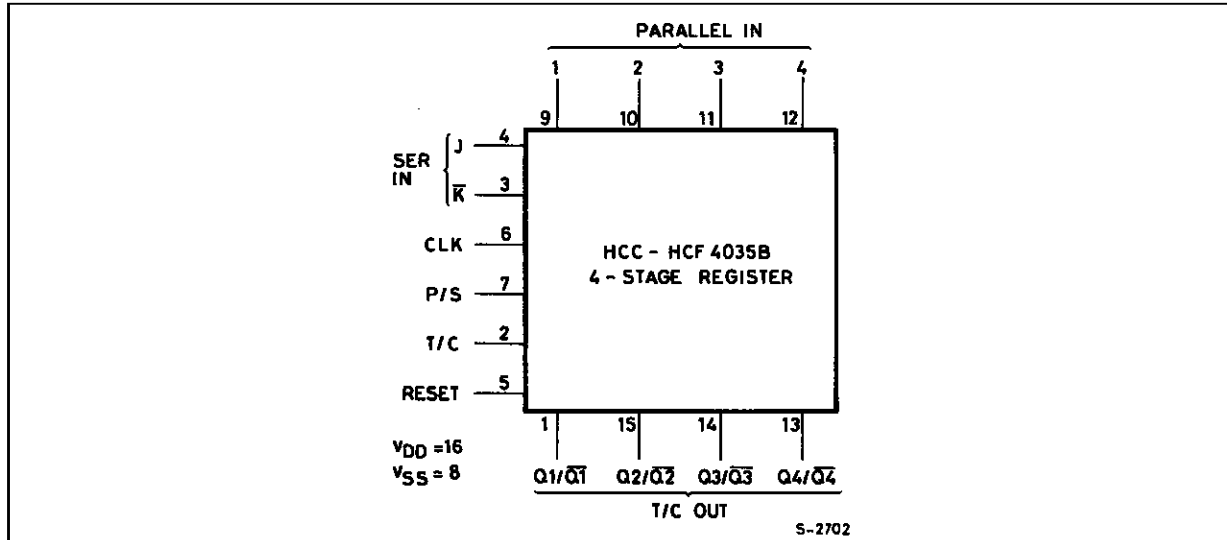




# HCC/HCF4035B

## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

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

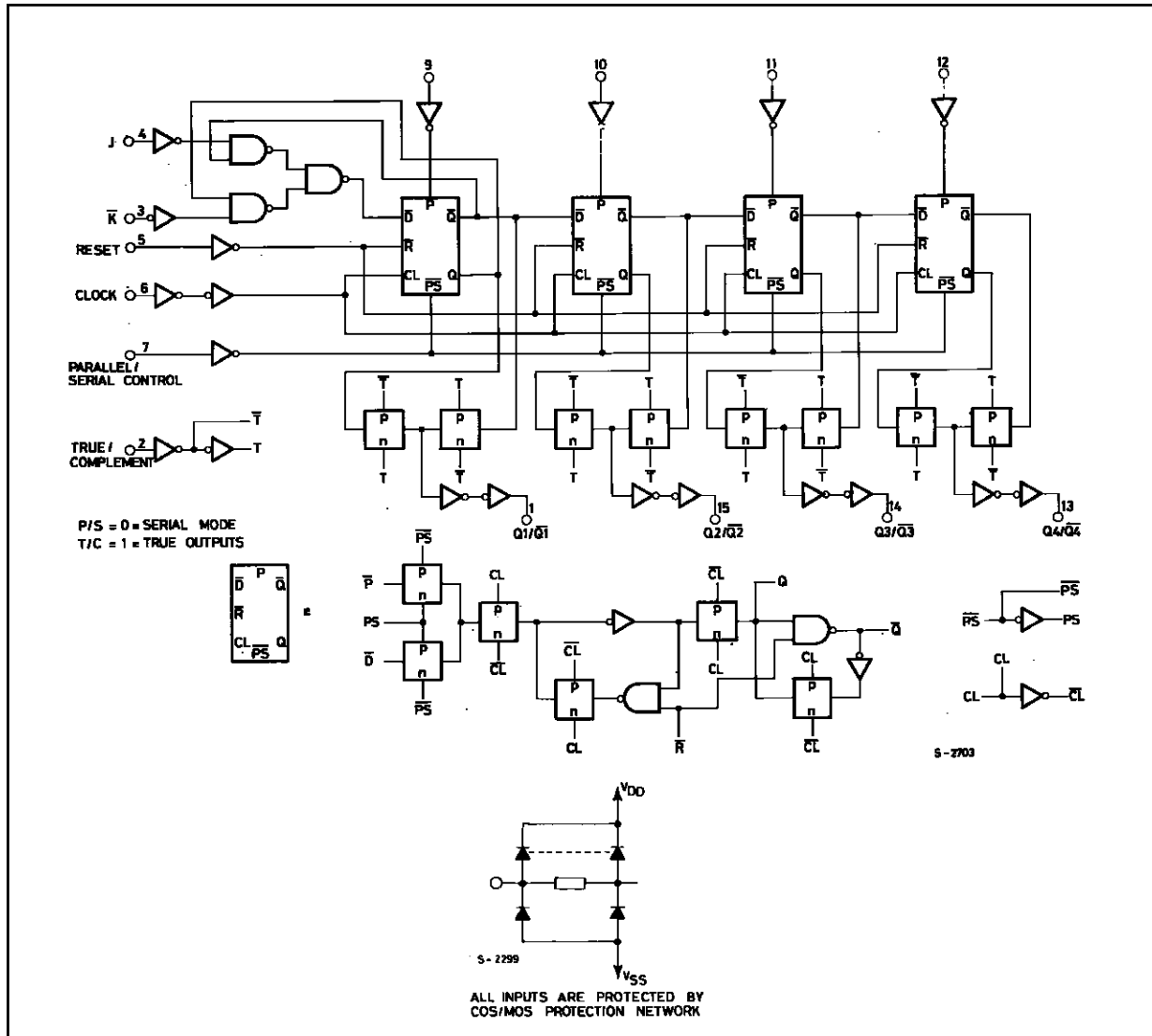
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure 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: <b>HCC</b> Types <b>HCF</b> Types	3 to 18 3 to 15	V
$V_i$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature: <b>HCC</b> Types <b>HCF</b> Types	-55 to +125 -40 to +85	$^{\circ}C$

LOGIC DIAGRAM



TRUTH TABLE  
FIRST STAGE

Clock ( $\phi$ )	$t_{n-1}$ (inputs)				$t_n$ (outputs)
	J	$\bar{K}$	R	$Q_{n-1}$	$Q_n$
	0	X	0	0	0
	1	X	0	0	1
	X	0	0	1	0
	1	0	0	$Q_{n-1}$	$\overline{Q_{n-1}}$ Toggle Mode
	X	1	0	1	1
	X	X	0	$Q_{n-1}$	$Q_{n-1}$
X	X	X	1	X	0

**STATIC ELECTRICAL CHARACTERISTICS** (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value						Unit	
			V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>O</sub>   (μA)	V <sub>DD</sub> (V)	T <sub>Low</sub> *		25°C			T <sub>High</sub> *		
							Min.	Max.	Min.	Typ.	Max.	Min.		Max.
I <sub>L</sub>	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	
V <sub>OH</sub>	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 <sub>OL</sub>	Output Low Voltage		5/0		< 1	5		0.05			0.05		V	
			10/0		< 1	10		0.05			0.05			
			15/0		< 1	15		0.05			0.05			
V <sub>IH</sub>	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 <sub>IL</sub>	Input Low Voltage			4.5/0.5	< 1	5		1.5			1.5		V	
				9/1	< 1	10		3			3			
				13.5/1.5	< 1	15		4			4			
I <sub>OH</sub>	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 <sub>OL</sub>	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 <sub>IH</sub> , I <sub>IL</sub>	Input leakage Current	HCC Types	0/18	Any Input		18		± 0.1		±10 <sup>-5</sup>	± 0.1		± 1	
		HCF Types	0/15	Any Input		15		± 0.3		±10 <sup>-5</sup>	± 0.3		± 1	
C <sub>I</sub>	Input Capacitance		Any Input						5	7.5			pF	

\* T<sub>Low</sub> = -55°C for HCC device : -40°C for HCF device.

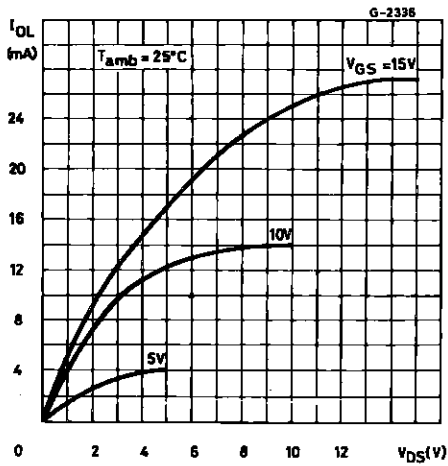
\* T<sub>High</sub> = +125°C for HCC device : +85°C for HCF device.

The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5V min. with V<sub>DD</sub> = 15V.

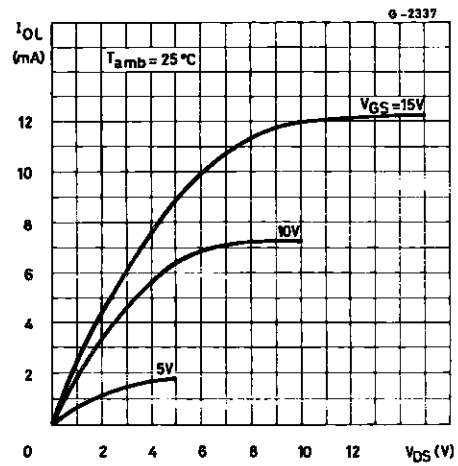
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD} = 0.3\%/^{\circ}\text{C}$ , all input rise and fall time = 20ns)

Symbol	Parameter	Test Conditions		Value			Unit
			$V_{DD}$ (V)	Min.	Typ.	Max.	
<b>CLOCKED OPERATION</b>							
$t_{PLH}, t_{PHL}$	Propagation Delay Time		5		250	500	ns
			10		100	200	
			15		75	150	
$t_{THL}, t_{TLH}$	Transition Time		5		100	200	ns
			10		50	100	
			15		40	80	
$f_{CL}$	Maximum Clock Input Frequency		5	2	4		MHz
			10	6	12		
			15	8	16		
$t_w$	Clock Pulse Width		5		100	200	ns
			10		45	90	
			15		30	60	
$t_r, t_f$	Clock Input Rise or Fall Time		5		15		$\mu\text{s}$
			10		15		
			15		15		
$t_{setup}$	Data Setup Time J/K Lines		5		110	220	ns
			10		40	80	
			15		30	60	
$t_{setup}$	Data Setup Time Parallel-In-Lines		5		70	140	ns
			10		25	50	
			15		20	40	
<b>RESET OPERATION</b>							
$t_{PLH}, t_{PHL}$	Propagation Delay Time		5		230	460	ns
			10		100	200	
			15		80	160	
$t_w$	Reset Pulse Width		5		125	250	ns
			10		55	110	
			15		40	40	

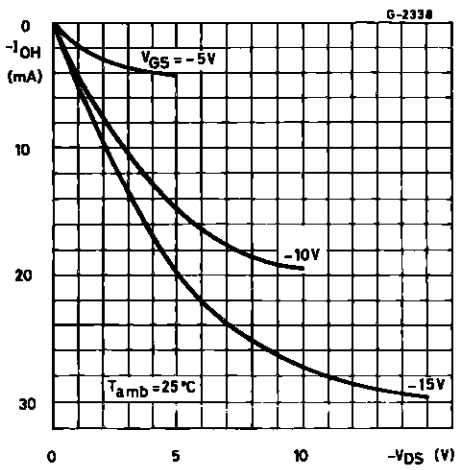
Typical Output Low (sink) Current Characteristics.



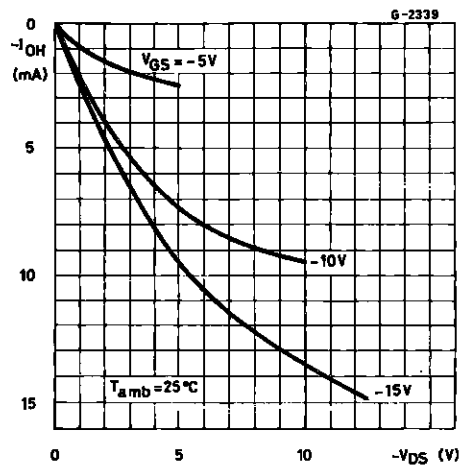
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.

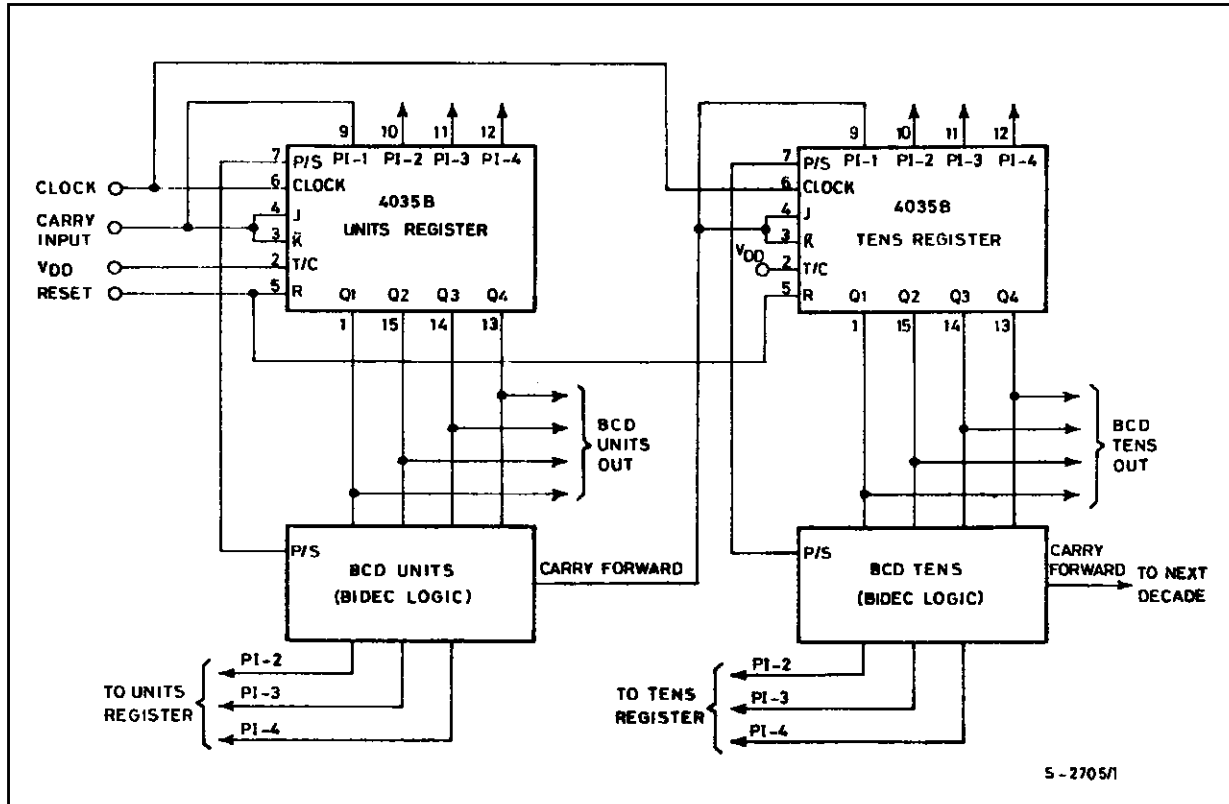


Minimum Output High (source) Current Characteristics.

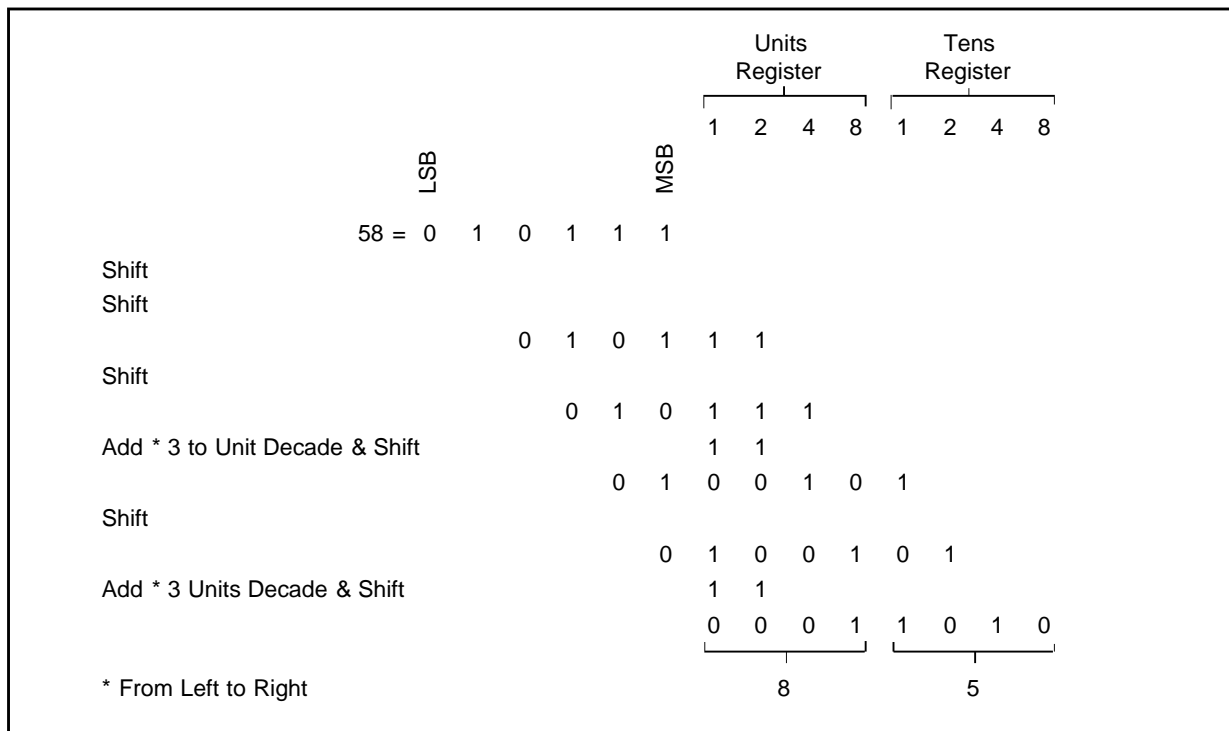


TYPICAL APPLICATIONS

BINARY-TO-BCD CONVERTER

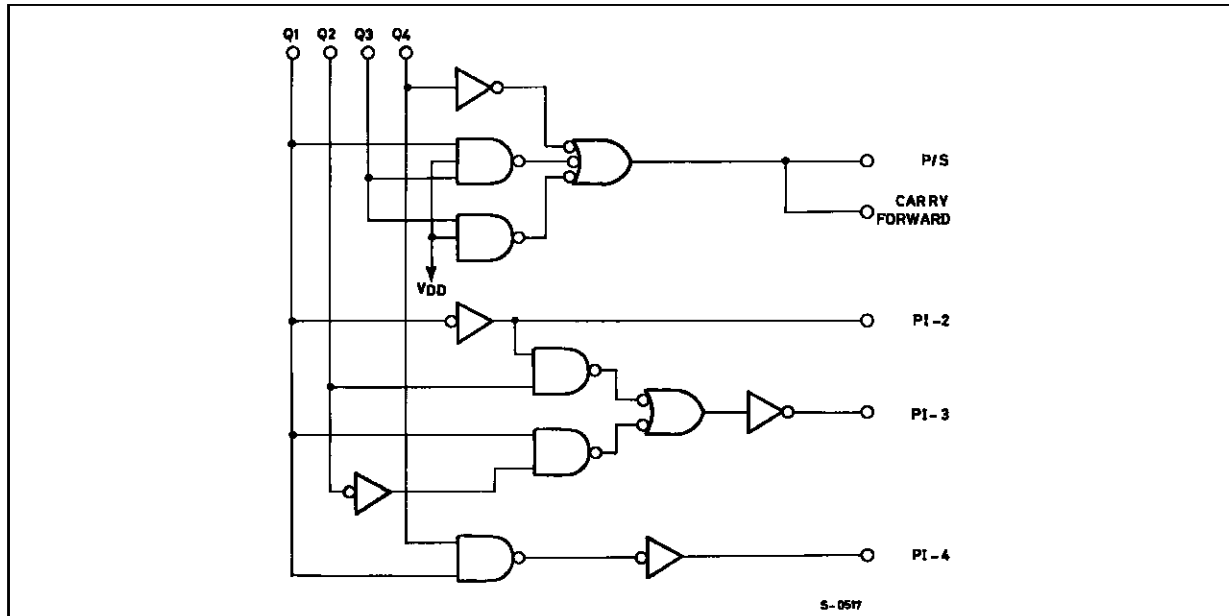


EXAMPLE OF BINARY-TO-BCD CONVERSION

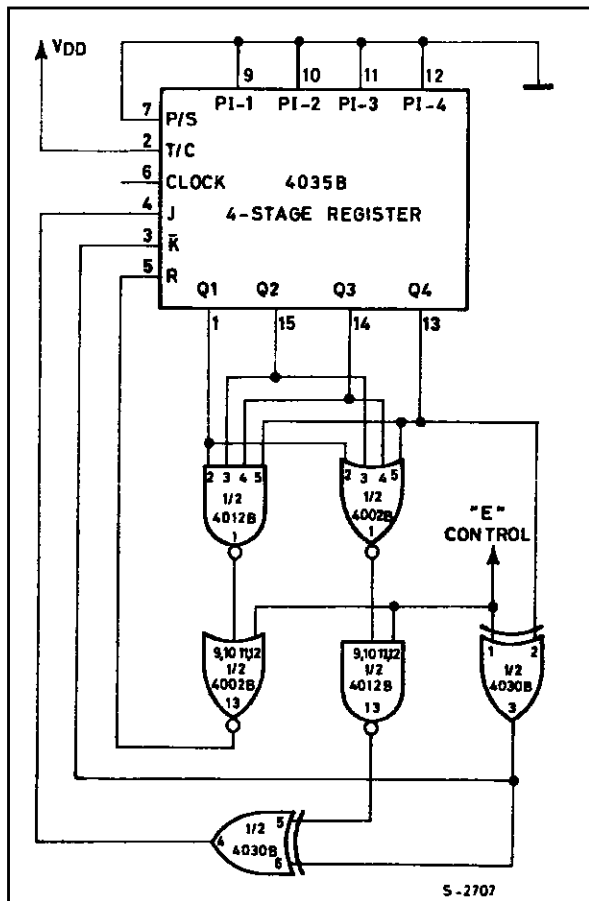


TYPICAL APPLICATIONS

BIDEC LOGIC



DOUBLE SEQUENCE GENERATOR



STATE SEQUENCES

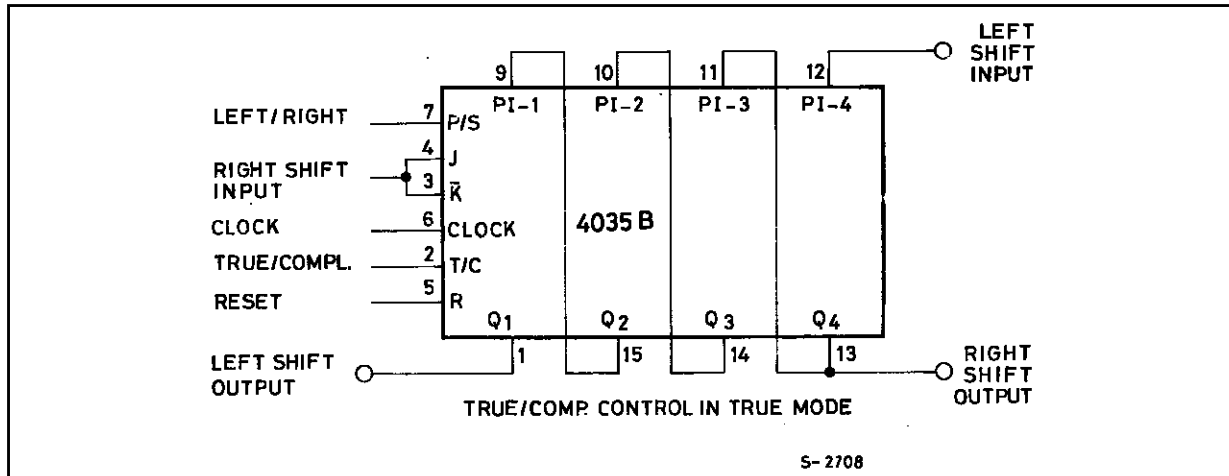
Using a control line (E) two different state sequences can be generated. For example, suppose the following two sequences are desired on command (control line E).

	Control = E = 0					1			
	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>		Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>
0	A	B	C	D	15	A	B	C	D
1	0	0	0	0	14	0	0	1	1
2	1	0	0	0	13	1	0	1	1
5	0	1	0	0	10	0	1	0	1
10	1	0	1	0	5	1	0	1	0
4	0	0	1	0	11	1	1	0	1
9	0	0	0	1	6	0	1	1	0
3	1	1	0	0	12	0	0	1	1
6	0	1	1	0	9	1	0	0	1
13	1	0	1	1	2	0	1	0	0
11	1	1	0	1	4	0	0	1	0
7	1	1	1	0	8	0	0	0	1
14	0	1	1	1	1	1	0	0	0
12	0	0	1	1	3	1	1	0	0
8	0	0	0	1	7	1	1	1	0



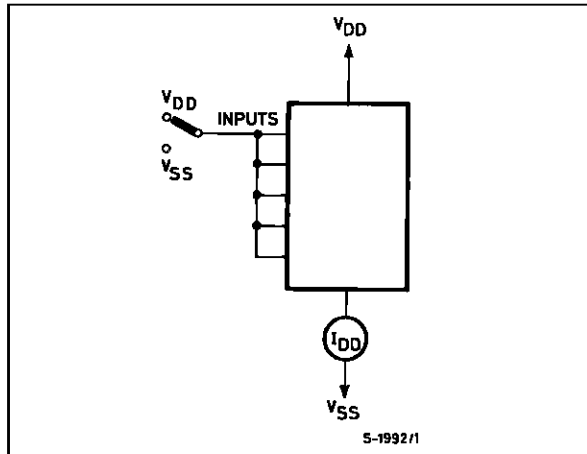
TYPICAL APPLICATIONS

SHIFT LEFT/SHIFT RIGHT REGISTER

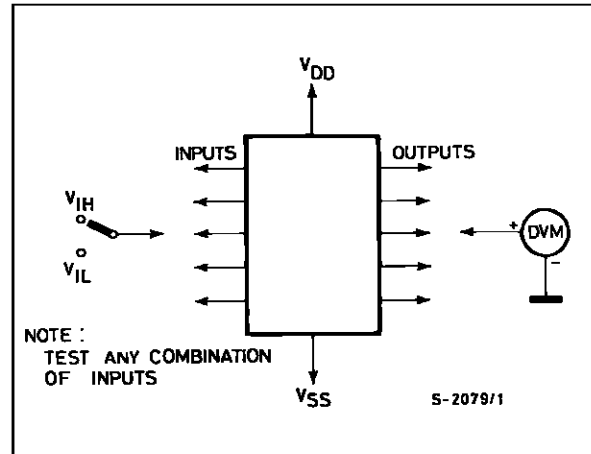


TEST CIRCUITS

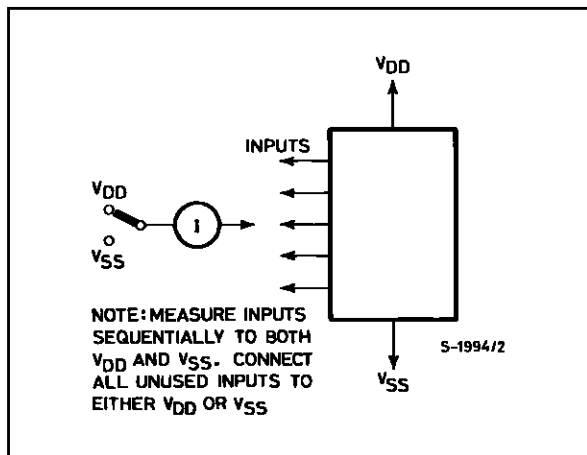
Quiescent Device Current



Input Voltage.



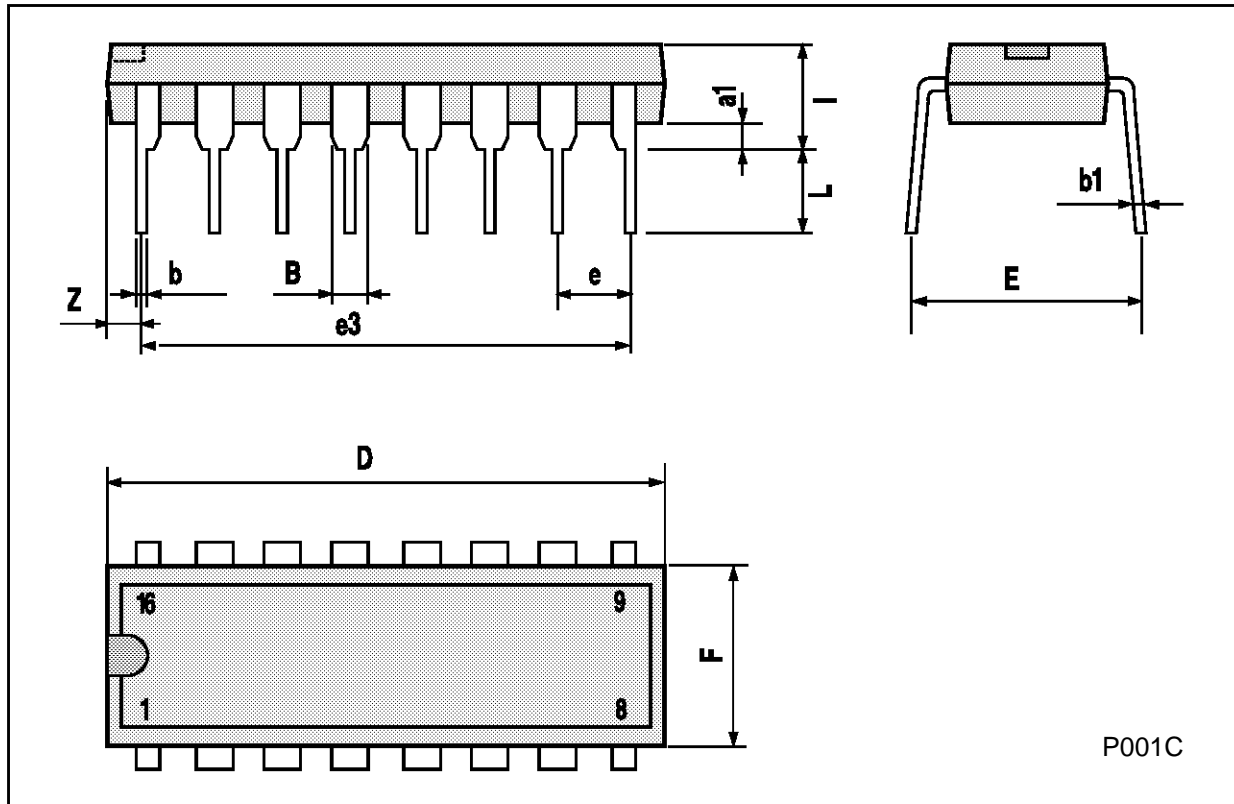
Input Current.



HCC/HCF4035B

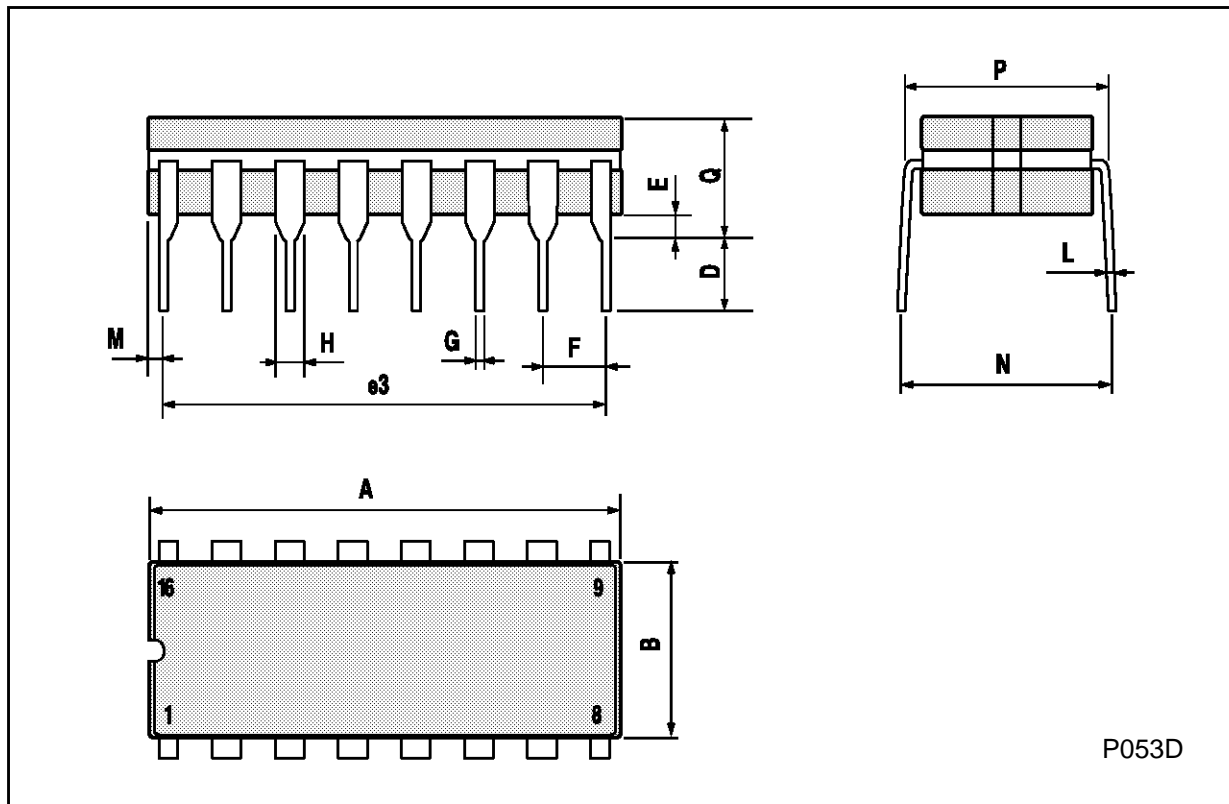
**Plastic DIP16 (0.25) MECHANICAL DATA**

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



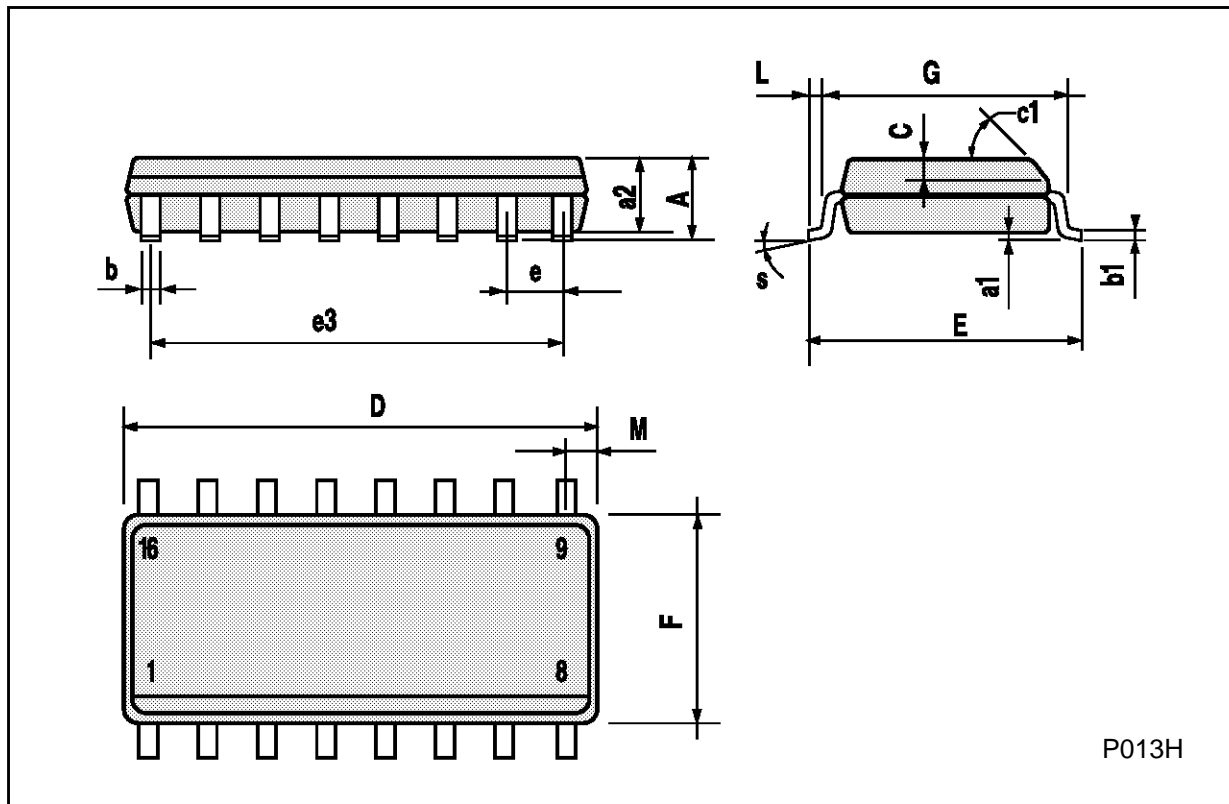
**Ceramic DIP16/1 MECHANICAL DATA**

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



**SO16 (Narrow) MECHANICAL DATA**

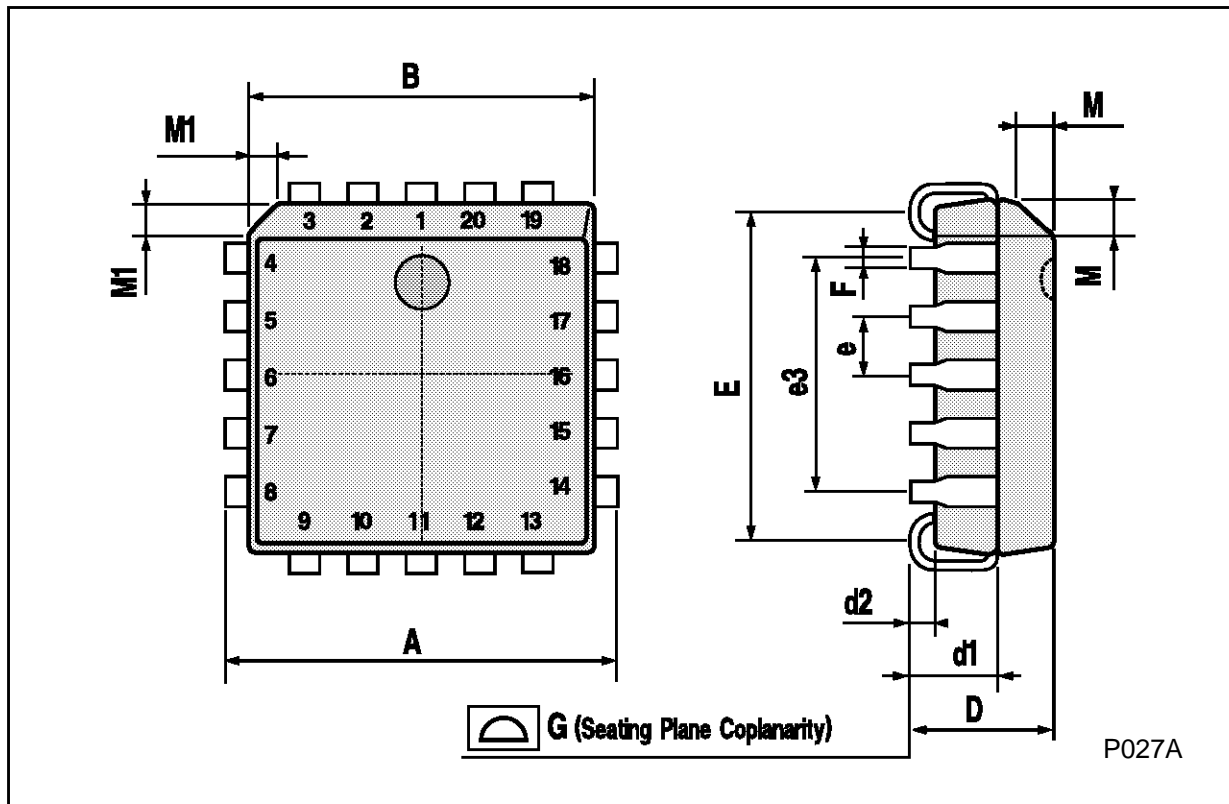
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157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



## HCC/HCF4035B

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