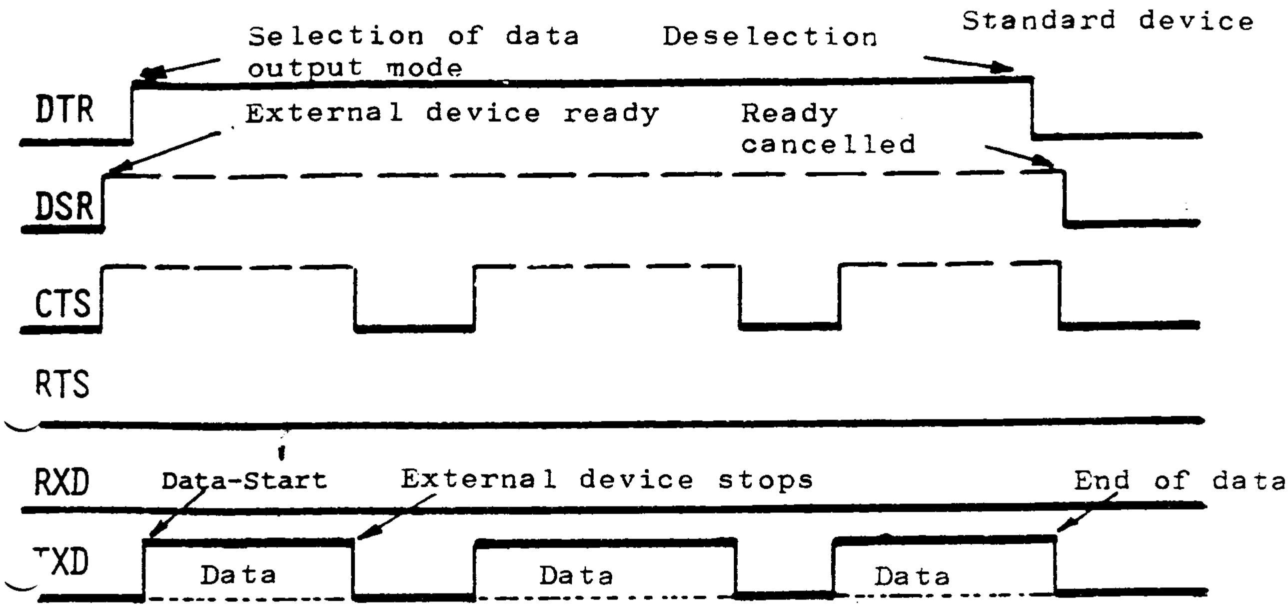


The DTR signal switches to high on selection of the data input mode. If the ready signal of the external device is to be evaluated, the DSR signal must be connected and machine datum 411, bit 3 must be set.

The data reception is controlled by RTS. The RTS switches to high on data start and the external device can transmit data.

If the NC cannot manage the flow of received data, it stops transmission by removing the RTS signal. The RTS signal becomes logical '1' again when the NC is ready for reception again. The NC cancels the RTS signal at the end of data transmission.

Data output (NC ⟶ Standard device)



The DTR signal switches to high on selection of the data output mode.

If the ready signal of the external device is to be evaluated, the DSR signal must be connected and machine datum 412, bit 3 must be set.

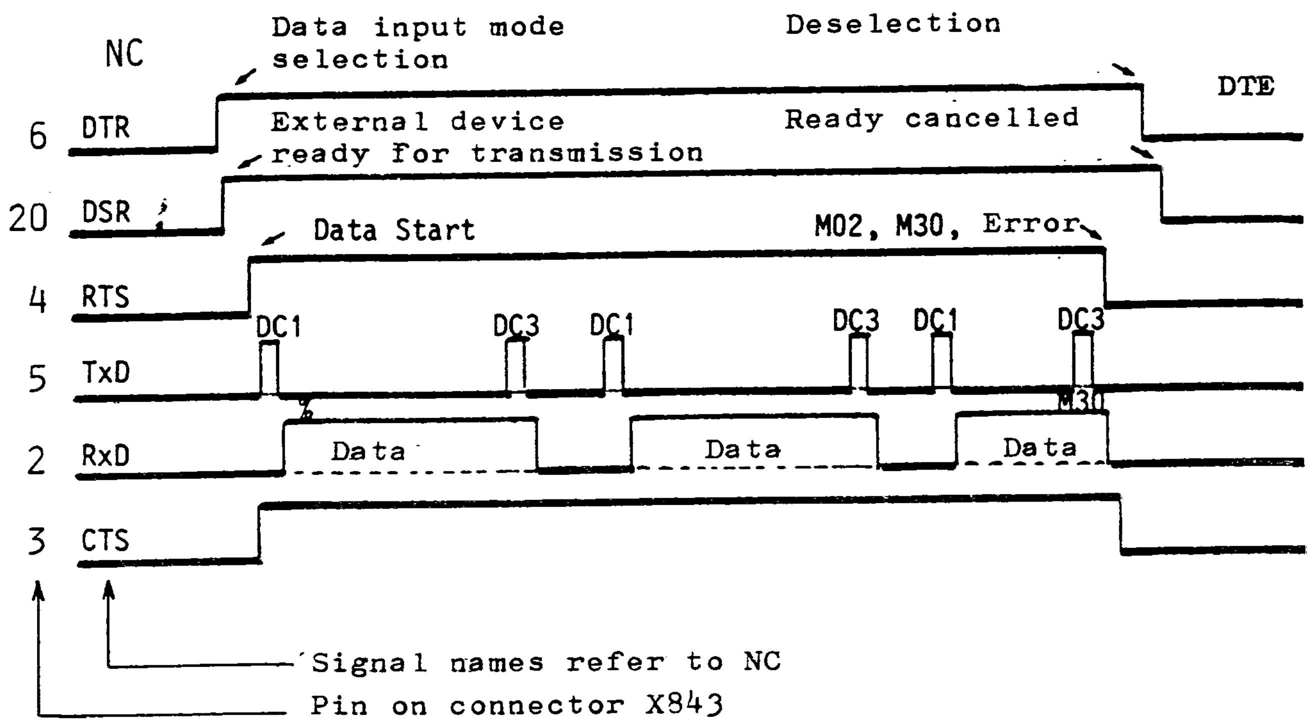
If the external device is to be able to stop the data flow, the signal CTS must be connected.

The NC can transmit data as long as the CTS signal is logical high.

8.6.13 Signal diagrams for special peripheral devices

Special devices use the control signals DC1 to DC4 on the TxD/RxD lines for data transfer control instead of the standard control signals RTS/CTS.

Data input (Special device ⟶ NC)



If DSR is connected to the external device, then this signal must be switched to '1' during the entire data transmission. If it is not connected, DSR automatically becomes '1'.

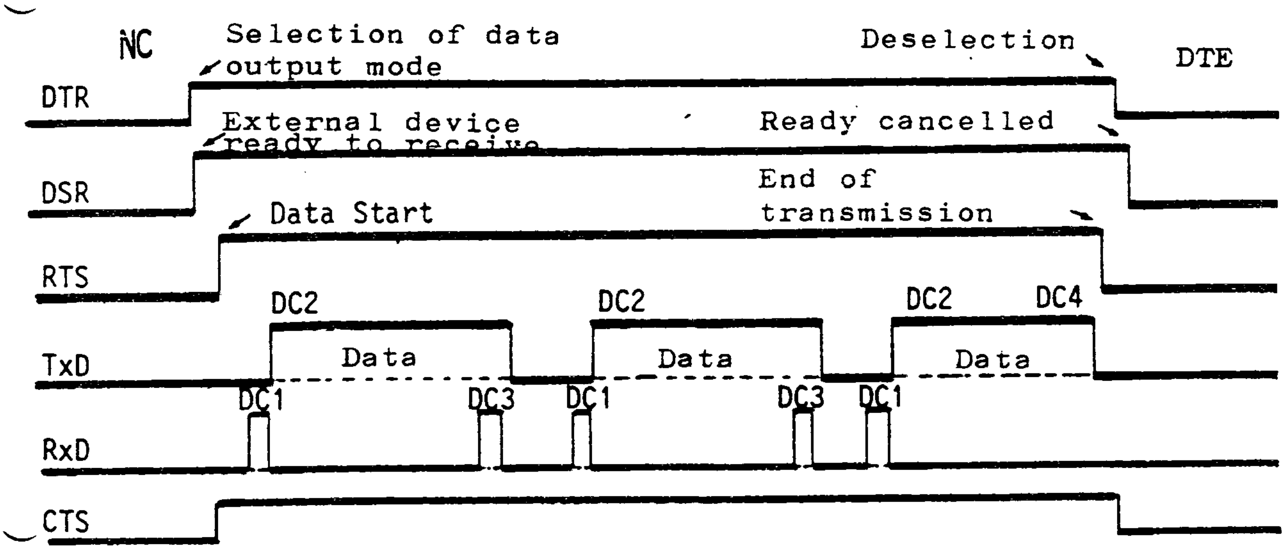
The NC switches RTS to '1' on data start. RTS is cancelled in the event of an error or on program end.

Normally, the RTS line need not be connected to the external device.

The NC starts the data transmission by sending DC1. The external device responds by transmitting data to the control. If the NC cannot manage the data reception, it stops the data transmission by DC3. In general, the external device cannot stop precisely on the character, therefore the NC can handle an overflow of a few characters. If the NC is ready for reception again, data transfer continues with a new DC1. On program end or in the event of an error, the transmission is stopped by DC3 and the RTS is switched to "O".

If the CTS line is connected, the CTS signal should already be high on data start and should only be switched to low at the end of data transmission.

Data output (NC ⟶ Special device):



The DTR signal becomes "1" on data output mode selection. If DSR is connected, it must be "1" during data transmission. RTS switches to 1 on data start.

The NC waits until it receives DC1 before sending data. The data start with the control signal DC2.

If the external device cannot manage the flow of data, then the NC can stop the transmission by a DC3 signal. The NC may still send up to 2 characters after receiving the DC3 signal before it stops.

The external device restarts the transmission by a new DC1. The output of NC data is terminated by DC4 and cancellation of RTS.

If the CTS line is connected, is should be on high level at least for the duration of the data transmission.

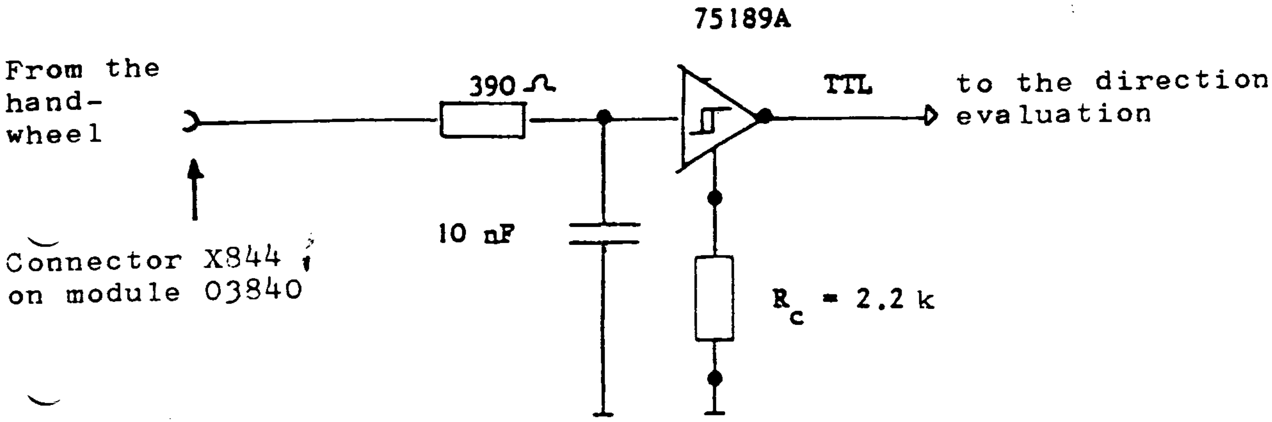
Significance of the DC control signals (DC1 to DC4)

DC1	Switch on reader
DC2	Switch on punch
DC3	Stop reader
DC4	Stop punch

A machine datum specifies whether the control signals have no parity or even parity.

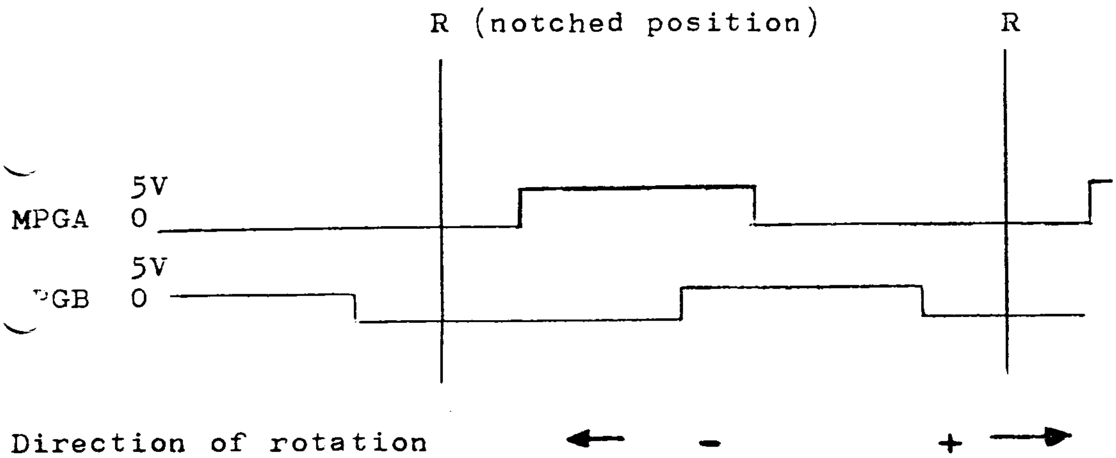
8.7 Handwheel (manual pulse generator) interface:

Receiver circuit



Method of operation:

Two 90 degrees phase-shifted pulses A and B are generated on transition from one notched position to the next (mark-space ratio 1:1)



The outputs A and B are at low level in the notched positions.
Here, Icc becomes a maximum (≈ 140mA)
Input hysteresis: +3V for H
+2V for L

8.8 Machine control panel

8.8.1 Connection of the machine control panel 3T/3TT to the PLC

PLC inputs byte addresses	Bit number 7	6	5	4	3	2	1	0
e. g. 48	Operating mode selector switch D 8	C 7	B 6	A 5	Feed/rapid traverse override switch D 4	C 3	B 2	A 1
49	Key lock 16	Dry run 15	Skip block 14	Single block 13	Block search 12	Spindle override switch C 11	B 10	A 9
50	Override effective for rapid traverse	Rapid traverse key	Direction keys X + 23	X - 22	Z + 21	Z - 20	X 19	X 18
51	Spindle stop 33	Spindle start 32	Feed stop 31	Feed start 30	Hand-wheel 29	Cycle start 28	free 27	free 26
52	free 41	free 40	free 39	free 38	free 37	free 36	free 35	free 34
53	free 49	free 48	free 47	free 46	free 45	free 44	free 43	free 42

Pin number

Pin 17 does not exist

X Pin 18,19 are not wired on the machine control panel. They cannot be used for customer keys.

**) available for customer keys

8.8.2 Connection of the machine control panel 3M to the PLC

PLC inputs byte addresses	Bit number 7	6	5	4	3	2	1	0
e.g. 48	Operating mode selector switch D 8	C 7	B 6	A 5	Feed/rapid traverse override switch D 4	C 3	B 2	A 1
49	Key lock 16	Dry run 15	Skip block 14	Single block 13	Block search 12	Spindle override switch C 11	B 10	A 9
50	Override effective for rapid traverse	Rapid traverse key	Direction keys + 23	- 22	Code for axis selector switch B 21	A 20	X 19	X 18
51	Spindle stop 33	Spindle start 32	Feed stop 31	Feed start 30	free 29	Cycle start 28	free 27	free 26
52	free 41	free 40	free 39	free 38	free 37	free 36	free 35	free 34
53	free 49	free 48	free 47	free 46	free 45	free 44	free 43	free 42

Pin number

Pin 17 does not exist

X Pin 18, 19 are not wired on the machine control panel. They cannot be used for customer keys.

**) available for customer keys

8.8.3 Code table for operating mode selector switch (Gray coded) S15 (according to schematic 03720)

TEST no. 7, Byte 0

Code table

Position	Connec-tion	Symbol	Code D	C	B	A	Signal name
1	1		0	0	0	1	DO
2	3		0	0	1	1	DI
3 → *)	5						
4	7		0	0	1	0	MDA
5 → +)	9						
6	11		1	0	1	0	JOG
7	13	1	1	0	1	1	INC
8	15	10	1	0	0	1	INC
9	17	100	1	0	0	0	INC
10	19	1000	1	1	0	0	INC
11	21	10000	1	1	0	1	INC
12 → *)	23		0	1	0	1	MDI-PP
13	25		0	1	0	0	MDI-SE-TE
14	27		0	1	1	0	AUT
15 → +)	29						
16	31		1	1	1	0	REF

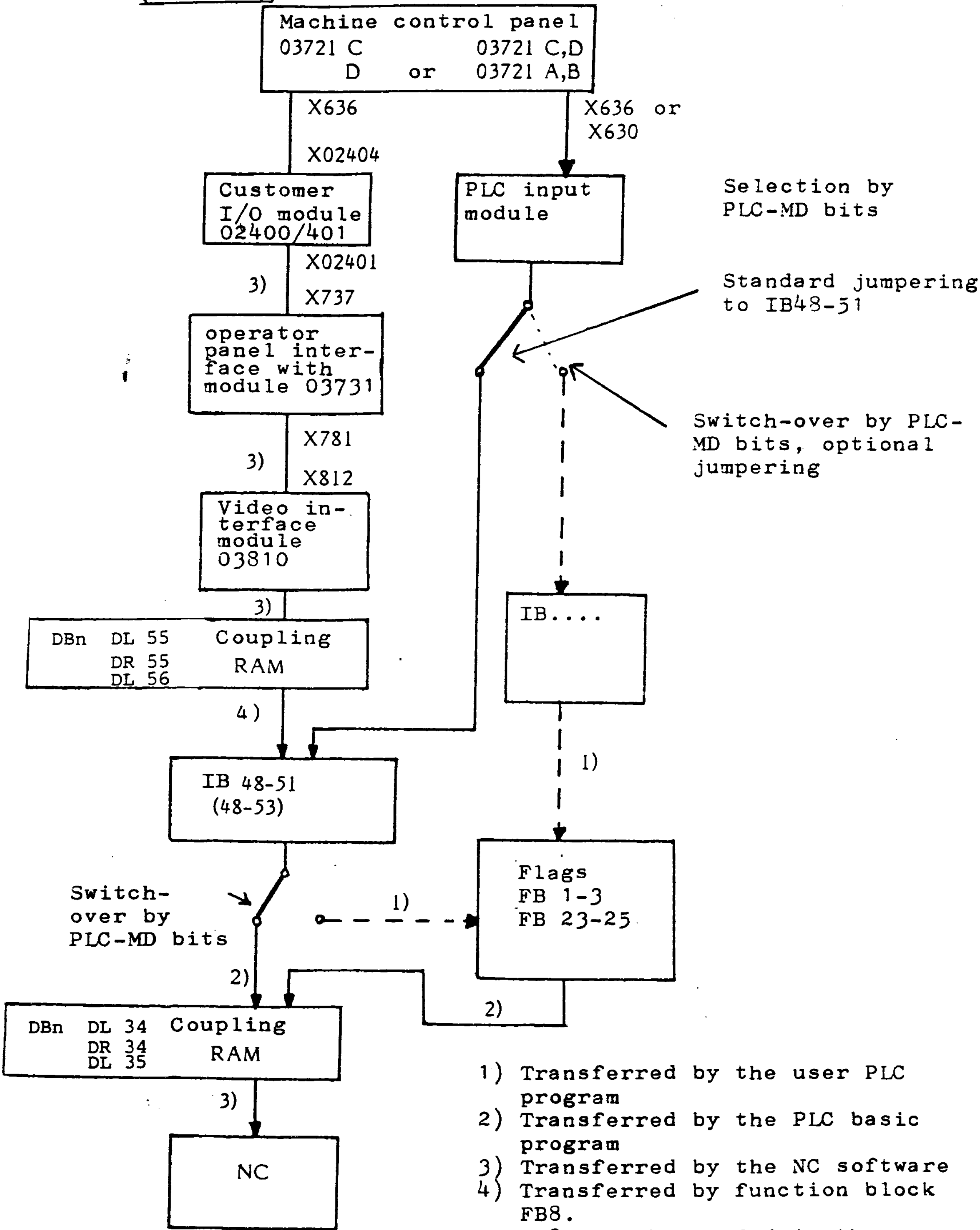
The software generates the following clear functions (on switchover):

*) RESET: (Clearing of all non-buffered control units and memories, except block number-, actual value-, and machine data memory just as in the event of program end or reset key.)

+) CLPROAC: (Clearing of "program active" and "feed hold".)

Furthermore, on transition from MDA to AUT and vice versa:
RESET in order to prevent interference in the automatic program by TEACH-IN or PLAYBACK. (RESET occurs only if a program is processed in automatic mode).

8.8.4 Possible connections of the machine control panel (M. C. P.)



1) Transferred by the user PLC program
2) Transferred by the PLC basic program
3) Transferred by the NC software
4) Transferred by function block FB8.
   FB8 must be loaded in the user program.
   Automatic call-up by the basic program.
   Observe the PLC-MD bit.

8.9 Interface adapter plug and - adapter, measuring circuit diagnostics plug.

8.9.1 Interface adapter plug

The following disconnecting adapters are available for measuring on the cables connected to the modules:

15-pole: Ident number 400 91 337
25-pole: Ident number 400 91 350
50-pole: Ident number 400 91 374

8.9.2 Interface adapter

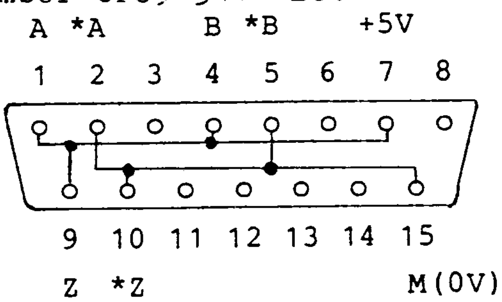
Interface adapter for output signals with disconnecting switch, test socket and interruptible LED for each output, located in a housing 220 x 130 x 50 mm^3 with 50-pole pin connector and a 0.4 m long cable with a 50-pole socket connector. This adapter can be interconnected between the output cable and the module 03 400.

Device designation: 6FC9 330-0BA
Order number: Ident number 706 88 203.

8.9.3 Measuring circuit diagnostics plug

This plug is used for testing the control without connected encoder or with non-available axis (Designation MK DS in System 8 diagnostics case, jumper plug for actual value).
Each axis requires such a plug.
Order number: Ident number 400 91 279

For self-producing of this jumper plugs:
Sub-miniature connector, 15-pole, socket (complete).
Order-number 6FC9 341-1EC.
Wiring:



As seen from the wiring (rear) side

Identification: System 3 and 8 MK DS
Connector and adapter can be ordered from SIEMENS AG, ZN Nürnberg-Workshop, Würzburger Straße 121, 8510 FÜRTH.

Chapter 9

-Overview of NC modules and jumpering-

Contents

9.1 General:

No jumpers have to be modified on commissioning except those for the addressing of the I/0 boards in accordance with the PLC user program. On exchange of spare parts, it must be checked whether the adjusted jumpers of the spare part module coincide with the "fixed jumpers" given in the Commissioning Instructions. The jumpers which can be modified on the modules must coincide with the exchanged board in accordance with the PLC program.

Jumpering is grouped as follows:

- Fixed jumpers:
  These jumpers must not be modified
- Jumpers according to the PLC program:
  The I/0 boards have to be adjusted in accordance with the byte adresses of the PLC user program (refer to Setion 12)
- Jumpers which can be modified:
  These are subdivided in:
- Standard jumpers
  The controls are delivered containing these jumpers

  Special jumpers
  Modified of the standard standard jumpers on commissioning

For jumpering of the SIMATIC S5 - modules refer to Section 12.
An adapter module (drawing number 548 187 9001.00 AS,
ES 902- adapter, 96 poles) is recommended for measurements on the printed circuit boards or at the NC bus connector. Secure the module to prevent falling off (Stud with thread M4).
Ident number for adaptor: 706 77 558.
For measurements on cables connected to the modules the following interconnecting adaptors are available:

15-pole: Ident number 400 91 337
25-pole: Ident number 400 91 350
50-pole: Ident number 400 91 374

To be ordered from: Siemens AG, ZN Nuremberg, Workshop at Fürth
Würzburgerstraße 121, 8510 Fürth

Refer also to Section 8.

Note: The jumper sockets should be pulled out perpendicularly to the board in order to avoid bending of the pins. Re-plug with care accordingly.
The pins are numbered with respect to the view onto the soldering side of the jumpers sockets.

9.2 Comparison list of the most important modules and their application in Section 3, basic model 4A and 4B:

	Previous type desig-nation	Basic model 4A 5 MHz	Basic model 4B 5 MHz	Basic model 4B 8 MHz	Basic model 4C 8 MHz
CPU's:					
6FX 1111- 0AC00	03160	x	x	-	-
6FX 1111- 0AA01 *	03161	x	x	-	-
6FX 1111- 0AA01 **	03161	-	x	x	-
6FX 1111- 0AA02 *	03162	x	x	-	-
6FX 1111- 0AA02 **	03162	-	x	x	-
6FX 1111- 0AB02 **	-	-	x	x	-
6FX 1111- 0AM02	-	x	-	-	-
6FX 1111- 0AN02	-	-	x	x	-
6FX 1111- 0AP02	-	-	-	-	x
* RESTART 811.9011.00					
PROM's 811.9012.00					
** RESTART 817.7133.01					
PROM's 817.7134.02					
Memory modules:					
EP/RAM: 6FX 1120- 2CA00	-	-		x	x
EP/RAM: 6FX 1120- 2CA01	-	-	x	x	x
RAM: 6FX 1190- 1AE00 (F00/G00)	03260-E,F,G	x		-	
EPROM: 6FX 1118 1AA01	03201-A	x		-	
EPROM: 6FX 1118 1AA02	03202-A	x		-	
Measuring circuits					
6FX 1125- 1AA01	03316	x	x	x	x
6FX 1123- 7AA01	03326	x	x	x	x
6FX 1111- 1AA01	03351	x	x	x	x
6FX 1125- 1AA00	03315-A	x	x	-	-
6FX 1123- 7AA00	03325-A	x	x	-	-
6FX 1111- 1AA00	03350-A	x	x	-	-
Video PCB (operator panel interface) without graphics.					
6FX 1115- 0AA02	03811B	x	x	x	x
6FX 1115- 0AA01	03811A	x	-	-	-
6FX 1115- 0AB01	03811	x	x	x	x
Colour graphics:					
6FX 1125- 5AB01 / 5AB02 *	(03806)	-	x	x	x
6FX 1125- 5AA01 / 5AA02	03806A	x	-	-	-
Monochrome graphics:					
6FX 1123- 2AB01 *	(03816)	-	x	x	x
6FX 1123- 2AA01	03816A	x	-	-	-
* Character EPROM for basic model 4B 548 817.7880.04					

x ... PCB can be fitted
\- ... use not permitted

Comparison list continued:

	Previous type designation	Basic model 4A 5 MHz	Basic model 4B 5 MHz	Basic model 4B 8 MHz	Basic model 4C 8 MHz
<u>Coupling modules:</u>					
NC periphery coupling modules:					
6FX 1122- 2AB01	03841	-		x	
6FX 1122- 2AB02	03842	-		x	
6FX 1122- 2AC02	03842	-	-	x	x
6FX 1122- 2AD02	03842	-	-	x	x
6FX 1122- 2AM02	03842	-	-	x	x
6FX 1122- 2AA01	03841	x	x	-	-
6FX 1122- 2AA02	03842	x	x	-	-
6FX 1122- 2AK02	03841	x	x	-	-
NC- PLC- coupling modules:					
6FX 1122- 1AA01	03831	x	x	x	x
6FX 1122- 1AA02	03831	x	x	x	x
6FX 1122- 1AC02	03831	x	x	x	x
PLC- PLC/PLC-EU coupling modules:					
6FX 1192- 0AB00	03800B	x	-	-	-
6FX 1120- 3BB01	03845	x	x	x	x
6FX 1120- 3BA01	03845	x	x	x	x
6FX 1120- 3BB00	03845	x	x	x	x
6FX 1120- 3BB01	03845	x	x	x	x
6FX 1120- 3BD00	03845	x	x	x	x
6FX 1120- 3BE00	03845	x	x	x	x
<u>Test module</u>					
6FX 1118- 6AA01	03221	x	x	x	-
6FX 1118- 6AB00	03221B	x	x	x	x
<u>Service panel EPROMs</u>					
548 817.06 --.--		x	-	-	
548 819.06 --.--		-	x	x	
548 821.01 xx.xx		-	-	-	x

	Previous type designation	Basic model 4A 5 MHz	Basic model 4B 5 MHz	Basic model 4B 8 MHz	Basic model 4C 8 MHz
<u>Submodules</u>					
6FX 1123- 6AE00 * (EPROM)		-	x	x	-
6FX 1126- 0BB00 * (EPROM)		-	x	x	-
6FX 1126- 0BD00 (EPROM)		-	x	x	-
6FX 1126- 0BD01 (EPROM)		-	x	x	-
6FX 1128- 4BA00 (EPROM)		-	-	-	x
6FX 1128- 4BB00 (EPROM)		-	-	-	x
FX 1123- 6AC00 (RAM)		-	x	x	-
X 1126- 0BL00 (RAM) 1.) 2.)		-	x	x	-
6FX 1135- 3BC00 (RAM)		-	-	-	x
* EPROM 548 819.00 11 in location D3/D1					
" 12 in location D1/D2					
" 13 in location D4/D3					
" 14 in location D2/D4					
<u>NC-Software:</u>					
548.819.0 --.-- (D- version)		-	x	x	-
548.817.0 --.-- (C- version)		x	-	-	-
548.821.0 --.-- (E- version)		-	-	-	x
<u>PLC-CPU</u>					
130 WB 11		x	x	x	-
130 WB 12		x	x	x	x
130 WB 13		x	x	x	x
130 WB 14		x	x	x	x
<u>wer packs</u>					
6EV 3054-0CC	-	x	x	x	-
6EV 3054-0DC	Battery located externally	x	x	x	x
V 3054-0EC		x	x	x	x
V 3054-0FC		x	x	x	x

Designation of EPROM location:
1.) with software version D01/D81
2.) with software version D02/D03/D04/D05/D06

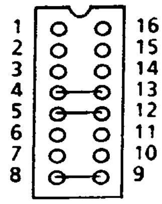
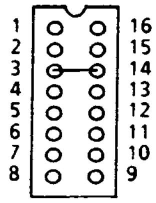
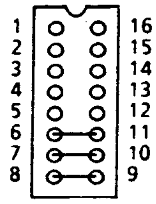
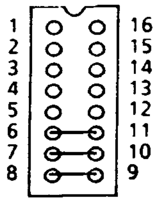
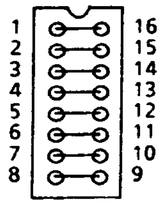
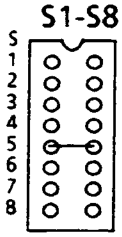
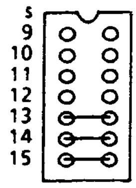
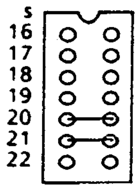
x ... PCB can be fitted
\- ... use not permitted

9.3 CPU modules:

9.3.1 CPU module 6FX1111-0AC00 (03160):

NC central controller module with microprocessor 8086
(PCB can not be fitted in basic model 4B/8 MHz)
Fixed jumpers:

Type	Designation	Signal	closed/open	Remark
Individual link	A-B	0 V	closed	
Individual link	D-E		open	Wait
Individual link	F-G		open	Wait
Individual link	H-K	SRDY	closed	

Jumper sockets	Remark
X1  X2  X3 	Interrupt
X4 	Wait
S1-S8  With 3T 3M; S1-S8  With 3TT	Coupling boundary
S9-S15 	Address interrupt
S16-S22 	Address RAM

Designation of the restart PROMs:
Location D53 811 90 11.00
Location D54 811 90 12.00

9.3.2 CPU module 6FX 111-0AA01/02 (03161/03162)

Replacement type for 03160

Ordered spare parts are delivered without the Restart Proms

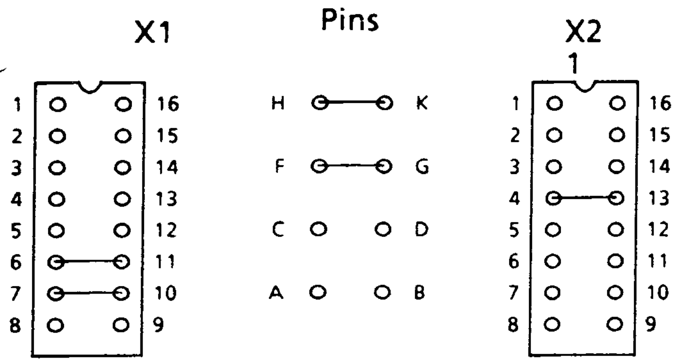
The module can be fitted with basic model 4A and 4B

Restart Proms:	basic model 4A:	D33:	811 9011.00	4B:	D33:	817 7133.00
	basic model 4A:	D34:	811 9012.00	4B:	D34:	817 7134.00

Microprocessor 8086-2 is fitted

The module contains on 16 KByte C-MOS memory. The basic model 4A uses this memory as working memory. The basic model 4B does not use this memory at all. There are two sockets on the front plate of the module for buffer current supply tothe RAM.

Fixed jumpers:



With 3TT (2 NCs in one tier) the jumper 4-13 is open. Refer also to Section 9.3.5.

NOTE: The models 3G in version 4B and 3N in version 4B use the Restart Proms of the basic model 4A.

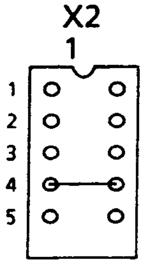
9.3.3 CPU module 6FX 1111-OAB02

Similar type as 6FX 1111-OAA02. But the C-Mos memory and the two sockets on the front plate are not provided anymore.

Ordered spare parts are delivered without the Restart Proms.

Cannot be used with basic model 4A..

Jumpering like - OAA01/02 exept for X2:



With 3TT (2 NCs in one tier) the jumper 4 is open. Refer als to Section 9.3.5.

9.3.4 CPU module 6FX 1111-OAM02

The NC central controller module and the Restart Proms are fitted for the basic model 4A.

This module corresponds to type 6FX 1111-OAA02

Designation of the restart Proms:

D33: 811 9011.00

D34: 811 9012.00

Jumpering like -OAA02.

9.3.5 CPU module 6FX 1111-OAN02

The NC control controller module and the restart Proms are fitted for the basic model 4B.

This module corresponds to type 6FX 1111-OAB02.

Designation of the Restart Proms:

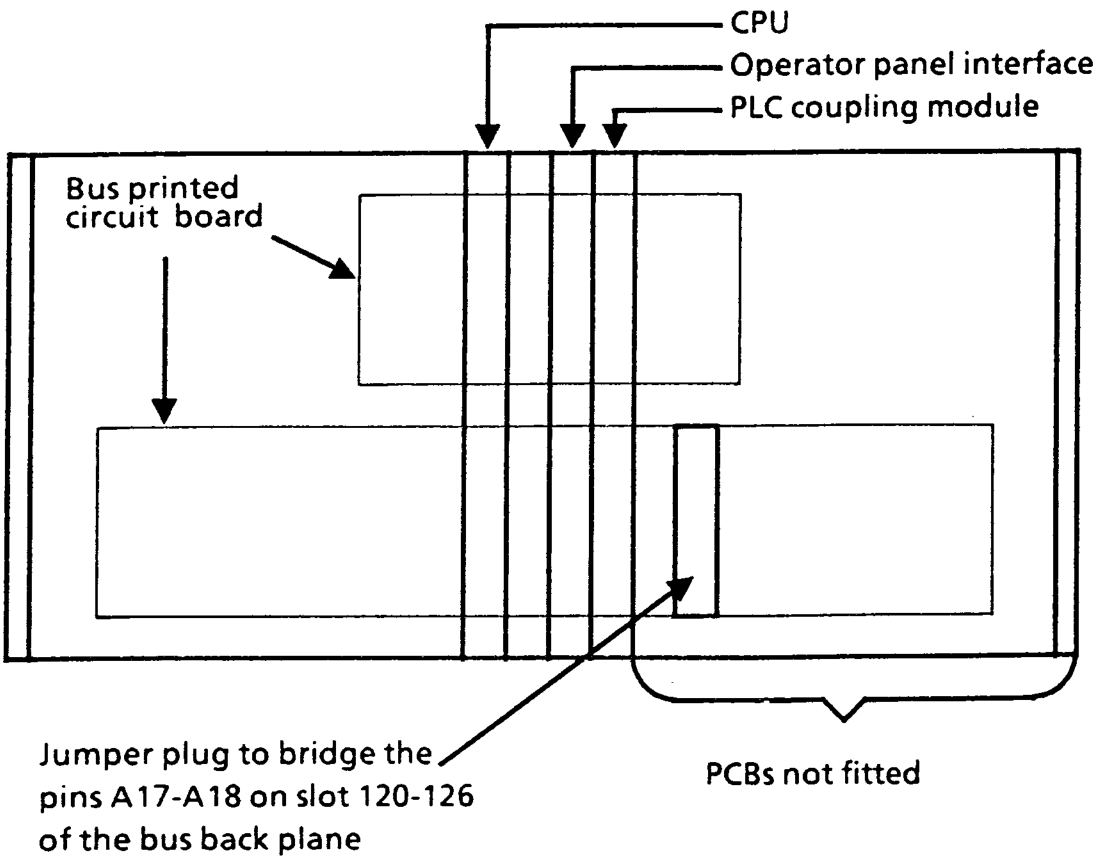
D33: 817 7133.01

D34: 817 7134.02

Jumpering line -OAB02.

9.3.6 Hints for jumpering of the CPU modules

Controllers which are prepared for two NCs, but the second NC not yet fitted (e.g. prepared for 3TT), have a BUS printed board like the 3TT.
In this case the jumpering must be carried out as with 3TT.
These controllers require a jumper plug on slot 120-126 of the bus printed circuit board in order to bridge pin A17-A18 on the bus packplane.



9.3.7 CPU module 6F 1111-0AP02 for basic version 4C

The microprocessor type 8086 from Intel is replaced by the type µ PD 70116C-8 (V30) from NEC in order to reduce the instruction processing times. Consequently, this allows the sample time for the position control loop to be reduced to 4 ms (3T) or 4.5 ms (3M) and the interpolation cycle time to 16 ms (3T) or 18 ms (3M) if the MD 428, bit 7 (reduced sample time) is set to "1".

If the MD 487, bit 7 is not set to "1", the same sample times apply as with basic version 4B (8 ms/9 ms and 16 ms/18 ms).

If two different types of NCs are fitted in one rack (e.g. a 3T and a 3M), then the 3T version requires the value 4 to be set in MD 383 (increase sample time in order to achieve identical sample times).

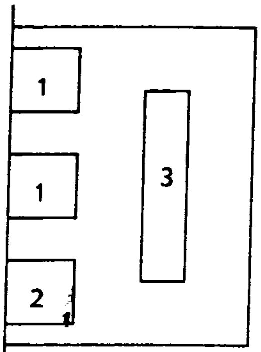
Jumpering:	closed	open
Jumper socket S1	6 - 11 7 - 10	1 - 16, 2 - 15, 3 - 14 4 - 12, 5 - 13, 8 - 9
Jumper socket S2	4 - 13 (open with 3TT, two NCs in one rack)	1 - 16, 2 - 15, 3 - 14, 5 - 12, 6 - 11, 7 - 10, 8 - 9
Single links	G - F, H - K	A - B, C - D

Restart PROMs: D33: 548 817.7133.01
D34: 548 817.7134.02

9.4 Memory modules:

9.4.1 Memory modules 6FX 1120-2 CA00

Memory module for basic model 4B only

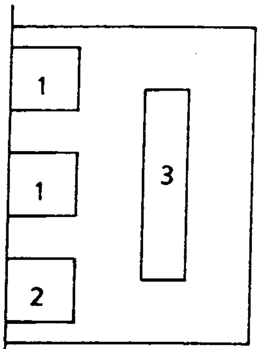


First module

1 Slot for EPROM submodule containing the NC system software
2 Slot for RAM submodule for the user program
3 Memory on the PCB for TE, T0, and Setting data (user data).

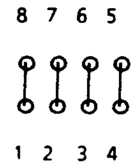
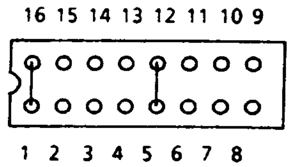
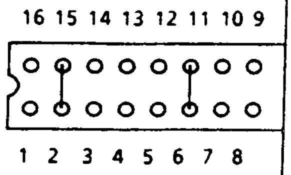
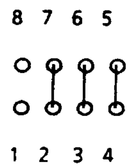
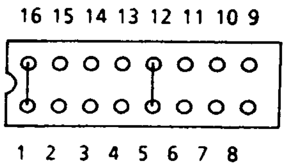
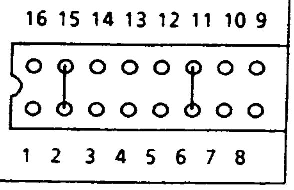
Speicher und RAM-Modul werden von der Batterie im
This memory and the RAM submodule are buffered by the battery located in the power pack.

In the event of option "part program memory expansion" this board is fitted twice.



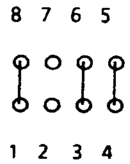
Second module

1 RAM submodules fitted dependent upon memory expansion
2 Always empty
3 32K RAM on PCB for part program expansion

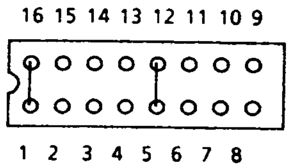
Jumpering:		System 3 basic model 4B (5MHz)	(8MHz)
1st memory module with 4B software system	X2		
	X1		
2nd memory module only with option C45/C46	X2		
	X1		

The individual links W1, W2, W3, W4, W5, W6 are closed.
Link A - B is open

Note: Jumpers X2 with models 3G, 3N:



Jumpers X1 with model 3G 5/8 MHz:



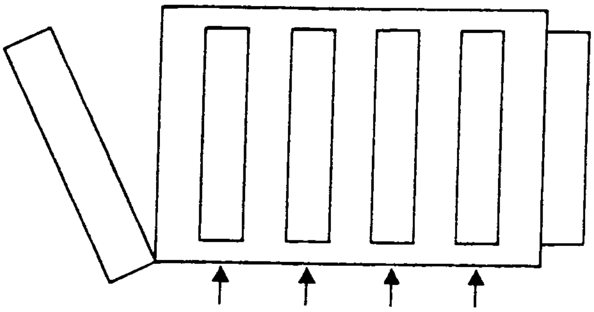
9.4.2 <u>EPROM submodule 6FX 1123-6AE00</u>
For memory module 6FX 1120-2CA00
With 4 EPROMs type D27 256

Links

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13
-	X	-	X	X	X	-	X	-	-	X	-	X

Link between B10 and B12 on PCB

- = open
X = closed



Assembly with software version 01/81	13	11	14	12
	23	21	24	22
02, 03, 04,05, 06	14	13	12	11
	24	23	22	21

1st submodule (top slot)
548 819.0011.- -
" 0012.- -
" 0013.- -
" 0014.- -

2nd submodule (center slot)
548 819.0- 2 1. - -
" 0- 2 2. - -
" 0- 2 3. - -
" 0- 2 4. - -

Language
Location of submodule
Location of EPROMS
Software version

9.4.3 <u>EPROM submodule 6FX 1126-0BB00</u>

Replacement type for 6FX 1123-6AE00. For version 4B only.
The jumpers are printed circuit links on the PCB.
Jumpers: closed: B1, B3, B5, B6, B8, B10:

open: B2, B4, B7, B9, B11

Assembly of the EPROMs as with submodule 6FX 1126-6AE00.

9.4.4 <u>EPROM submodule 6FX 1126-0BD01</u>

Replacement type for 6FX 1126-0BB0. For version 4B only.
Jumpering as with this type.

9.4.5 <u>RAM submodule 6FX 1123-6AC00</u>

For memory module 6FX 1120-2CA00. For version 4B only.
Four RAMs type HM 6264 LP-15 oder TC 5564 are fitted.

Links

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13
-	X	X	-	-	X	-	-	-	-	-	X	X

- = open
X = closed

9.4.6 <u>RAM submodule 6FX 1126-0BL00</u>

Replacement type for 6FX 1123-6AC00, for version 4B only.

Jumpers:

closed: B1, B2, B5, B7, B9, B11

open: B3, B4, B6, B8, B10

9.4.7 <u>RAM memory module 6FX 1190-1A*00 (03260-*)</u>

RAM memory for basic model 4A

* ....E, F, G dependent upon memory expansion

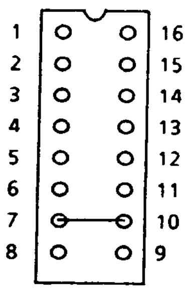
03260 E with 8k CMOS memory for an user program of 8 000 punched tape characters.

03260 F with 12k CMOS memory for an user program of 16 000 punched tape characters.

03260 G with 20k CMOS memory for an unser program of 32 000 punched tape characters.

The working memory of the CPU occupies 3k CMOS and the buffered data (battery located in power pack) 5k CMOS as for machine data, tool offsets, setting data. The remaining buffered CMOS RAM memory is available for the user program. There are two sockets on the front plate of the module. Prior to removing the module from supply a 5V back-up battery can be connected for data save.

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remark
Socket	1 - 16		open	Addr. 16
X1	2 - 15		"	Addr. 17
	3 - 14		"	Addr. 18
	4 - 13		"	Addr. 19
	5 - 12	W3	open	Wait 3
	6 - 11	W2	"	Wait 2
	7 - 10	W1	closed	Wait 1
	8 - 9	W0	open	Wait 0
Individual link	W4	W4	open	Wait 4

9.4.8 <u>RAM memory module 03210 BA (for version 4A only) :</u>

Former type of 03260. The module comprises:

3k words NMOS memory for working memory of the CPU. These data are not buffered by the back-up battery.

5k words CMOS memory for the buffered data (Battery located in power pack) as machine data, tool offsets, setting data and 8k characters for user program.

Fixed jumpers:

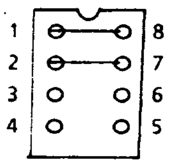
Type	Designation	Signals	Closed/open	Remark
Individual link	B 1	RVCC RAM 0	closed	
Individual link	B 2	+ 5 V	open	
Individual link	2 W	Wait 2	closed	

9.4.9 <u>EPROM memory module 6FX 1118-1AA01/-1AA02 (03201/03202)</u>

EPROM memory for the basic model 4A

With sockets for 32 EPROMs of the NC system software.

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remark
Socket X1  *	1 - 8 2 - 7 3 - 6 4 - 5		closed closed open open	Addr. 17 Addr. 18 Addr. 19 not used
Individual link " " " "	W1 W0 W2 W3 W4	Wait 1 Wait 0 Wait 2 Wait 3 Wait 4	closed open " " "	

* Link 1-8 has to be open if the PCB is used with graphics as the second EPROM memory module.

First PCB: With 32 EPROMs for system software

Second PCB: With 20 EPROMs for graphics software
(With option C03/C04 12 EPROMs only)
The second PCB is present with graphics only

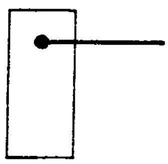
9.4.10 EPROM memorys module for basic version 4C 6FX 1120- 2CA01

It replaces the former module 6FX 1120- 2CA00. EPROMs type 27512 (64 k-Byte) are fitted on two submodules:

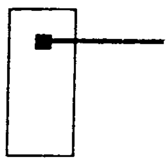
Submodule no.	Number of EPROMS	Memory volume
1	4	256 k byte
2	2	128 k byte

Submodule number 2 contains the display images and the language. In order to change the language only the second submodule need be replaced.

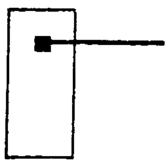
Submodule for version 4C:



RAM submodule for part program memory:
6FX 1135- 3BC00



1st EPROM submodule for the NC system program, four EPROMs type 27512 are fitted: 6FX 1128- 4BA00 (submodule without EPROMs fitted) or 6FX 1821- 0AX02 (submodules with EPROMs fitted).



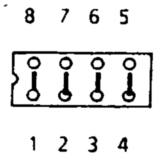
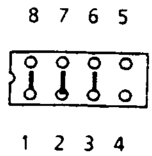
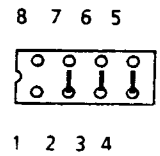
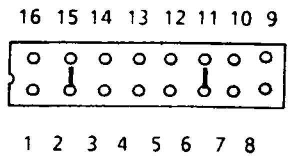
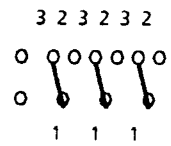
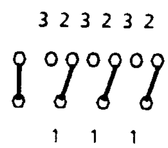
2nd EPROM submodule for the NC system program (displays and language), two EPROMs type 27512 are fitted on location D1 and D3. 6FX 1128- 4BB00 (submodule without EPROMs fitted) or 6FX 1821- 0AX- 3 (submodule with EPROMs fitted)

Language: 0....English
1....German

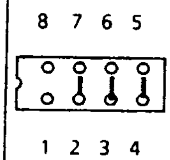
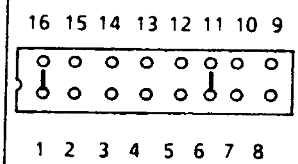
The software number 548.812....is labelled on the submodule.The individual link B3 is open, links B1, B2, B4 have no significance.

Attention: The former memory module 6FX 1120- 2CA00 for the basic version 4B cannot be used in conjunction with basic version 4C.

Jumpering of the memory module 6FX 1120- 2CA01 for basic version 4B and 4C.

Jumper type	Designation	Meaning	Sinumerik System 3T/M version 4B	version 4C
Jumper links	S2	System select		
		With memory expansion (option C45 or C46)		—
Jumper links	S1	Wait 8 MHz		
Jumper links	S3...S6	Module address	S3 S4 S5 S6 	S3 S4 S5 S6 

Special jumpers:

Jumper links	S2	RAM expansion		—
Jumper links	S1	Wait 5 MHz		—

Applicable submodules:

System	Module 1	Module 2	Module 3
Version 4B Basic board	6FX 1126 - 0BB00 - 0BD00 - 0BD01		6FX 1126 - 0BL00
Version 4B RAM expansion	6FX 1126 - 0BC00		———
Version 4C	6FX 1135 - 3BC00	6FX 1128 - 4BA00	6FX 1128 - 4BB00

9.5 Measuring circuit modules

9.5.1 Overview arranged according to type designation

Application with 3M or 3T with C-axis	03316 03326	03315 03325	03310 A/B 03323
Application with 3T	03351	03350	03310 A 03323
Remark	works at 8 and 5 MHz 14 bit DAC	works at 5 MHz only 14 bit DAC	works at 5 MHz only 12 bit DAC
Application with basic model 4A/4B/4C	4A, 4B and 4C	4A	4A

Remark: Type 03340 (12 bit DAC) was only dispatched in low numbers.
For jumpering refer to Commissioning Instruction, Part 1. With basic model 4A, link 8-9 on S3 must be open.
The module can not be used with basic model 4B.

9.5.2 Measuring circuit-actual value processing module 6FX 1125-1AA00 (03315)

Replacement type for 03310, cannot be used with basic model 4B/8 MHz or 4C.

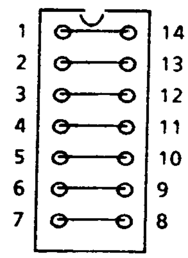
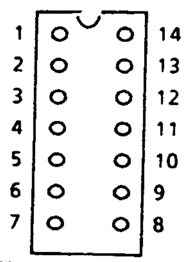
- 4 actual value inputs
- 1 measuring probe input
- To be used together with PCB 03325
- ULA circuits
- Integrated EXE can be fitted
- 5 MHz

Fixed jumpers:

Type	Designation	Signal	Closed/open	Remark
Individual link	S3	SFBG1	closed	Address
"	S4	SFBG2	open	"
Individual link	WS1		open	
"	WS2		"	
"	L-K	Mext-Mint	"	
Individual link	W1		open	Wait
"	W2		"	"
"	W3		closed *	"
"	W4		open	"

* Link E3 on the track of the printed circuit board

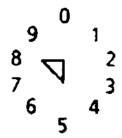
Fixed jumpers for EXE:

Type	Designation	Signal Meaning	without Option integr. EXE	with Option integrated EXE
Socket	1-14	-	closed	open
X3 - X-axis	2-13	*SDMB	"	"
X1 - Y-axis	3-12	SDMB	"	"
X2 - Z-axis	4-11	*SDMA	"	"
X4 - 4th-axis	5-10	SDMA	"	"
	6-9	*SDMZ	"	"
without Opt.	7-8	SDMZ	"	"
				
with Option				
				

Variable adjustments for measuring probe

Type	Designation	Signal	Standard setting	Standard setting
Solder pins "	A - B/R 32 C - D/R 33 E - F		A o-[1,5k]--o B C o open o D E o open o F	Different adjustments according to type of measuring probe output Refer to Section 8 (Interface)

9.5.3 <u>Measuring circuit-actual value processing module 6FX 1125-1AA01 (03316)</u>
like 03 315, however for 8 MHz.

Type	Designation	Signal	Closed/open	Remark
Socket X1:2ndaxis (Y) X2:3rdaxis (Z) X3:1staxis (X) X4:4thaxis(4th)	1-16 2-15 3-14 4-13 5-12 6-11 7-10 8-9	*SDMB SDMB *SDMA SDMA *SDMZ SDMZ - -	Closed without integrated EXE Open with integrated EXE	
Rotary switch	S3	Module address		
Individual link	WS1 WS2		open open	PCB modification version
PCB track link	W1 W2 W3 W4	*RDY	closed open open open	Waits
Individual link	W5 W6	*CSINI *IR 1.		

For jumpering of the input for measuring probe refer to Section 8, page 15.

With PROM 548 817. 7348. 03 fitted on location D48 and

548 817. 7347. 03 fitted on location D49.

9.5.4 Measuring circuit-command value processing module 6FX 1123-7AA00 (03325)

Replacement type for 03323, cannot be used with basic model 4B/8 MHz or 4C.

- 1 Actual value input
- 5 Command value outputs
- 14 Bit DAC, 1 VELO = $\frac{10V}{8192}$
- ULA circuits
- To be used together with PCB 03315 only
- 5 MHz

…xed jumpers:

Type	Designation	Signal	Closed/open	Remark
Individual link	S1	SFBG1	closed	Address
"	S2	SFBG2	open	"
Individual link	L-K	M-EXT	open	
"	R-S	M-EXT	"	
"	R-U *	0 V	closed	

* link on PCB track

Fixed jumpers:

Type	Designation	Signal	Closed/open	Remark
Individual link	WW1		open	Wait
"	WW2		"	"
"	WW3		closed *	"
"	WW4		"	"
Individual link	W13		open	-
"	W14		"	-

* links WW3 and WW4 are tracks on PCB

Adjustable jumpers for command value output:

Type	Designation	Signals	Meaning	Standard setting	Remark
Individual link	W7	CVG1	1st axis	closed	For further information refer to Section 8 (Interface)
"	W8	0 V	1st axis	"	
"	W11	CVG2	2nd axis	"	
"	W12	0 V	2nd axis	"	
"	W3	CVG3	3rd axis	"	
"	W4	0 V	3rd axis	"	
"	W9	CVG4	4th axis	"	
"	W10	0 V	4th axis	"	
"	W1	CVG5	5th axis	"	
"	W2	0 V	5th axis	"	
"	W5	CVG6	Reserve	"	
"	W6	0 V	Reserve	"	

Attention: There are no solder pins fitted for these links

Adjustable jumpers for servo ready simulation:

Type	Designation	Signal	Standard setting Signal servo ready	Special setting
			provided by the drive	not provided
Solder pins	P-N		open	closed

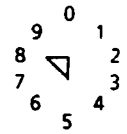
Adjustable jumpers for input of the measuring probe: not used

Jumpers for command value output:

Type	Designation	Signal	Standard setting	Special setting
Solder pins	A-B/C33	Command val. 1	open	For further in-formation refer to Section 8 (Interface)
	A-B/C49	Command val. 2	"	
"	A-B/C19	Command val. 3	"	
"	A-B/C41	Command val. 4	"	
"	A-B/C7	Command val. 5	"	
"	A-B/C27	Reserve	"	
Solder pins	A-B/R26	Command val. 1	A o-[10k]-o B	For further information refer to section 8 (Interface)
	A-B/R36	Command val. 2	"	
"	A-B/R16	Command val. 3	"	
"	A-B/R31	Command val. 4	"	
"	A-B/R11	Command val. 5	"	
"	A-B/R21	Reserve	open	

9.5.5 Measuring circuit-command value processing module 6FX 1123-7AA01 (03326)

like 03 325, however, for 8 MHz

Type	Designation	Signal	Closed/open	Remark
Rotary switch	S1	Module address		
Individual link	W2 W4 W6 W8 W10 W12	AGND	closed " " " " "	0V for switching the command value to 0. For special application and jumpering refer to Section 8
"	W13 W14		open open	PCB modification version
"	WW1 WW2 WW3 WW4		closed open open open	Waits
Individual link	P-N	*SRDY	closed: open:	Servo ready simulation on the module *SRDY must be provided from external (drives)
"	R 60 R 63	*CSINI *IR 1	open open	

Jumpers for the measuring probe: not used

With PROM 548 817. 7336. 03 fitted on location D36 and

548 817. 7736. 03 fitted on location D38.

9.5.6 Measuring circuit module 6FX 1111-1AA00 (03350)

Replacement type for 03310/03323, cannot be used with basic model 4B/8 MHz or 4C.

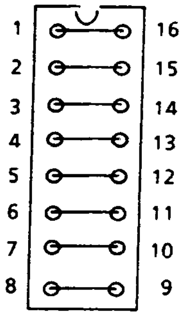
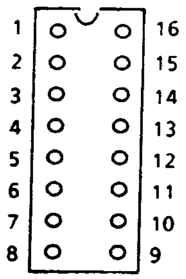
- 3 Actual value inputs
- 3 Command value outputs
- 14 Bit DAC, 1 VELO = $\frac{10V}{8192}$
- ULA circuits
- Integrated EXE can be fitted
- 1 Input for measuring probe
- Model 3T requires only this measuring module
- 5 MHz

Fixed jumpers:

Type	Designation	Signal	Closed/open	Remark
Individual link	S1	-	open	
"	S2	-	"	
Individual link	S3	SFBG1	closed	Address
"	S4	SFBG2	open	"
Individual link	L-K	M-EXT	open	
"	R-S	M-EXT	"	
"	V-W	M-EXT	"	
"	T-U	0 V	closed *	
Individual link	W7		open	Wait
"	W8		"	
"	W9		closed *	
"	W10		open	

* Connection W9 and link T-U are tracks on the PCB

Fixed jumpers for EXE

Type	Designation	Signal	Without option integr. EXE	With option integrated EXE
Socket	1-16	-	closed	open
X1: Z-Achse	2-15	-	"	"
X3: X-Achse	3-14	*SDMB	"	"
	4-13	SDMB	"	"
Without option	5-12	*SDMA	"	"
	6-11	SDMA	"	"
	7-10	*SDMZ	"	"
	8-9	SDMZ	"	"
With option				
				

Socket X2 for spindle, always without integrated EXE.

Adjustable settings for measuring probe (refer to module 03315)

Adjustable jumper for servo ready simulation (refer to module 03325)

Adjustable jumpers for command value output:

Type	Designation	Signal	Meaning: Command value	Standard setting	Special setting
Individual link	W1	CVG1	1st axis	closed	For further information refer to Section 8 (Interface)
"	W2	0 V	1st axis	"	
"	W3	CVG2	2nd axis	"	
"	W4	0 V	2nd axis	"	
"	W5	CVG3	3rd axis	"	
"	W6	0 V	3rd axis	"	

Attention: There are no solder pins provided for these links

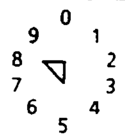
Adjustment for command value output:

Type	Designation	Meaning: Command value	Standard setting	Special setting
Solder pins	A-B/C18	Command value 1	open	For further information refer to Section 8 (Interface)
"	A-B/C19	Command value 2	"	
"	A-B/C35	Command value 3	"	
Solder pins	A-B/R21	Command value 1	10k R21	For further information refer to Section 8 (Interface)
"	A-B/R22	Command value 2	10k R22	
"	A-B/R23	Command value 3	10k R23	

9.5.7 <u>Combined actual value/command value measuring circuit module</u>

<u>6FX 1111-1AA01 (03351)</u>

like 03 350, however for 8 MHz.

Type	Designation	Signal	Closed/open	Remark
Individual link	S1 S2	- -	open open	PCB modification version
"	P-N	*SRDY	closed: With servo ready simulation open: With servo ready supplied from external (drives)	
"	R54 R59	*CSINI *IR 1	open open	
Rotary switch	S3	Module adress		
Individual link	W2 W4 W6	AGND	closed closed closed	0V for command value. For special application and jumpering refer to Section 8
"	W7 W8 W9 W10		closed open open open	Waits
Socket X1: 2^{nd} axis X2: 3^{rd} axis X3: 1^{st} axis	1-16 2-15 3-14 4-13 5-12 6-11 7-10 8-9	- - *SDMB SDMB *SDMA SDMA *SDMZ SDMZ	All links closed: <u>without</u> integrated EXE All links open: <u>with</u> integrated EXE	

For adjustments for the various measuring probes refer to Section 8, page 15.

With PROM 548 817. 7348. 03 fitted on location D48 and

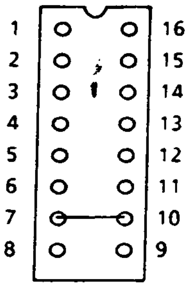
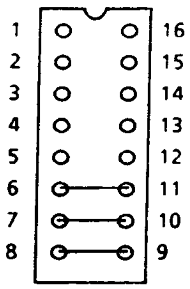
548 817. 7348. 03 fitted on location D49.

9.5.8 Measuring circuit module (actual value) 6FX 1120-1A..01 (03311 A/B/C)

Previous type of 03315/03350. For basic version 4A only.

- Module for 2 or 4 actual values
- To be used together with module 03320/03322/03323
- 5 MHz

Fixed jumpers:

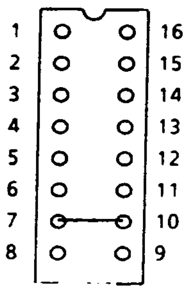
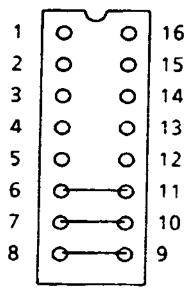
Type	Designation	Signals	Closed/open	Remark
Socket X5	1 - 16		open	Addr. 0
	2 - 15		"	Addr. 10
	3 - 14		"	Addr. 6
	4 - 13		"	Addr. 9
	5 - 12		"	Addr. 7
	6 - 11		"	Addr. 19
	7 - 10		closed	Addr. 8
	8 - 9		open	Addr. 5
Socket X6	1 - 16		open	Addr. 18
	2 - 15		"	Addr. 11
	3 - 14		"	Addr. 17
	4 - 13		"	Addr. 12
	5 - 12		"	Addr. 16
	6 - 11		closed	Addr. 13
	7 - 10		"	Addr. 15
	8 - 9		"	Addr. 14
Individual link	P-R	SCLKSM	open	5 MHz

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remarks
Individual link	W0	Wait 0	open	
"	W1	Wait 1	closed	
"	W2	Wait 2	open	
Individual link	C-D		open	03310 A
"	C-D		closed	03310 B

Remark: In the event of more than 3 actual values, the module 03310 B is mounted pick-a-back onto the module 03310 A. Both modules have the same jumpers except for the pins C-D.

Adjustable jumpers

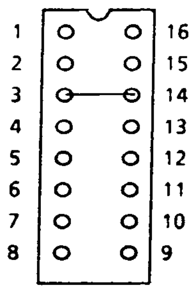
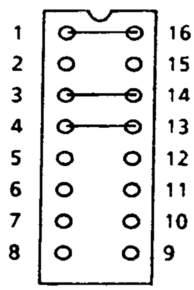
Type	Designation	Signals	Standard setting encoder actual value diff. input	Special setting encoder actual value with TTL signals
Socket X1 and X2 Standard jumpers  Special jumpers 	1 - 16	*DMA	closed	open
	2 - 15	*DMB	"	"
	3 - 14	*DMZ	"	"
	4 - 13	IDMA	"	closed
	5 - 12	IDMB	"	"
	6 - 11	DMA	open	"
	7 - 10	DMB	"	"
	8 - 9	DMZ	"	"

9.5.9 Measuring circuit (command value) module 6FX 1120-2AA03/-2AB03 (03323 A/B):

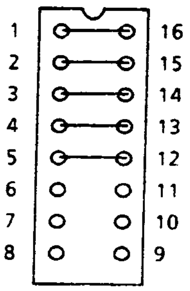
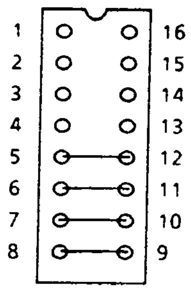
Previous type of 03325/03350. For basic version 4A only.

- 1actual value input
- 5 command value outputs
- 12 bit DAC 1 VELO = $\frac{10V}{2048}$
- To be used together with module 03310 or 03311 only
- 5 MHz

Fixed jumpers

Type	Designation	Signals	Closed/open	Remark
Individual link	AF-AE	1 Wait	closed	
"	AD-AC	0 Wait	open	
"	AH-AG	2 Wait	"	
"	AA-AB	SCLk5M	"	
Socket	1 - 16		open	Addr. 19
X2	2 - 15		open	Addr. 10
	3 - 14		closed	Addr. 8
	4 - 13		open	Addr. 9
	5 - 12		"	Addr. 5
	6 - 11		"	Addr. 6
	7 - 10		"	Addr. 7
	8 - 9		"	Addr. 3
Socket	1 - 16		closed	Addr. 13
X3	2 - 15		open	Addr. 12
	3 - 14		closed	Addr. 15
	4 - 13		"	Addr. 14
	5 - 12		open	Addr. 17
	6 - 11		"	Addr. 16
	7 - 10		"	Addr. 18
	8 - 9		"	Addr. 11

Adjustable jumpers

Type	Designation	Signals	Standard setting encoder actual value diff. input	Special setting encoder actual value TTL signal input
Socket X1 Standard jumpers	1 - 16	*DMA	closed	open
	2 - 15	*DMB	"	"
	3 - 14	*DMZ	"	"
	4 - 13	IDMA	"	closed
	5 - 12	IDMB	"	"
	6 - 11	DMA	open	"
	7 - 10	DMB	"	"
	8 - 9	DMZ	"	"
Special jumpers				
				

Type	Designation	Signal	Standard setting Signal servo ready	Special setting
			provided by the drive	not provided
Soldering pin	P-N	Servo ready simulation	open	closed

Measuring point

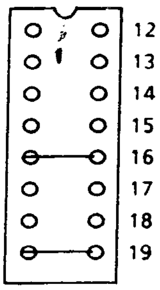
Type	Designation	Signal	Remark
Pin	T, W, Z, D, G	CVS 1...5	Command val. axis 1..5
"	S, V, Y, C, F	(internal)	Enable axis 1...5
"	Q, R, U, E, L	*SEEN 1...5	Servo enable axis 1...5
"	X	*NC-ready	NC-ready simulation

9.6 Operator panel interface

9.6.1 Video interface module 6FX 1115-0AA01 (03811)

- 5 MHz
- For connection of the operator panel
- 2 connectors on the front plate

Fixed jumpers

Type	Designation	Signal	Closed/open	Remark
Socket	12		open	Addr. 12
S2	13		"	Addr. 13
	14		"	Addr. 14
	15		"	Addr. 15
	16		closed	Addr. 16
	17		open	Addr. 17
	18		"	Addr. 18
	19		closed	Addr. 19
Individual link	A-B		open	Hardware identif.
"	C-D		"	"
"	E-F		"	M-screen
"	G-H		"	External clock
"	K-L		closed	Screen blanking
"	M-N		open	"
	S1	VAB9		Operating mode

Comment: The module 03810 can also be used with basic model 4A. Refer to Commissioning Instructions, Part 1.

9.6.2 Video interface module 6FX 1115-0AB01

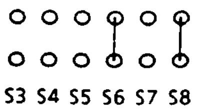
Like 6FX 1115-0AA01, however for 5 and 8 MHz.

9.6.3 Video interface module 6FX 1115-0AA02 (03811)

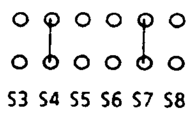
- To be used in 8 MHz and 5 MHz version (basic model 4A, 4B or 4C)

Jumpers:

5 MHz



8 MHz



All other jumpers as with 6FX 1115-0AA01

9.6.4 Video interface (colour graphics) module

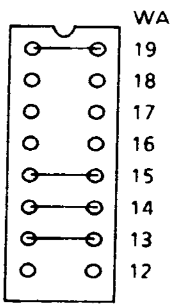
6FX 1125-5AA01/02 (03805/03806)

Used for basic model 4A.

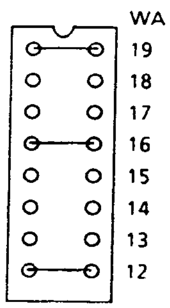
The module is fitted in conjunction with the colour monitor for colour graphics. Pay attention to the jumpering on module 03841.

Jumpers:

Socket X1



Socket X2



Individual links:
closed: W-F, W-I
open: A-B, C-D, W3, W4, W5, W6, WSW, WNI

9.6.5 Video interface (colour graphics) module 6FX 1125-5AB01/02 (03806)

Used for basic model 4B.

Jumpering as with module -5AA01.

With character PROM: 548 817 7880.

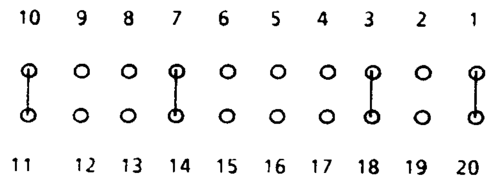
9.6.6 Video interface (monochrome graphics) module 6FX 1123-2AA00/01 (03815/03816):

Used for basic model 4A.

The module is fitted at monochrome graphics.

Pay attention to the jumpering on module 03841.

Jumpers: Socket P2



Individual links:
closed:W-I
open: WNI, W-B

9.6.7 Video interface (monochrome graphics) module 6FX 1123-2AB01 (03816):

Used for basic model 4A, 4B or 4C

Jumpering as with module -2AA01

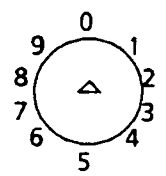
With character PROM: 548 817 7803.

9.7 Coupling modules:

9.7.1 NC coupling module 6FX 1122-1AA01/02 (03831)

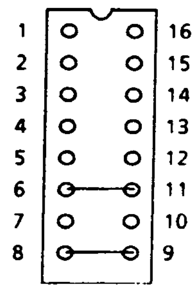
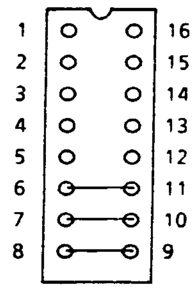
- Module is fitted in the PLC section
- Used for coupling to the NC:
  With 3T and 3M coupling via the bus back plane.
  With 3TT and 3T/3M with expanded I/0 area coupling via cable and front connector X832 (03830)- X842 (03840).
- Coupling RAM for data exchange NC-PLC
- Service switch S1

S1:



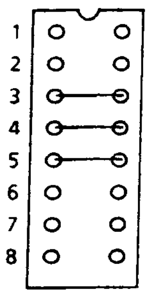
Normally set to position 0
For further information refer to Section 4.

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remark
Socket P2	1 - 16	ADR 12	open	NC-Address
	2 - 15	ADR 13	"	"
	3 - 14	ADR 14	"	"
	4 - 13	ADR 15	"	"
	5 - 12	ADR 16	"	"
	6 - 11	ADR 17	closed	"
	7 - 10	ADR 18	open	"
	8 - 9	ADR 19	closed	"
One PLC in one tier				
Socket P3	1 - 16	-	open	
	2 - 15	-	"	
	3 - 14	-	"	
	4 - 13	ADR 11	"	PLC-address
	5 - 12	ADR 12	"	"
	6 - 11	ADR 13	closed	"
	7 - 10	ADR 14	"	"
	8 - 9	ADR 15	"	"
Individual link	C - D	KCLK2M	open	CLK 2MHz (PLC)
"	E - F	0 V	"	Board select
"	G - H	KCLK5M	"	CLK 5MHz (NC)
"	L - K	0 V	"	2k/1k

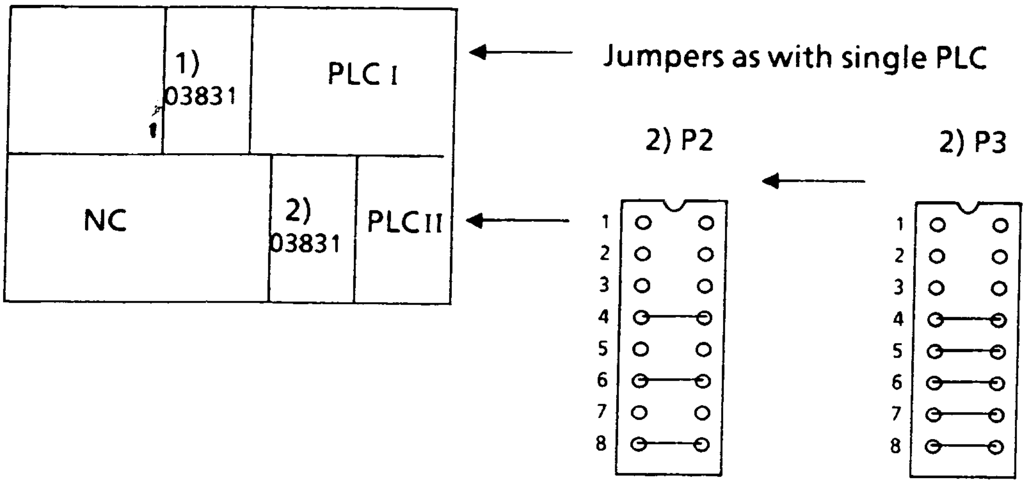
Jumpering of P2 with dual PLC (PLC I and PLC II in the same tier)

Socket P2:



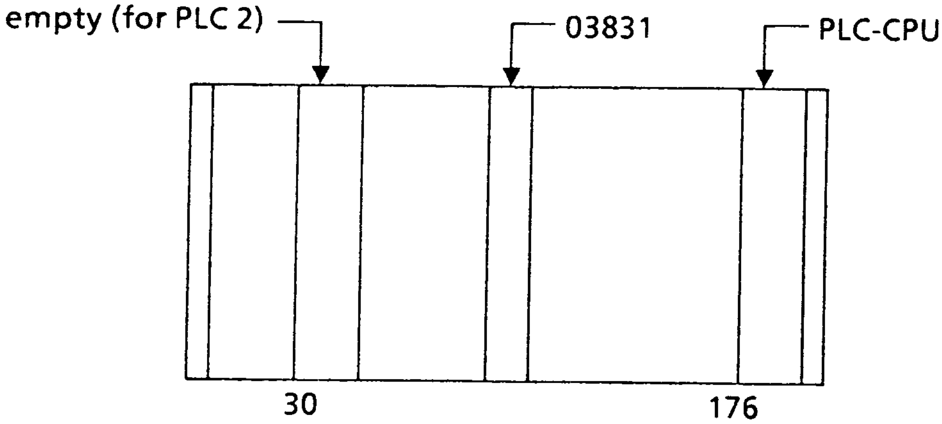
Attention:
In case of an external dual PLC, socket P2 must be jumpered as with single PLC.

Jumpers with option N35: Valid only for deliveries prior to 1987. The second 03831 board is no longer fitted from 1987 on.



1) Jumpering of P2 and P3 as specified for one PLC in one tier.
   P2 : 6-11, 8-9 closed
   P3 : 6-11, 7-10, 8-9 closed
2) Jumpering of P2 and P3 as specified with option N35

A PLC rack can also be prepared for a dual PLC to be retrofitted:

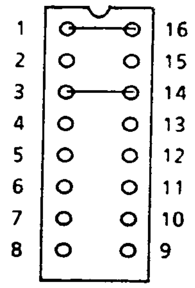
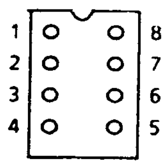
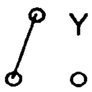


The PLC-CPU is fitted in slot 176 (a standard single PLC is fitted in slot 70).
Basic PLC program as with single PLC.
Jumpering of P2 on module 03831 as with dual PLC.

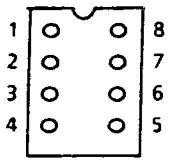
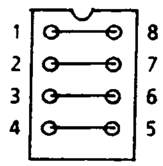
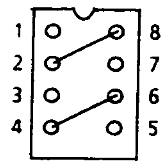
9.7.2 Coupling module 6FX 1122-2AA01/02 (03841/03842) or 6FX 1122 - 1AC02

- Module is fitted in the NC section
- Used from coupling to the PLC (see module 03831)
- Connector X842 for connecting a PLC rack (expanded I/0 area)
- Connector X843 for the serial interface (V.24, RS232)
- Machine data protection switch S1 on the front plate
- 2 LEDs for monitoring of the CPU (refer to Section 4)
- Temperature monitoring (threshold one)
- Sliding switches S2 for activation of the test module and other functions.
- 5 MHz version (to be used for basic model 4A)
- Quartz 14,8 MHz for clock generator

xed jumpers

Type	Designation	Signales	Closed/open	Remark
Socket P4 	1 - 16 2 - 15 3 - 14 4 - 13 5 - 12 6 - 11 7 - 10 8 - 9	ADR 19 ADR 18 ADR 17 ADR 16 ADR 15 ADR 13/14 - -	closed open closed open " " " "	Address " " " " " " "
Socket P3 	1 - 8 2 - 7 3 - 6 4 - 5		open " " "	Check points " " "
Individual link " "	M - N R - S  Y X W	0 V IREX 0 V	closed open Y-X = closed	NC-version Bus switchover

Adjustable jumpers

Type	Designation	Signals	Standard setting NC is active for the serial interface (RS232,TT4) supply	Special setting NC is passive for the serial interface (RS232,TTY) supply.
Socket P2 	1 - 8 2 - 7 3 - 6 4 - 5	0 V TTY 1 TTY 3 0 V		

Sliding switches S2 for jumpering of:

Slide switch	Open	Closed
1	NC1/NC2	NC3/NC4
2	PLC internal PLC and NC in the same tier	PLC external PLC in a separate tier
3	3M/3T	3T/C200
4	Without test module	With test module active for NC1/NC3
5	Without test module	Without module and graphics active for NC1/NC3
6	Without graphics NC1/NC3	With graphics NC1/NC3
7	Without test module	With test module active for NC2/NC4 aktiv
8	Without test module	With test module and graphics active for NC2/NC4
9	Without graphics NC2/NC4	With graphics NC2/NC4
0	5 MHz	8 MHz

9.7.3. Coupling module 6FX 1122- 2AK02

- Module used for 3TE, 3TTE or 3ME (Export version) 5 MHz, all other specifications as with 6FX 1122- 2AA01/02

9.7.4 PLC coupling module 6FX 1122-2AB01/02 (03841/03842), -2AC02, -2AD02, -2AM02.

- 8 MHz version for basic model 4B or 4C
- Jumpering as with -2AA01/02
- Slide switch S2.0 must be closed for basic model 4B/8MHz
- Slide switch S2.0 has no significance in case of basic model 4C (operates always at 8 MHz)
- Quartz 24 M
- Module -2AC02 or -2AM02 are used for export versions 3TE, 3TTE, 3ME.

9.7.5 Coupling module 6FX 1120-3BB01/3BA01 (03845)

6FX 1120-3BB00 6FX 1120-3BB01 6FX 1120-3BE00	*)	6FX 1120-3BA00 6FX 1120-3BA01 6FX 1120-3BD00	**)

*) = > used as expansion unit interface (EU-IF)
*) = > used as central controller interface (CC-IF)
**) = > used as periphery interface

The coupling module 6FX1120-3BB00/B01/E00 is always fitted in the PLC section of the control (PLC = > PROGRAMMABLE LOGIC CONTROL) . It is used for data exchange between the central unit (PLC) and the expansion unit (EU) or between two central units (1st PLC and 2nd PLC). The addresses, data, and control signals are transferred as differential signals.

Transmission distance: maximum 1m with ribbon cable
maximum 50m round cable (twisted pair).

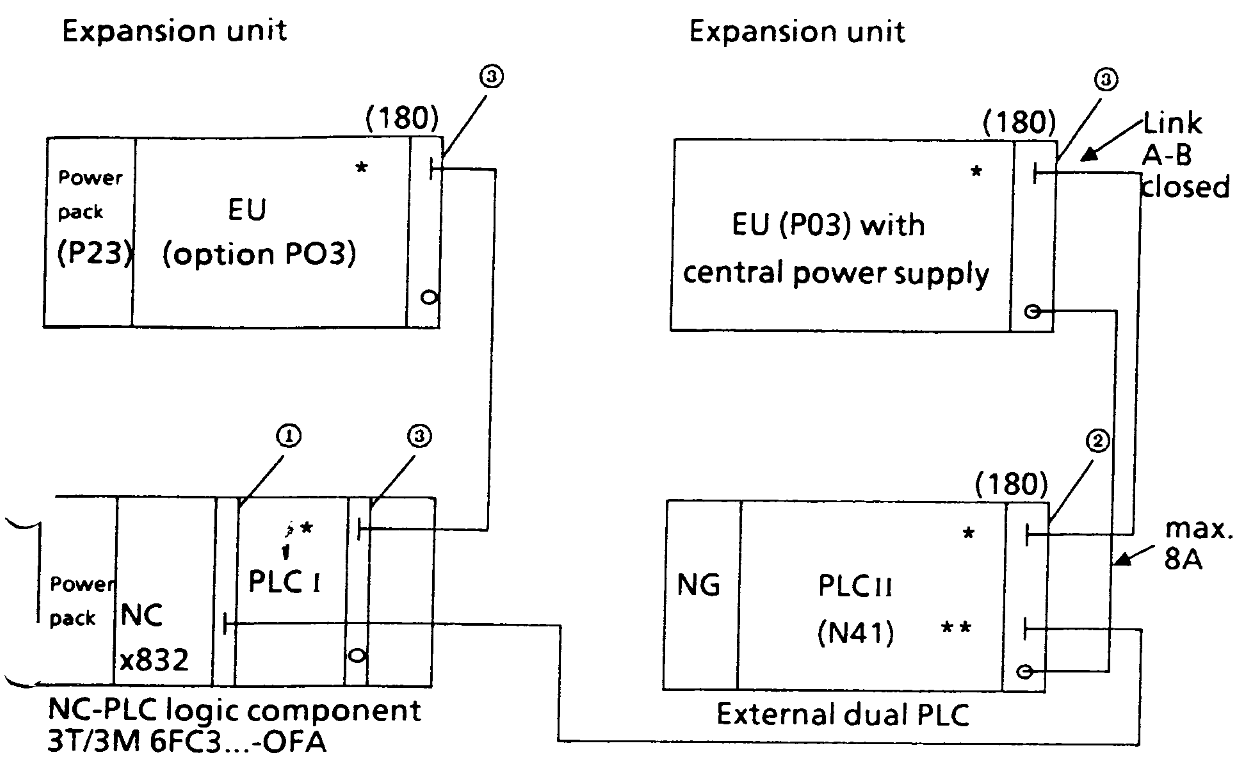
- Front connector X03848 for EU-IF or CC-IF
- Front connector X03847 for periphery interface. This connector is only available with 6FX 1120-3BA00.
- 5V power supply for EU without own power pack: maximum 8A. Cable cross section 6 mm^2, maximum length 1m to central power supply.

Cable cross section	minimum: 6 mm^2
Cable length	maximum: 1 m

There is no greater cable length permitted in order to avoid noise disturbances!

Note: A current balance has to be carried out for the expansion unit. The power pack of the central controller can only supply maximum 8A for the expansion unit and the interface of the board is also rated for this amount of current only.

Application example:



① NC coupling module 6FX 1122-1AA01 (03831)

② PLC/PLC coupling module 6FX 1120-3BA01 (03845A)

③ CC/EU interface 6FX 1120-3BB01 (03845B)

* Connector X03 848

** Connector X03 847

The module 6ES5-310-3 can also be fitted in the EU. Via the module 03845 an "Electronic terminator" EKL 484 can be linked on instead of the EU.

mpers:

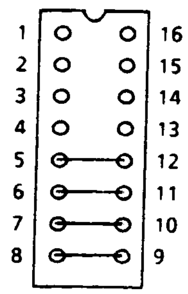
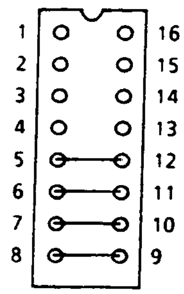
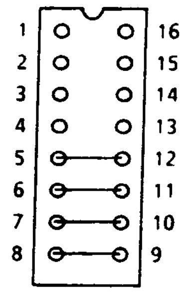
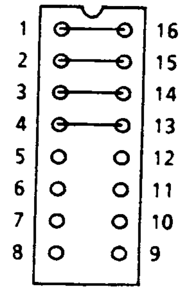
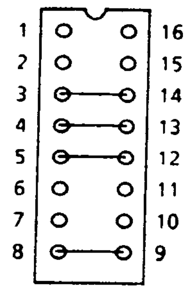
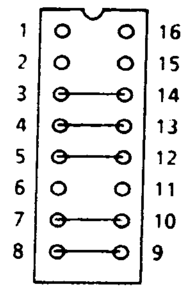
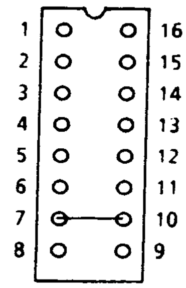
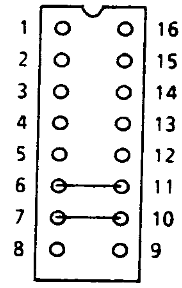
Link A-B: If the coupling module is used with central power supply this link on the module (CC-IF) has to be closed.

k C-D: If the module is used with the type of back plane 6FX 1127- 7AA- - (dual PLC) on location 76 and 156 or 6FX 1122-8AA00 (01600) the link has to be open.
In all other cases the link is closed.

Link E-F,G-H: no significance (link open)

With dual PLC and central power supply:

- Place the coupling module on location 156 of PLC I (left hand next to PU interface).
  Link C-D open.
- Place the coupling module on location 76 of PLC II (left hand next to 03831).
  Link C-D open.

Version	6FX 1120-3BA01		6FX 1120-3BB01	
Module fitted in:	CC without EU	CC with EU	CC (EU-IF)	EU (CC-IF)
Socket X1				
Socket X2				

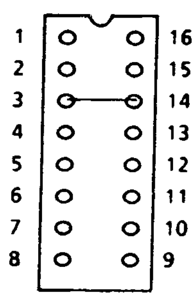
9.7.6 Coupling module for expansion unit 6FX 1191-0AB00 (03800B)

Used for connection of the PLC expansion unit at NC without expanded I/0 area. Pay attention to revision bulletins H 3057, H 3058 and manufacturing version C of the power pack 03502.

This module was replaced by type 6FX1120-3BB00/01.

This module was only used in basic model 4A.

Fixed jumpers

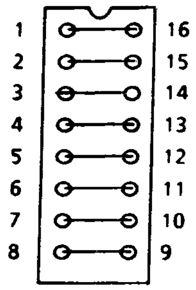
Type	Designation	Signals	Closed/open	Remarks
Socket P1 	1 - 16		open	
	2 - 15		"	
	3 - 14		closed	+ 5 V
	4 - 13		open	
	5 - 12		"	
	6 - 11		"	
	7 - 10		"	
	8 - 9		"	

9.8 Power packs

9.8.1 Power pack 6EV 3054-0CC (03502):

- Power pack for the logics component
- External supply voltage +24V DC (tolerance 20...30V) to be connected to terminals C1 and D1 (M).
- Output voltages : +5V, maximum current rating 25A
  +15V, maximum current rating 0.3A
  -15V, maximum current rating 0.3A
- NC - ON push button to be connected to terminals G, H
- LED "Fault Output Voltage": This LED lights up on actuating of the "Fault Monitoring" push button, if any one of the three output voltages were causing the drip- out of the power pack. The LED remains dark in the event of an input voltage failure.
- "Reset" push button for performing a general hardware system reset.
- "5V Reference" potentiometer for adjusting the 5V output voltage to approx. 5.15 - 5.25V.
- "Nominal Current 25A ≙ 10" socket for measuring the 5V loading of the power pack.
- " + 5V"and "M"sockets for checking the 5V output voltage.
- Puffer battery 3.6V/5Ah located within the power pack behind a metal cover plate.
- Battery monitoring: Refer to Section 4

Fixed jumpers for 03502:

Type	Designation	Closed/open	Remark
Socket	1 - 16	closed	Clear
X1	2 - 15	"	Under voltage + 24 V
	3 - 14	"	Under voltage + 5 V
	4 - 13	"	Under voltage + 15 V
	5 - 12	"	Under voltage + 5 V
	6 - 11	"	Under voltage - 15 V
	7 - 10	"	Under voltage - 15 V
	8 - 9	"	Group signal
Individual link	S-T	closed	Thyristor (Overvltg. 5V)
"	Z-Y 1)	"	Battery voltage
"	ZA-ZB	"	+ 15 V monitoring
"	ZC-ZD	"	- 15 V monitoring
"	ZY-ZZ	"	VCC RAM
"	X6	"	Monitoring
"	ZG-ZH 2)	"	Current limitation

1) Designation U-V in case of power pack 03501

2) This link does not exist in case of power pack 03501

Sockets X2 and X3 are used for works testing.

9.8.2 Power pack 6EV 3054-0DC

Replacement type for 6 EV 3054-0CC, battery in PVC- box on front plate

Socket X1: closed 1-16, 2-15, 3-14, 4-13, 5-12, 6-11, 7-10, 8-9

Individual links: closed S1, E-F, AA-AB, A-R98-B

All other jumpers as with 6EV 3054- 0CC

9.8.3. Power pack 6EV 3054- 0FC

Replacement type for 6EV 3054- 0DC

Battery box as with 6EV 3054- 0DC

Jumpers and connections as with 6EV 3054- 0DC

9.8.4 Power pack 6EV 3113-0AD (03510)

Power pack on the operator panel

No jumpers

9.8.5 Power pack 6EV 3114-0AD

Power pack on the operator panel

Replacement type of 6 EV 3113-OAD

No jumpers

9.9 Operator panel

9.9.1 Operator panel module 6FX 1125-7AA01 (03731)

Replacement type for module 03780

Operator panel interface for monochrome- and colour monitor.

With application of the customer I/0 module, this operator panel interface must be used.

+ 24V DC supply required for the operator panel (fuse 2.5A)

Potentiometer R36: With the Mitsui - monitor type for adjustment of the brightness. No function with the Sampo - monitor type or with a colour monitor.

Potentiometer R10: For the contrast adjustment with monochrome monitor. With colour monitor the contrast is adjusted on the monitor PCB.

Potentiometer R8, R9: No significance.

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remarks
Individual link	A B	0 V	open	
"	E		E-D closed	monochrome monitor
"	C D			
"	F G	0 V	closed	monochrome monitor
"	H K	0 V	"	
"	L M		open	for VIDEO G
"	O P		"	for VIDEO R
"	S T		"	for VIDEO B

Fom redesign version E on, the potentiometers R8 and R9 do not exist and the individual links O - P and S - T are bridged by an 0 Ohm resistor.

From redesign version F on, the potentiometer R36 is no longer fitted. In conjunction with a MITSUI monitor this potentiometer need to be retrofitted on replacement of the module.

9.9.2 Operating panel 6FX 1125-AB01

Replacement type for 6FX 1125-AA01

Specifications and jumpering as with module 6FX 1125-AA01, redesign version F.

9.9.3 Operating panel 6FX 1115-0AAD (03781)

Operating panel interface (previous type)
Fixed jumpering
Individual link A-B closed
Fuse 2.5 A (medium time-lag) 24V
Potentiometer R17 for adjustment of contrast.
Potentiometer R18 for adjustment of brightness.
This module can not be used in conjunction with customer I/0 module or colour graphics.

9.9.4 Operating panel keyboard 6FX 1120-5AA00 (03770)

Module with keyboard fitted on the operating panel
No jumpers

9.9.5 Monitors

The following monitors are used:	Former type	New type
9 inch monochrome	(MITSUI)	SAMPO
12 inch monochrome	(MITSUI)	SAMPO
12 inch colour	(MITSUBISHI)	SAMPO

The former monitors are replaced since 11/86 by a new type (SAMPO).
Only this new monitor can be supplied as spare part.

Spare part packages: Monitor spare part packages for System 3 (mechanical conversion kit included)

- 6FC3981-7DS
  9 inch monitor, monochrome
  (b/w), (15V DC)

- 6FC3981-7DT
  12 inch monitor, monochrome
  (b/w), 220V AC

- 6FC3981-7DU
  12 inch monitor, colour 220V AC

Note that the new 12 inch monochrome monitors require a 220V power supply.
Both version of the colour monitors require a 220V power supply.
For adjustment of the monitors refer to Section 4.9.

9.10 Machine control panel 6FX 1118-8A 01 (03721)

6FX 1118-8AC01 (03721 C) with 03635 for 3M
6FX 1118-8AD01 (03721 D) with 03635 for 3T

Type 03721 A with 03631 for 3M
03721 B with 03631 for 3T

These previous types do not allow the connection of a customer I/0 module.

The connecting module 6FX 1126-8AA00 (03635) is fitted on the machine control panel

9.11. Customer I/O modules:

9.11.1 Customer I/0 module 6FX 1124-6AA00 (02400A)

Comprises 64 inputs, 24V24
24 outputs, 0.5A each, 24V
8 outputs, 0.1 each, 24V

Maximum 2 customer I/0 modules can be connected to the NC operator panel

Address range: QB 48 - QB 55
IB 48 - IB 63

Terminal block X 02 403 for 24V and M

Fuse 6.3 A

The red LEDs flash at short circuit of the 0.5A outputs

LED	V37	V36	V35
Module 1	QB 48	QB 49	QB 50
Module 2	QB 52	QB 53	QB 54

Address coding: Rotary switch S1 and S2

Rotary switch	Module 1		Module 2		
	02400	02401	02400	02401	
Position S1	2	1	0	0	for inputs
Position S2	1	2	0	0	for outputs

Fixed jumpers

Type	Designation	Signal	Closed/open	Remark
Individual link	B 0	M	open	M inputs
Individual link	B 1	M	open	M outputs
Individual link	B 2	M	closed	M external
Individual link	A-B	*0PC RDY	open	

9.11.2 Customer I/O module 6FX 1124 - 6AA01 (02401A)
- 6AA02 (02401A)

Replacement type for 6FX 1124 - 6AA00

Setting of the rotary switches S1 and S2 for address coding

Rotary switch	Module 1	Module 2	
Position of S1	1	0	Inputs
Position of S2	1	0	Outputs

All other settings as with module 6FX 1124- 6AA00

9.11.3 Customer I/0 module 6FX 1124- 6AB00 (02400B)

-64 Inputs, 24V
-No outputs fitted
-Rotary switch S2 has no significance

Rotary switch	Module 1	Module 2
Position of S1	2	0

9.11.4 Customer I/O module 6 FX 1124 - 6AB01 (02401B)
- 6AB02 (02401B)

Replacement type for module 6FX 1124-6AB00

Rotary switch	Module 1	Module 2
Position of S1	1	0

9.12 Test module 6FX 1118-6AB01 (03220)

This module is not included in the scope of standard delivery of System 3

Fixed jumpers:

Type	Designation	Signals	Closed/open	Remark
Individual link	S16		closed	Addr. 16*
"	S17		open	Addr. 17
"	S18		"	Addr. 18*
"	S19		"	Addr. 19
Individual link	W4		closed	Wait 3
"	W1		open	Wait 0
"	W2		"	Wait 1
"	W3		"	Wait 2
"	W5		"	Wait 4

* With basic model 4A, link S16 is open and S18 closed.
With basic model 4B, link S16 is closed and S18 open.

9.13 System software for version 3T, 3TT and 3M

The EPROMs type 27256 are fitted on submodules which are plugged into the receptacles of the memory module (basic version 4B and 4C)

9.13.1 System software (standard functions) is contained in 4 EPROMs on the 1st submodule

Basic version	Standard system	Export system
4B	6FX 1820-0AX01	6FX 1820-7AX01
4C	6FX 1821-0AX02	6FX 1821-7AX02

9.13.2 System software and language software is contained in 4 EPROMs on the 2nd submodule

Language	Basic version 4B	Basic version 4C
English	6FX 1820-0AX02	6FX 1821-0AX03
German	6FX 1820-0AX12	6FX 1821-0AX13
French	6FX 1820-0AX22	6FX 1821-0AX23
Italian	6FX 1820-0AX32	6FX 1821-0AX33
Spanish	6FX 1820-0AX42	6FX 1821-0AX43
Dutch	6FX 1820-0AX52	6FX 1821-0AX53
Russian	6FX 1820-0AX62	6FX 1821-0AX63
Swedish	6FX 1820-0AX72	6FX 1821-0AX73

9.13.3 System software and language for basic model 4A is contained in 32 EPROMs, type 2532 fitted on an EPROM board.

Language	Standard system	Export system
English	6FC 3448-7AA	6FC 3448-7LA
German	6FC 3448-7AB	6FC 3448-7LB

For the graphics option, an additional module containing the system software 6FX 118-1AA02 is necessary.

9.13.4 PLC basic interface program software

Variant of PLC	In basic version 4A, 4B	In basic version 4C
Single PLC	6FX 1817-0AX15	6FX 1822-0AX15
Dual PLC I	6FX 1817-0AX16	6FX 1822-0AX16
Dual PLC II	6FX 1817-0AX17	6FX 1822-0AX17
Triple PLC	6FX 1817-0AX18	6FX 1822-0AX18

Chapter 10

-RS 232 peripheral devices-

Contents

10.1 Tape reader type T40/T50

Tape reader T50: GNT27, Reader with tape winder
Order code: B03
Retrofit order number: 6FC3 984-1FD

Tape reader T40: GNT28, Reader without winder, but with spooling drive
Order code: B02
Retrofit order number: 6FC3 984-1FC

Reading speed: max. 250 character/sec. (9600 baud)

Reading direction: Both devices read the tape from left to right.
If the direction needs to be changed, remove the resistor R1 on the rear board of T50

Mains supply: 220V + 10/-15 %, 47-63 Hz
For tape reels with maximum 175 mm outer diameter, corresponding to approx. 120 m punched tape (48000 punched tape characters).

Interface: RS232 full duplex (V.24, RS-232 C.)

Baud rates: 150, 300, 600, 1200, 2400, 4800, 9600 baud

Character format: 1 start bit, 8 data bits, 2 stop bits — character code: ISO oder EIA

Pin allocation:

```
Reader (pins, male):        SINUMERIK (sockets, female)
(25 - pole Cannon)             (25 - pole Cannon)
     PG  1 <------------------< 1 G
     TD  2 <------------------< 2 RxD
     CTS 5 <------------------< 5 RTS
     GND 7 <------------------< 7 Mext
```

Cable: Order number 6FC9 344-1P.

Machine data in NC for SYSTEM 3:
411 = 11000111 for 9600 baud.

Tape reader GNT 27/28 used as standard peripheral device

The new reader types do not work in handshaking mode anymore, in contrast to the former types. They are controlled as standard devices via the standardized RS232 interface. An on-the-character stop is therefore no longer possible. If several programs are punched out consecutively on one tape, as with program tapes created elsewhere, a space of approx. 20 blanks has to be left between them.

These blanks are automatically generated when programs are punched out from the SINUMERIK, provided the "tape output without leader" machine datum is not set.
These new tape reader types can make it necessary to modifiy already existing tapes in order to enable consecutive programs which are separated by a M02 or M30 only to be read.
Operating modes can be set on the reader module on the rear of the reader (GNT28) or on the hinged rear panel of the reader (GNT27).

For an automatic reader start by the NC via the DATA START key, the reader must be ready for operation. The "Reader Start" LED is bright in this case.

Adjustments on the reader type GNT27 (with winder)

The GNT27 reader is preadjusted in the works so that no modifications have to be carried out on the device as such. The reader is adjusted as standard device with 9600 baud.

Data format:	1 start bit
	8 data bits
	2 stop bits

The CTS (clear to send) signal is used

Setting of the data format on jumpers 27SO2.

The parity bit is generated and checked:

odd parity	Jumper : 1 and 5 with 6
even parity	Jumper : 5 with 6
no parity	Jumper : 1 OPEN

Stop - bit

1	Jumper : 4 with 6
2	Jumper : 4 OPEN

Word length:

5 bit	Jumper : 2 and 3 with 6
6 bit	Jumper : 2 with 6
7 bit	Jumper : 3 with 6
8 bit	Jumper : 2 and 3 OPEN

Jumpers 27PO1 are not used!

Setting of the baud rates on jumpers 27PO2

9600 baud	Jumper socket 2 and 5 fitted
4800 baud	Jumper socket 3 and 5 fitted
2400 baud	Jumper socket 4 and 5 fitted
1200 baud	Jumper socket 1 fitted
600 baud	Jumper socket 2 fitted
300 baud	Jumper socket 3 fitted
150 baud	Jumper socket 4 fitted

Attention: Only the above specified jumpers are to be fitted!

Adjustments on the reader type GNT 28 (without winder)

Switch assembly A:

CTS (clear to send) signal	SWA-1
used	CLOSED
not used	OPEN

DC1/DC3 control signals	SWA-2
not used	CLOSED
used	OPEN

Parity bit is generated and checked	SWA-4	SWA-5
odd	CLOSED	CLOSED
even	CLOSED	OPEN
no parity	OPEN	X

stop bit	SWA-6
1	CLOSED
2	OPEN

Word length	SWA-7	SWA-8
5 bit	CLOSED	CLOSED
6 bit	CLOSED	OPEN
7 bit	OPEN	CLOSED
8 bit	OPEN	OPEN

Switch SWA-3 is not used!

Switch assembly B

Setting of baud rates:

9600 baud	SWB-1	CLOSED
4800 baud	SWB-2	CLOSED
2400 baud	SWB-3	CLOSED
1200 baud	SWB-4	CLOSED
600 baud	SWB-5	CLOSED
300 baud	SWB-6	CLOSED
150 baud	SWB-7	CLOSED
75 baud	SWB-8	CLOSED

Attention: Only one switch is to be closed at a time!

Data back up on diskette

Using these new readers as standard devices allows part programs to be directly transferred from tape to diskette in the programmer by means of the TRANS PGIN software without going via the NC.

The standard cable (Order number 6FC9 340-7PC) specified in the TRANS PGIN description can be used for this purpose. Only the baudrate must be adjusted to 1200 baud on the jumper socket 27PO2.

The TRANS PGIN data transfer description, Order number 6FC3 981-7AJ, is available.

10.2. PG 675/685 connection to RS232 interface

General remarks

The PG 675/685 makes it possible to develop, load and document NC part programs on the basis of the CP/M-86 system software in conjunction with the TRANS PGIN software package and the Word star or VEDIT editors.

This User`s Guide is intended to help the first time user to master the above tasks and to simplify handling.

10.2.1 Diskette handling

After power-on, the CP/M-86 operating system is loaded from the system diskette located in floppy drive A:.

Formatting

Before a program can be stored on disk, the disk has to be formatted. Only diskettes without write protection can be formatted.

Call up via FORMAT

Call up:	A> Format	Return key
Answer:	CP/M-86 DISK FORMAT UTILITY VERSION 1.0 Type "C" to cancel Unformatted disk in drive B: ? (Y/N)	
Input:	Y or N (yes / no) after entering Y the system starts the format routine for the disk in drive B:.	
Answer:	Format started.	

After formatting the system asks if another disk is to be formatted. With the input N for no and the return key, the format function can be exited.

Change of disks

After each change of disk, CTRL C must be keyed in if you want to write on the new disk. If this is not done then the data cannot be stored on the disk, since each disk change activates a write protect. (Message: Bdos Error R/O).

Info Functions

After formatting or copying, the contents of the disk can be displayed or the status of the disk can be checked by two instructions.

Instruction via DIR

This well-known function allows the disk directory to be displayed or printed out. The printout is initiated with the keys CRTL and P (Hardcopy).

Call up: A > DIR Return key

Directory of the disk in drive A:

Call up: A > DIR B: Return key

Directory of the disk in drive B:

All existing data files are listed on screen, but without showing the memory space occupied.

Instruction via STAT

The command data file STAT contains several functions.

Call up: A > STAT *.* Return key

All existing data files are listed and the occupied memory of the individual data files and the total amount of memory occupied and the memory space still available is shown.

Additionally the disk status "RW" or "RO" is displayed.

RW: READ/WRITE
RO: READ ONLY

Call up: A > STAT B: Return key

The disk status "RW" or "RO" and the available memory space is displayed.

RW: READ/WRITE
RO: READ ONLY

Further information about DIR and STAT can be found in the Reference Guide for CP/M-86.
Order number C79000-M8500-C54-1, GWK.

Copying and displaying of data files

Individual data files can be copied with the command PIP. They can be displayed with the command TYPE.

The PIP command

PIP is a command data file established in CP/M-86.

Examples:

Copying with the same name

A> PIP B: =TEST copy from A: to B:

Copying with rename

A> PIP TEXT.NEW =TEXT.OLD

A> PIP B:TEST1 =B:TEST0

Linking files

A> PIP B:TEST = B:TEXT1, B:TEXT3, B:TEXT5

Up to a maximum of 10 files can be specified.

Peripherial device as target (NC or printer)

A> PIP LST: = B:TESTPROG

Copying with change of disk

Always copy from A: to B: when copying data files with disk change:.
After loading the PIP command, the source disk should be located in drive A:. Then copy to target disk in B:.

A> PIP	Return key
*	Disk change in drive A:
B: =TESTPROG	Copy from A: to B:

The TYPE command

Any data file can be displayed on screen with the TYPE command. This command simplifies checking of a data file contents, since no entry into an editor is necessary.

TYPE B:TEST 1 Return key

Scrolling of the display can be stopped with CTRL S and it can be started again with CTRL S or CTRL Q.

10.2.2 Generating data files

New data files can be generated with the help of various editors, such as:

ED (included CP/M-86)
VEDIT
Wordstar

The choice of editor is left to the user`s discretion. For documentation Wordstar would be used, as in this case. For more information refer to the corresponding descriptions.

General data file structure

A file name can comprise:

1 to 8 letters/digits, one point and up to 3 further characters.

The drive name must be specified if the named data file is not to be stored on the diskette in the drive selected.

Example: A> VEDIT B:TESTPROG.SY3

It makes sense to have two disks, a system disk and a working disk. Ideally, all CP/M-86 program files are stored on the system disk and all new data files on the working disk. Furthermore it is advantageous to generate another disk for data back up.

Generating part programs

The only restrictions for NC part program generation are those in the NC Programming Guide. The data file names can be freely selected except for the endings such as ".SYS, .CMD, .SUB, .LIB or .DIR".

Example:

```
TESTPROG.SY3

%999
(THIS IS A TEST PROGRAM FOR)
(HANDLING THE CP/M ON PG 675)
N5 G04 F1
N10 M00
N15 @31
(A SUBROUTINE IS FOLLOWING )
N20 L22201
N20 G04 F2
N25 a00-5
N30 M30

%SP
L22200
N1 (TEST OUTPUT AUX. FUNCTIONS)
N2 M06 S111 T0101 H22
N3 G04 F2
N4 M07 S222 T0000 H33
N5 M17
N6 M30
```

10.2.3 Loading part programs

Part programs can be loaded into the NC as well as into the PG 675/685. Informations about the different types of coupling and the preconditions for connection are found in the following sections.

Transfer PG --> NC

To transfer data (part programs) into the NC the PIP command is used.

Example: A> PIP LST: = B:L979

Only one data file can be transferred at a time, however, it can contain several programs.

The transfer of several files is simplified by loading the PIP program into the working memory of the PG.

Further detailed information in Section 10.2.8.

Transfer NC --> PG

To load data (e.g. part programs) into the PG 675 the PGIN command is used.

The PGIN program contains:

* Recognition of the type of data (main programs, subroutines, machine data, tool offsets) from basic version 4C on, the R parameters and the background memory can be read out and recognized on reading-in.

* Check for correct program end

* Storage and display of program number and the number of characters of main programs and subroutines.

Example: A> PGIN B:L979

Further detailed information in Section 10.2.9.

10.2.4 Documentation of part programs

The documentation of part programs can be freely selected.

Example:

```
L123
"
"
N70 G91 ZR78       (Traverse to drilling position)
R51  R50           (Retract to safety distance)
R52 R53            (Actual angle + incremental angle)
@02-8 R27 R52      (Increment hole counter)
G90 M17            (Compare counter)
M02                (End)
```

Data backup disk

Established programs or programs read out of the NC can be stored on a data diskette. This diskette should only be used to store checked and working part programs.

Printout of a listing

An additional possibility for data backup is the printout of files on a printer. This can be done for example with a PT88.

Output of a punched tape

A further possibility for data backup is punching files onto a tape using a printer/puncher combination. This can be done for example on a PT80. This type of storage only makes sense for real part programs, such as cycles, which remain on each machine.

10.2.5 Cables

Cable: PG 675/685 -- SINUMERIK both sides with 25-pole CANNON connector

Order number 6FC9 340-7PC (Length 10 metres) (1200 baud)

PG 675/685 (Pins, male)				SINUMERIK (sockets, female)
Screen	25	<--------------------------<	1	Screen
RxD	5	<--------------------------<	3	TxD
TxD	11	<--------------------------<	2	RxD
CTS	9	<--------------------------<	5	RTS
RTS	13	<--------------------------<	4	CTS
Ground	2	<--------------------------<	7	Ground
1200 baud	3	<----		
	4	< refer to 10.2.2		
	17	<		

10.2.6 Other baud rate settings

Pin	3	4	17
9600	X	X	X
4800	X	0	X
2400	0	X	X
1200	X	0	0
600	0	X	0
300	X	X	0
110	0	0	X

(X -> Pin connected to pin 2)

10.2.7 NC machine data

Baud rates general:

9600	111	Bit 2, 1, 0 in machine data 411 and 412
4800	110	
2400	101	
1200	100	
600	011	
300	010	
110	000	

Machine data of the NC:

411 = 11000100	with 1200 baud
412 = 11000100	
416 = 1XXXXXX1	block end: CR LF, and RS232
425 = XXXX0XXX	program end with trailer
434 = XXXX0X0X	data output without header/gap (basic model 4C only)

Data start identifications:

Depending on the type of data, the NC sends data start identifiers prior to the output of the data. On reading in data from the PG 675/685, the same start identifiers must exist in the file.

% xxxx	CR LF	Code for main programs
% SP	CR LF	Code for subroutines
% T E	CR LF	Code for machine data
% T O	CR LF	Code for tool offset data
% R	CR LF	Code for R parameter (4C only)
% H	CR LF	Code for H parameter (4C only)

10.2.8 Procedure for data transfer from PG 675/685 to SINUMERIK

1. Cable connection on programmer: RS232 interface DRUCKER/PRINTER

2. Cable connection on NC: RS232 interface

3. Load operating system CP/M-86 into programmer (Drive 0 or A)

4. Program call on programmer:

   PIP LST: = B: "file name" [E]

   [E] with display of the transfer on the screen

   Example: A > PIP LST: = B:L979[E]

5. Start the NC with the DATA START key

6. Start the programmer with the return key
   The start sequence is not fixed since the enable is given by RTS.

   Now the specified file is loaded in the NC and displayed on the screen of the programmer.

   On transfer of several main programs to the SINUMERIK 3 a new DATA START has to be given after each main program.

If several files have to be transferred to the NC one can load the PIP program in order to avoid repeated system call of PIP.

Example:	1. part A > PIP	Return key
	2. part *LST. = B: file name	Return key

Only the second part of the call up with a new file name need to be repeated.

After the transfer is finished the "PIP SYSTEM" is exited with the return key. After that the identifier "A >" is displayed.

10.2.9 Procedure for data transfer from SINUMERIK to PG 675/685

1. Cable connection on programmer: RS232 interface DRUCKER/PRINTER
2. Cable connection on NC: RS232 interface
3. Load operating system CP/M-86 into programmer (Drive 0 or A)
4. Program call on programmer: (Program PGIN.CMD on diskette in drive A)

   PGIN B: "file name"

   Example: A>PGIN B:L979
5. Start of the programmer with the return key
6. Start of the NC with the DATA START key

Now the specified programs of the NC are stored on disk in the programmer under the specified file name.

The characters received are displayed on the programmer screen during the transfer and simultaneously checked for overflow and stop bit errors (e.g. wrong baud rate). If an error is detected the transfer is aborted and an error message is displayed.

The data receiving program PGIN, edition 27.02.82, can store programs with a maximum length of up to 256 K bytes.

The reception of data is finished when:

1. 40 times 00Hex have been sent (output from NC)
2. the key "***" on the PG 675/685 is actuated
3. if the number of received characters exceeds the limit of 256 K.

The program header is evaluated if the first character (apart from 00Hex) is % or CR.

After the transfer of main programs or subroutines the system automatically produces a directory with the program numbers and the length of the programs (see example). The characters are counted in the same way as with Sinumerik.

After transferring different data types, the type of data is displayed and no directory is produced.

If the data start identifier does not comply with a specified code, the "unknown data" message is displayed after the transfer. Nevertheless the received data are still stored on disk.

Examples: Program call:	Stored in drive:	Name of data file:	Directory name:
A>PGIN	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
A>PGIN B:	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
A>PGIN B: TEST	B:	TEST	TEST.DIR
A>PGIN TEST	A:	TEST	TEST.DIR
B>PGIN	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
B>PGIN TEST	B:	TEST	TEST.DIR
B>PGIN A:TEST	A:	TEST	TEST.DIR
B>PGIN A:TEST. UP	A:	TEST.UP	TEST.DIR

tt = day
mm = month > of the internal clock
jj = year

If a data file name with extension is entered, then the extension DIR is not permitted, since the directory is already stored under this name.

With the TYPE B:"file name".DIR command the directory of the transferred main programs and subroutines can be displayed.

Example: A>TYPE B: TEST-L.DIR

L 95	1609 CH	L 97	1178 CH	L 98	310 CH	L 801	33 CH
L 803	42 CH	L 804	42 CH	L 805	58 CH	L 806	90 CH
L 951	75 CH	L 970	107 CH	L 971	104 CH	L 981	58 CH
L 990	54 CH	L 999	12 CH				

Example: A>TYPE B:TEST-%.DIR
% 120 105 CH % 22 105 CH.

Now the specified programs of the NC are stored on disk in the programmer under the specified file name.

The characters received are displayed on the programmer screen during the transfer and simultaneously checked for overflow and stop bit errors (e.g. wrong baud rate). If an error is detected the transfer is aborted and an error message is displayed.

The data receiving program PGIN, edition 27.02.82, can store programs with a maximum length of up to 256 K bytes.

The reception of data is finished when:

1. 40 times 00Hex have been sent (output from NC)
2. the key "****" on the PG 675/685 is actuated
3. if the number of received characters exceeds the limit of 256 K.

The program header is evaluated if the first character (apart from 00Hex) is % or CR.

After the transfer of main programs or subroutines the system automatically produces a directory with the program numbers and the length of the programs (see example). The characters are counted in the same way as with Sinumerik.

After transferring different data types, the type of data is displayed and no directory is produced.

If the data start identifier does not comply with a specified code the "unknown data" message is displayed after the transfer.
Nevertheless the received data are still stored on disk.

Examples: Program call:	Stored in drive:	Name of data file:	Directory name:
A>PGIN	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
A>PGIN B:	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
A>PGIN B: TEST	B:	TEST	TEST.DIR
A>PGIN TEST	A:	TEST	TEST.DIR
B>PGIN	B:	tt/mm/jj.TXT	tt/mm/jj.DIR
B>PGIN TEST	B:	TEST	TEST.DIR
B>PGIN A:TEST	A:	TEST	TEST.DIR
B>PGIN A:TEST. UP	A:	TEST.UP	TEST.DIR

tt = day
mm = month > of the internal clock
jj = year

If a data file name with extension is entered, then the extension DIR is not permitted, since the directory is already stored under this name.

With the TYPE B:"file name".DIR command the directory of the transferred main programs and subroutines can be displayed.

Example: A>TYPE B: TEST-L.DIR

```
L  95   1609 CH  L  97   1178 CH  L  98   310 CH  L 801   33 CH
L 803     42 CH  L 804     42 CH  L 805    58 CH  L 806   90 CH
L 951     75 CH  L 970    107 CH  L 971   104 CH  L 981   58 CH
L 990     54 CH  L 999     12 CH
```

Example: A>TYPE B:TEST-%.DIR
% 120 105 CH % 22 105 CH.

Chapter 11

-Commissioning of the PLC and notes on the PLC-

Contents

11.1 Prerequisites, settings

11.1.1 Complement

PLC 130 WB, Central controller unit 6ES5 921-3WB with receptacles for two EPROM submodules with maximum 16 K user program instructions. Furthermore, a RAM memory of 2.9 K instructions is provided on the module. Hereof, the basic interface program occupies:

with 1 NC : 950 words RAM (DB 10, 14, 15, 21)

with 2 NCs : 1130 words RAM (DB 10, 14, 21, 23)

with 3 NCs: 1310 words RAM (DB 10, 14, 15, 21, 23, 25)

with 4 NCs: 1490 words RAM (DB 10, 14, 15, 21, 23, 25, 27)

The remaining RAM memory is available for the user program (DB 9 for PLC machine data, standard function block package 0 to 7, machine control program and others).

EPROM submodules

1st submodule is for the basic interface program (always included when delivered).

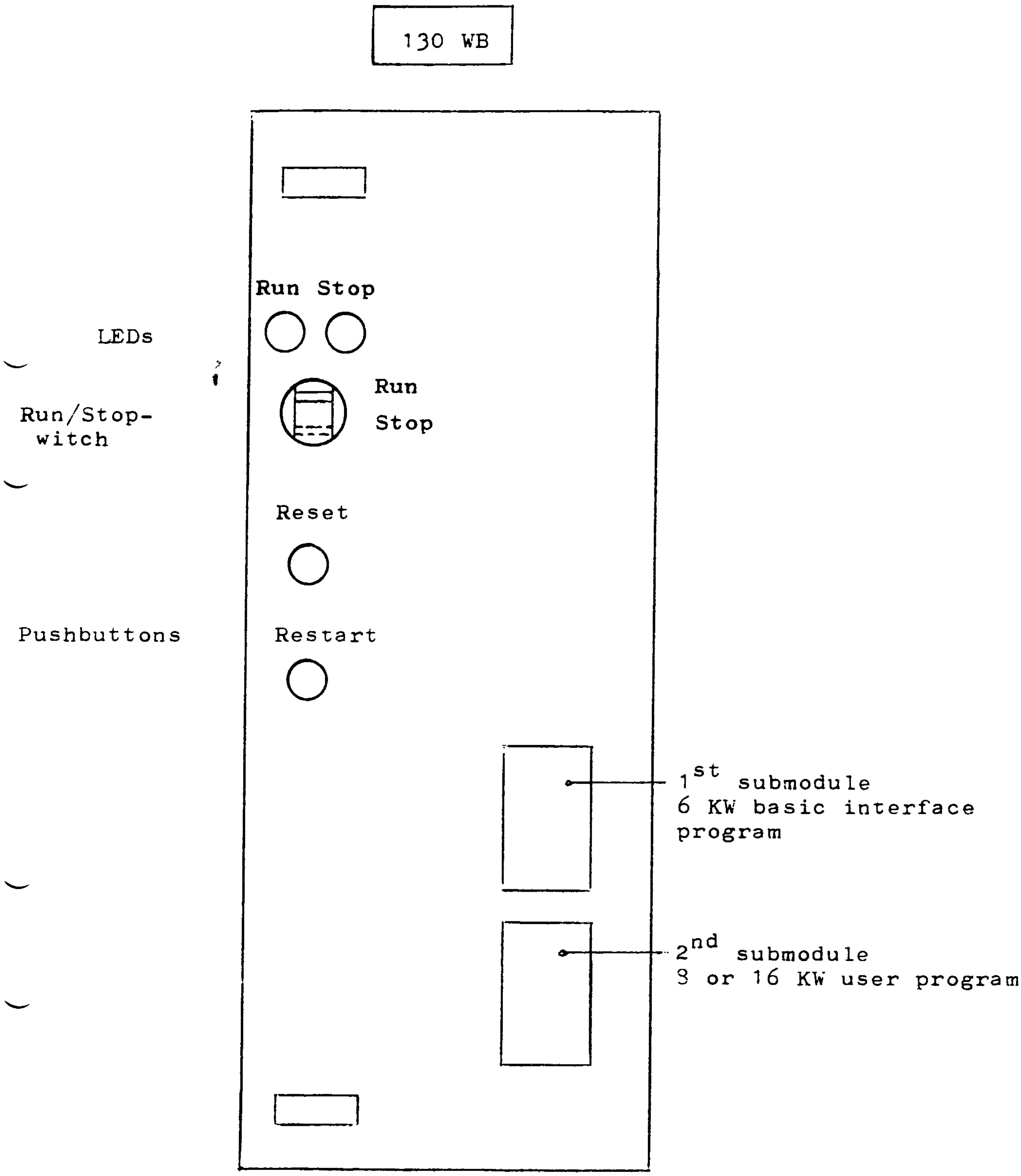
Type 01210 AA, with 3 EPROMs type 2732 fitted or
Type 01210 BA, with 2 EPROMs type 2764 fitted.

2nd submodule is for the user program

8 KW for user option N32, type 01210 BA with 2 EPROMs type 2764

16 KW for user option N32, type 01210 BA with 4 EPROMs type 2764

11.1.2 Front view of the central controller unit 6ES5921-3WB



11.1.3 Function of the pushbuttons, switches and LEDs

- Manual system cold restart (new start): OB 20 is performed by switching the run/stop switch on the CPU from run to stop and back to run.
- Manual system cold restart with reset of the retentive flags/timers/counters: OB 20.

  Switch the run/stop switch from stop to run while keeping the "reset" pushbutton simultaneously actuated.
- Manual warm start (restart): OB 21
  Switch the run/stop switch from stop to run while keeping the "reset" pushbutton actuated simultaneously:
- Automatic warm restart after power-off: OB 22
  Run/stop switch remains in "run" position while the PLC power supply is switched on.
- Initial clear of the PLC-RAM: Refer to Section 11.5.2.
- Green LED is on: PLC runs.
- Red LED is on: PLC circles in the stop loop.
- Green and red LEDs on: PLC is in the cold restart routine.

11.2 System start-up routines of the 130 WB

11.2.1 System cold restart (OB 20)

11.2.1.1 System cold restart without reset

If no organization block OB 22 is entered in the address list on automatic restart (power-on after mains failure), a system cold start OB 20 is performed. The system cold restart of the PLC is carried out when the run /stop switch is switched from STOP position to RUN position.

Prior to branching into the user program the following functions are performed on system cold start:

- Checking the system program memory (sum check)
- Checking the user memory
- Establishing the address lists: Only those blocks are entered into the address list which are identified as valid.
- Clearing (reset) of the following components:
  - Non-retentive flags (FB 128 to FB 255)
  - Process image of inputs
  - Process image of outputs
  - Input- and output modules
  - Analog peripheral modules
- Establishing a module check list. All fitted and functioning input- and output modules are registered in this check list.
- OB 20 is called up during the system cold restart prior to the start of the cyclic processing of the user program. This organization block can be used to default the control in a defined starting condition.
- Periphery check
- Sum check via the user memory.

  The system cold restart is indicated by the green and red LED on the CPU of the PLC, which are both on simultaneously.

11.2.1.2 System cold restart with reset

An additional reset of the PLC is performed, if the RESET pushbutton is actuated during initialization of a system cold restart (Run /stop switch is switched from STOP to RUN position). Stored results and operating conditions are no longer taken into account. System cold restart with reset causes the additional clearing (reset) of the following components:

- Counters
- Timers
- Retentive flags (FB 0 to FB 127)

All other functions of the system cold restart are the same as above.

11.2.2 Warm restart; OB 21, OB 22

Warm restart is a start-up routine which takes results and operational conditions prior to the interrupt into account. In comparison to a system cold restart, the following functions are dealt with differently:

- Counters, timers and flags remain unchanged.
- No address list is established.
- The process image of the inputs is not updated with the status of the input modules.
- The module check list is not updated prior to calling up organization blocks OB 21, OB 22.(No new scanning of the peripheral modules.)
- The outputs on the modules are reset.
- The cycle time monitor is retriggered for the remaining part of the interrupted cycle.
- Program processing is continued from the point of the interruption. The necessary data are stored in the interrupt stack. The interrupted cycle is continued from the point of interruption on, in order to complete calculations, for example, before a new cycle is started again.
- Process image of the outputs: The process image of outputs must not be transferred to the output modules at the end of the interrupted cycle, because, due to the interruption, it may be out of step with the machine conditions.

  Both the process image and the outputs on the output modules are reset at the end of the interrupted cycle. Subsequently, the command output disable is removed and the driver stages of the output modules become operational again. Afterwards, regular cyclic operation is resumed.
- As with system cold restart, a sum check covering the operating system and the user program is carried out.

If a warm restart is permitted, the user can default operating data machine specifically by using organization block OB 22 (warm restart after power failure) or organization block OB 21 (warm restart).

If a warm restart is interrupted at any point, the operating system branches into the stop loop if a warm restart is reattempted. The "NEUSTART" and "NIWIED" interrupt flags are set.

11.2.2.1 Manual warm restart (OB 21)

A manual warm restart is performed if the run/stop switch is switched from STOP to RUN position while the restart pushbutton is actuated simultaneously. A manual warm restart is carried out irrespective of the existence of organization block OB 21 or OB 22.

If the "NEUSTART" interrupt flag (SD 6 H5) is set, a manual warm restart attempt is suppressed. The operating system then branches into the stop loop. The "NIWIED" interrupt flag (SD 7 L4) is set. Regular operation can only be achieved by system cold start.

11.2.2.2 Automatic warm restart (OB 22)

An automatic warm restart is only carried out on power-on after mains failure. No interrupt flags may be set which inhibit the automatic warm restart. An automatic warm restart is carried out successfully if the following conditions are satisfied:

- The run/stop switch must be in RUN position.
- The back-up battery must be in good condition.
- Organization block OB 22 must be entered in the address list (DB 0). If not, OB 20 is processed.

An automatic system cold restart is performed by the operating system on mains switch-on if the "NEUSTART" interrupt flag is set or if the identification "NAU" is not set in the interrupt stack (Mains-off in stop condition of the PLC.).

If another interrupt flag beside "NAU" is entered in the interrupt stack, then the operating system branches into the stop loop. The "NI WIED" interrupt flag SD 7 L4 is set.

11.3 NC-PLC-Monitoring

1. PLC-Monitoring (DBn, DR 54, bit 0: NC sets the bit, PLC acknowledges):

   The NC sets the signal to "1" every 350 ms (with software version ≤ C06 every 200 ms) if the PLC has acknowledged the "1" state before. The NC monitors "PLC fault" if the PLC did not acknowledge the bit.

2. NC-Monitoring (DBn, DL 54, bit 0: PLC sets the bit, NC acknowledges):

   The PLC sets the signal to "1" if the NC did acknowledge the "1" state before. If the NC does not acknowledge the bit, then the OB 10 sets an error bit "FM: NCBB" (DBm, DW 145, bit 12), and consecutively the FB 22 clears the process image of inputs (NCBB1 = 0, NCBB2 = 0).

   The error bit is set in the time interval ≥ 100 ms by the OB 10 if the NC does not acknowledge the monitoring bit.

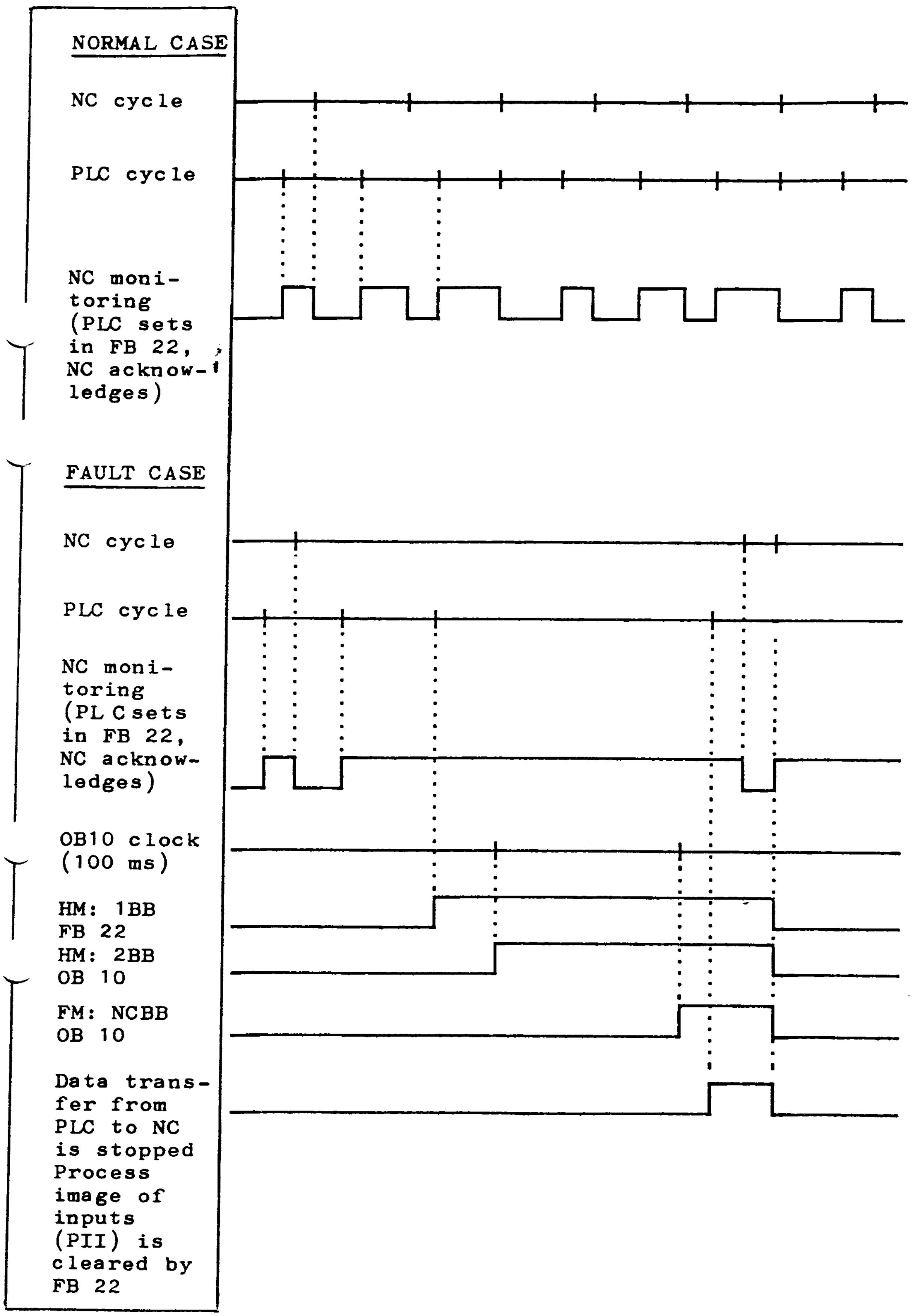
DBn:		DBm:	
20	for NC 1	21	for NC 1
22	for NC 2	23	for NC 2
24	for NC 3	25	for NC 3
26	for NC 4	27	for NC 4

Note: In case of a dual PLC, PLC II is acknowledged in DW 53.

DBn	7	6	5	4	3	2	1	0
PLC0;PLC1, DL54 PLC2, DL53								NC monitoring PLC sets NC acknowledges
PLC0;PLC1, DR54 PLC2, DR53								PLC monitoring NC sets PLC acknowledges

PLC0 = Single PLC

Sequence of NC monitoring:



11.4 Basic interface program

The basic interface program contains standard function blocks andhandles the following tasks:

- Establishing DBs (e. g. DB 20, DB 21).
- Defaulting the NC/PLC interface on system start-up.
- Monitoring the NC.
- Generation of the basic signals (FB 12).
- Activating of NC-oriented function blocks. (e. g. FB 20 = Decoding of M functions).
- Status display of I, Q, F, T, C, DB, DW (refer to Operating Instructions).
- Organization of the process - and time-alarm controlled programs.
- Transfer of the PLC machine data into the coupling RAM.

If the user does not establish PLC machine data, then the basic interface program sets the default state of the PLC machine data on system start-up (e. g. only 1 NC, machine control panel transfer to NC via IB48).

Designation of the basic interface program for single PLC:

```
548 317 500X.09
           |  └── Version
           └───── EPROM location 1 or 2
```

The version of the basic interface program can be read by means of the status display.

```
DB 10 DW 255 0009
              | └─ Version
              └─── 00 = Single PLC
                   01 = Dual   PLC 1
                   02 = Dual   PLC 2
```

11.5 Commissioning

11.5.1 Function check of the PLC

Check without user program:

- Submodule 1 (basic interface program) plugged-in.
- Submodule 2 removed.
- Machine control panel connected to an I/O module with address coding for IB 48.
- PLC initial clear.

If the PLC does not run thereafter (green LED on), check the following:

- Correct initial clearing of the PLC.
- PG interface or PLC memory in correct location.
- Defective PLC-CPU.

11.5.2 Clearing of the PLC (initial clear)

The following sequence must be adhered to:

1. PLC-switch to stop.
2. Actuate reset pushbutton on the PLC-CPU and perform a hardware reset on the power pack simultaneously.
3. Set PLC-switch to run and wait until green LED is on.
4. Set PLC-switch to stop.
5. Set PLC-switch to run, subsequently the green LED must be on.
6. Perform a hardware reset first on the PLC power pack and subsequently on the NC power pack in order to start up the NC.

Operating system
Gap
Fitted user RAM
User RAM on PLC-CPU
DB 0
Gap or NC-PLC coupling RAM
ST
SD
64 Counters
128 Timers
Flags
PII, PIQ
Periphery

Cleared on initial clear

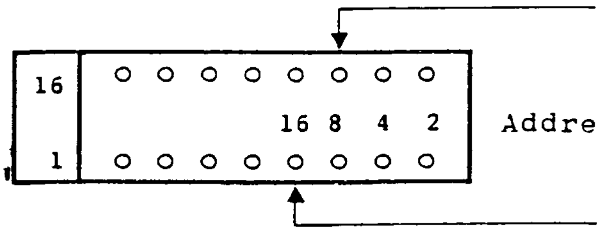
11.5.3 User program:

The RAM memory modules can be used to check the user program.

With SIMATIC modules the starting address must be adjusted correctly:

a) Module S5-340-3KB--

Jumper socket fitted on location number 51:



Jumper in conjunction with a 16 K memory module - 3KB21

Address weight in K words

Jumper in conjunction with a 8K memory module - 3KB11

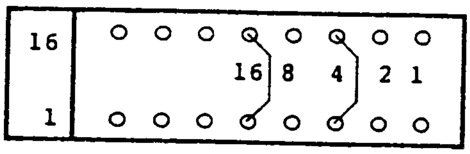
Jumper socket on location no. 71 (masking) without jumpers.

With module S5-340-3KB31: Jumper 2-15
Loop 7-10.

b) Module S5-350 with 4K RAM:

RAM area 1

Location no. 4



Address weight in K words

c) A RAM module can also be fitted into the bottom slot of the 130 WB:

6FX 1123-6 AL00 with 16 K words.

11.5.6 Commissioning hints

- The NC only starts up if the PLC is in operation (green LED lights up).
- Three possibilities exist to establish the PLC machine data (MD):

  Default state (preset by the basic interface program)
  DB9 in the user program
  PLC-MD in the NC.

  DB9 and the PLC-MD in the NC must not be present simultaneously (refer to Section 7).
- Changing the address coding of an I/O module requires a PLC initial clear.
- The battery for the PLC-RAM is located in the power pack.

11.6 Dual PLC

11.6.1 Hardware structure and coupling concept

The hardware structure of System 3, basic model 4 with dual PLC corresponds to the schematics in the Interface Descriptions, Part 2.

The two PLC can be assembled as follows:

a) Two 130 WB central modules are fitted in one rack:

   PLC 1 - CPU in location 176

   PLC 2 - CPU in location 30.

   The coupling RAM 6 FX1122-1AA01 (03331) is fitted in location 86. The communication between PLC1 and PLC2, as well as to the individual NCs, is carried out via the coupling RAM. Each PLC has its own S5-bus system to communicate with its own periphery. The PLC1 bus comprises locations 106 to 176, the PLC2 bus comprises locations 30 to 96.

b) Individual PLC-CPUs are located in two separate racks (external dual PLC).

The communication between PLC1 and PLC2, as well as to the individual NCs, is carried out via the coupling RAM 6FX1122-1AA01 (03831). An additional PLC-coupling module 6FX1120-3BA00 (03845) links the coupling RAM area to external PLC2.

For this external dual PLC-variant, the user must set the "external dual PLC" machine data bit in PLC1 in order to achieve cyclic operation of both PLC1 and PLC2 simultaneously.

Splitting of the PLC program:

- PLC1 Machine control program
- PLC2 Display programs, tool management and supplementary programs.

In an installation with only two NCs, for example the coupling - RAM data blocks DB24 (DW0---DW130) for the internal NC3/PLC interface and DB26 (DW0---DW130) for the internal NC4/PLC interface are not used in cyclic operation. In this case, these data blocks can be occupied by the user e. g. for establishing the additional data exchange between PLC1 and PLC2. The basic interface program clears these data blocks on each system start-up (power-on, hardware reset) and defaults some data words.

For the possible module configurations refer to Interface Description, Part 2, Section 1.

11.6.2 PLC-machine data

Three possibilities exist for PLC1:

- DB9 not present: The basic interface program generates the standard PLC machine data in the coupling RAM (DB20) for the 1st NC.
- DB9 present: The basic interface program transfers the DB9 machine data into the coupling RAM.
  Generally, the entire PLC machine data area for the NC must be established in DB9 (e. g. with one NC: DW0.....DW35, with two NCs: DW0.....DW69).
- PLC machine data established in the NC machine data memory: The NC transfers the PLC machine data into the coupling RAM on system start-up.

Note: The user must set the PLC1 "external dual PLC" machine data bit if the external dual PLC variant is used.

In the PLC2, a DB9 with only one data word (DW0) must be established generally (Bit 0, 1: Number of NCs).

Remark: If the PLCII contains only the basic interface program it branches into the stop state. A DB9 with DW0 must always be present.

DB9		1	0
DW0		Number of NCs	

00 = 1 NC
01 = 2 NCs
10 = 3 NCs
11 = 4 NCs

11.6.3 Basic interface program

Two different basic interface programs exist for the dual PLC:

PLC1	548 817.5201.--	versions 01, 02, 04
	548 817.5202.--	
PLC2	548 817.5301.--	versions 01, 02, 04
	548.817.5302.--	

.6.4 Commissioning instructions

Switch-on-sequence:

Since the start-up of PLC1, PLC2 and NC is coordinated a specified switch-on sequence must be adhered to.

Generally, the non-intelligent expansion unsits (EU) are switched on first. Subsequently, the units (racks) which do not contain a coupling RAM follow. At last, the unit containing the coupling RAM or coupling RAMs is switched on.
All units (racks) can be switched on simultaneously if the total start-up time difference does not exceed 100 ms.

The following switch-on sequence is recommended with hardware assemblies according to Interface Description, Part 2.

Dual PLC in one rack

1st EU
2nd NC
3rd PLC1 and PLC2 (dual PLC)

External dual PLC, PLC1 located in the NC rack:

1st EU
2nd PLC2
3rd PLC1, NC

External dual PLC, PLC1 in a separate rack:

1st EU
2nd PLC2, NC
3rd PLC1

Initial clear

Generally, the initial clear of the PLC2 with an external dual PLC variant functions only if the PLC1 does not stop on system start-up (power-on, hardware reset).

NC cancel functions

On performing the NC cancel functions, the reset push-button on the PLC power-pack and subsequently on the NC power-pack need to be actuated, otherwise the PLC stops and prevents the NC to leave the PLC fault monitoring loop. If only one reset pushbutton is actuated or if the PLC1 or 2 remains in stop condition, then the NC cancel function is not carried out. Power-OFF-ON is an alternative to actuating the reset push-buttons.

Status display

Key 0 activates status for PLC1

Key 1 activates status for PLC2

The status display for dual PLC requires the DB39 for the basic display to be present in the user program of PLC2.
From version 04 on, this DB39 is established by the basic interface program.

NC machine datum

MD 425, bit 2 has to be set to "1" for dual PLC in order to activate the NC-PLC2 monitoring via DW53 of DB20 of the PLC2.

As far as the NC is concerned, there is no difference in the data exchange between NC and PLC in case of single or dual PLC.

Jumpering

Observe the jumpering on the coupling module 6FX1122-1AA01/02 (03 831) for dual PLC.
Refer to Section 9.

11.6.5 Rack prepared for dual PLC

In this case, one PLC-CPU is fitted in slot for PLC I. PLC II does not exist. The basic interface program is as with single PLC. The jumpering on the coupling module must be as with dual PLC.

11.7 Function blocks

11.7.1 Key to product number of function blocks

Valid for System 8 with 130 W (A) - (B) or 150 S
as well as System 3, basic version 4

E88530 - B 3 0 0 0 - A - 0

For SINUMERIK → E88530

Item number B = User FB (SINUMERIK)
S = Standard FB not for SINUMERIK

3 Number range for FBs used in SINUMERIK PLCs

0 = System 8 FB0...99
1 = System 8 FB200...255
2 = System 3, model 4 FB0...99
3 = System 3, model 4 FB100...199

Consecutive numbers

Type of PLC: A = 130 W(A)
B = 150 A/K
C = 130 W(B)
D = 150 S

Version 0 ... 99

11.7.2 Function block packages

Package 0:

Digital functions. Function blocks (FB) of the basic interface program and FBs for the NC-PLC interface. General FBs.

Package 1:

Function blocks for displaying PLC displays on screen, display programs for fault messages, head line display, operator-dialog line etc.

Package 2:

Function blocks for "flexible tool management". Modules for tool magazine and tool turret.

Package 3:

Function blocks for tool life monitoring.

Package 4:

Function blocks for sequence chains.

Package 5:

Function blocks for the interface module AS512.

Package 6:

Function blocks for the electronic gear (ELG) used in conjunction with System 3.

Package 7:

Function blocks for computer link.

11.8 Compatibility of NC-PLC software versions

11.8.1 SINUMERIK System 3T or 3M, basic version 4B/130 WB with single PLC:

The table shows whether the corresponding NC- and PLC software versions function together.

This table does not show whether new functions require a new NC- or PLC software version. This can be read in the appropriate NC- or PLC Service Information.

Software version		NC software version							Package 1: Version of display program					
		D 01	81	02	03	04	05	06	01	02	03	04	05	06
PLC basic interface program version	01													
	02													
	03													
	04													
	05	1)	1)	1)	1)	1)	1)	1)	X	X	X			
	06	1)	1)	1)	1)	1)	1)	1)	X	X	X			
	07	X	X	X	X	X	X	X				X	X	X
	08	X	X	X	X	X	X	X				X	X	X
	09	X	X	X	X	X	X	X				X	X	X
Package 1 Version of display program	01	X	X	X	X	1)	1)	1)						
	02	X	X	X	X	1)	1)	1)						
	03	X	X	X	X	1)	1)	1)						
	04		X	X	X	X	X	X						
	05		X	X	X	X	X	X						
	06		X	X	X	X	X	X						

PLC basic interface program version: 548 817.500*.--
Order number GWE-AZN: 548.817.9015.--
Version of display program: 6FC9 371-2FA--

x This combination is generally possible.
1)Combination generally possible if "graphics" option is not present (colour or monochrome).

C.. = S32.. NC software version for System 3, basic version 4A
D.. = S33.. NC software version for System 3, basic version 4B.

11.3.2 SINUMERIK System 3T or 3M, basic version 4B/130 WB with dual PLC:

The table shows whether the corresponding NC- and PLC software versions function together.

This table does not show whether new functions require a new NC- or PLC software version. This can be read in the appropriate NC- or PLC Service Information.

Software version			NC software version D 01	81	02	03	04	05	06	Package 1: Display program version PLC1 01 / PLC2 01	PLC1 01 / PLC2 02	PLC1 01 / PLC2 03	PLC1 01 / PLC2 04
	PLC1	PLC2											
PLC basic interface program version	01	01	X	X	X	X	X	X	X	X	X	X	X
	02	02	X	X	X	X	X	X	X	X	X	X	X
	03	03	X	X	X	X	X	X	X	X	X	X	X
	04	04	X	X	X	X	X	X	X	X	X	X	X
	PLC1	PLC2											
Package1 Display program version	01	01	X	X	X	X	X	X	X				
	01	02	X	X	X	X	X	X	X				
	01	03	X	X	X	X	X	X	X				
	01	04	X	X	X	X	X	X	X				

PLC basic interface program version: PLC1: 548 817.520*.--
PLC2: 548 817.530*.--

Order number: GWE-AZN: PLC1: 548 817.9016.--
PLC2: 548 817.9017.--

Display program version: PLC1: 6FC9 371-2FB--
PLC2: 6FC9 371-2FC--

X This combination is generally possible.

1) Combination is generally possible if no "graphics" option present (colour or monochrome).

C.. = S32.. NC software version System 3, basic version 4A.

D.. = S33.. NC software version System 3, basic version 4B.

11.8.3 SINUMERIK System 3T or 3M, basic version 4A/130 WB with single PLC:

The table shows whether the corresponding NC- and PLC software versions function together.

This table does not show whether new functions require a new NC- or PLC software version. This can be read in the appropriate NC- or PLC Service Information.

Software versions		NC software version									Package 1: Display program version					
		C 01	02	03	04	05	06	07	81	08	01	02	03	04	05	06
PLC basic interface program version	01	X														
	02	X														
	03	X									X	X	X			
	04	X									X	X	X			
	05		X	X	X	1)	1)	1)	1)	1)	X	X	X			
	06		X	X	X	1)	1)	1)	1)	1)	X	X	X			
	07		X	X	X	X	X	X	X	X				X	X	X
	08		X	X	X	X	X	X	X	X				X	X	X
	09		X	X	X	X	X	X	X	X				X	X	X
Package 1: Display program version	01	X	X	X	X	1)	1)	1)	1)	1)						
	02	X	X	X	X	1)	1)	1)	1)	1)						
	03	X	X	X	X	1)	1)	1)	1)	1)						
	04		X	X	X	X	X	X	X	X						
	05		X	X	X	X	X	X	X	X						
	06		X	X	X	X	X	X	X	X						

PLC basic interface program version: 548 817.500*.--
Order number GWE-AZN: 548 817.9015.--

Display program version: 6 FC9 371-2FA--

X Combination is generally possible
1) Combination is generally possible if no "graphics" option present (colour or monochrome)

C.. = S32.. NC software version for System 3, basic version 4A
D.. = S33.. NC software version for System 3, basic version 4B.

11.8.4 SINUMERIK System 3T or 3M, basic version 4A/130 WB with dual PLC:

The table shows whether the corresponding NC- and PLC software versions function together.

This table does not show whether new functions require a new NC- or PLC software version. This can be read in the appropriate NC- or PLC Service Information.

Software versions			NC software version C 03	04	05	06	07	81	08	Package 1: Display program version PLC1 01 / PLC2 01	PLC1 01 / PLC2 02	PLC1 01 / PLC2 03	PLC1 01 / PLC2 04
	PLC1	PLC2											
PLC basic interface program version	01	01	X	X	X	X	X	X	X	X	X	X	X
	02	02	X	X	X	X	X	X	X	X	X	X	X
	03	03	X	X	X	X	X	X	X	X	X	X	X
	04	04	X	X	X	X	X	X	X	X	X	X	X
	PLC1	PLC2											
Package1: Display program version	01	01	X	X	X	X	X	X	X				
	01	02	X	X	X	X	X	X	X				
	01	03	X	X	X	X	X	X	X				
	01	04	X	X	X	X	X	X	X				

PLC basic interface program version: PLC1: 548 817.520*.--
PLC2: 548 817.530*.--

Order number GWE-AZN: PLC1: 548 817.9016.--
PLC2: 548 817.9017.--

Display program version: PLC1: 6FC9 371-2FB--
PLC2: 6FC9 371-2FC--

X Combination is generally possible

C.. = S32.. NC software version System 3, basic version 4A

D.. = S33.. NC software version System 3, basic version 4B

11.9 Troubleshooting in the PLC

11.9.1 Test aids:

The integral status program can be used for checking inputs, outputs, flags etc. (refer to Section 8).

A PG 670/675/685 programmer must be used to test programs and read-out the ISTACK.

11.9.2 Interrupt analysis (ISTACK):

1	Control bits								Control bits SD5
	NB	PBSSCH	BSTSCH	SCHTAE	ADRBAU	SPABBR	NAUAS	QUITT	
	NB	NB	NB	NB	NB	NB	NB	NB	
2	STOZUS X	STOANZ X	NEUSTA X	WIEDAN	BATPUF X	NB	BARB	BARBEND	SD6
	NB	UAFEHL	MAFEHL X	EOVH X	NB	NB	NB	NB	
3	ASPNPR	ASPNRA X	KOPFNI	PROEND	NB	PADRFE	ASPLUE	RAMADFE	SD7
	KEINAS	SYNFEH X	NINEU X	NIWIED	NB	EAFEHL	SUMF	URLAD X	
4	Interrupt stack								I -STACK read-out
	Depth: 01								
	BEF-REG: 7000		SAZ: 05BE		DB-ADR: 0000				
	BST-STP: EB03		-NR.:		DB-NR.:				
			REL-SAZ:						
5	AKKU1: E3B8		AKKU2: E3B8						
	Result flags:	ANZ1	ANZ0	OVFL X	CARRY X	ODER	STATUS X	VKE X	$\overline{ERAB}$
6	Cause of fault:	STOPS	STUEB	NAU	QVZ	ZYK	BAU	NNN	STS X

Display with PG 670/675/685 programmer

The INTERRUPT STACK is a stack memory into which the system program enters information when a stop occurs, which is needed by the PLC for COLD RESTART or WARM RESTART. The contents of the interrupt stack can be read-out **with** the programmer when the PLC is in stop state ("OUTPUT ISTACK"). The ISTACK supplies important information on the CAUSE of the STOP. Along with the ISTACK, the PG 670, 675, 685 programmer also displays the contents of the system data words SD 5, SD 6, SD 7.

1 + 2 CONTROL BITS IN SYSTEM DATA WORD (SD5/SD6)

Operating condition displays and operating control flags which are set, reset and evaluated by the operating system e. g. on system restart.

3 CONTROL BITS IN SYSTEM DATA WORD (SD7)

These flags provide additional information on the cause of an interrupt and the procedure prior to a new system start-up.

4 INFORMATION ON THE POINT OF INTERRUPT (FAULT LOCATION)

5 STATE OF THE ARITHMETIC UNIT:

This includes the contents of accumulator 1 and 2, the bracket memory and the result flags for those binary and digital operations, the processing of which was interrupted by the STOP.

6 CAUSE OF INTERRUPTION (IN ISTACK):

This line gives the user the initial information on the cause of an interruption of the cyclic processing. The cause displayed decides the subsequent fault diagnostics procedure.

The control bits in the system data words have the following significance:

1 CONTROL BITS IN SYSTEM DATA WORD (SD5):

PBSSCH Unassigned

BSTSCH The "Compress memory" function (COMP:PC) has not been terminated. Repeat the "Compress memory" function with the programmer after the cyclic operation (green LED lights up) has been resumed.

SCHTAE Block gap in the user memory. System start-up only possible after initial clear/load and cold restart.

ADRBAU — Block address list not yet established or updated.

SPABBR — The "Compress memory" function has been interrupted by a power failure or by PLC-stop.

NAUAS — Identifier for programmer interface power failure. Not used.

2 CONTROL BITS IN SYSTEM DATA WORD SD6:

STOZUS, STOANZ — Stop identifier. STOANZ indicates that the PLC is in stop state.

NEUSTA — Cold restart: Cyclic operation can only be achieved by way of a cold restart.

WIEDAN* — Warm Restart aborted.

BATPUF — Central controller contains a back-up battery for the RAM memory.

BARB, BARBEND — Condition displays for the "program check" function with the programmer.

UAFEHL — Interrupt stack processed without recognizeable fault entry.

MAFEHL — Group signal for entries in the system data word SD7.

EOVH — Controller processes input byte 0 (Interrupt processing).

3 CONTROL BITS IN SYSTEM DATA WORD SD7:

ASPNPR Indicates that the additional user memory fitted consists of EPROM only.

ASPNRA Indicates that the user memory consists of RAM only. Generally, a 5.8 K Byte RAM memory on the CPU is at disposal for the user. Therefore, the PLC can be operated without additional user memory fitted.

KOPFNI Indicates that the block type has not been recognized on establishing the address list.

If the identifier is set, the PLC does not function. Therefore, the program branches into the STOP loop.
Remedy: Initial clear/reload.

PROEND Unassigned

PADRFE Indicates that the user EPROM memory is wrongly addressed.
If the identifier is set, the PLC does not function. Therefore, the program branches into the micro-programmed STOP loop.
Remedy: Readdressing of the EPROM submodules in accordance with the specifications.

ASPLUE Indicates that the user memory contains address gaps. This identifier is set in combination with the "PADRFE" or "RAMADRFEHL" identifiers.
If the identifier is set, the PLC does not function. Therefore, the program branches into the STOP loop.
Remedy: Readdressing of the user memory.

RAM EDFE — Indicates that the user RAM memory is wrongly addressed. If the identifier is set, the PLC does not function. Therefore, the program branches into the micro-programmed STOP loop.
Remedy: Readdressing of the user RAM memory in accordance with the given specifications.

KEIN AS — Indicates that, up to 48 K, no additional user memory is plugged in or addressed. That means, the PLC has only the user RAM on the CPU at its disposal.

SYNFEH — Indicates that, in certain parts of the user memory, there is no synchronization pattern or an illegal code is stored.
It is not possible to find blocks if the memory contents are undefined. Therefore, the program branches into the STOP loop.
Remedy: Initial clear/reload.

NINEU
a) Indicates, that a cold restart cannot be carried out. This bit is always set in conjunction with another detailed error identifier. The exact reason for aborting the attempted cold restart is shwon by additional error identifiers.
Remedy: Initial clear/reload.
b) The cold restart could not be carried out. Meanwhile, the fault has been cleared.

NIWIED — Warm restart not possible. Initiate a cold restart.

EAFEHL
a) I/O module or EU interface defective.
Remedy: Replace defective module and/or perform initial clear/reload.
b) I/O configuration changed.
Remedy: Initial clear/reload.

SUMF A checksum error has been detected in the system program memory or in an user program. If the checksum error occurs again after initial clear and cold restart, replace the system program memory and reload the user program.

URLAD Indicates that cyclic operation can only be achieved by means of initial clear and reload with subsequent cold restart. The initial clear/reload is performed by the programmer interface in the address range 0 to 64 K Byte. All RAM memory locations are reset to 0000H.

4 INFORMATION ON THE POINT OF INTERRUPT (ERROR LOCATION):

TIEFE No significance

BEF-REG MC-5 code of the last statement processed. With programming fault, this is in most of the cases the statement causing the error.

BST-STP Address of the memory location into which the last block stack (BSTACK) entry was made. This bit has no significance. If required, perform the "OUTPUT BSTACK" function.

SAZ Address of the memory location which would have been processed next if the stop had not occured. In the event of the "NNN" error, the SAZ contains the address of the statement which caused the fault. The contents of this memory location can be read in MC-5 code with the command "OUTPUT ADR: PC, "SAZ"!"
The **error can** be located more easily by means of "Block number" and "REL-SAZ".

"BST" NR.	Specification of the OB/PB/FB block processed prior to the STOP. In case of program errors, the error location within this block must be searched for with "OUTPUT PC, "BST-NO!"!"
REL-SAZ	Relative address in the specified block. The relative block addresses are additionally displayed on screen of the PG 670/675/685 programmer if the key-operated "input disable" switch is turned to the right. The relative block address corresponds to the absolute address "SAZ". The statement containing the error is located directly before the relative address.
DB-ADR. DB-NR.	Starting address and number of the last data block called in the program.

5 STATE OF THE ARITHMETIC UNIT

AKKU 1 AKKU 2	Contents of both accumulators

Result flags:

ANZ 0 ANZ 1	Identifier bit 1 and 0 with 2-3 meanings depending on type of logic (e. g. arithmetic result, comparison result, bit test result in shift operations).
OVFL	Overflow; the maximum number range has been exceeded in the arithmetic operation just completed.
CARRY	Carry between the two bytes of the arithmetic unit.
ODER	OR memory. The result of the logic operation RLO was = "1" in a previous OR logic operation.

STATUS	Signal status of the last operand processed.
VKE	Result of logic operation (RLO) of the last statement processed.
ERAB	The last statement processed was the first scan of a new logic (beginning of a new logic program module).

6 CAUSE OF INTERRUPTION (IN ISTACK)

STOPS	STOP switch on
NNN	Error in statement syntax The user has programmed illegal operations (e. g. access to data blocks with statement parameter greater than data block length) or operations which are not comprised in the operation volume of the S5-130W.
STS	System stop due to:

a) User stop request
By means of the STS statement, the user can cause the operating system to branch into the stop loop at the end of the current cycle. The branching is carried out by the Stop statement of the system software STS.

b) General system fault
Fault evaluation is possible by using additional identifiers (Control bits in system data word SD5/SD6).
If no causes are found there, the fault inhibiting the operating system is serious. (e. g. wrong address jumpering of the memory)

STUEB	Block stack overflow

With each block call the return address in the calling block is stored in the block stack. If the block stack overflows, the S5 - 130 W programmable controller branches into the stop loop.

NAU	Power failure

If the run/stop switch on the PLC-CPU is in "RUN" position when power is switched on, then the PLC performs an automatic cold restart or, if the OB 22 is present, an automatic warm restart.

QVZ	Acknowledgement delay

An acknowledgement delay is recognized when an addressable area does not answer back within the monitoring time when addressed. Dependent upon the range addressed, there are two possible acknowledgement delays:

- Acknowledgement delay on memory access.
- Acknowledgement delay on periphery access.

ZYK	Cycle time exceeded

The step 5 program is interrupted and the PLC stops if the cycle time is exceeded. The cycle time can be exceeded, for example, due to programming errors (program execution time too long).

The cycle monitor time is defaulted to 360 ms in case of S5-130 WB (cannot be changed).

BAU Back-Up battery failure

A monitoring circuit in the power pack generates the battery failure signal. Battery failure is recognized by the PLC on cold restart. The program branches into the stop loop.

If, during a battery failure, the mains supply also fails, the contents of the RAM are corrupted. The user must initial clear/reload the PLC.
In cyclic operation, the battery can be replaced without causing an interrupt.

9.3 Block stack (BSTACK)

Two items of information are entered into the BLOCK STACK of the S5-130W PLC every time an exit is made from a block in the course of program processing:

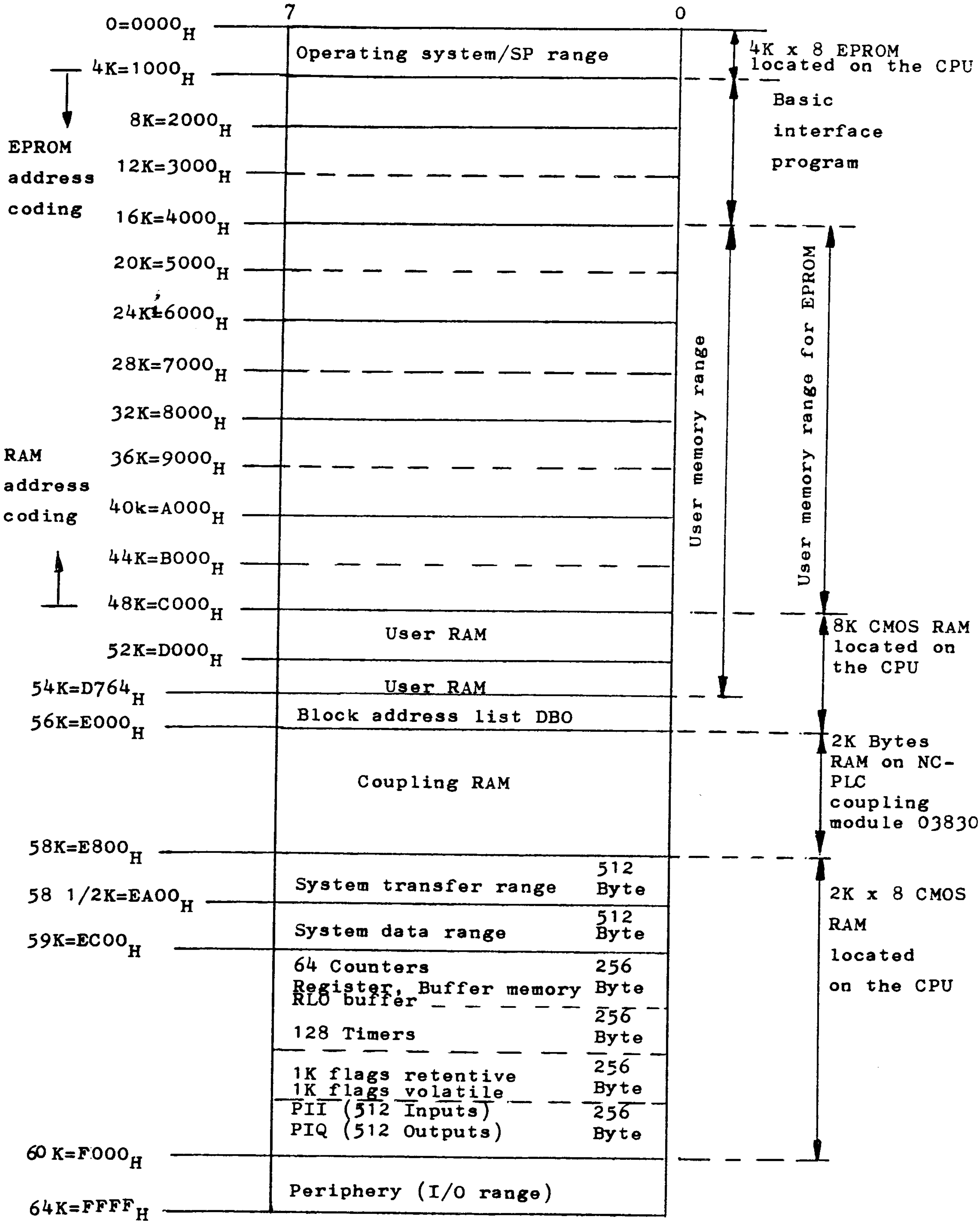
1. The start address of the data block valid before exiting the block.

2. The number of the memory address from which program processing is to be continued after returning from the block called (return jump address).

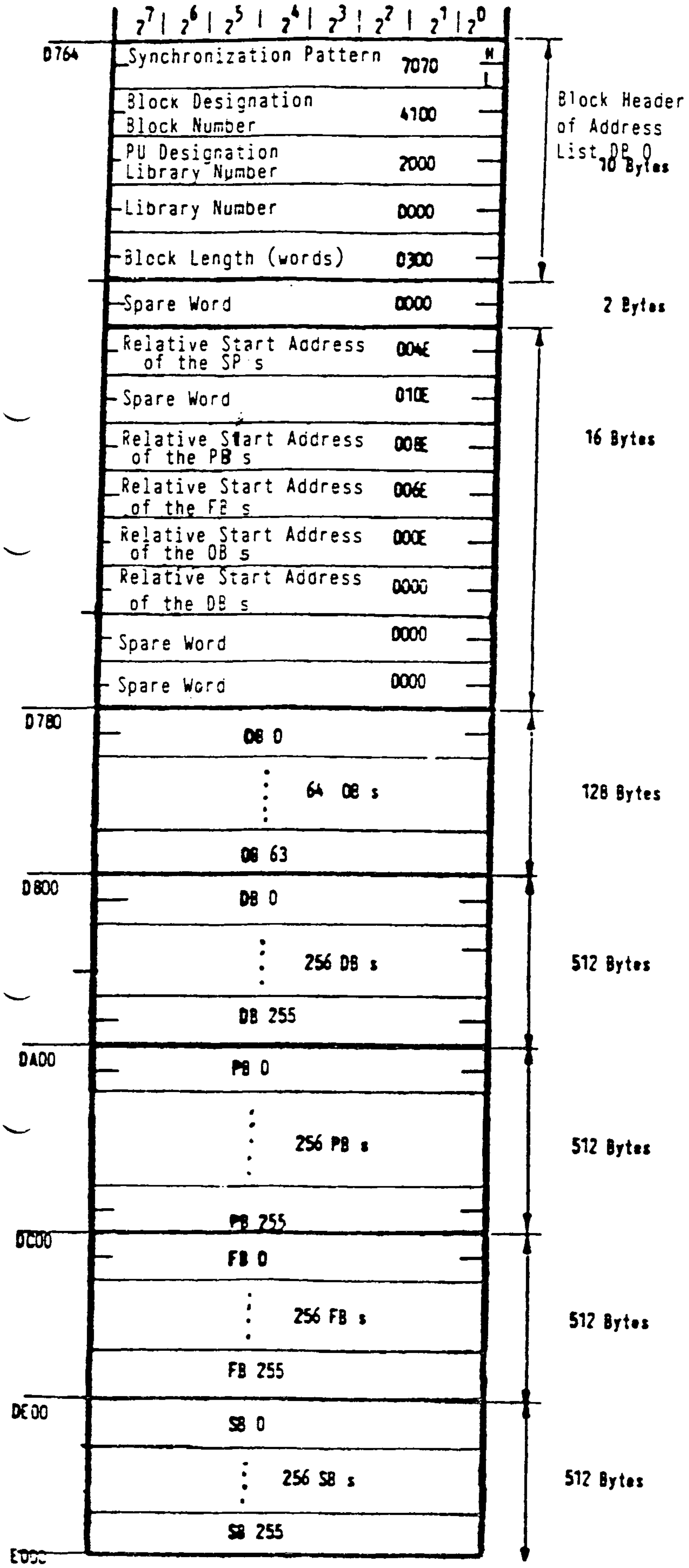
The information stored in the block stack can be read by the PG670/675/685 (OUTPUT BSTACK!) when the S5-130W PLC is in STOP STATE.

11.10 PLC LISTS

11.10.1 Memory map of the 130WB:



11.10.2 Structure of the address list of the 130 WB PLC



Address List Format

Absolute Start Address of Address List Blocks

DB s	D800
PB s	DA00
FB s	DC00
OB s	D780
SB s	DE00

Relative Start Address of Address List Blocks
(Distance in words from the header address of the address list)

DB s	004E
PB s	008E
FB s	00CE
OB s	000E
SB s	010E

Distance Address of the Address List Blocks
(Distance in bytes from the start address of DB 0)

DB s	006A
PB s	00AA
FB s	00EA
OB s	002A
SB s	012A

Length of the Address List Blocks in Bytes

DB s	0200
PB s	0200
FB s	0200
OB s	0080
SB s	0200

Header Address of the Address List

D764

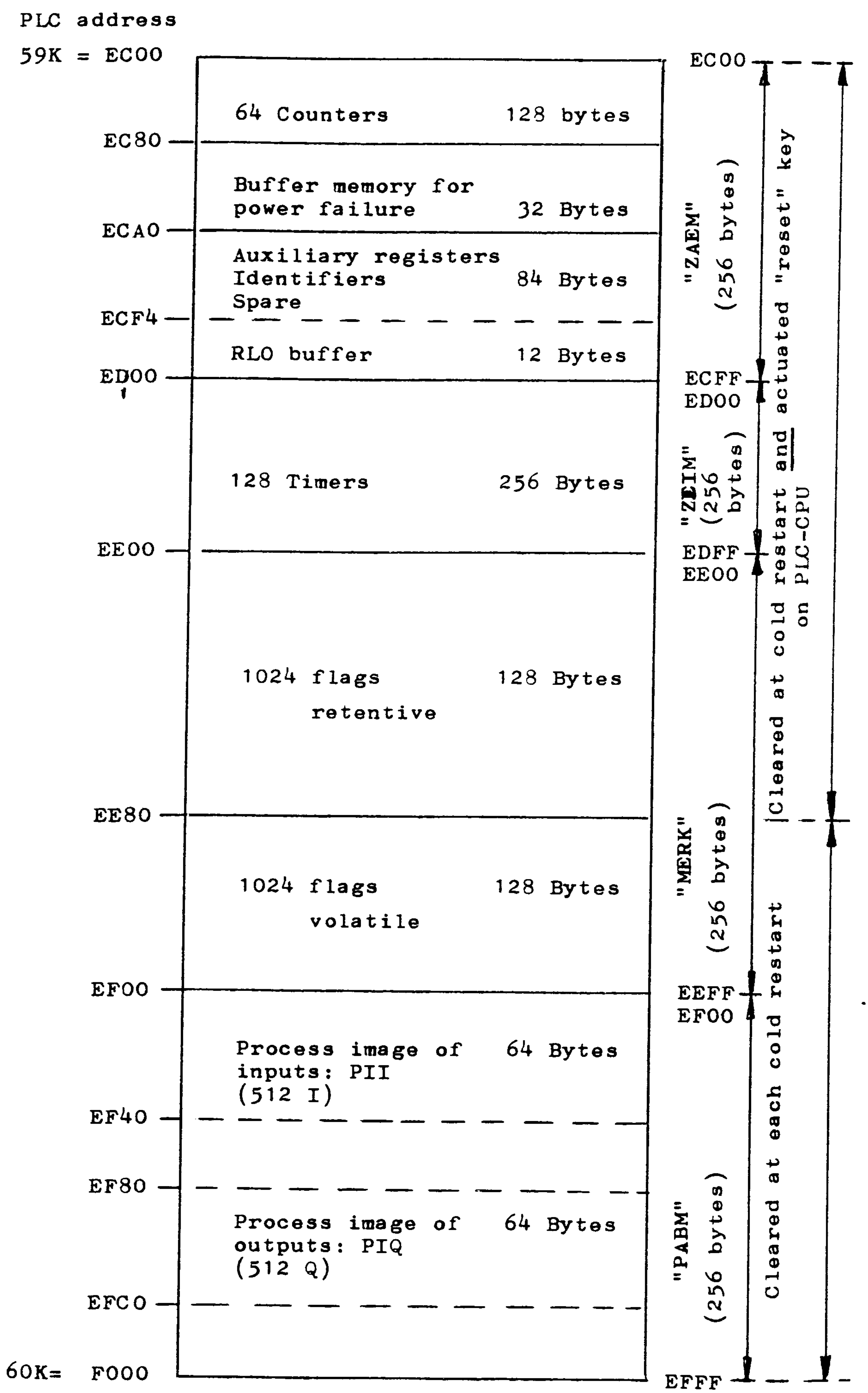
Absolute Start Address of the Address List

D76E

Length of Address List

In bytes: 089C
In words: 044E

11.10.3 Memory map of the internal RAM memory of the 130 WB



11.10.4 Instruction lists overview :

Instruction lists arranged according to the function volume of S5-130W (versionB)

Opera-tion		Parameter	MC-5 Code + Bit addr.	MC-5 Code + Byte addr.
		Basic operation set: Binary logic operations		
A	I	0.0 to 63.7	C0	00
A	Q	0.0 to 63.7	C0	80
A	F	0.0 to 255.7	80	00
A	T	0 to 127	F8	00
A	C	0 to 127	B8	00
AN	I	0.0 to 63.7	E0	00
AN	Q	0.0 to 63.7	E0	80
AN	F	0.0 to 255.7	A0	00
AN	T	0 to 127	FC	00
AN	C	0 to 63	BC	00
O	I	0.0 to 63.7	C8	00
O	Q	0.0 to 63.7	C8	80
O	F	0.0 to 255.7	88	00
O	T	0 to 127	F9	00
O	C	0 to 63	B9	00
ON	I	0.0 to 63.7	E8	00
ON	Q	0.0 to 63.7	E8	80
ON	F	0.0 to 255.7	A8	00
ON	T	0 to 127	FD	00
ON	(	0 to 63	BD	00
O A(			FB BA	00 00
O( )			BB BF	00 00
	I	Set-/resetting operations 0.0 to 63.7	D0	00
S S	Q F	0.0 to 63.7 0.0 to 255.7	D0 90	80 00
R R	I Q	0.0 to 63.7 0.0 to 63.7	F0 F0	00 80
	F I	0.0 to 255.7 0.0 to 127.7	B0 D8	00 00
R	A	0.0 to 127.7	D8	80
R	F	0.0 to 255.7	98	00
		Timer operations		
SP	T	0 to 127	34	00
SE	T	0 to 127	1C	00
SR	T	0 to 127	24	00
SS	T	0 to 127	2C	00
SF	T	0 to 127	14	00
R	T	0 to 127	3C	00
		Counter operations		
S	C	0 to 63	5C	00

Opera-tion		Parameter	MC-5 Code + Bit addr.	MC-5 Code + Byte addr.
		Counter operations		
R	C	0 to 63	7C	00
CU	C	0 to 63	6C	00
CD	C	0 to 63	54	00
		Load and transfer oper.		
L	IB	0 to 63	4A	00
L	IW	0 to 62	52	00
L	QB	0 to 63	4A	80
L	QW	0 to 62	52	80
L	PB	0 to 255	72	00
L	PW	0 to 254	7A	00
L	DW	0 to 255	32	00
L	DL	0 to 255	22	00
L	DR	0 to 255	2A	00
L	FB	0 to 255	0A	00
L	FW	0 to 254	12	00
L	T	0 to 127	02	00
LD	T	0 to 127	0C	00
L	C	0 to 63	42	00
LD	C	0 to 63	4C	00
L	KB1)	0 to 255	28	00
L	KC	Counter 000 to 999	30 XX	01 XX
L	KT	Time value 000.0 to 999.3	30 XX	02 XX
L	KF	Fixed-point number -32768 to 32767	30 XX	10 XX
L	KS	ASCII character any two characters	30 XX	10 XX
L	KY	2 bytes 0.0 to 255	30 XX	20 XX
L	KH	Hexadezimal code entered via PG 0 to FFFF	30 XX	40 XX
L	KM	Bit pattern (16bits) entered via PG 0...0to1..1	30 XX	80 XX
T	IB	0 to 63	4B	00
T	IW	0 to 62	53	00
T	QB	0 to 63	4B	80
T	QW	0 to 62	52	80
T	PB	0 to 127, 128 to 255	73	00
T	PW	0 to 126, 128 to 254	7B	00
T	DW	0 to 255	33	00
T	DL	0 to 255	23	00
T	DR	0 to 255	2B	00
T	FB	0 to 255	0B	00
T	FW	0 to 254	13	00

Operation	Parameter	MC-5 Code	
		+ Bit addr.	+ Byte addr.
	Comparison operations		
! = F		21	80
>< F		21	60
> F		21	20
> = F		21	A0
<F		21	40
< = F		21	C0
	Block calls		
SU PB	0 to 255	75	00
SC PB	0 to 255	55	00
SU FB	0 to 255	3D	00
SC FB	0 to 255	1D	00
SU SB	0 to 255	7D	00
SC SB	0 to 255	5D	00
SU OB*)	0 to 31	6D	00
SC OB*)	0 to 31	4D	00
	Other functions		
BE		65	00
BEC	BE conditional	05	00
BEU	BE unconditional	65	01
C DB	Calling DB 1-255	20	00
STP	Stop request	70	03
STS *	System stop 6)	70	00
	MC5 operations		
NOP 1		FF	FF
NOP 0		00	00
BLD 4)	0 to 255	10	FF
	Supplementary oper.: 5) Digital logic operations		
A X 7)	1 to 126	07	00
AN X	1 to 126	27	00
O X	1 to 126	0F	00
ON X	1 to 126	2F	00
	Set operations		
S X	1 to 126	17	00
RB X	1 to 126	37	00
= X	1 to 126	1F	00
	Timer and counter oper.		
FR T	0 to 127	04	00
F C	0 to 63	44	00
FR X	1 to 126	06	00
SP X	1 to 126	36	00

Operation	Parameter	MC-5 Code	
		+ Bit addr.	+ Byte addr.
SR X	1 to 126	26	00
SEC X	1 to 126	1E	00
SSU X	1 to 126	2E	00
SFD X	1 to 126	16	00
RD X	1 to 126	3E	00
	Load and transfer oper.		
L X	1 to 126	46	00
LD X	1 to 126	0E	00
LW X	1 to 126	3F	00
T X	1 to 126	66	00
L RS	0 to 255	62	00
L RI	0 to 255	6A	00
T RI	ACCU1 = > ST0-255	6B	00
LIR *)	(ACCU1) = > REG 0or2	40	00
TIR *)	REG 0or2 = > (ACCU1)	48	00
TAK *)	ACCU1 < = > ACCU2	70	02
TNB	1 to 255	03	00
TBS	0 to 255	63	00
	Arithmetic operations		
+ F	ACCU1 + ACCU2 = > ACCU1	79	00
- F	ACCU2 - ACCU1 = > ACCU1	59	00
ADDBF*	-128 to + 127 + ACCU1	50	00
ADDKF*	- 32768 + ACCU1 + 32767	58 XX	00 XX
	Conversion operations		
CFW	One's compl. in ACCU1	01	00
CSW	Two's compl. in ACCU1	09	00
	Digital logic operations		
A W	ACCU1 & ACCU2 = > ACCU1	41	00
O W	ACCU1 v ACCU2 = > ACCU1	49	00
XO W	ACCU1 XOR ACCU2 = > ACCU1	51	00
	Shift operations		
SLW 3)	0 to 15 ACCU1	61	00
SRW 3)	0 to 15 ACCU1	69	00
	Jump operations		
JU	- 127 absolute jump	2D	00
JC	conditional jump	FA	00
JZ	ACCU1 = 0	45	00
JN	to ACCU1 ≠ 0	35	00
JP	ACCU1 > 0	15	00
JM	ACCU1 < 0	25	00
JO	+ 127 overflow	0D	00

Operation	Parameter	MC-5 Code + Bit addr.	MC-5 Code + Byte addr.	Operation	Parameter	MC-5 Code + Bit addr.	MC-5 Code + Byte addr.
	Other functions						
D	1-255 decr. ACCU1	19	00	TBN RS	0.0 to 255.15	70 8X	57 XX
I	1-255 incr. ACCU1	11	00	SU RS*	0.0 to 254.15	70 4X	57 XX
IA	Inhibit alarms	08	00	RU BS*	0.0 to 254.15	70 0X	57 XX
RA	Enable alarms	08	80	TB RI	0.0 to 255.15	70 CX	47 XX
BAS	Disable comm. output	BE	00	TBN RI	0.0 to 255.15	70 8X	47 XX
BAF	Enable comm. output	FE	00	SU RI	0.0 to 255.15	70 4X	47 XX
DO X	Par (1-126) = Instr.	76	00	RU RI	0.0 to 255.15	70 0X	47 XX
DO IX	ACCU1(Add) = = >Instr.	7E	00	TB T	0.0 to 127.15	70 CX	25 XX
DO DW	DW 0-255, I : 00, Q : 80	6E Instr.	00 XX	TBN T	0.0 to 127.15	70 8X	25 XX
DO FW	0 to 255	4E	00	SU T	0.0 to 127.15	70 4X	25 XX
TB D	0.0 to 255.15	70 CX	46 XX	RU T	0.0 to 127.15	70 0X	25 XX
TBN D	0.0 to 255.15	70 8X	46 XX	TB C	0.0 to 63.15	70 CX	15 XX
SU D	0.0 to 255.15	70 4X	46 XX	TBN C	0.0 to 63.15	70 8X	15 XX
RU D	0.0 to 255.15	70 0X	46 XX	SU C	0.0 to 63.15	70 4X	15 XX
TB RS	0.0 to 255.15	70 CX	57 XX	RU C	0.0 to 63.15	70 0X	15 XX

MC5 operation
3) SL 0 and SR 0 = NOP 0
4) Display format instructions:
BLD 130 generates a line feed
BLD 131 change to STL (Statement list)
BLD 255 SE (Segment end)
5) Only in FBs
6) 7070 has the same effect
* Change "PRESET" of PG to "system operations", to be programmed in FBs only
B Byte
W Word
7) X : Formal operand
PG 670: A =, AN =, etc.
8) PG 670 : FRT etc.

11.10.5 Instruction list for S5-130W(B) arranged according to Hexa code (without system operations)

0000	NOP 0
0100	CFW
0200	L T PAR
0400	F T PAR
0500	BEC
0600	FR = PAR No.
0700	A = PAR No.
0900	CSW
0A00	L FB PAR
0B00	T FB PAR
0C00	LD T PAR
0D00	JO = Cond. Jump at 0
0E00	LD = PAR No.
0F00	O = PAR No.
1000	BLD number
1200	L FW PAR
1300	T FW PAR
1400	SF T PAR
1500	JP = Cond.JP at pos.
1600	SFD = PAR No.
1700	S = PAR No.
1C00	SE T PAR
1D00	JC FB Block No.
1E00	SEC = PAR No.
1F00	= = PAR No.
2000	C DB Block No.
2120	> F
2140	< F
2160	>< F
2180	! = F
21A0	> = F
21C0	< = F
2200	L DL PAR
2300	T DL PAR
2400	SR T PAR
2500	JM = Cond.JP at minus
2600	SR = PAR No.
2700	AN = PAR No.
2800	L KB Constant
2A00	L DR PAR
2B00	T DR PAR
2C00	SS T PAR
2D00	JU = Uncond.JP (symb.addr.)
2E00	SS U = PAR No.
2F00	ON = PAR No.
3001 0000	L KC
3002 0000	L KT
3004 0000	L KF
3010 0000	L KS
3020 0000	L KY
3040 0000	L KH
3080 0000	L KM

3200	L DW PAR
3300	T DW PAR
3400	SP T PAR
3500	JN = Cond.JP at neg.
3600	SP = PAR No.
3700	RB = PAR No
3C00	R T PAR
3D00	JU FB Block No.
3E00	RD = PAR No.
3F00	LW = PAR No.
4100	A W
4200	L C PAR
4400	F C PAR
4500	JZ = PAR No.
4600	L = PAR No.
4900	O W
4A00	L IB PAR
4A80	L QB PAR
4B00	T IB PAR
4B80	T QB PAR
4C00	LD C PAR
5100	XO W
5200	L IW PAR
5280	L QW PAR
5300	T IW PAR
5380	T QW PAR
5400	C D C PAR
5500	JC PB PAR
5900	- F
5C00	S C PAR
5D00	JC SB PAR
6100	SL Number
6200	L RS Addr.
6500	BE
6600	T = PAR No.
6900	SR Number
6A00	L RI Addr.
6B00	T RI Addr.
6C00	CU C PAR
7015 0000	RU C BIT/WORD ADDR.
7015 4000	SU C BIT/WORD ADDR.
7015 8000	TBN C BIT/WORD ADDR.
7015 C000	TB C BIT/WORD ADDR.
7025 0000	RU T BIT/WORD ADDR.
7025 4000	SU T BIT/WORD ADDR.
7025 8000	TBN T BIT/WORD ADDR.
7025 C000	TB T BIT/WORD ADDR.
7046 0000	RU D BIT/WORD ADDR.
7046 4000	SU D BIT/WORD ADDR.
7046 8000	TBN D BIT/WORD ADDR.
7046 C000	TB D BIT/WORD ADDR.

7047 0000	RU RI BIT/WORD ADDR
7047 4000	SU RI BIT/WORD ADDR
7047 8000	TBN RI BIT/WORD ADDR
7047 0000	TB RI BIT/WORD ADDR
7200	L PB PAR
7300	T PB PAR
7500	JU PB Block No.
7900	+F
7A00	L PW PAR
7B00	T PW
7C00	R C PAR
7D00	JU SB BLOCK No.
8000	A F BIT/BYTE-PAR
8800	O F BIT/BYTE-PAR
9000	S F BIT/BYTE-PAR
9800	= F BIT/BYTE-PAR
A000	AN F BIT/BYTE-PAR
A800	ON F BIT/BYTE-PAR
B000	R F BIT/BYTE-PAR
B800	A C PAR
B900	O C PAR
BA00	A(
B800	O(
BC00	AN C PAR
BD00	ON C PAR
BF00	)
C000	A I BIT/BYTE-PAR
C080	A Q BIT/BYTE-PAR
C800	O I BIT/BYTE-PAR
C880	O Q BIT/BYTE-PAR
D000	S I BIT/BYTE-PAR
D080	S Q BIT/BYTE-PAR
D800	= I BIT/BYTE-PAR
D880	= Q BIT/BYTE-PAR
E000	AN I BIT/BYTE-PAR
E080	AN Q BIT/BYTE-PAR
E800	ON I BIT/BYTE-PAR
E880	ON Q BIT/BYTE-PAR
F000	R I BIT/BYTE-PAR
F080	A T PAR
F800	O T PAR
F900	JC = Cond.JP on RLO=1
FA00	O
FB00	AN T PAR
FC00	ON T PAR
FD00	NOP 1
FFFF	

Chapter 12

-Overview PLC Modules and Jumperings-

Contents

12.1 PLC central unit 130-WB (6ES5921-3WB)

PLC-CPU with slots for two EPROM submodules.
One EPROM submodule for the basic PLC program.
One EPROM submodule for maximum 16 k user program
9 kByte RAM, there of 2,9 k words for PLC user program.
Microprocessor 8 x 305.
The 130 WB module consists of 2 boards:
CPU-130 W and memory board 01200. Both are connected electrically via a flat ribbon cable.
For significance of switches and LEDs on the front plate refer to Section 11.

Fixed jumpers for CPU-130 W (U1):

Type	Designation	Signal	Closed/open	Remark
Individual link	F-G		closed	
Individual link	K-L		closed	

P1 to P5 are test sockets

Fixed jumpers for memory module 01200 (U2):

Type	Designation	Signal	Closed/open	Remark
Individual link	W1		open	Address RAM
Individual link	W2		open	
Individual link	W3		closed	
Individual link	W4		open	
Individual link	W5		closed	
Individual link	A-B		open	

Address decoder: D2 8032 002.00
D6 8032 006.00

Operating system program: D1 548803.2001.00

With 130 WB12, the link W1 on U2 is closed on delivery.

W1 closed: Data exchange with AS512 via flags

W1 open: Data exchange with AS512 via the system transfer area

12.2 PLC modules

12.2.1 EPROM submodules

The EPROM submodules are inserted in the slots of the 130 WB module

Type	No.	Memory k Byte	Remark	Links												
				B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13
6FX1123 6AB 00 (01210BA) PROM type 2764	2	6k	Basic PLC progr.	x	-	x	x	x	x	-	x	-	-	-	x	x
	2	8k	Option N 32	x	-	x	x	x	x	-	x	-	-	-	x	x
	4	16k	Option N 34	x	x	x	x	x	x	-	x	-	-	-	x	x
01210-AA PROM type 2732	3	6k	Basic pro-gram	-	x	x	-	x	x	-	x	x	-	-	-	x
	4	8k	Option N 32	x	x	x	-	x	x	-	x	x	-	-	-	x

Preconditions for PG 670:

	Module 01210AA	Module 01210BA
Manufacturing version PG 670	C	B, C
Operating system	from 08 on	from 08 on
Adapter	-	needed

The operating system version of the PG 675 must be > 02. No adapter is necessary.

The modules MS 820, 6ES5-371 and 6ES5-373 can be used as well. Th-
module 6ES5-370 cannot be used. In case of module 6ES5-373 or 6FX1
6BA00 fitted in the upper slot, filler -DBs must be programmed. These
exist already in the basic PLC program in case of module 6FX1123-6BA

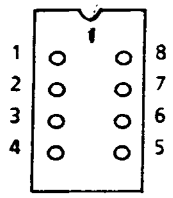
12.2.2 RAM submodule 6FX1123 6AL00

The module 6FX1123-6AL00comprises 16, words for option N 39.
This module is plugged-in in the lower slot of 130 WB 12 and can be u:
during commissioning.

12.3 GWE input/output modules

12.3.1 I/0-module 6FX1118 -4AA01 (03401)

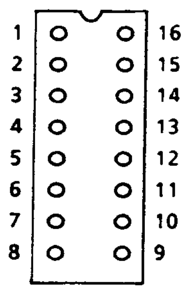
- for 48 inputs, 24 V
- for 24 outputs, 0.1 A each, 24 V
- fuse 1.5 A, medium time-lag.

Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket S1 	1 - 8	address	-	x
	2 - 7	"	-	x
	3 - 6	"	-	x
	4 - 5	"	open	-

* Refer to Section 12.8.

12.3.2 I/O module 03400

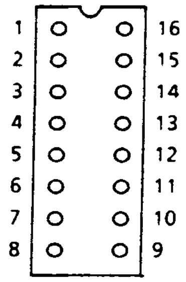
- like 6FX1118 - 4AA01

Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket X1 	1-16	address	-	x
	2-15	"	-	x
	3-14	"	-	x
	4-13	"	open	-
	5-12	free		-
	6-11	"		-
	7-10	"		-
	8-9	"		-

* Refer to Section 12.8

12.3.3 Input module 6FX1192 - 4AA00 (03410)

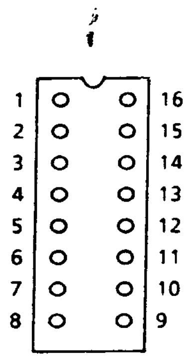
- For 96 inputs, 24 V

Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket X1		without effect	-	-
Socket X2	1-16	address	-	x
	2-15	"	-	x
	3-14	"	open	-
	4-13	"	"	-
	5-12	"	"	-
	6-11	"	"	-
	7-10	"	"	-
	8-9	free	"	-
Individual link	A-B	MEXT	closed	-
"	C-D	MEXT	"	-

* Refer to Section 12.8

12.3.4 Output module 6FX 1123-0AA01 (03421)

- For 48 outputs, 0.5 A each, 24 V
- Connector X422 on the front plate for 24 V and MEXT
- Fuse 16 A, very quick acting (FF type)

Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket	1-16	address	-	x
X1	2-15	"	-	x
	3-14	"	-	x
	4-13	"	open	-
	5-12	"	"	-
	6-11	"	"	-
	7-10	"	"	-
	8-9	"	"	-
Individual link	S1		open	-
"	S2		"	-
"	B1		closed	-
"	B2	MEXT	"	-
"	B3	MOUT	"	-
"	A B		open	-
"	C D		"	-
				-

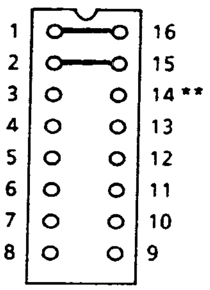
* Refer to Section 12.8

12.3.5 Output module 6FX1130 - 6BA00

Replacement type for 6FX1123 - 0AA01
Only the PLC bus connector is fitted
Jumper socket X1 as with 6FX1123 - 0AA01
Individual links: B1 closed
B2 closed
A-B open

12.3.6 I/O module 6FX1111 - 4AA00 (03450)

- For 32 inputs, 24 V
- For 32 outputs, 0.1 A each, 24 V
- Fuse 1.5 A, medium time-lag

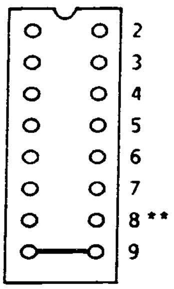
Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket X1		without effect	-	-
Socket X2 	1-16 2-15 3-14 4-13	Address " " "	closed " closed/ ** open open	- - - -
	5-12 6-11 7-10 8-9	" " " "	- - - -	x x x x
Individual link " "	A-B D-C D-E	MEXT Address "	open " "	- - -

*Refer to Section 12.8

* Closed at manufacturing version AA and AB.
Open from version AC on.

12.3.7 Output module 6FX1112 - 0AA01 (03461)

- For 16 outputs, 2 A each, 24 V
- Terminal block X464 for 24 V and MEXT connection on the front plate
- Fuse 1.6 A, medium time-lag.

Type	Designation	Signal meaning	Fixed jumpers	Jumpers according to PLC program *
Socket S1		without effect	-	-
Socket S0	S2	address	-	x
	S3	"	-	x
	S4	"	-	x
	S5	"	-	x
	S6	"	-	x
	S7	"	open	-
	S8	"	closed/ **	-
			open	
	S9	"	closed	-
Individual link	S18	without	-	-
"	S19	effect	-	-

*Refer to Section 12.8

** Closed at manufacturing version AA and AB.
Open from version AC on.

12.4 SIMATIC input/output modules

12.4.1 Input module 6ES5-420-3

32 inputs, 24 V

Type	Designation	Signal	Closed/open	Remark
Individual link	BR 1		closed	RDY is generated with address and MEMR

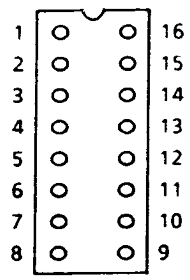
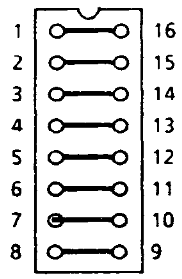
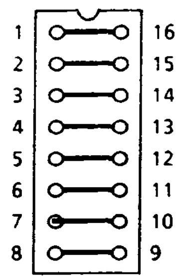
umper socket on location 16: Jumpers according to PLC program, refer to Section 12.8

12.4.2 Input module 6ES5-432-3

For 16 inputs, 24 V with group signal

Type	Designation	Signal	closed/open	Remark
Individual link	BR 1		closed	RDY is generated with address and MEMR

Adjustable jumpers:

Standard setting (delivery state)			
Location 11 	Location 43 	Location 44 	Br2 = open Br3 = closed
For special settings refer to Instruction Manual 130 W			

Jumper socket on location 1: Jumpers according to PLC program, refer to Section 12.9

12.4.3 Output module 6ES5-444-3

- For 16 outputs, 2 A each, 24 V with
  4 fuses F1 to F4, 4 A slow acting

Fixed jumpers

Type	Designation	Signal	Closed/open	Remark
Individual link	BR 1		closed	RDY is generated with address and MEMR

Adjustable jumpers

Type	Designation	Standard setting BASP effective	Special setting BASP not effective
Individual link	BR 2	open	closed

Jumper socket on location 1: Jumpers according to PLC program, refer to Section 12.9

12.4.4 Output module 6ES5-445-3

For 32 outputs, 0.5 A each, 24 V

Jumpers as with module 444-3 (Section 12.11)

12.5 Expansion unit and interfaces

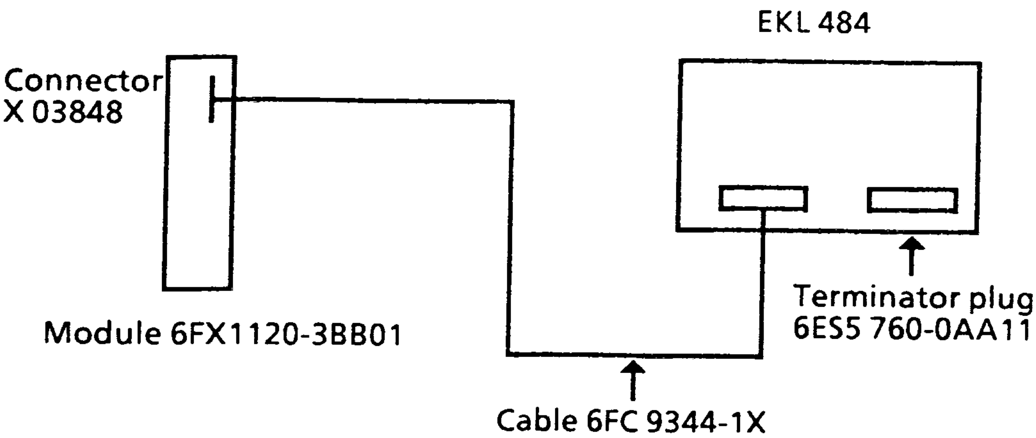
Types of interfaces:

CC module	EU module	NC type	Type of coupling
03800B	6ES5-310-3	3T/3M	symmetrical
6ES5-301-3	6ES5-310-3	3T/3M - OHA	symmetrical
6ES5-300-5	6ES5-312-5	3T/3M - OHA	asymmetrical
6ES5-301-5	6ES5-310-3	3TT	symmetrical
6ES5-300-5	6ES5-312-5	3TT	asymmetrical

Pay attention to the terminator plug.
For GWE modules as CC/EU interfaces refer to Section 9.
The coupling module 6FX1120-3BB01 (03845) replaces all above listed interfaces.

12.6 Electronic terminator EKL 484

The electronic terminator 6ES5484-8A-11 can be used as decentralized expansion unit for binary signals. It consists of interface module and input/output module. The input module comprises 16 inputs, the I/O module provides 8 inputs and 8 outputs (24 V, 2A).



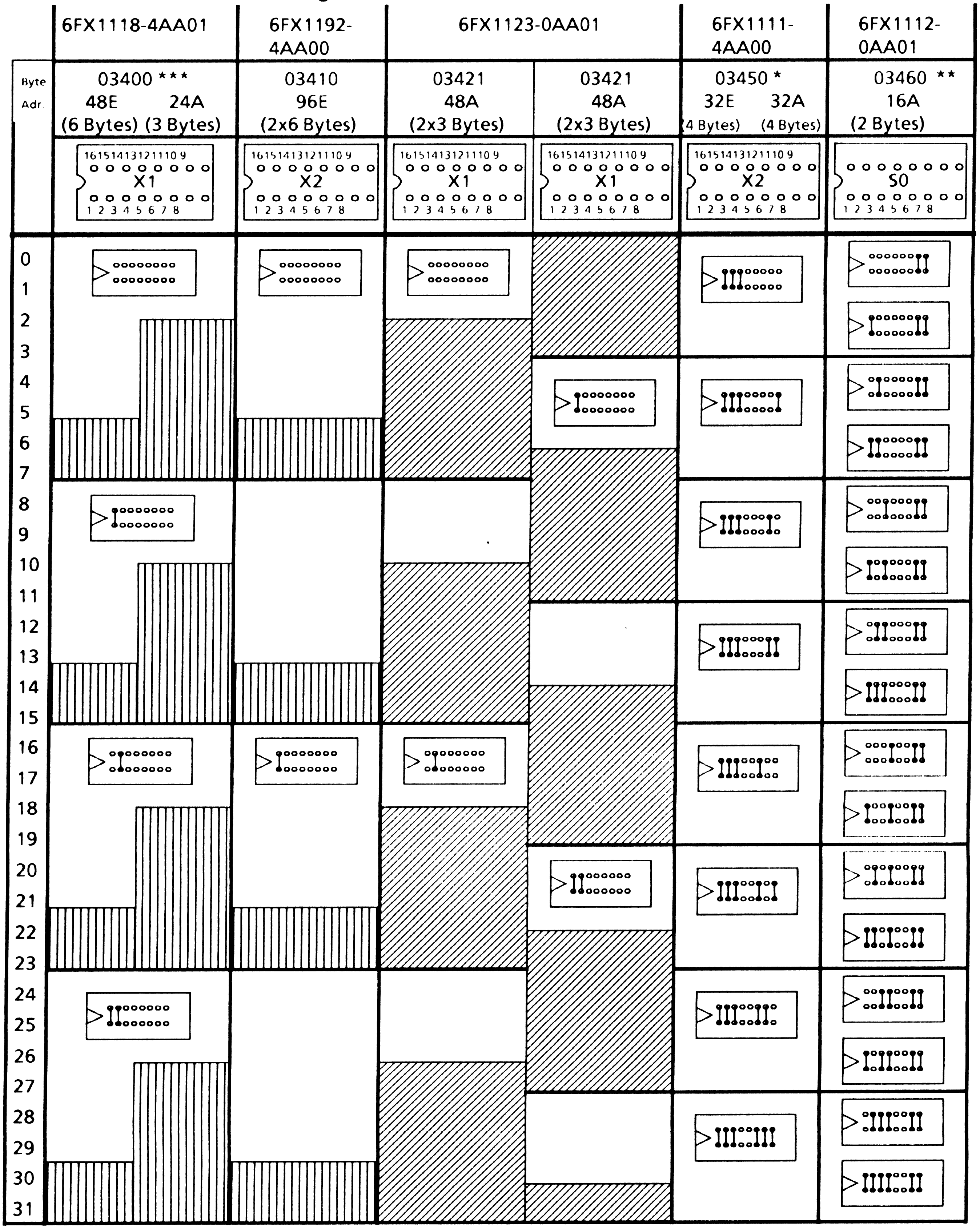
12.7 PLC memory modules 340/350

The modules 6ES5-340 and 6ES5-350 do not belong to standard system 3 delivery volume.
The modules are used for commissioning and program testing. For adjustments refer to Section 11.

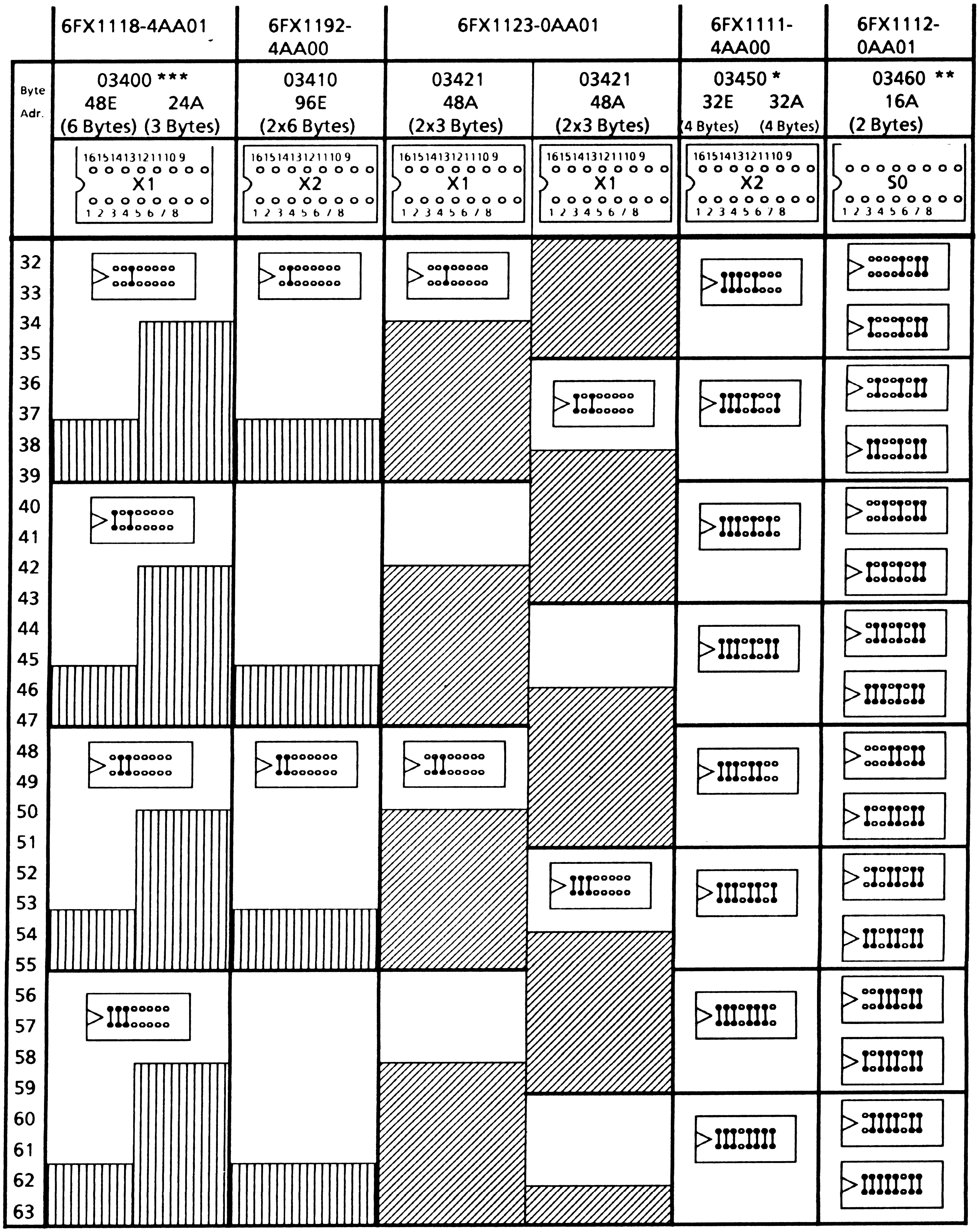
12.8 List of adjustments (addressing) according to the PLC program for the GWE I/O modules.

The modules can be fitted in the rack at random order.

A number is assigned by means of jumpering to each module which determines the address range at the same time.



Jumpering of GWE I/O modules continued:



Inhibited addresses, not to be used by other modules.

These addresses can be allocated to other modules.

* Bei Baugruppen mit Ausgabestand AC entfällt die Brücke 3-14

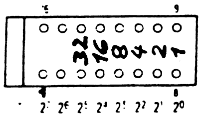
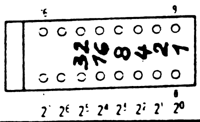
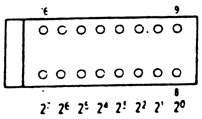
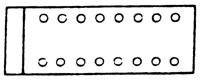
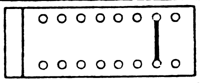
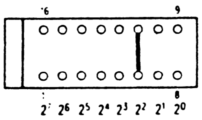
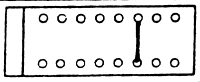
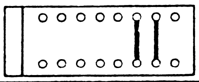
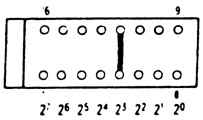
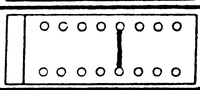
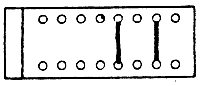
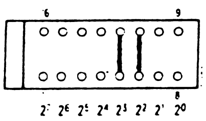
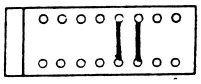
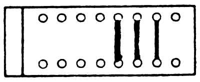
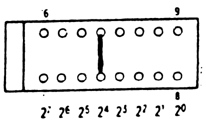
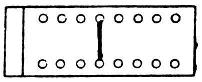
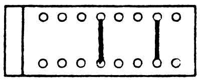
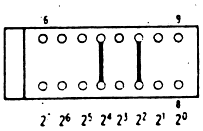
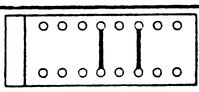
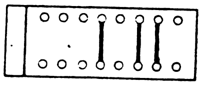
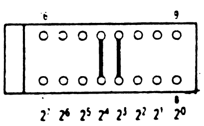
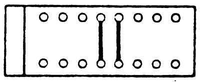
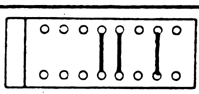
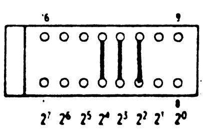
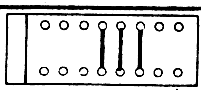
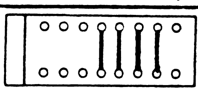
** Bei Baugruppen mit Ausgabestand AC entfällt die Brücke 8-11

*** Bei der Baugruppe 6FX1118-4AA01 entspricht der Sockel X1 dem S1, Brücke 1-16/4, 2-15/5, 3-14/4, 4-13/7

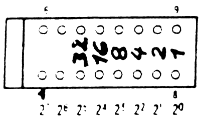
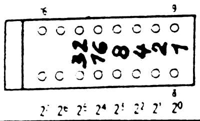
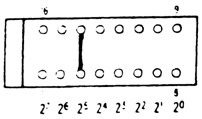
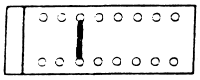
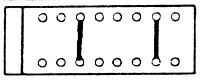
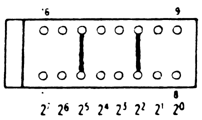
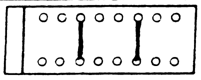
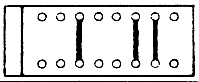
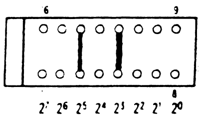
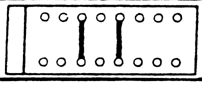
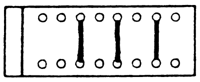
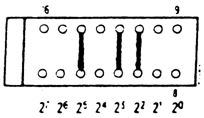
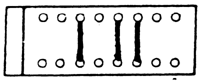
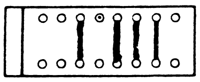
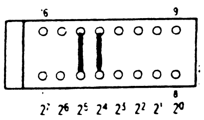
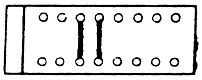
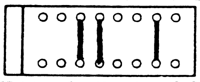
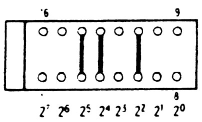
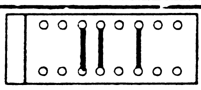
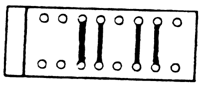
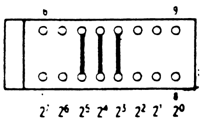
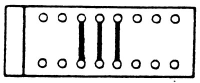
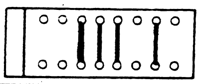
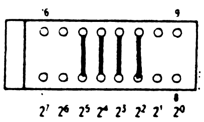
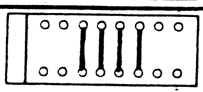
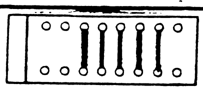
12.9 List of adjustments (addressing) according to the PLC program for the S5-I/O modules.

The modules can be fitted in the rack at random order.

A number is assigned by means of jumpering to each module which determines the address range at the same time.

Byte Adr.	S5-420 S5-445	S5-444 S5-432
		
0 1		
2 3		
4 5		
6 7		
8 9		
10 11		
12 13		
14 15		
16 17		
18 19		
20 21		
22 23		
24 25		
26 27		
28 29		
30 31		

Jumpering of S5-I/O modules continued:

Byte Adr	S5-420 S5-445	S5-444 S5-432
		
32 33		
34 35		
36 37		
38 39		
40 41		
42 43		
44 45		
46 47		
48 49		
50 51		
52 53		
54 55		
56 57		
58 59		
60 61		
62 63		

To Siemens AG E 885 Postfach 48 48 D-8500 Nürnberg 1	**Suggestions** **Corrections**
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	Installation Guide **Order No.:** 6ZB5 410-0CH02-0AA0 **Edition:** 05.89
Sender: Name Company/Dept. Address Telephone /	Should you come across any printing errors when reading this publication, we would ask you to inform us accordingly, using this form. We would also welcome any suggestions you may have in the way of improvement.

Suggestions and/or corrections

Energy and Automation Group
Department for Numerical Controls and
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