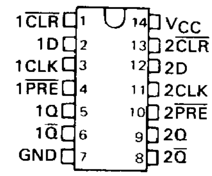
DUAL D-TYPE POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

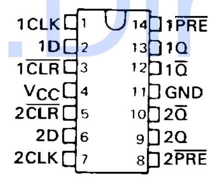
REVISED DECEMBER 1983

- **Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs**
- **Dependable Texas Instruments Quality and Reliability**

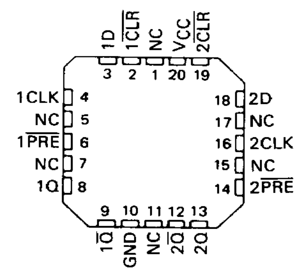
SN5474, SN54H74, SN54L74 . . . J PACKAGE
SN54LS74A, SN54S74 . . . J OR W PACKAGE
SN7474, SN74H74 . . . J OR N PACKAGE
SN74LS74A, SN74S74 . . . D, J OR N PACKAGE
(TOP VIEW)



SN5474, SN54H74 . . . W PACKAGE
(TOP VIEW)



SN54LS74A, SN54S74 . . . FK PACKAGE
SN74LS74A, SN74S74 . . . FN PACKAGE
(TOP VIEW)



NC - No internal connection

description

These devices contain two independent D-type positive-edge-triggered flip-flops. A low level at the preset or clear inputs sets or resets the outputs regardless of the levels of the other inputs. When preset and clear are inactive (high), data at the D input meeting the setup time requirements are transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold time interval, data at the D input may be changed without affecting the levels at the outputs.

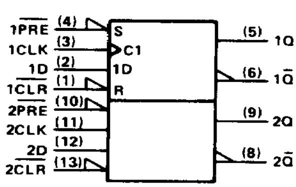
The SN54' family is characterized for operation over the full military temperature range of −55 °C to 125 °C. The SN74' family is characterized for operation from 0 °C to 70 °C.

FUNCTION TABLE

INPUTS				OUTPUTS	
$\overline{PRE}$	$\overline{CLR}$	CLK	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H†	H†
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q_0	$\overline{Q}_0$

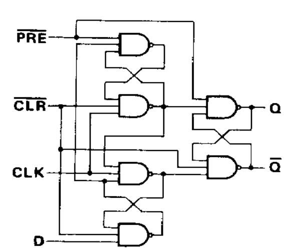
† The output levels in this configuration are not guaranteed to meet the minimum levels in V_{OH} if the lows at preset and clear are near V_{IL} maximum. Furthermore, this configuration is nonstable; that is, it will not persist when either preset or clear returns to its inactive (high) level.

logic symbol



Pin numbers shown on logic notation are for D, J or N packages.

logic diagram

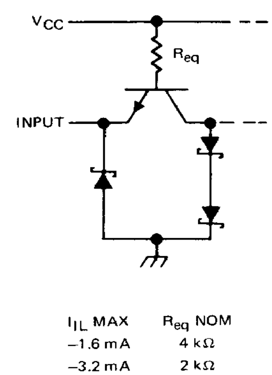


TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

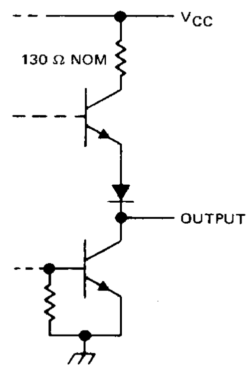
schematics of inputs and outputs

'74

EQUIVALENT OF EACH INPUT

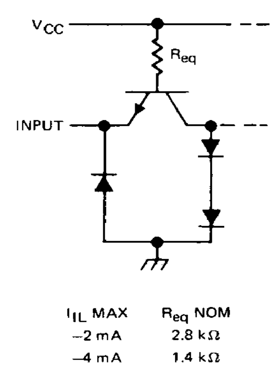


TYPICAL OF ALL OUTPUTS

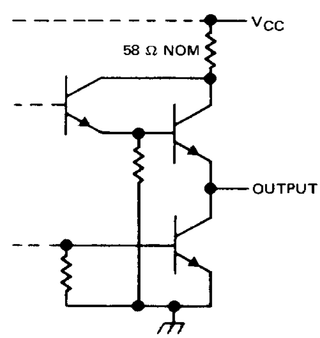


'H74

EQUIVALENT OF EACH INPUT



TYPICAL OF ALL OUTPUTS

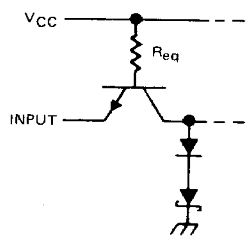


TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

schematics of inputs and outputs (continued)

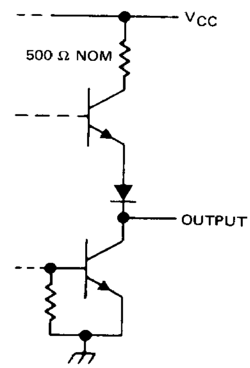
'L74

EQUIVALENT OF EACH INPUT



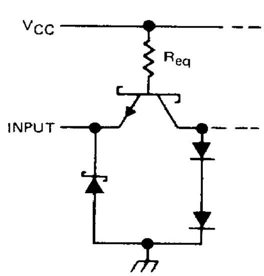
I_{IL} = MAX	R_{eq} NOM
−0.18 mA	40 kΩ
−0.36 mA	20 kΩ

TYPICAL OF ALL OUTPUTS



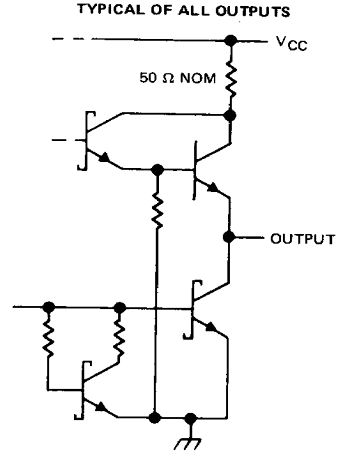
'S74

EQUIVALENT OF EACH INPUT



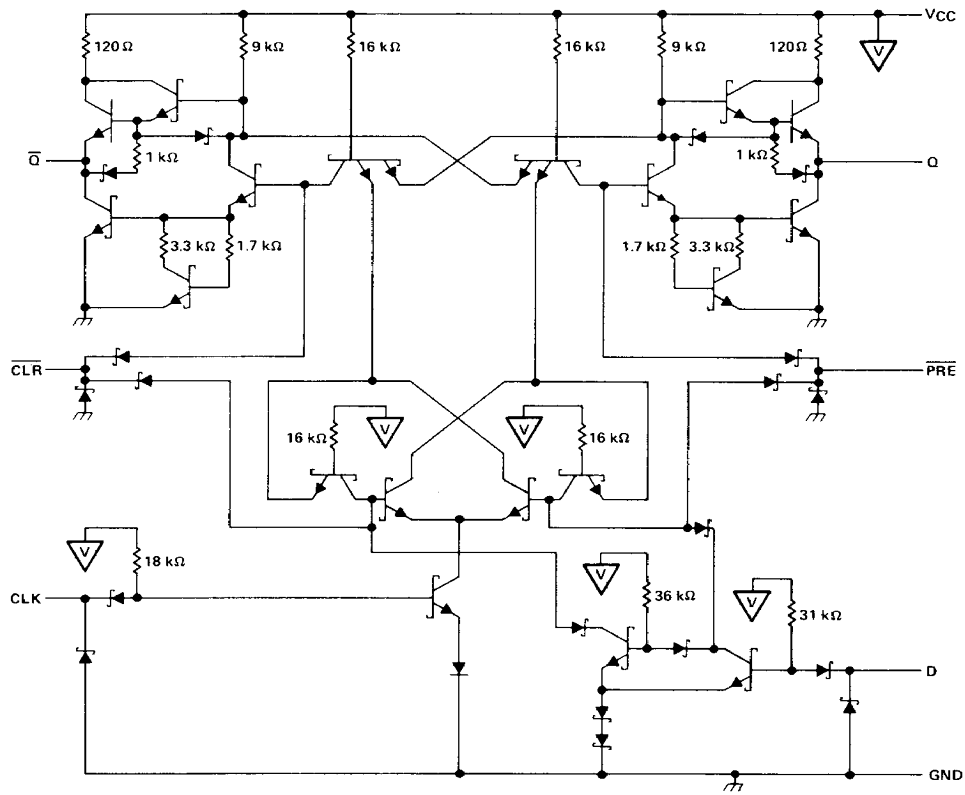
I_{IL} MAX	R_{eq} NOM
−2 mA	2.8 kΩ
−4 mA	1.4 kΩ
−6 mA	940 Ω

TYPICAL OF ALL OUTPUTS



schematic

'LS74A



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: '74, 'H74, 'L74, 'S74	5.5 V
'LS74A	7 V
Operating free-air temperature range: SN54'	− 55°C to 125°C
SN74'	0°C to 70°C
Storage temperature range	− 65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

recommended operating conditions

			SN5474 MIN	SN5474 NOM	SN5474 MAX	SN7474 MIN	SN7474 NOM	SN7474 MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.8			0.8	V
I_{OH}	High-level output current				−0.4			−0.4	mA
I_{OL}	Low-level output current				16			16	mA
t_w	Pulse duration	CLK high	30			30			ns
		CLK low	37			37			ns
		$\overline{PRE}$ or $\overline{CLR}$ low	30			30			ns
t_{su}	Input setup time before CLK↑		20			20			ns
t_h	Input hold time-data after CLK↑		5			5			ns
T_A	Operating free-air temperature		−55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN5474 MIN	SN5474 TYP‡	SN5474 MAX	SN7474 MIN	SN7474 TYP‡	SN7474 MAX	UNIT
V_{IK}		V_{CC} = MIN, I_I = −12 mA			−1.5			−1.5	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −0.4 mA	2.4	3.4		2.4	3.4		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 16 mA		0.2	0.4		0.2	0.4	V
I_I		V_{CC} = MAX, V_I = 5.5 V			1			1	mA
I_{IH}	D	V_{CC} = MAX, V_I = 2.4 V			40			40	mA
	$\overline{CLR}$				120			120	
	All Other				80			80	
I_{IL}	D	V_{CC} = MAX, V_I = 0.4 V			−1.6			−1.6	mA
	$\overline{PRE}$★				−1.6			−1.6	
	$\overline{CLR}$★				−3.2			−3.2	
	CLK				−3.2			−3.2	
I_{OS}§		V_{CC} = MAX	−20		−57	−18		−57	mA
I_{CC}		V_{CC} = MAX, See Note 2		8.5	15		8.5	15	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
★ Clear is tested with preset high and preset is tested with clear high.
§ Not more than one output should be shorted at a time.
NOTE 2: With all outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

switching charateristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 400 Ω, C_L = 15 pF	15	25		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$				25	ns
t_{PHL}						40	ns
t_{PLH}	CLK	Q or $\overline{Q}$			14	25	ns
t_{PHL}					20	40	ns

NOTE 3: See General Information Section for load circuits and voltage waveforms.

recommended operating conditions

			SN54H74			SN74H74			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.8			0.8	V
I_{OH}	High-level output current				−1			−1	mA
I_{OL}	Low-level output current				20			20	mA
t_w	Pulse duration	CLK high	15			15			ns
		CLK low	13.5			13.5			
		$\overline{CLR}$ or $\overline{PRE}$ low	25			25			
t_{su}	Setup time-before CLK↑	High-level data	10			10			ns
		Low-level data	15			15			
t_h	Hold time - data after CLK↑		5			5			ns
T_A	Operating free-air temperature		−55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54H74 MIN	SN54H74 TYP‡	SN54H74 MAX	SN74H74 MIN	SN74H74 TYP‡	SN74H74 MAX	UNIT
V_{IK}		V_{CC} = MIN, I_I = −8 mA			−1.5			−1.5	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −1 mA	2.4	3.4		2.4	3.4		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA		0.2	0.4		0.2	0.4	V
I_I		V_{CC} = MAX, V_I = 5.5 V			1			1	mA
I_{IH}	D	V_{CC} = MAX, V_I = 2.4 V			50			50	μA
	$\overline{CLR}$				150			150	
	$\overline{PRE}$ or CLK				100			100	
I_{IL}	D	V_{CC} = MAX, V_I = 0.4 V			−2			−2	mA
	$\overline{CLR}$★				−4			−4	
	$\overline{PRE}$★				−2			−2	
	CLK				−4			−4	
I_{OS}§		V_{CC} = MAX	−40		−100	−40		−100	mA
I_{CC}		V_{CC} = MAX, See Note 2		15	21		15	25	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.
★ Clear is tested with preset high and preset is tested with clear high.
NOTE 2: With all outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 280 Ω, C_L = 25 pF	35	43		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$				20	ns
t_{PHL}						30	ns
t_{PLH}	CLK	Q or $\overline{Q}$			8.5	15	ns
t_{PHL}					13	20	ns

NOTE 3: See General Information Section for load circuits and voltage waveforms.

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

recommended operating conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage		2			V
V_{IL}	Low-level input voltage				0.7	V
I_{OH}	High-level output current				−0.1	mA
I_{OL}	Low-level output current				2	mA
t_w	Pulse duration	CLK high or low	200			ns
		$\overline{CLR}$ or $\overline{PRE}$ low	100			
t_{su}	Setup time before CLK↑		50			ns
t_h	Hold time data after CLK↑		15			ns
T_A	Operating free-air temperature		−55		125	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.7 V, I_{OH} = −0.1 mA	2.4	3.3		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.7 V, I_{OL} = 2 mA		0.15	0.3	V
I_I	D	V_{CC} = MAX, V_I = 5.5 V			0.1	mA
	$\overline{CLR}$				0.3	
	$\overline{PRE}$ or CLK				0.2	
I_{IH}	D	V_{CC} = MAX, V_I = 2.4 V			10	μA
	$\overline{CLR}$				30	
	$\overline{PRE}$ or CLK				20	
I_{IL}	D or $\overline{PRE}$	V_{CC} = MAX, V_I = 0.3 V			−0.18	μA
	$\overline{CLR}$ or CLK				−0.36	
I_{OS}		V_{CC} = MAX	−3		−15	mA
I_{CC}		V_{CC} = MAX, See Note 2		0.8	1.5	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
NOTE 2: With all outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 4 kΩ, C_L = 50 pF	2.5	3		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$			50	75	ns
t_{PHL}	$\overline{PRE}$ or $\overline{CLR}$ (CLK high)	$\overline{Q}$ or Q			80	150	ns
	$\overline{PRE}$ or $\overline{CLR}$ (CLK low)				80	150	
t_{PLH}	Clock	Q or $\overline{Q}$		15	65	100	ns
t_{PHL}				15	65	150	ns

NOTE 3: See General Information Section for load circuits and voltage waveforms.

3

TTL DEVICES

recommended operating conditions

			SN54LS74A MIN	SN54LS74A NOM	SN54LS74A MAX	SN74LS74A MIN	SN74LS74A NOM	SN74LS74A MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.8	V
I_{OH}	High-level output current				−0.4			−0.4	mA
I_{OL}	Low-level output current				4			8	mA
f_{clock}	Clock frequency		0		25	0		25	MHz
t_w	Pulse duration	CLK high	25			25			ns
		$\overline{PRE}$ or $\overline{CLR}$ low	25			25			ns
t_{su}	Setup time-before CLK↑	High-level data	20			20			ns
		Low-level data	20			20			ns
t_h	Hold time-data after CLK↑		5			5			ns
T_A	Operating free-air temperature		−55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54LS74A MIN	SN54LS74A TYP‡	SN54LS74A MAX	SN74LS74A MIN	SN74LS74A TYP‡	SN74LS74A MAX	UNIT
V_{IK}		V_{CC} = MIN, I_I = −18 mA			−1.5			−1.5	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX, I_{OH} = −0.4 mA	2.5	3.4		2.7	3.4		V
V_{OL}		V_{CC} = MIN, V_{IL} = MAX, V_{IH} = 2 V, I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
		V_{CC} = MIN, V_{IL} = MAX, V_{IH} = 2 V, I_{OL} = 8 mA					0.35	0.5	V
I_I	D or CLK	V_{CC} = MAX, V_I = 7 V			0.1			0.1	mA
	$\overline{CLR}$ or $\overline{PRE}$				0.2			0.2	mA
I_{IH}	D or CLK	V_{CC} = MAX, V_I = 2.7 V			20			20	μA
	$\overline{CLR}$ or $\overline{PRE}$				40			40	μA
I_{IL}	D or CLK	V_{CC} = MAX, V_I = 0.4 V			−0.4			−0.4	mA
	$\overline{CLR}$ or $\overline{PRE}$				−0.8			−0.8	mA
I_{OS}§		V_{CC} = MAX, See Note 4	−20		−100	−20		−100	mA
I_{CC}		V_{CC} = MAX, See Note 2		4	8		4	8	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.
NOTE 2: With all outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.
NOTE 4: For certain devices where state commutation can be caused by shorting an output to ground, an equivalent test may be performed with V_O = 2.25 V and 2.125 V for the 54 family and the 74 family, respectively, with the minimum and maximum limits reduced to one half of their stated values.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 2 kΩ, C_L = 15 pF	25	33		MHz
t_{PLH}	$\overline{CLR}$, $\overline{PRE}$ or CLK	Q or $\overline{Q}$			13	25	ns
t_{PHL}					25	40	ns

NOTE 3: See General Information Section for load circuits and voltage waveforms.

3 TTL DEVICES

recommended operating conditions

			SN54S74			SN74S74			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.8			0.8	V
I_{OH}	High-level output current				– 1			– 1	mA
I_{OL}	Low-level output current				20			20	mA
t_w	Pulse duration	CLK high	6			6			ns
		CLK low	7.3			7.3			
		$\overline{CLR}$ or $\overline{PRE}$ low	7			7			
t_{su}	Setup time, before CLK ↑	High-level data	3			3			ns
		Low-level data	3			3			
t_h	Input hold time - data after CLK ↑		2			2			ns
T_A	Operating free-air temperature		– 55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54S74			SN74S74			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = MIN, I_I = – 18 mA,			– 1.2			– 1.2	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = – 1 mA	2.5	3.4		2.7	3.4		V
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA			0.5			0.5	V
I_I		V_{CC} = MAX, V_I = 5.5 V			1			1	mA
I_{IH}	D	V_{CC} = MAX, V_I = 2.7 V			50			50	mA
	$\overline{CLR}$				150			150	
	$\overline{PRE}$ or CLK				100			100	
I_{IL}	D	V_{CC} = MAX, V_I = 0.5 V			– 2			– 2	mA
	$\overline{CLR}$★				– 6			– 6	
	$\overline{PRE}$★				– 4			– 4	
	CLK				– 4			– 4	
I_{OS}§		V_{CC} = MAX	– 40		– 100	– 40		– 100	mA
I_{CC}		V_{CC} = MAX, See Note 2		15	25		15	25	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.
★ Clear is tested with preset high and preset is tested with clear high.
NOTE 2: All outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 280 Ω, C_L = 15 pF	75	110		MHz
t_{PLH}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$			4	6	ns
t_{PHL}	$\overline{PRE}$ or $\overline{CLR}$ (CLK high)	$\overline{Q}$ or Q			9	13.5	ns
	$\overline{PRE}$ or $\overline{CLR}$ (CLK low)				5	8	
t_{PLH}	CLK	Q or $\overline{Q}$			6	9	ns
t_{PHL}					6	9	ns

NOTE 3: See General Information Section for load circuits and voltage waveforms.

3

TTL DEVICES