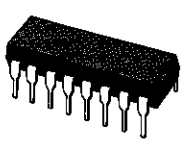
SGS-THOMSON MICROELECTRONICS

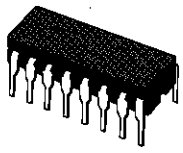
HCC4029B
HCF4029B

PRESETTABLE UP/DOWN COUNTER BINARY OR BCD DECADE

- MEDIUM SPEED OPERATION - 8MHz (typ.) @ C_L = 50pF AND V_{DD}-V_{SS} = 10V
- MULTI-PACKAGE PARALLEL CLOCKING FOR SYNCHRONOUS HIGH SPEED OUTPUT RESPONSE OR RIPPLE CLOCKING FOR SLOW CLOCK INPUT RISE AND FALL TIMES
- "PRESET ENABLE" AND INDIVIDUAL "JAM" INPUTS PROVIDED
- BINARY OR DECADE UP/DOWN COUNTING
- BCD OUTPUTS IN DECADE MODE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N°. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



EY
(Plastic Package)



F
(Ceramic Package)

M1
(Micro Package)

C1
(Chip Carrier)

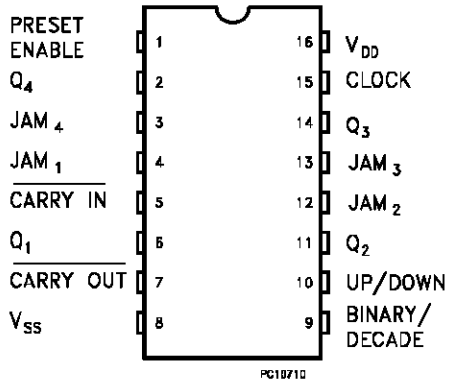
ORDER CODES :

HCC4029BF	HCF4029BM1
HCF4029BEY	HCF4029BC1

DESCRIPTION

The **HCC4029B** (extended temperature range) and **HCF4029B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4029B** consists of a four-stage binary or BCD-decade up/down counter with provisions for look-ahead carry in both counting modes. The inputs consist of a single CLOCK, CARRY-IN (CLOCK ENABLE), BINARY/DECADE, UP/DOWN, PRESET ENABLE, and four individual JAM signals. Q1, Q2, Q3, Q4 and a CARRY OUT signal are provided as outputs. A high PRESET ENABLE signal allows information on the JAM INPUTS to preset the counter to any state asynchronously with the clock. A low on each JAM line, when the PRESET-ENABLE signal is high, resets the counter to its zero count. The counter is advanced one count at the positive transition of the clock when the CARRY-IN and PRESET ENABLE signals, are low. Advancement is inhibited when the CARRY-IN or PRESET ENABLE signals are high. The CARRY-OUT signal is normally high and goes low when the

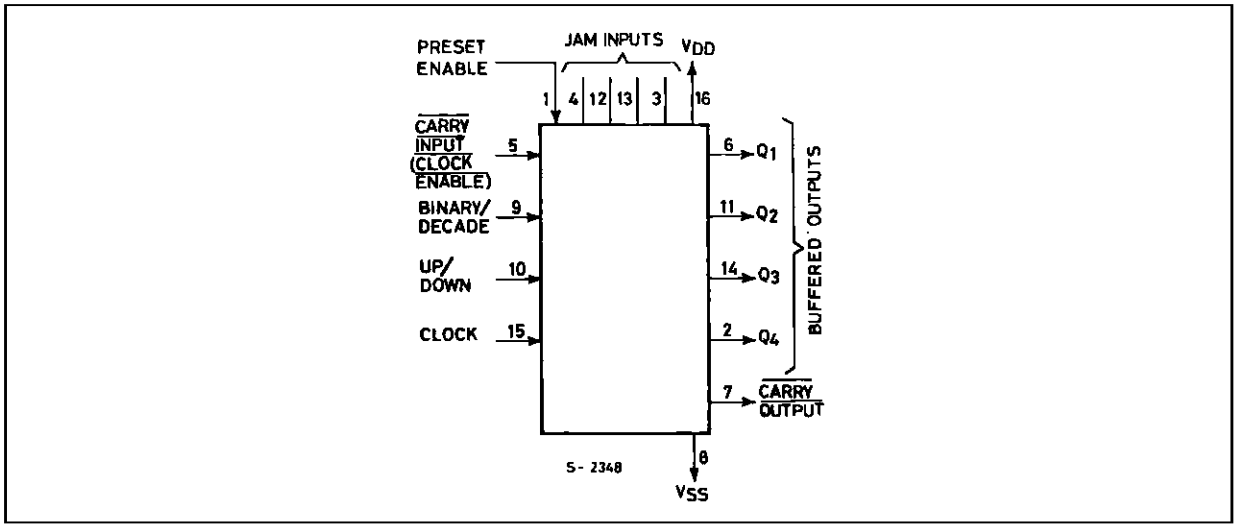
PIN CONNECTIONS



NC = No Internal Connection

counter reaches its maximum count in the UP mode or the minimum count in the DOWN mode provided the CARRY-IN signal is low. The CARRY-IN signal in the low state can thus be considered a CLOCK ENABLE. The CARRY-IN terminal must be connected to V_{SS} when not in use. Binary counting is accomplished when the BINARY/DECADE input is high ; the counter counts in the decade mode when the BINARY/DECADE input is low. The counter counts Up when to UP/DOWN INPUT is high, and Down when the UP/DOWN INPUT is low. Multiple packages can be connected in either a parallel-clocking or a ripple-clocking arrangement as shown in cascading counter packages. Parallel clocking provides synchronous control and hence faster response from all counting outputs. Ripple-clocking allows for longer clock input rise and fall times.

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{DD} *	Supply Voltage: **HCC** Types **HCF** Types	-0.5 to +20 -0.5 to +18	V V
V_i	Input Voltage	-0.5 to V_{DD} + 0.5	V
I_I	DC Input Current (any one input)	± 10	mA
P_{tot}	Total Power Dissipation (per package) Dissipation per Output Transistor for Top = Full Package Temperature Range	200 100	mW mW
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	^oC ^oC
T_{stg}	Storage Temperature	-65 to +150	^oC

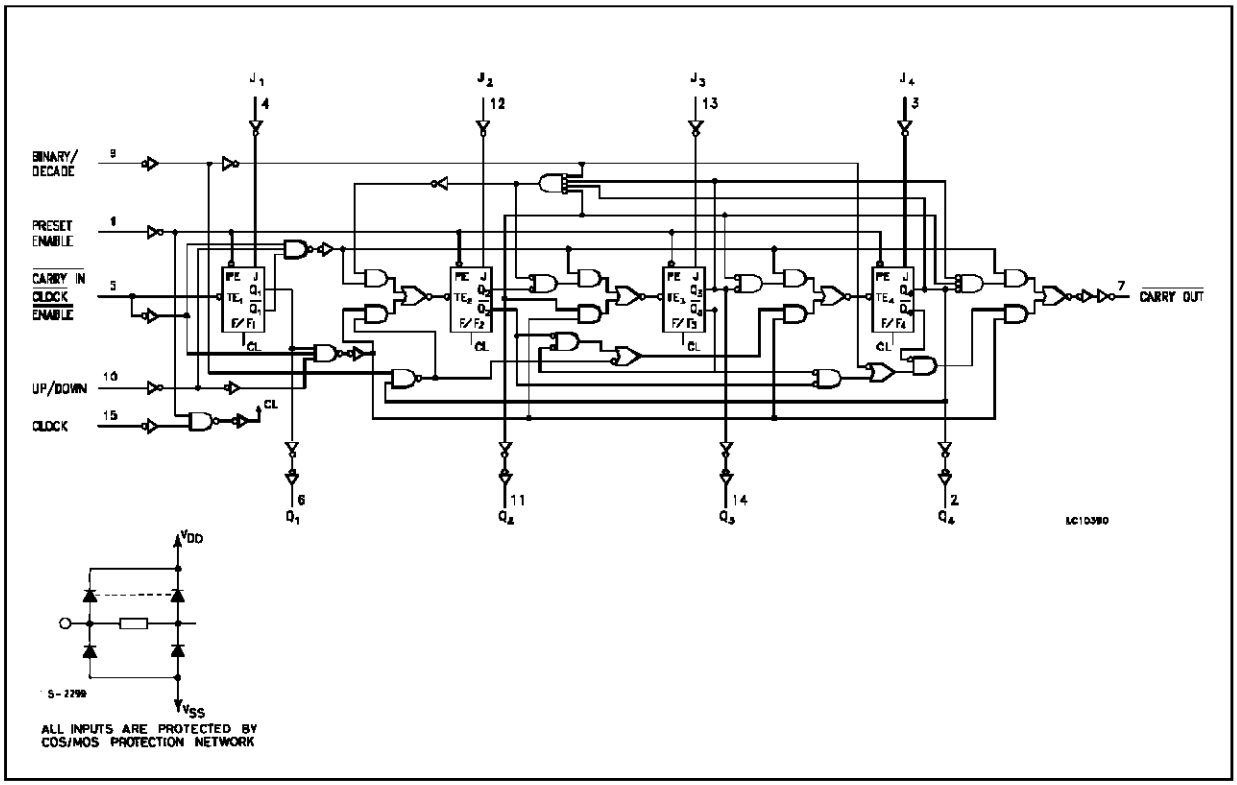
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage: **HCC** Types **HCF** Types	3 to 18 3 to 15	V V
V_I	Input Voltage	0 to V_{DD}	V
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	^oC ^oC

LOGIC DIAGRAMS



TRUTH TABLES

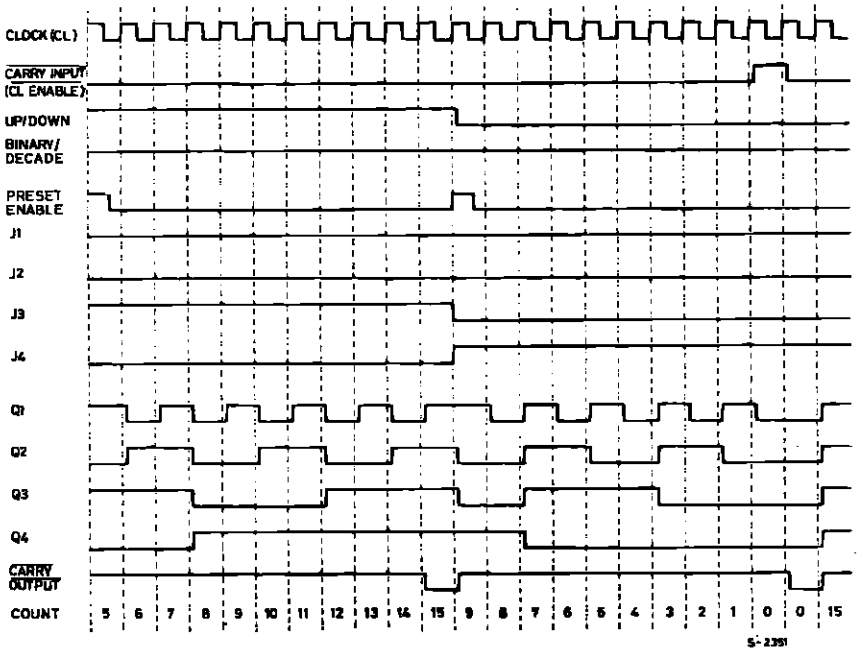
CLOCK	TE	PE	J	Q	$\overline{Q}$
X	X	O	O	O	I
⌝⌞	O	I	X	$\overline{Q}$	Q
X	X	O	I	I	O
⌝⌞	I	I	X	Q	$\overline{Q}$ NC
⌞⌜	X	I	X	Q	$\overline{Q}$ NC

X DON'T CARE

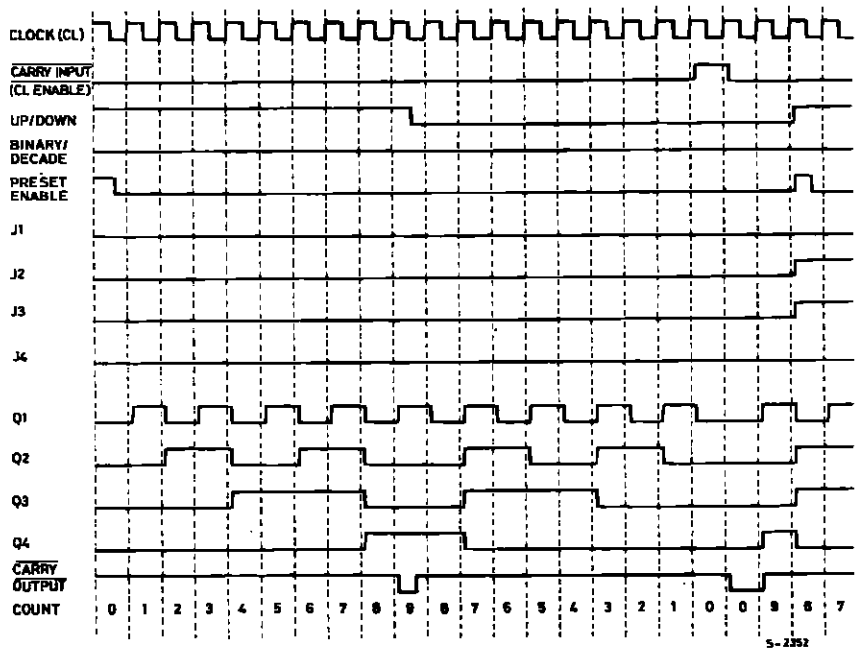
Control Input	Logic Level	Action
BIN/DEC (B/D)	I O	Binary Count Decade Count
UP/DOWN (U/D)	I O	Up Count Down Count
Preset Enable (PE)	I O	Jam In No Jam
Carry In (CI) (Clock Enable)	I O	No Counter Advance at Pos. Clock Transition Advance Counter at Pos. Clock Transition

TIMING DIAGRAMS

Binary Mode



Decade Mode



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditios				Value							Unit
			V_I (V)	V_O (V)	$\|I_O\|$ (µA)	V_{DD} (V)	T_{LOW} * Min.	T_{LOW} * Max.	25 °C Min.	25 °C Typ.	25 °C Max.	T_{HIGH} * Min.	T_{HIGH} * Max.	
I_L	Quiescent Current	HCC Types	0/5			5		5		0.04	5		150	µA
			0/10			10		10		0.04	10		300	
			0/15			15		20		0.04	20		600	
			0/20			20		100		0.08	100		3000	
		HCF Types	0/5			5		20		0.04	20		150	
			0/10			10		40		0.04	40		300	
			0/15			15		80		0.04	80		600	
V_{OH}	Output High Voltage		0/5		< 1	5	4.95		4.95			4.95		V
			0/10		< 1	10	9.95		9.95			9.95		
			0/15		< 1	15	14.95		14.95			14.95		
V_{OL}	Output Low Voltage		5/0		< 1	5		0.05			0.05		0.05	V
			10/0		< 1	10		0.05			0.05		0.05	
			15/0		< 1	15		0.05			0.05		0.05	
V_{IH}	Input High Voltage			0.5/4.5	< 1	5	3.5		3.5			3.5		V
				1/9	< 1	10	7		7			7		
				1.5/13.5	< 1	15	11		11			11		
V_{IL}	Input Low Voltage			4.5/0.5	< 1	5		1.5			1.5		1.5	V
				9/1	< 1	10		3			3		3	
				13.5/1.5	< 1	15		4			4		4	
I_{OH}	Output Drive Current	HCC Types	0/5	2.5		5	-2		-1.6	-3.2		-1.15		mA
			0/5	4.6		5	-0.64		-0.51	-1		-0.36		
			0/10	9.5		10	-1.6		-1.3	-2.6		-0.9		
			0/15	13.5		15	-4.2		-3.4	-6.8		-2.4		
		HCF Types	0/5	2.5		5	-1.53		-1.36	-3.2		-1.1		
			0/5	4.6		5	-0.52		-0.44	-1		-0.36		
			0/10	9.5		10	-1.3		-1.1	-2.6		-0.9		
			0/15	13.5		15	-3.6		-3.0	-6.8		-2.4		
I_{OL}	Output Sink Current	HCC Types	0/5	0.4		5	0.64		0.51	1		0.36		mA
			0/10	0.5		10	1.6		1.3	2.6		0.9		
			0/15	1.5		15	4.2		3.4	6.8		2.4		
		HCF Types	0/5	0.4		5	0.52		0.44	1		0.36		
			0/10	0.5		10	1.3		1.1	2.6		0.9		
			0/15	1.5		15	3.6		3.0	6.8		2.4		
I_{IH}, I_{IL}	Input Leakage Current	HCC Types	0/18	Any Input		18		±0.1		$±10^{-5}$	±0.1		±1	µA
		HCF Types	0/15			15		±0.3		$±10^{-5}$	±0.3		±1	
C_I	Input Capacitance			Any Input						5	7.5			pF

* T_{LOW} = -55 °C for **HCC** device: -40 °C for **HCF** device.

* T_{HIGH} = +125 °C for **HCC** device: +85 °C for **HCF** device.

The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD} = 5 V, 2 V min. with V_{DD} = 10 V, 2.5 V min. with V_{DD} = 15 V

DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, C_L = 50 pF, R_L = 200 KΩ, typical temperature coefficent for all V_{DD} values is 03 %/°C, all input rise and fall times= 20 ns)

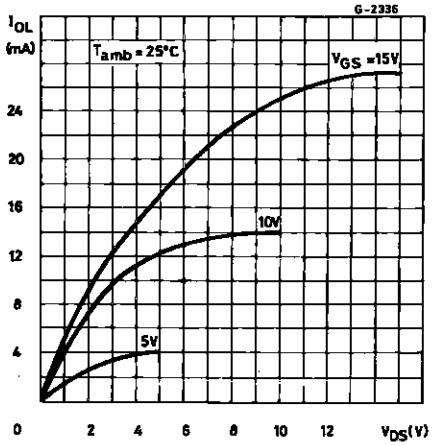
Symbol	Parameter	Test Conditions		Value			Unit
			V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time (Q Outputs)		5		250	500	ns
			10		120	240	
			15		90	180	
t_{PLH} t_{PHL}	Propagation Delay Time (Carry Output)		5		280	560	ns
			10		130	260	
			15		95	190	
t_{TLH} t_{THL}	Transition Time (Q Outputs, Carry Output)		5		100	200	ns
			10		50	100	
			15		40	80	
t_W	Minimum Clock Pulse Width		5		90	180	ns
			10		45	90	
			15		30	60	
t_r, t_f **	Clock Rise and Fall Time		5			15	µs
			10			15	
			15			15	
t_{setup} *	Minimum Setup Time (Carry Input)		5		30	60	ns
			10		10	20	
			15		6	12	
t_{setup}	Minimum Setup Time (B/D or UD)		5		170	340	
			10		70	140	
			15		50	100	
f_{max}	Maximum Clock Input Frequency		5	2	4		MHz
			10	4	8		
			15	5.5	11		
PRESET ENABLE							
t_{PLH} t_{PHL}	Propagation Delay Time (Q Outputs)		5		235	470	ns
			10		100	200	
			15		80	160	
t_{PLH} t_{PHL}	Propagation Delay Time (Carry Output)		5		320	640	
			10		145	290	
			15		105	210	
t_W	Minimum Preset Enable (Pulse Width)		5		65	130	ns
			10		35	70	
			15		25	50	
t_{rem} *	Minimum Preset Enable (Removal Time)		5		100	200	ns
			10		55	110	
			15		40	80	
CARRY INPUT							
t_{PHL} t_{PLH}	Propagation Delay Time (Carry Output)		5		170	340	ns
			10		70	140	
			15		50	100	
t_{setup} ***	Minimum Setup Time (Carry In)		5		25	50	ns
			10		15	30	
			15		12	25	
t_{hold}	Minimum Hold Time (Carry In)		5		100	200	
			10		35	70	
			15		30	60	

* From Up/Down, Binary/Decade, Carry In or Preset Enable Control Inputs to Clock Edge

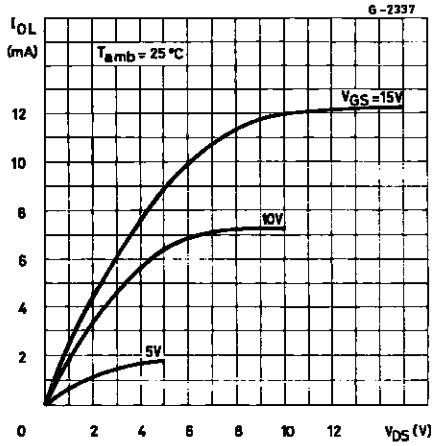
** If more than one unit is cascated in the parallel clocked application tr should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitance load.

*** From Carry in to Clock Edge.

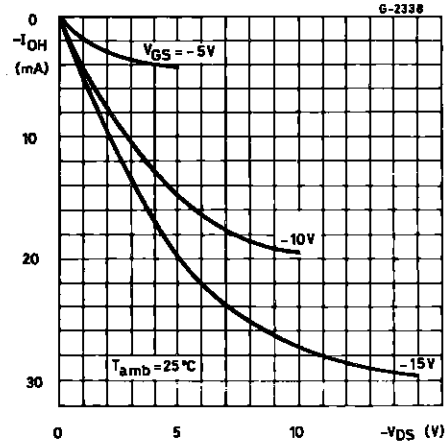
Typical Output Low (sink) Current Characteristics.



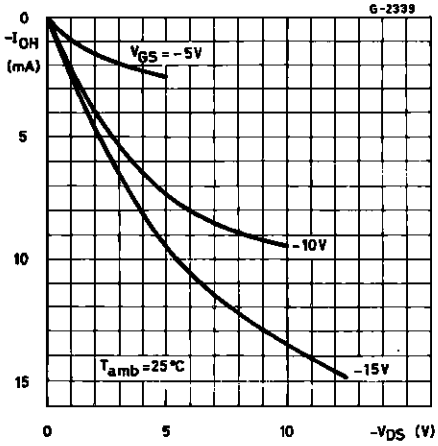
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.

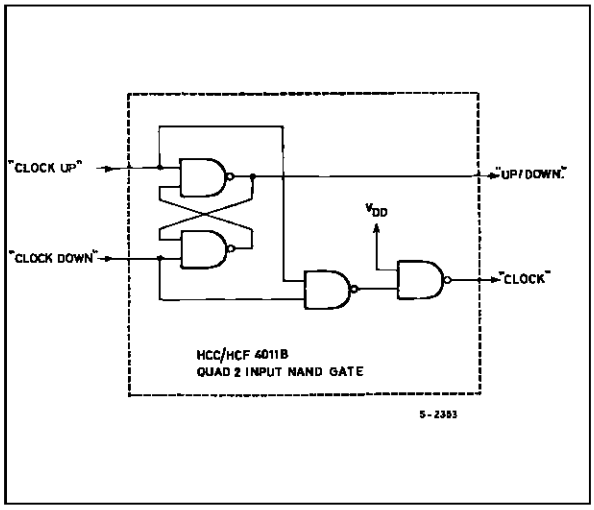


Minimum Output High (source) Current Characteristics.



APPLICATIONS

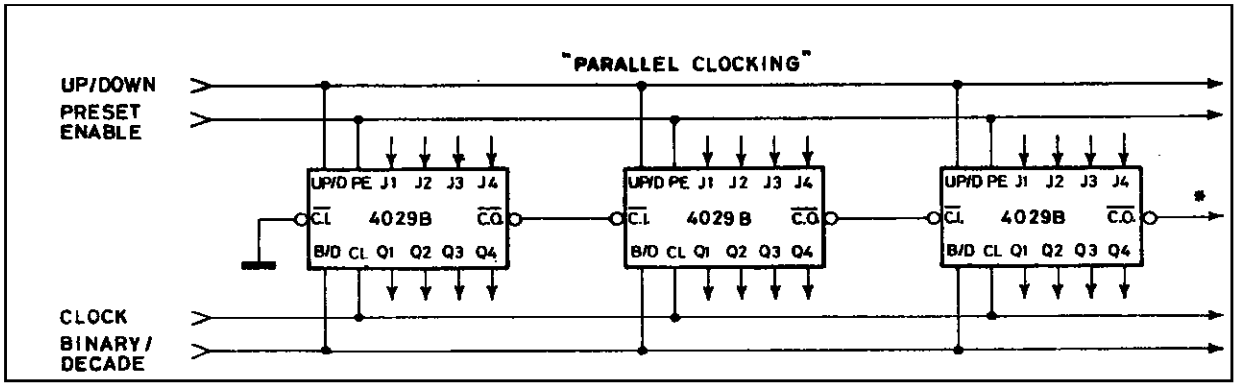
Conversion of Clock up, Clock Down Input Signals to Clock and Up/Down Inputs Signals.



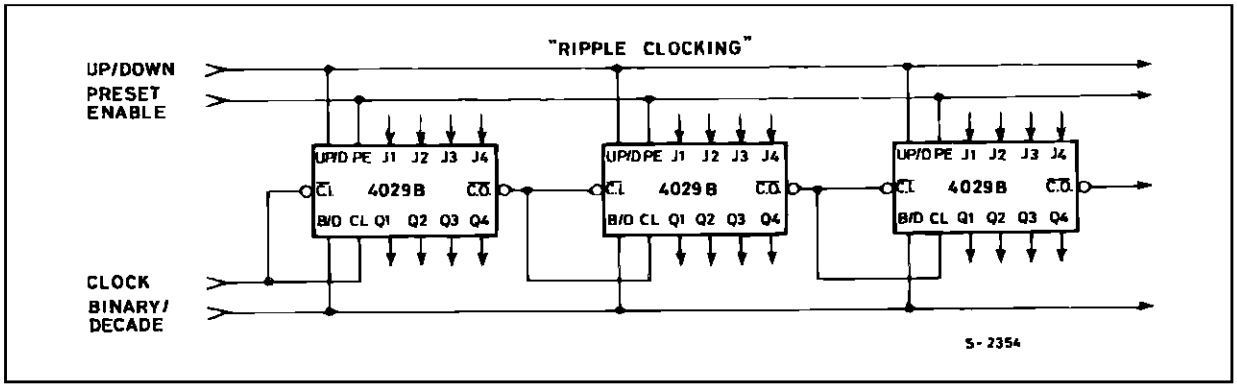
The **HCC/HCF4029B** CLOCK and UP/DOWN inputs are used directly in most applications. In applications where CLOCK UP and CLOCK DOWN inputs are provided, conversion to the **HCC/HCF4029B** CLOCK and UP/DOWN inputs can easily be realized by use of the circuit.

HCC/HCF4029B changes count on positive transitions of CLOCK UP or CLOCK DOWN inputs. For the gate configuration shown below, when counting up the CLOCK DOWN input must be maintained high and conversely when counting down the CLOCK UP input must be maintained high.

Cascading Counter Packages.



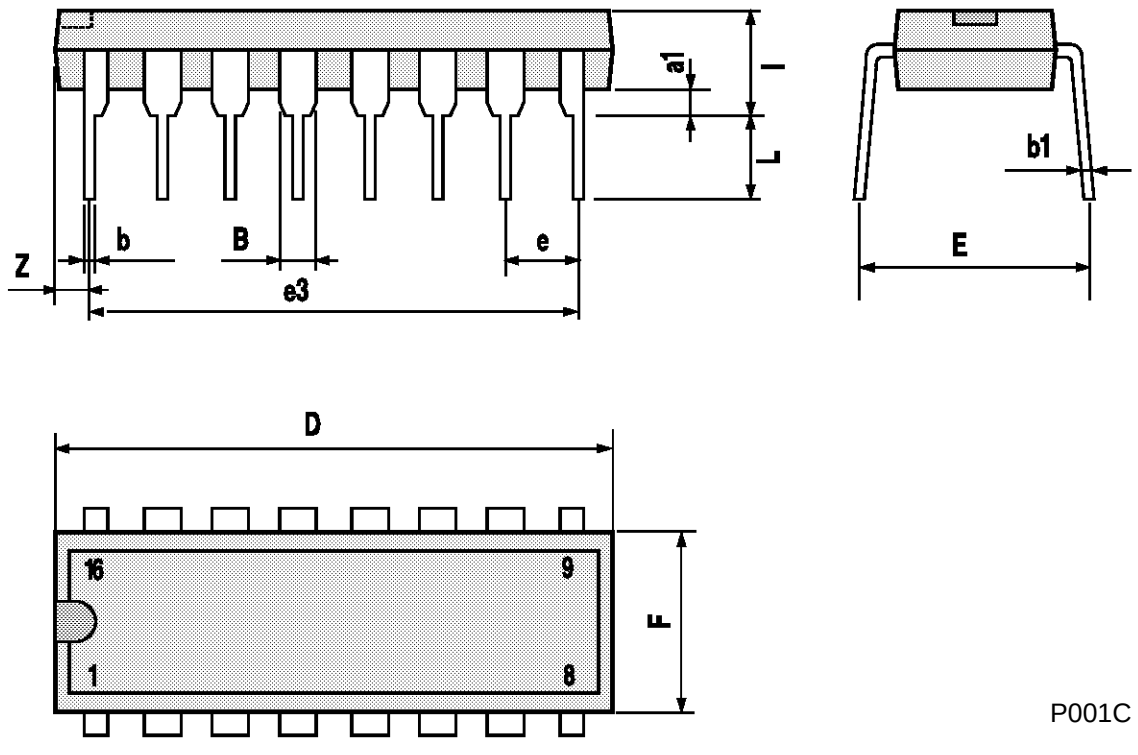
* CARRY-OUT lines at the 2nd, 3rd, et., stages may have a negative-going glitch pulse resulting from differential delays of different **HCC/HCF4029B** IC's. These negative-going glitches do not affect proper **HCC/HCF4029B** operation. However, if the CARRY-OUT signals are used to trigger other edge-sensitive logic devices, such as FF's or counters, the CARRY-OUT signals should be gated with the clock signal using a 2-input NOR gate such as **HCC/HCF4001B**.



Ripple Clocking Mode : The Up/Down control can be changed at any count. The only restriction on changing the Up/Down control is that the clock input to the first counting stage must be high.

Plastic DIP16 (0.25) MECHANICAL DATA

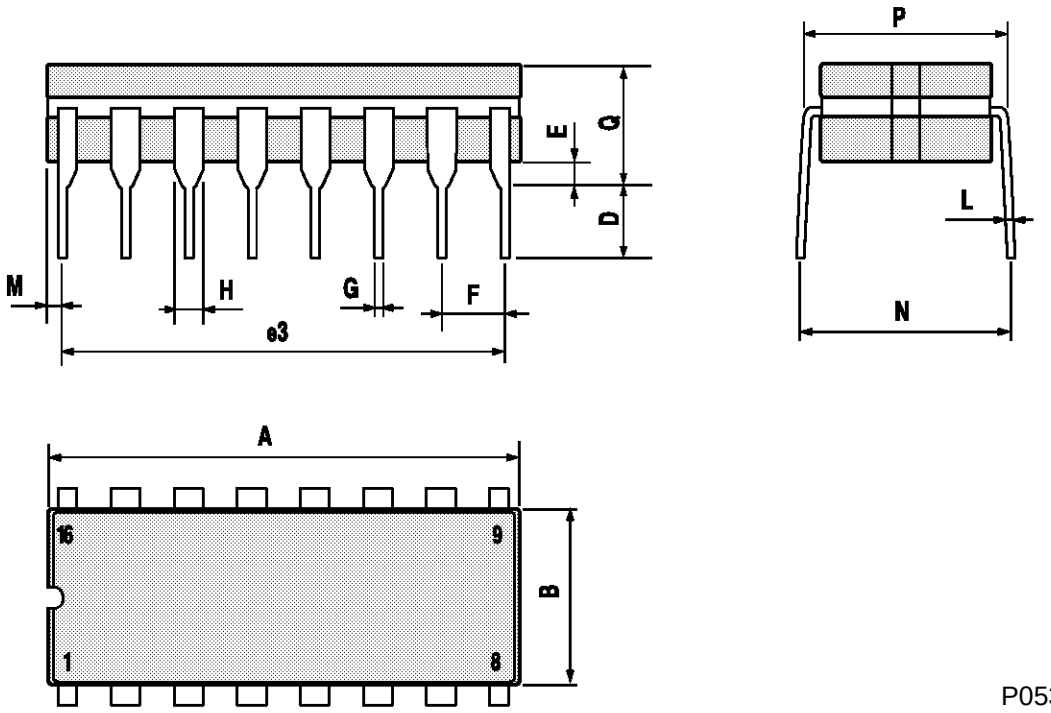
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

Ceramic DIP16/1 MECHANICAL DATA

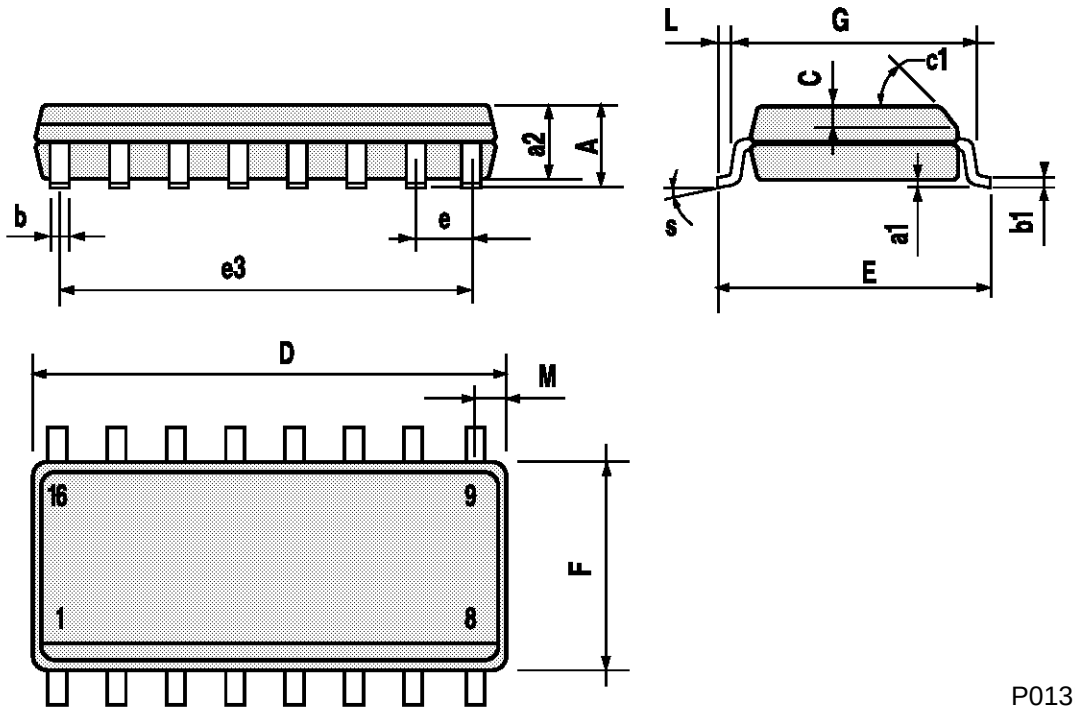
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053D

SO16 (Narrow) MECHANICAL DATA

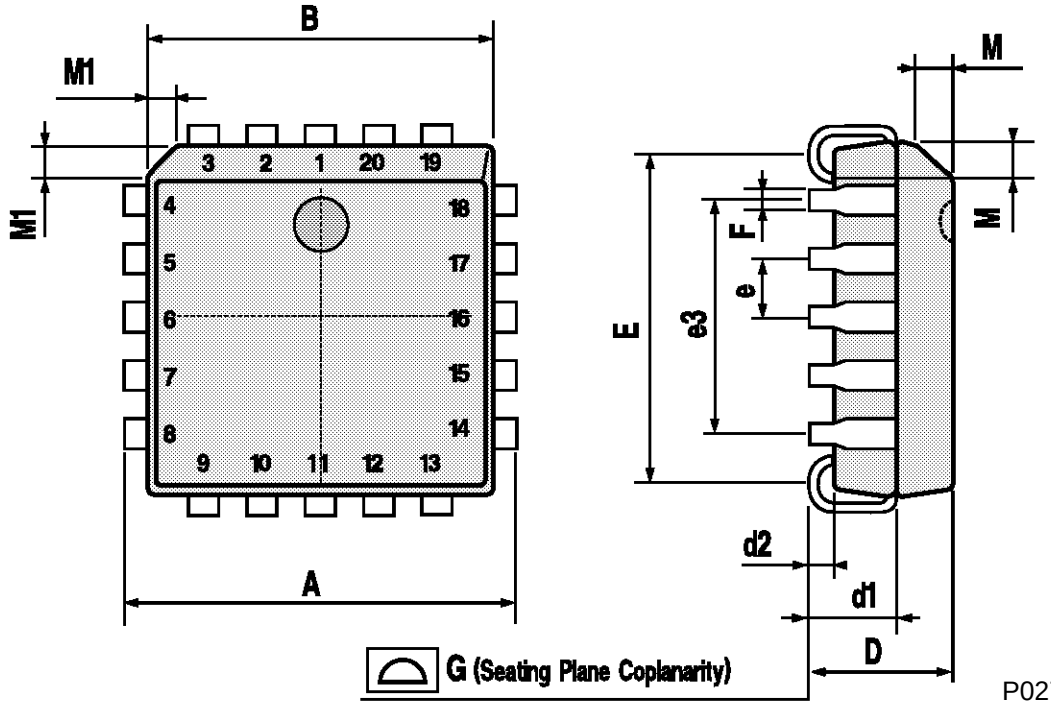
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



P027A