Modular Potentiometers with Cermet (P11) or Conductive Plastic Elements (PA11)

FEATURES

- CECC 41300
- GAM T1
- P11 version for industrial and military applications
- PA11 version for professional audio applications
- Trimmer version T11/TA11 (see document No. 51021)
- Miniature module size: 12.5 mm square - low current compatibility
- Five shaft diameters and 12 terminal styles
- Multiple assemblies - up to seven modules
- Shaft and panel sealed version
- Up to twenty-one indent positions
- Switch modules
- Concentric shafts
- Motorized version
- Custom designs

VERSATILE	MODULAR	COMPACT	ROBUST

ELECTRICAL SPECIFICATIONS

		PA11	P11
Resistive Element		Conductive plastic	Cermet
Electrical Travel		270° ± 10°	270° ± 10°
Resistance Range*	**Linear Law**	1 kΩ to 1 MΩ	10 Ω to 10 MΩ
	Non Linear Law	470 Ω to 500 kΩ	100 Ω to 2.2 MΩ
Tolerance	**Standard**	± 20 %	± 20 %
	On request	-	± 5 % or ± 10 %
Power Rating	**Linear Law**	0.5 W at + 70 °C	1 W at + 70 °C
	Non linear Laws	0.25 W at + 70 °C	0.5 W at + 70 °C
	Multiple Assemblies	0.25 W at + 70 °C per module	0.5 W at + 70 °C per module
Temperature Coefficient (Typical)		± 500 ppm/°C	± 100 ppm/°C (R ≥ 100 Ω)
Limiting Element Voltage		350 V	350 V
Contact Resistance Variation	**Linear Law**	1 %	2 % or 3 Ω
End Resistance (Typical)		2 Ω	2 Ω
Independent Linearity (Typical)	**Linear Law**	± 5 %	± 5 %
Insulation Resistance		10^6 MΩ min.	10^6 MΩ min.
Dielectric Strength		1500 V_{RMS} min.	1500 V_{RMS} min.
Attenuation		90 dB max. and 0.05 dB min.	-
Mechanical Rotational Life		50 000 cycles	50 000 cycles

* Consult Vishay Sfernice for other ohmic values

MECHANICAL SPECIFICATIONS PA11 AND P11

Mechanical Travel: 300° ± 5°

Operating Torque, Single and Dual Assemblies:

- **3 mm, 4 mm (1/8") dia. Shafts** 0.5 to 1.3 Ncm max. (0.7 to 1.8 oz-inch max.)
- **6 mm (1/4") dia. Shafts** 0.7 to 1.5 Ncm max. (1 to 2.1 oz-inch max.)

Three to Seven Modules (per module): 0.2 to 0.3 Ncm max. (0.3 to 0.45 oz-inch max.)

End Stop Torque:

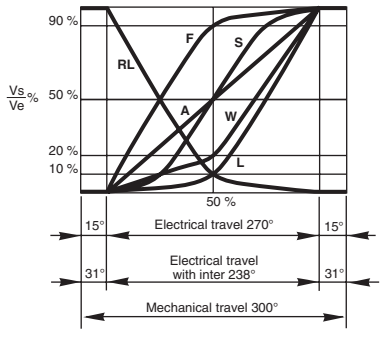
- **3 mm, 4 mm (1/8") dia. Shafts** 25 Ncm max. (2.1 lb-inch max.)
- **6 mm (1/4") dia. Shafts** 80 Ncm max. (6.8 lb-inch max.)

Tightening Torque:

- **6 mm, 7 mm (1/4") dia. bushings** 150 Ncm max. (13 lb-inch max.)
- **10 mm (3/8") dia. bushings** 250 Ncm max. (21 lb-inch max.)

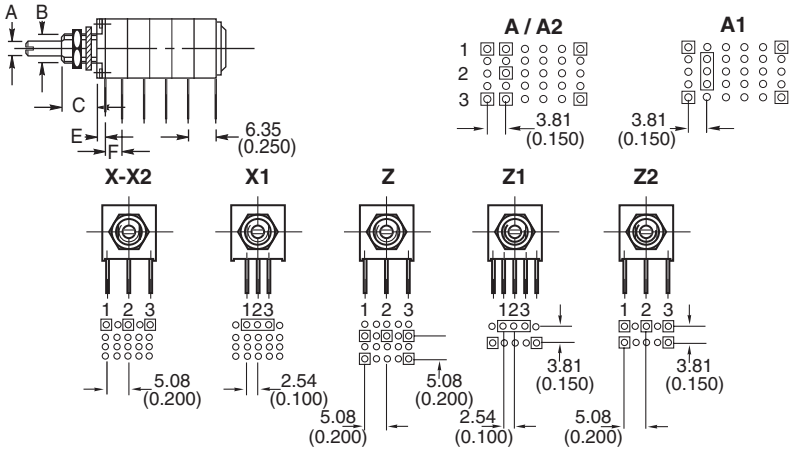
Weight 7 g to 9 g per module (0.25 to 0.32 oz)

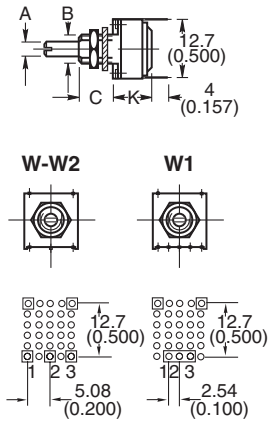
VARIATION LAWS



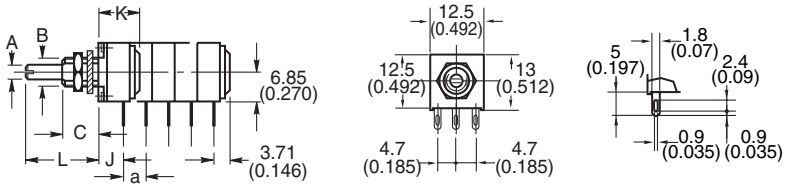
DIMENSIONS in millimeters [inches]

PCB PIN OUT A - A_1 - A_2/X - X_1 - X_2/Z - Z_1 - Z_2/W - W_1 - W_2



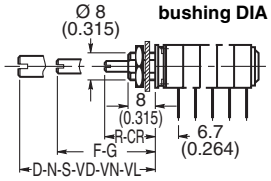


SOLDER LUGS Y

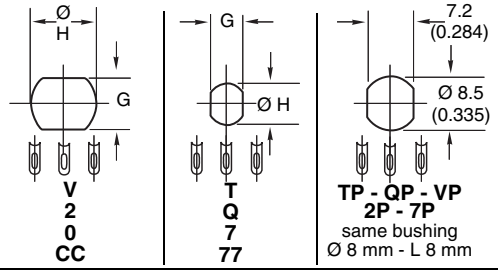


PANEL AND SHAFT SEALED TP/QP/VP/2P/7P

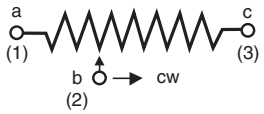
All models have to same bushing DIA 8 mm - L 8 mm



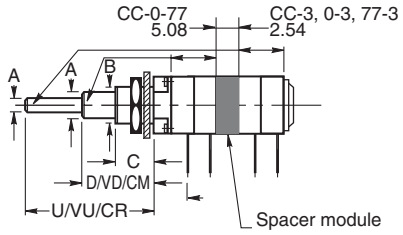
PANEL CUT OUT



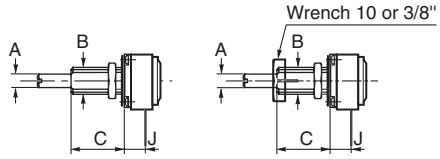
CIRCUIT DIAGRAM



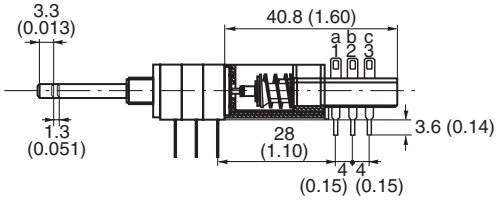
CONCENTRIC SHAFT



P11/PA11 71 **P11/PA11 71H**
P11/PA11 72 **P11/PA11 72H with spindle baking nut**



SWITCH: MOMENTARY PUSH OR PUSH-PUSH



The position of each module is free

Shafts	T	Q	V	CC	7	71	72	2	0	77
	dimensions mm ± 0.5				dimensions inches ± (0.01)					
A Shafts Ø	3	4	6	3/6	1/8"	1/8"	1/8"	1/4"	1/8" 1/4"	0.07 1/8"
B Bushing Ø	6	7	10	10	1/4"	1/4"	1/4"	3/8"	3/8"	1/4"
C L	8	8	9.5	9.5	1/4"	3/8"	1/2"	3/8"	3/8"	1/4"
J version Y, X, X_1, X_2	5	5	7	7	0.200	0.200	0.200	0.278	0.278	0.200
K	9.1	9.1	11.1	-	0.357	0.357	0.357	0.436	-	-
E version Z	1.8	1.8	3.8	3.8	0.071	0.071	0.071	0.150	0.150	0.071
E version	1.6	1.6	3.6	3.6	0.063	0.063	0.063	0.14	0.14	0.063
F	version Z : 5.08 (0.200)				versions A- A_1-A_2-Z_1-Z_2 : 3.81 (0.150)					
G Panel	5.2	6.2	8.2	8.2	0.197	0.197	0.197	0.323	.323	0.197
H Cutout Ø	6.5	7.5	10.5	10.5	0.268	0.268	0.268	0.394	0.394	0.268
a	variable 5.08 (0.200)				7.62 (0.300)			10.16 (0.400)		
Thread	M 0.75				32 threads/inch					
Nut	8	10	12	12	0.313	0.313	0.313	0.500	0.500	0.313
Shaft lengths L	Measurement from the mounting face, see ordering procedures									

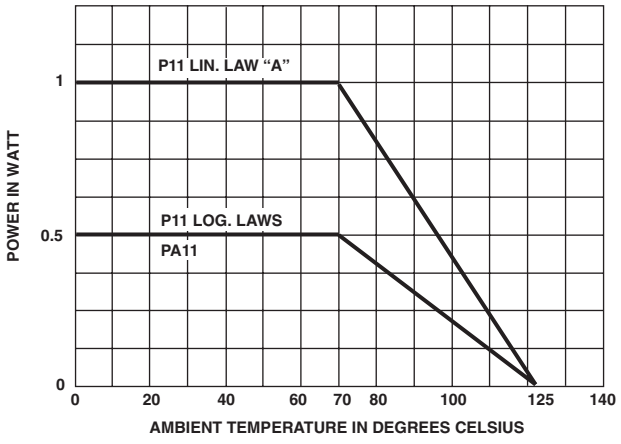
ENVIRONMENTAL SPECIFICATIONS

	PA11	P11
Operating Temperature Range	- 55 °C + 125 °C	- 55 °C + 125 °C
Climatic Category	55/125/21	55/125/56
Sealing	IP64	IP64
Storage Temperature	- 55 °C + 125 °C	- 55 °C + 150 °C

STANDARD RESISTANCE ELEMENT DATA

STANDARD RESISTANCE VALUES	P11 CERMET						PA11 CONDUCTIVE PLASTIC LINEAR LAW			CT	
	LINEAR LAW			NON LINEAR LAW						- 55 °C	+ 125 °C
	MAX. POWER AT 70 °C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	MAX. POWER AT 70 °C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	MAX. POWER AT 70 °C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	P11	PA11
Ω	W	V	mA	W	V	mA	W	V	mA	ppm/°C	
22	1	4.69	213.2							± 200	
47		6.85	145.8								
100		10	100								
200		14.8	67.4	0.5							
470		21.6	46.1		15.3	32.7					
1k		31.6	31.6		22.4	22.4	0.5	22.4	22.4		
2.2k		46.9	21.3		33.2	15.1		33.2	15.1		
4.7k		63.5	14.5		48.5	10.3		48.5	10.3		
10k		100	10		79.7	7.07		79.7	7.07	± 100	± 1000
22k		148.3	6.7		105	4.77		105	4.77		
47k		216.7	4.6		153	3.26		153	3.26		
100k	1	316.2	3.16	0.5	224	2.24	0.5	224	2.24		
220k	0.56	350	1.59	0.26	332	1.51	0.5	332	1.51		
470k	0.26	350	0.75	0.12	350	0.74	0.26	350	0.74		
1M	0.12	350	0.35		350	0.35					
2.2M	0.05	350	0.16								
4.7M	0.02	350	0.07								

POWER RATING CHART



MULTIPLE ASSEMBLIES

Standard assemblies can comprise up to 7 modules in addition to the shaft and bushing module.

Detents module (CV)

Switch modules (RS or RSI)

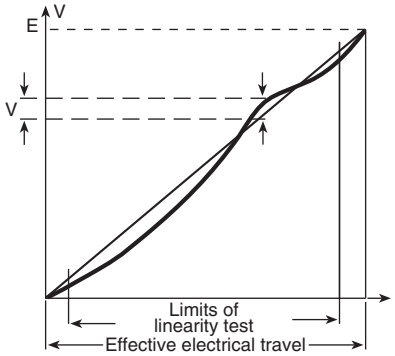
Potentiometer modules

Spacer module (EV) to increase the distance between rows of pins from 5.06 mm (0.200) to 10.16 mm (0.400).

Screening module, with ground terminal.

The position of each module is free except the push/push, momentary push and motor which has to be the last module.

LINEARITY - CONFORMITY

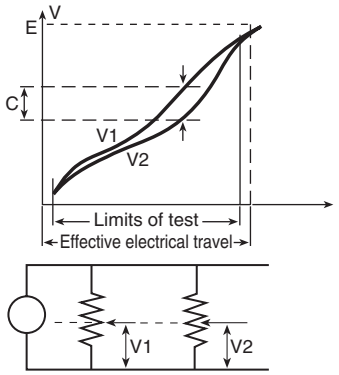


The independent linearity (conformity for the non linear laws) is the maximum gap ΔV between the actual variation curve and the theorical variation curve the nearest to it. The linearity and the conformity are expressed in percentage of the total applied voltage E

$$\text{linearity conformity} = \frac{\pm\ \Delta V\ \text{max}}{E}$$

They are measured over 90 % of actual electrical travel (centered).
On request linearity can be guaranteed in linear law.
For example: linearity ± 2 % + J 145 option (see ordering procedure).

INTERLINEARITY - INTERCONFORMITY



It is the maximum deviation between the actual voltage outputs of 2 or more pot modules in the same assembly. It is expressed as a percentage of the total applied voltage, or preferably in dB attenuation.

Interlinearity is measured between 2 pot modules, over 10 to 90 % of the attenuation.

The interlinearity or interconformity is expressed as a percentage of the total applied voltage :

$$I\ \% = \frac{|CI|}{E}$$

Or in decibels by comparison between outputs V1 and V2

$$I\ \text{dB} = 20 \log \frac{V_1}{V_2}$$

PERFORMANCE

TESTS	CONDITIONS	TYPICAL VALUES AND DRIFTS	P11 CERMET	PA11 CONDUCTIVE PLASTIC
Load Life	1000 h at + 70 °C (90'/30')	total resistance shift	± 2 %	± 10 %
		contact resistance variation	± 4 %	± 5 %
Temperature Cycle	5 cycles - 55 °C to 125 °C	total resistance shift	± 0.2 %	± 0. 5 % typical
Moisture	+ 40 °C 93 % relative humidity	total resistance shift insulation resistance	56 days ± 2 % > 1000 MΩ	21 days ± 5 % > 10 MΩ
Rotational Life	P11/PA11: 50 000 cycles	total resistance shift contact resistance variation	± 5 % ± 5 %	± 6 % ± 2 %
Climatic Sequence	Dry heat at + 125 °C/Damp heat Cold - 55 °C/Damp Heat 5 cycles	total resistance shift	± 1 %	-
Shock	50 G 11 ms 3 shocks - 3 directions	total resistance shift resistance setting change	± 0.2 % ± 0.5 %	± 0.2 % ± 0.5 % typical
Vibration	10 - 55 Hz 0.75 mm or 10 G 6 hours	total resistance shift voltage setting change	± 0.2 % ± 0.5 % typical	± 0.2 % ± 0.5 % typical

OPTIONS

MODULES : RS ON/OFF SWITCH RSI CHANGEOVER SWITCH

The position of each module is free.

RS and RSI rotary switches are housed in a standard P11 module size 12.7 x 12.7 x 5.08 mm (0.5" x 0.5" x 0.2"). They have the same terminal styles as the assembled electrical modules.

CAUTION: Because of the switch actuation travel, the potentiometer total electrical travel is reduced to 240° ± 10°

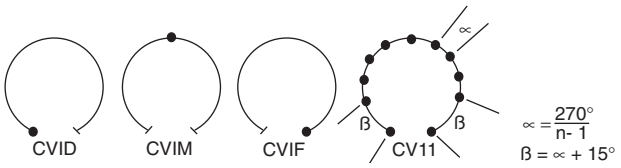
Switch actuation is described as seen from the shaft end.
D: means actuation in maximum CCW position
F: means actuation in maximum CW position
The switch actuation travel is 25° with a total mechanical travel of 300° ± 5°.

MODULES : PUSH/PUSH SWITCH RSPP MOMENTARY/PUSH SWITCH RSMP

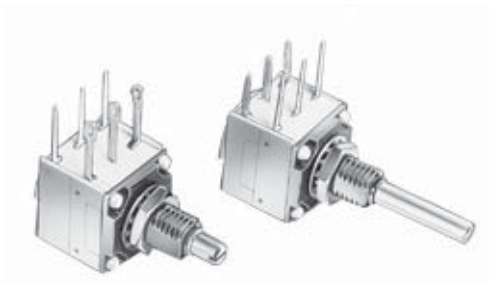
The switches are manufactured by ITT, F.U. series (NE18 series available on request).
They have to be the last element of potentiometer and are linked to electrical module by an interface.
RSPP and RSMP switches are available only with P11/PA11 T-Q or 7 series not with P11/PA11 V or 2 series.
Options :
2 reversing switches F2 4 reversing switches F4
6 reversing switches F6 8 reversing switches F8
Available with shafts R (T), G (Q), CR (7) others shafts on request.
Not available with panel sealed option.
Number of modules before the switch limited to 3 modules.

VALLEY DETENTS

The valley detents mechanism is housed in a standard P11 module. Up to 21 detents position available.
Count detents as follows : 1 for CCW position, 1 for full CW position, plus the other positions forming **equal resistance increments** (linear taper) - **not equal angles.**
Available now : CVID - CVIF - CVIM
CV3 - CV11 - CV21



SWITCH MODULES



RSD SINGLE POLE SWITCH, NORMALLY OPEN

In full CCW position, the contact between 1 and 3 is open. It is made at the beginning of the travel in CW direction.

RSF SINGLE POLE SWITCH, NORMALLY OPEN

In full CW position, the contact between 1 and 3 is open. It is made at the beginning of the travel in CCW direction.

RSID SINGLE POLE CHANGEOVER

In full CCW position, the contact is made between 3 and 2 and open between 3 and 1. Switch actuation (CW direction) reverses these positions.

RSIF SINGLE POLE CHANGEOVER

In full CW position, the contact is made between 1 and 2 and open between 1 and 3. Switch actuation (CCW direction) reverses these positions.

RSPP F2 : PUSH/PUSH SWITCH WITH TWO REVERSING SWITCHES

Idle position : the contact is made between 1 and 2 and a and b. It is open between 2 and 3 and b and c.

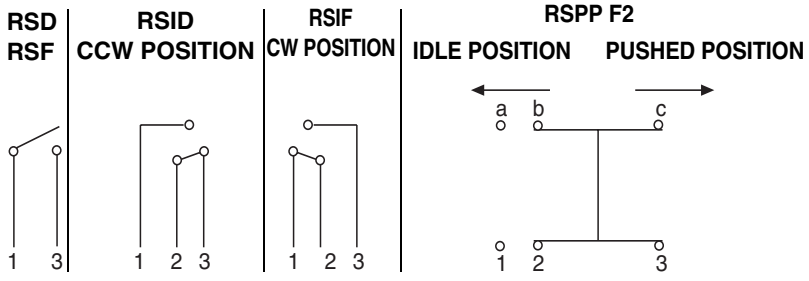
Pushed position: the contact is made between 2 and 3 and b and c. It is open between 1 and 2 and a and b.

Not available on P11V and P11-2.

On request for P11Q and P11-7.

SWITCH SPECIFICATIONS			
MODEL		**RS - RSI**	**F2 to F8**
Switching Power max.		62.5 VA υ 15 VA =	50 VA υ
Switching Current max.		0.25 A 250 Vυ 0.5 A 30 V =	0.5 A υ
Max. Current Through Element		2 A	2 A
Contact Resistance		30 mΩ	100 mΩ
Dielectric Strength	**Terminal to Terminal**	1000 V_{RMS}	1500 V_{RMS}
	Terminal to Bushing	2000 V_{RMS}	2000 V_{RMS}
Max. Voltage Operation		250 V υ 30 V =	250 V υ
Insulation Resistance Between Contacts		10^6 MΩ	10^3 MΩ
Life at P max.		10 000 actuations	100 000 actuations
Minimal Travel		25°	3.3 mm to 4.7 mm
Operating Temperature		- 40 °C to + 85 °C	- 20 °C + 70 °C

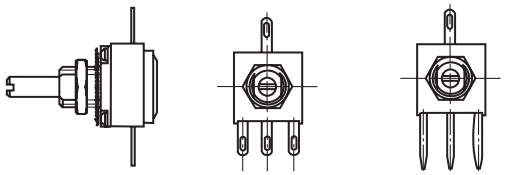
ELECTRICAL DIAGRAM



CENTER TAP "J"

The extra terminal is a solder lug connected at 50 % of electrical travel and situated in the potentiometer module opposite the terminals.

Center tap short circuit 11° of travel.



SHAFTS (see Ordering Information)

The shaft lengths are always measured from the mounting face.

Standard shafts are designed by a letter code (one or two digits). Shafts slots are aligned to ± 10° of the wiper position.

CONCENTRIC SHAFTS

The CC or 0 or 77 concentric shaft versions allies the total flexibility of the P11/PA11 modular system to the advantage of having two separate shafts.

The outer 6 mm or 1/4" or 1/8" dia. shaft drives the modules situated immediately behind the panel, before the spacer module.

The inner 3 mm or 1/8" or 0.07" dia. shaft drives the modules situated after the spacer module.

Spacer is available with a choice of two spacer thickness :

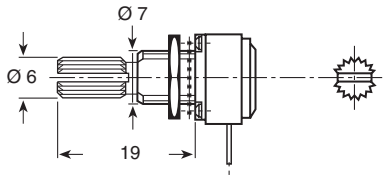
5.08 mm designations: CC, 0, 77

2.54 mm designations: CC-3, 0-3, and 77-3. See dimensional drawings on second page of this data sheet

CUSTOM SHAFTS

When special shafts are required - flat, threaded ends, special shaft lengths, etc. a drawing is required.

SPLINED SHAFT "I"



FLATTED SHAFT

PA11/P11 - 2 = VHM **PA11/P11 - 7 = CDM**

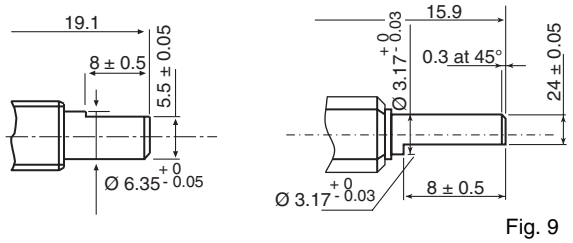


Fig. 9

NEUTRAL MODULE "EN"

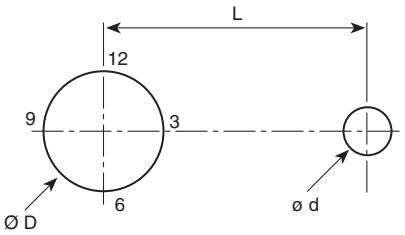
Neutral or screen module is housed in a standard P11 module. It is used as a screen between two electrical modules.

The leads can be connected to ground.

LOCATING PEGS (Anti-rotation lugs)

The locating peg is provided by a plate mounted on the bushing and positioned by the module sides.
Four set positions are available, clock face orientation: 12, 3, 6, 9.

All P11 bushings have a double flat. When panel mounting holes have been punched accordingly, an anti-rotation log is not necessary.



CODE	P11 - PA11					EFFECTIVE HIGH PEG
	VERSION	T-7	V-CC	Q	2-0	
B24	ø D mm	6.5	10.5	7.5	10	0.7
	ø d mm	2	2	2	2	
	L mm	6.2	6.2	6.2	6.2	
B30	ø d mm	2	2	2	2	0.7
	L mm	7.75	7.75	7.75	7.75	
B53	ø d mm	–	3.5	–	3.5	1.1
	L mm	–	13.5	–	13.5	

TRIMMERS T11
See data sheet document No. 51021

MARKING

POTENTIOMETER MODULE
VISHAY logo, nominal ohmic value (Ω, kΩ, MΩ), two stars identify PA11 version, tolerance in % - variation law, manufacturing date (four digits), "3" for the lead 3.

SWITCH MODULE
Version, manufacturing date (four digits), "c" for common lead.

INDENT MODULE
Version, manufacturing date (four digits).

ORDERING INFORMATION

P11 Cermet element	PA11 Conductive plastic element
SERIES	

Y	Solder lugs - radial 4.70 mm (.200") pin spacing
X	PCB pins - radial
Z	PCB pins - radial with front support plate
A	PCB pins - radial with front and back support plates
W	PCB pins - axial with 2 extra pins - 1 module only
-	5.08 mm (.200") pin spacing for X, Z, W pins section 0.9 x 0.3 mm² (.035" x .012")

1	2.54 mm (.100") pin spacing for X, Z, W pins section 0.6 x 0.3 mm² (.024" x .012") 5.08 mm (.200") pin spacing
2	for X, Z, W pins section 0.6 x 0.3 mm² (.024" x .012")
-	5.08 mm (.200") space between modules
3	7.62 mm (.300") space between modules
4	10.16 mm (.400") space between modules

TERMINAL STYLES

B24	Distance from shaft center of 6.2 mm (.244") for all models. Plate thickness of 0.4 mm (.015").
B30	Distance from shaft center of 7.75 mm (.305") for all models. Plate thickness of 0.4 mm (.015").
B53	Distance from shaft center of 13.5 mm (.531") for V, 2, CC and O models. Plate thickness of 0.8 mm (.031").

Locating pegs can be placed at 12, 3, 6 or 9 o'clocks. Not available with panel and shaft sealing option P.

LOCATING PEGS

P: All panel sealing versions have a bushing of 8mm dia. and 8 mm length. The shafts K - M - E - CK -CM -CD - CH are not-standard

PANEL-SHAFT SEALING OPTION

OPTIONS

SINGLE SHAFT			
BUSHING			SHAFT DIA.
	DIA.	LENGTH	
T	6	8	3
Q	7	8	4
V	10	9.5	6
2	3/8"	3/8"	1/4"
7	1/4"	1/4"	1/8"
71	1/4"	3/8"	1/8"
72	1/4"	1/2"	1/8"
CONCENTRIC SHAFT			
CC	10	9.5	3 - 6
O	3/8"	3/8"	1/8" - 1/4"
77	1/4"	1/4"	0.07" - 1/8"

*All panel sealing versions have a bushing of 8 mm dia, and 8 mm length

SHAFT AND BUSHING

FROM MOUNTING FACE					
		Dia.	Length	End Flat	End Shaft
T	K	3	9.5	}	slotted
	M	3	12.5		
	R	3	22		
Q	E	4	9.5		slotted
	F	4	12.5	}	
	G	4	22		
	I	6	19		splined
V	D	6	16	}	slotted
	N	6	25		
	S	6	50		
AP		Custom - specify or. quote drawing.			
		Dia.	Length	End Flat	End Shaft
7	CDM	1/8"	5/8"	}	slotted
	CK	1/8"	3/8"		
7	CM	1/8"	1/2"	}	slotted
71	CD	1/8"	5/8"		
72	CH	1/8"	3/4"		
	CR	1/8"	7/8"		
2	VD	1/4"	5/8"	}	slotted
	VR	1/4"	7/8"		
	VN	1/4"	1"		
	VL	1/4"	1.1/2"		
	VHM	1/4"	3/4"		flat
CC	D	6	16	}	plain
CC-3	U	3	28.5		
77	CM	1/8"	1/2"	}	plain
77-3	CR	0.07"	0.874"		
0	VD	1/4"	5/8"	}	plain
0-3	VU	1/8"	9/8"		

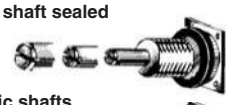
STANDARDS SHAFT LENGTHS

SHAFT AND BUSHING MODULE | OPTION INDENTS MODULE | OPTION SWITCH MODULE | 1st POTENTIOMETER MODULE | 2nd POTENTIOMETER MODULE | 3rd POT MODULE

PA11	7	X13	or	B24 / P	CR	CV1M	RSD	100 k	20 %	A	J84	10 k	20 %	A	J + J84	100 k

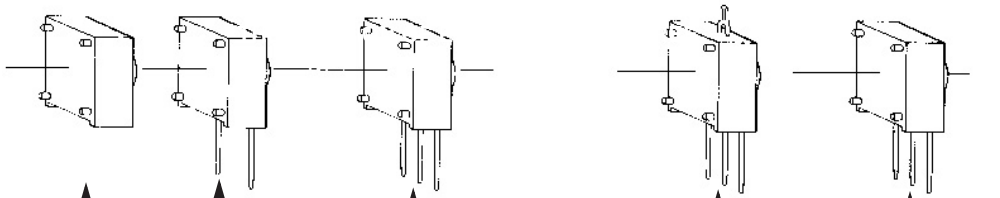
THE POSITION OF EACH MODULE IS FREE

Panel and shaft sealed



Concentric shafts

Locating peg



SHAFT AND BUSHING MODULE | OPTION INDENTS MODULE | OPTION SWITCH MODULE | 1st POTENTIOMETER MODULE | 2nd POTENTIOMETER MODULE | 3rd POT MODULE

PA11	7	X13	or	B24 / P	CR	CV1M	RSD	100 k	20 %	A	J84	10 k	20 %	A	J + J84	100 k

OPTION INDENT MODULE	
CV1M	1 indent at half travel
CV1D	1 indent CCW position
CV1F	1 indent CW position
CV3	3 indents inc.CW & CCW
–	–
–	–
–	–
CV11	11 indents
–	–
–	–
–	–
–	–
CV21	21 indents etc.

Former CRN version (N-1 equal mechanical angles) available on request.

OPTION SWITCH MODULE	
RSD	Single pole open switch in CCW position - 2 pins
RSF	Single pole open switch in CW position - 2 pins
RSID	Single pole chargeover switch in CCW position - 3pins
RSIF	Single pole chargeous switch in CW position - 3 pins

An assembly can comprise 1 or more switch modules. Pin out RS and RSI is the print out as other assemblied modules.

OHMIC VALUE
Quote clearly multipliers K - M
10 Ω to 10 MΩ A linear law - cermet
100 Ω to 2.2 MΩ L, F, S non linear laws -cermet
Conductive plastic 1 kΩ to 1MΩ A linear law
470 Ω to 500 kΩ non-linear laws

VARIATION LAW	
A	Linear
L	CW log 10 %
F	CW reverse log
S	Audio S shape symetrical log
W	CW log 20%
RL	CCW log

TOLERANCE	
± 20 %	Standard
± 10 %	Optional
± 5 %	Optional (cerment only)

OPTIONS	
J	Center tap
J41	Panel sealed bushing 10 mm dia.
J44	Interlinearity ± 2 % (linear law)
J84	Accuracy of center point of CV1M to ± 2 % (except S law)
J123	Linearity ± 3 % (linear law)
J145	Linearity ± 2 % (linear law)
J152	Marking part number
EN	Empty module with screen
EV	Spacer module without pin
M	Motorized assembly
RSPP	Push Push switch
RSMP	Momentary Push switch
Servo	Electrical travel 300°

SAP PART NUMBERING GUIDELINES

P	1	1	S	2	T	0	A	B	S	Y	0	0	4	7	0	M	A
MODEL			STYLE	NB OF MODULES	BUSHING	PEG	SHAFT			LEADS			OHMIC VALUE/TOL/LAW OR SPECIAL				

See the end of this data book for conversion tables

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