

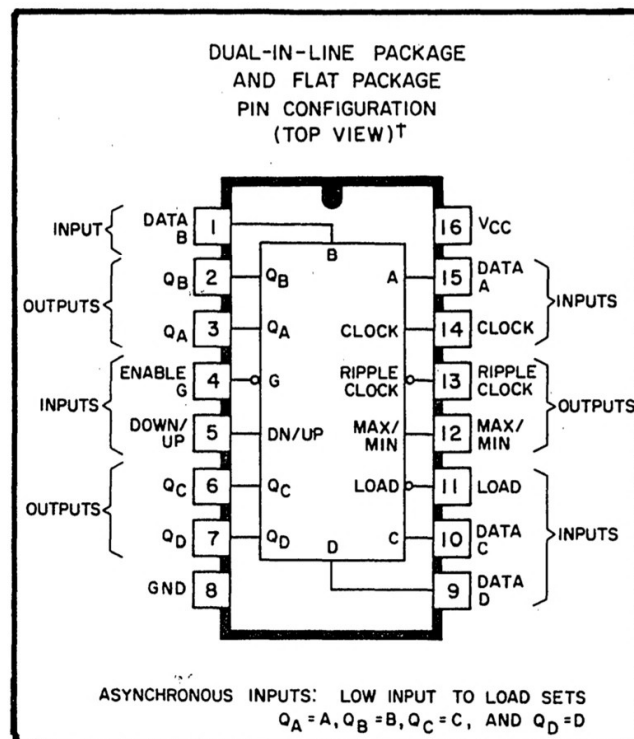


SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

- Counts 8-4-2-1 BCD or Binary
- Single Down/Up Count Control Line
- Count Enable Control Input
- Ripple Clock Output for Cascading
- Asynchronously Presetable with Load Control
- Parallel Outputs
- Cascadable for n-Bit Applications
- Typical Average Propagation Delay (Clock to Q Output)...20 ns
- Typical Power Dissipation...325 mW
- Typical Maximum Clock Frequency...25 Mhz

The ITT54190, ITT54191, ITT74190, and ITT74191 are synchronous, reversible up/down counters having a complexity of 58 equivalent gates. The ITT54191 and ITT74191 are 4-bit binary counters and the ITT54190 and ITT74190 are BCD counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the steering logic. This mode of operation will eliminate the output counting spikes which are normally associated with asynchronous (ripple clock) counters.

The outputs of the four master-slave flip-flops are triggered on a low-to-high-level transition of the clock input if the enable input is low. A high at the enable input inhibits counting. Level changes at the enable input should be made only when the clock input is high. The direction of the count is determined by the state of the down/up input. When low, the counter counts up and when high, it counts down.



[†]PIN ASSIGNMENTS FOR THESE CIRCUITS ARE THE SAME FOR ALL PACKAGES.

These counters are fully programmable; that is, the outputs may be preset to any state by placing a low on the load input and entering the desired data at the data inputs. The output will change to agree with the data inputs independently of the state of the clock input. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

Input buffers have been used to lower the fan-in requirement to only one normalized Series 54/74 load at all inputs except enable. This is important when the output of the driving circuitry is somewhat limited.

ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

Two outputs have been made available to perform the cascading function: ripple clock and maximum/minimum count. The latter output produces a high-level output pulse with a duration approximately equal to one complete cycle of the clock when the counter overflows or underflows. The ripple clock output produces a low-level output pulse equal in width to the low-level portion of the clock input when an overflow or underflow condition exists. The counters can be easily cascaded by feeding the ripple clock output to the enable input of the succeeding counter if parallel clocking is used, or

to the clock input if parallel enabling is used. The maximum/minimum count output can be used to accomplish look-ahead for high-speed operation.

Power dissipation is typically 325 milliwatts for either the decade or binary version. Maximum input clock frequency is typically 25 megahertz and is guaranteed to be at least 20 megahertz.

The ITT54190 and ITT54191 are characterized for operation over the full military temperature range of -55°C to 125°C ; the ITT74190 and ITT74191 are characterized for operation from 0°C to 70°C .

ITT54190, ITT74190 DECADE COUNTERS

typical load, count, and inhibit sequences

Illustrated below is the following sequence:

1. Load (preset) to BCD seven.
2. Count up to eight, nine (maximum), zero, one, and two.
3. Inhibit.
4. Count down to one, zero (minimum), nine, eight, and seven.

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

Supply voltage, V_{CC} (see Note 1) 7V

Input voltage (see Note 1) 5.5V

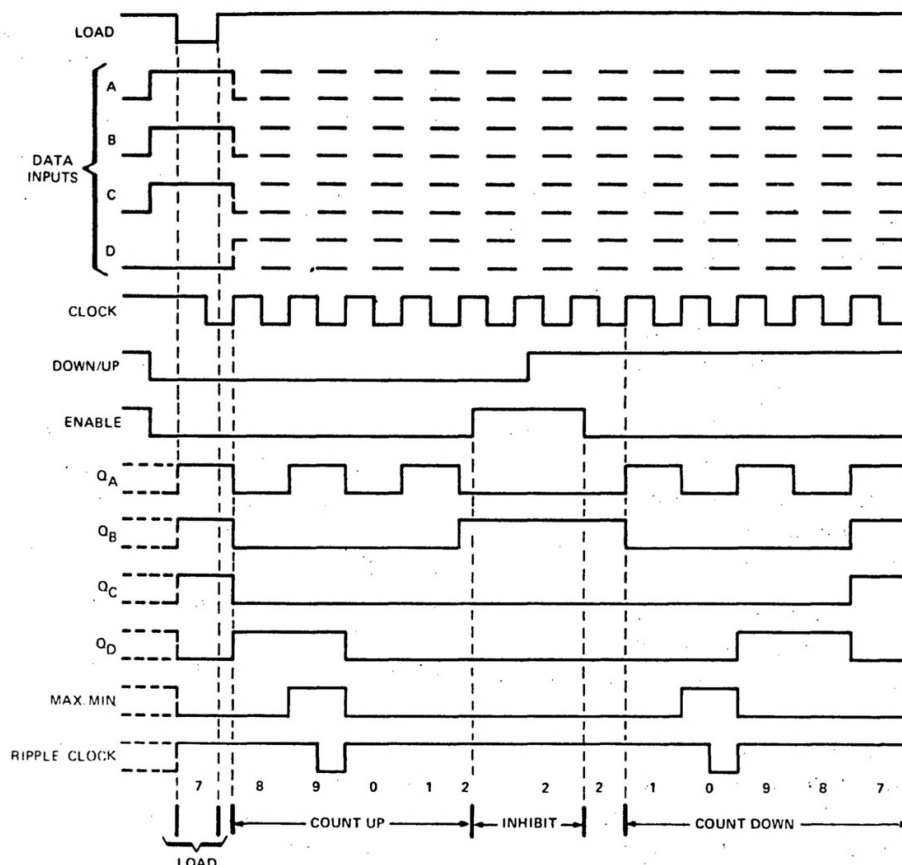
Operating free-air temperature range:

ITT54190, ITT54191 -55°C to 125°C

ITT74190, ITT74191 0°C to 70°C

Storage temperature range -65°C to 150°C

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



ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

recommended operating conditions

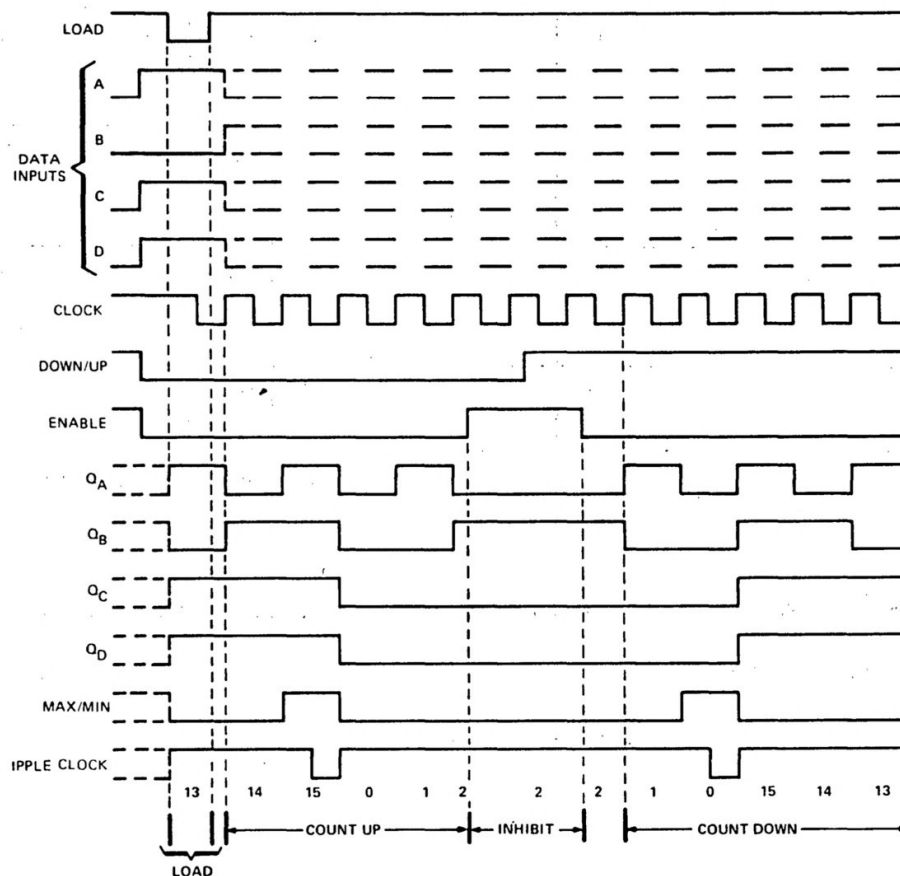
		ITT54190, ITT54191			ITT74190, ITT74191			Unit
		Min	Nom	Max	Min	Nom	Max	
Supply voltage, V _{CC}		4.5	5	5.5	4.75	5	5.25	V
Normalized fan-out from each output, N	High logic level	20			20			
	Low logic level	10			10			
Input clock frequency, f _{clock}		0		20	0		20	MHz
Width of clock input pulse, t _{w(clock)}		25			25			ns
Width of load input pulse, t _{w(load)}		35			35			ns
Data setup time, t _{setup} (See Figures 1 and 2)		20			20			ns
Data hold time, t _{hold}		0			0			ns
Operating free-air temperature, T _A		−55	25	125	0	25	70	°C

ITT54191, ITT74191 BINARY COUNTERS

typical load, count, and inhibit sequences

Illustrated below is the following sequence:

1. Load (preset) to binary thirteen.
2. Count up to fourteen, fifteen (maximum), zero, one, and two.
3. Inhibit.
4. Count down to one, zero (minimum), fifteen, fourteen, and thirteen.



ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

ELECTRICAL CHARACTERISTICS, over recommended operating free-air temperature range
(unless otherwise noted)

Parameter		ITT54190, ITT54191			ITT74190, ITT74191			Unit	Test Conditions ²
		Min	Typ ¹	Max	Min	Typ ¹	Max		
V_{IH}	High-level input voltage	2			2			V	$V_{CC} = \text{MIN}$
V_{IL}	Low-level input voltage			0.8			0.8	V	$V_{CC} = \text{MIN}$
V_I	Input clamp voltage			-1.5			-1.5	V	$V_{CC} = \text{MIN}, I_I = -12\text{mA}$
V_{OH}	High-level output voltage	2.4			2.4			V	$V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = 0.8\text{V}, I_{OH} = -800\mu\text{A}$
V_{OL}	Low-level output voltage			0.4			0.4	V	$V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = 0.8\text{V}, I_{OL} = 16\text{mA}$
I_I	High-level input current at maximum input voltage			1			1	mA	$V_{CC} = \text{MAX}, V_I = 5.5\text{V}$
I_{IH}	High-level input current at any input except enable			40			40	μA	$V_{CC} = \text{MAX}, V_I = 2.4\text{V}$
I_{IH}	High-level input current at enable input			120			120	μA	$V_{CC} = \text{MAX}, V_I = 2.4\text{V}$
I_{IL}	Low-level input current at any input except enable			-1.6			-1.6	mA	$V_{CC} = \text{MAX}, V_I = 0.4\text{V}$
I_{IL}	Low-level input current at enable input			-4.8			-4.8	mA	$V_{CC} = \text{MAX}, V_I = 0.4\text{V}$
I_{OS}	Short-circuit output current ³	-20		-65	-18		-65	mA	$V_{CC} = \text{MAX}$
I_{CC}	Supply current		65	105		65	105	mA	$V_{CC} = \text{MAX}$, See Note 2

¹ All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$.

² For conditions shown as MAX or MIN, use appropriate value specified under recommended operating conditions for the applicable device type.

³ Not more than one output should be shorted at a time.

Note 2: I_{CC} is measured with all inputs grounded and all outputs open.

ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

SWITCHING CHARACTERISTICS, $V_{CC} = 5V$, $T_A = 25^\circ C$, $N = 10$

Parameter ¹	From (Input)	To (Output)	Min	Typ	Max	Unit	Test Conditions
t_{max}			20	25		MHz	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PLH}	Load	Q_A, Q_B, Q_C, Q_D		22	33	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				33	50		
t_{PLH}	Data A, B, C, D	Q_A, Q_B, Q_C, Q_D		14	22	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				35	50		
t_{PLH}	Clock	Ripple Clock		13	20	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				16	24		
t_{PLH}	Clock	Q_A, Q_B, Q_C, Q_D		16	24	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				24	36		
t_{PLH}	Clock	Max/Min		28	42	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				37	52		
t_{PLH}	Down/Up	Ripple Clock		30	45	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				30	45		
t_{PLH}	Down/Up	Max/Min		21	33	ns	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$
t_{PHL}				22	33		

¹ t_{max} = maximum clock frequency

t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

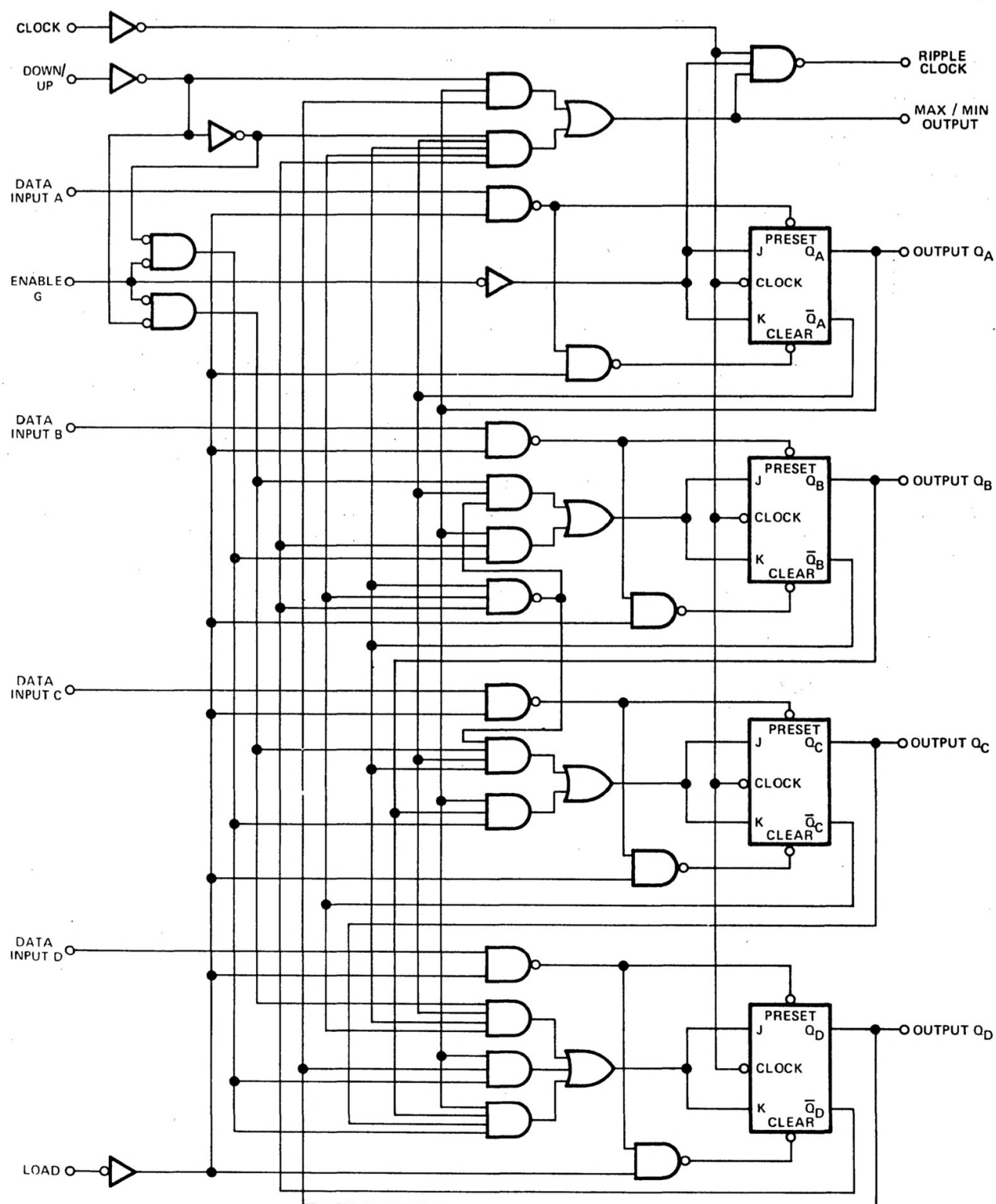
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ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

ITT54191, ITT74191 BINARY COUNTERS

functional block diagram



ITT54190, ITT54191, ITT74190, ITT74191

SYNCHRONOUS UP/DOWN COUNTERS WITH DOWN/UP MODE CONTROL

ITT54190, ITT74190 DECADE COUNTERS

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functional block diagram

