SGS-THOMSON MICROELECTRONICS

HCC/HCF4016B

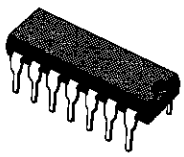
QUAD BILATERAL SWITCH

- 20V DIGITAL OR ± 10V PEAK-TO-PEAK SWITCHING
- 280Ω TYPICAL ON RESISTANCE FOR 15V OPERATION
- SWITCH ON RESISTANCE MATCHED TO WITHIN 10Ω TYP. OVER 15V SIGNAL INPUT RANGE
- HIGH ON/OFF OUTPUT-VOLTAGE RATIO : 65dB TYP. @ f_{is} = 10kHz, R_L = 10kΩ
- HIGH DEGREE OF LINEARITY : < 0.5% DISTORTION TYP. @ f_{is} = 1KHz, V_{is} = 5 V_{pp}, V_{DD} - V_{SS} ≥ 10V, R_L = 10kΩ
- EXTREMELY LOW OFF SWITCH LEAKAGE RESULTING IN VERY LOW OFFSET CURRENT AND HIGH EFFECTIVE OFF RESISTANCE: 100pA TYP. @ V_{DD} - V_{SS} = 18V, T_{amb} = 25°C
- EXTREMELY HIGH CONTROL INPUT IMPEDANCE (control circuit isolated from signal circuit 10^{12}Ω typ.)
- LOW CROSSTALK BETWEEN SWITCHES : 50dB TYP. @ f_{is} = 0.9MHz, R_L = 1kΩ
- MATCHED CONTROL-INPUT TO SIGNAL-OUTPUT CAPACITANCE : REDUCES OUTPUT SIGNAL TRANSIENTS
- FREQUENCY RESPONSE' SWITCH ON = 40MHz (typ.)
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C 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"

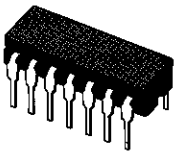
DESCRIPTION

The **HCC4016B** (extended temperature range) and **HCF4016B** (intermediate temperature range) are monolithic integrated circuit, available in 14-lead dual in-line plastic or ceramic package and plastic micropackage.

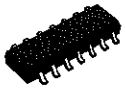
The **HCC/HCF4016B** Series types are quad bilateral switches intended for the transmission or multiplexing of analog or digital signals. Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch ON or OFF.



EY
(Plastic Package)



F
(Ceramic Frit Seal Package)



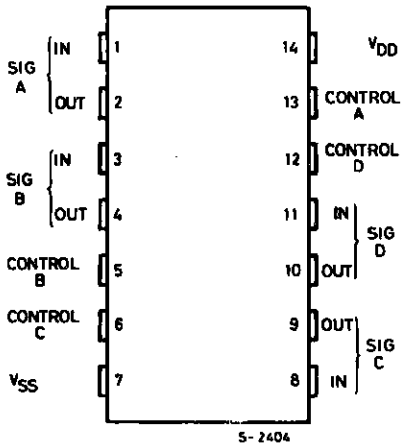
M1
(Micro Package)

C1
(Plastic Chip Carrier)

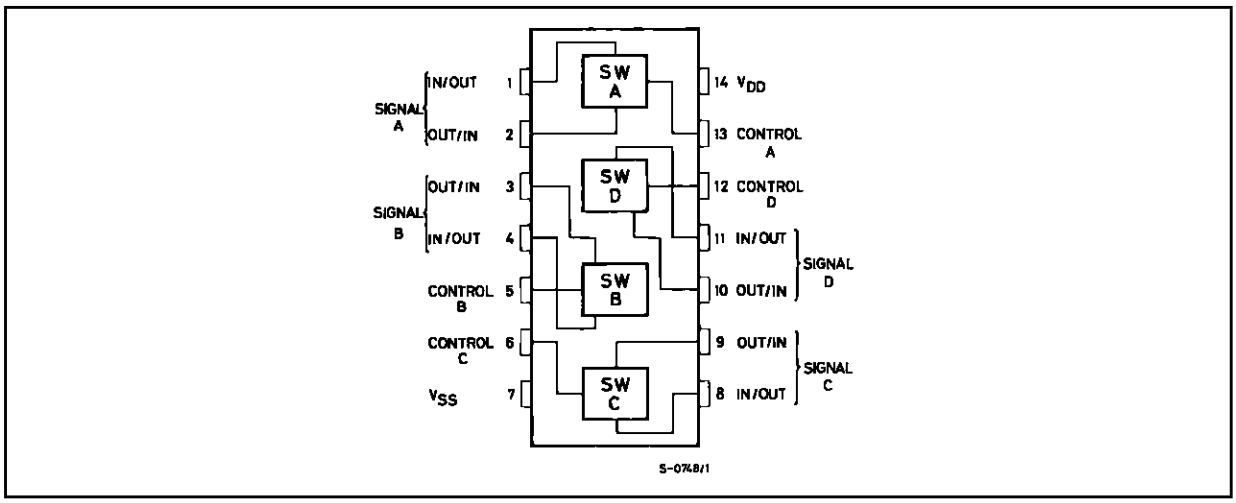
ORDER CODES :

HCC4016BF	HCF4016BM1
HCF4016BEY	HCF4016BC1

PIN CONNECTIONS



FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

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 T_{op} = Full Package-temperature Range	200 100	mW mW
T_{op}	Operating Temperature : **HCC** Types **HCF** Types	– 55 to + 125 – 40 to + 85	°C °C
T_{stg}	Storage Temperature	– 65 to + 150	°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.

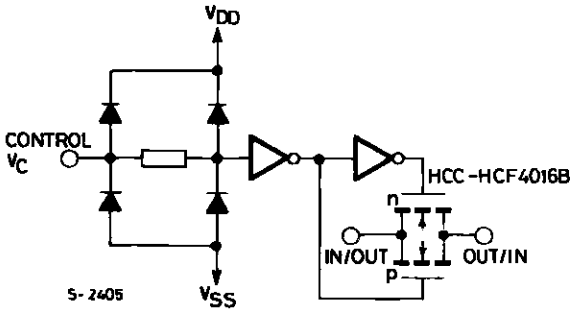
* All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage : **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	°C °C

SCHEMATIC DIAGRAM

1 OF 4 IDENTICAL SECTION



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value							Unit
				$V_C = V_{SS}$		V_{DD}	T_{Low}*		25°C			T_{High}*		
				V_{DD}	(V)	(V)	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent Device Current (all switches on or all switches off)	HCC Types				5		0.25		0.01	0.25		7.5	µA
						10		0.5		0.01	0.5		15	
						15		1		0.01	1		30	
						20		5		0.02	5		150	
		HCF Types				5		1		0.01	1		7.5	
						10		2		0.01	2		15	
						15		4		0.01	4		30	
SWITCH						V_{IS}								
R_{ON}	Resistance	HCC	R_L = 10kΩ•	+ 7.5	– 7.5	+ 7.5 – 7.5 ± 0.25		360 360 775		200 200 280	400 400 850		600 600 1230	Ω
		HCF				+ 7.5 – 7.5 ± 0.25		370 370 790		200 200 280	400 400 850		520 520 1080	
		HCC	R_L = 10kΩ•	+ 5	– 5	+ 5 – 5 ± 0.25		600 600 1870		250 250 580	660 660 2000		960 960 2600	
		HCF				+ 5 – 5 ± 0.25		610 610 1900		250 250 580	660 660 2000		840 840 2380	

* T_{Low}= – 55°C for **HCC** device : – 40°C for **HCF** device.
* T_{High}= + 125°C for **HCC** device : + 85°C for **HCF** device.

STATIC ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter		Test Conditions	V_C = V_{DD}	V_{SS} (V)	V_{DD} (V)	Value T_{Low}* Min.	T_{Low}* Max.	25°C Min.	25°C Typ.	25°C Max.	T_{High}* Min.	T_{High}* Max.	Unit
SWITCH (continued)														
R_{ON}	Resistance	HCC	R_L = 10kΩ•	+ 15	0	+ 15 + 0.25 + 9.3		360 360 775		200 200 300	400 400 850		600 600 1230	Ω
		HCF		+ 15	0	+ 15 + 0.25 + 9.3		370 370 790		200 200 300	400 400 800		520 520 1080	
		HCC	R_L = 10kΩ•	+ 10	0	+ 10 + 0.25 + 5.6		600 600 1870		250 250 560	660 660 2000		960 960 2600	
		HCF		+ 10	0	+ 10 + 0.25 + 5.6		610 610 1900		250 250 560	660 660 2000		840 840 2380	
ΔON	Resistance ΔRON (between any 2 of 4 switches)		R_L = 10kΩ•	+ 7.5	– 7.5	± 7.5				10				Ω
				+ 5	– 5	± 5				15				
Input or Output Leakage Current Switch OFF (effective off resistance)		HCC		V_{DD} +18	V_C = V_{SS} 0			± 0.1		10^{-5}	± 0.1		1	μA
		HCF		V_{DD} + 15	V_C = V_{SS} 0			± 0.3		10^{-5}	± 0.3		1	
C_I	Input Capacitance		V_{CC} = V_{SS} = – 5			+ 5				4				pF
C_O	Output Capacitance									4				
C_{IO}	Feedthrough									0.2				
CONTROL (V_C)														
V_{TH}	Switch Threshold Voltage		I_{IS} = 10μA			5	1		1	2.25		1		V
						10	2		2	4.5		2		
						15	2		2	6.75		2		
I_I	Input Current	HCC Types	$V_{IS} \le V_{DD}$			18		± 0.1		±10^{-5}	± 0.1		± 1	μA
		HCF Types				15		± 0.3		±10^{-5}	± 0.3		± 1	
C_I	Input Capacitance									5	7.5			pF

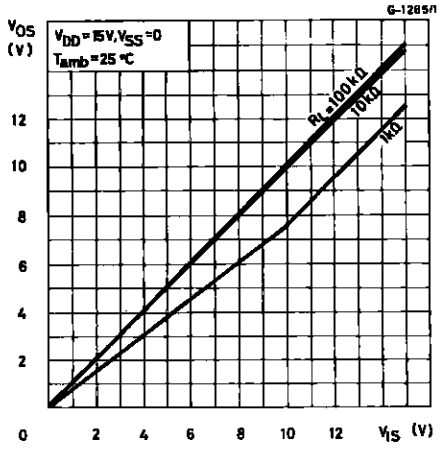
* T_{Low}= – 55°C for **HCC** device : – 40°C for **HCF** device.
* T_{High}= + 125°C for **HCC** device : + 85°C for **HCF** device.

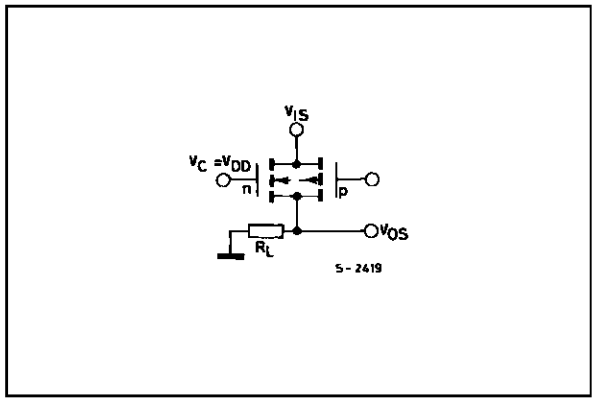
DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50pF all input square wave rise and fall time = 20ns)

Parameter	Test Conditions							Value		Unit
	V_C (V)	R_L (kΩ)	f_i (KHz)	V_I (V)	V_{SS} (V)	V_{DD} (V)		Typ.	Max.	
SWITCH										
t_{pd} Propagation Delay Time (signal intput to output)	= V_{DD}	10		10sq. Wave	GND	5		40	100	ns
						10		20	50	
						15		15	40	
Crosstalk Between any 2 of 4 Switches (f @ – 50dB) 20 log 10 $\frac{V_{O(B)}}{V_{I(A)}}$ = – 50dB	$V_{C(A)} = V_{DD} = +5$ $V_{C(B)} = V_{SS} = -5$	1		$V_{I(A)}$ Δ = 5p-p				0.9		MHz
Frequency Response Switch "ON" (sine wave input) At 20 log 10 $\frac{V_O}{V_I}$ = – 3dB	= V_{DD} = + 5	1		5p-p	– 5			40		MHz
Feedtrough (switch OFF) At 20 log 10 $\frac{V_O}{V_I}$ = – 50dB	= V_{SS} = – 5	1		– 5p-p		5		1.25		MHz
Sine Wave Distortion	= V_{DD} = 5	10	1	5p-p	– 5			0.4		%
CONTROL (V_C)										
Propagation Delay : (turn on control to output)	$V_{DD} - V_{SS}$ (sq. wawe)	1		V_{DD} or V_{SS}		5	V_{DD}–V_{SS} = 10V	35	70	ns
						10		20	40	
						15		15	30	
Max. Allowable Control Input Repetition Rate	10 (sq. wawe)	1		V_{DD}	GND	10		10		MHz
Crosstalk (control input to signal output)	10 (sq. wave)	10			GND	10		50		mV

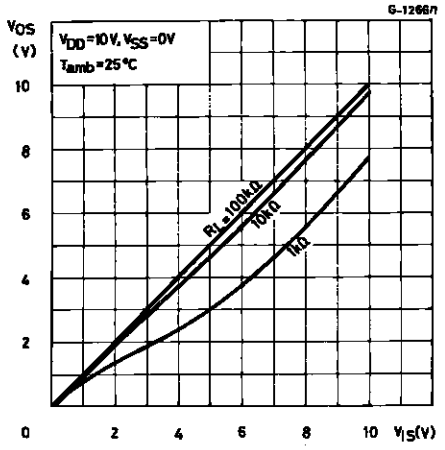
(Δ) Symmetrical about OV (•) For all test conditions.

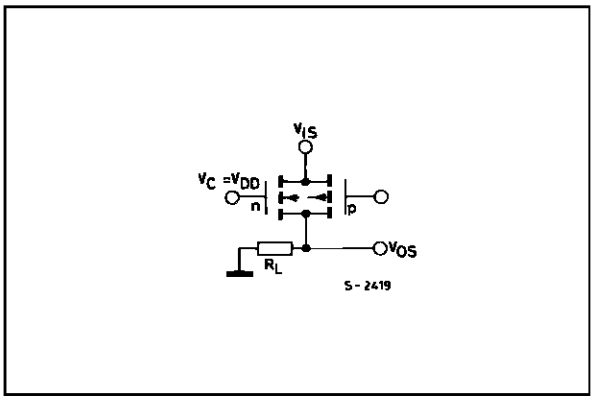
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 15V, V_{SS} = 0V, and Test Circuit.



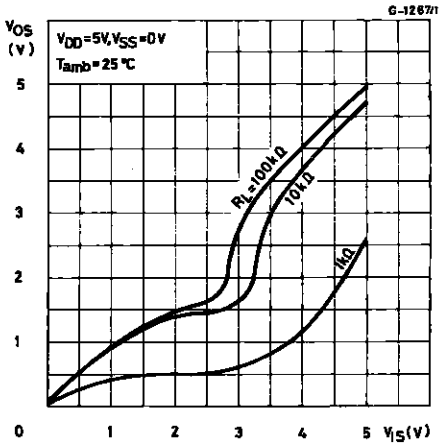


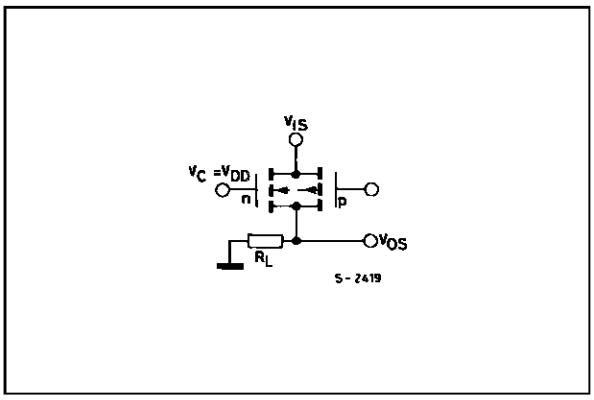
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 10V, V_{SS} = 0V, andTest Circuit.



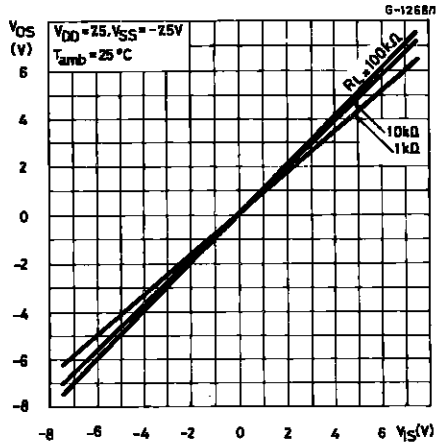


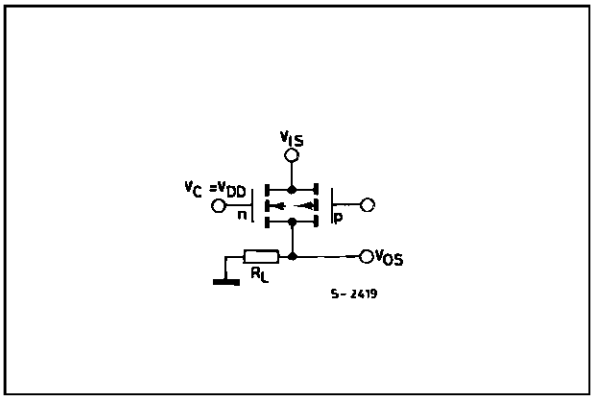
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 5V, V_{SS} = 0V, and Test Circuit.



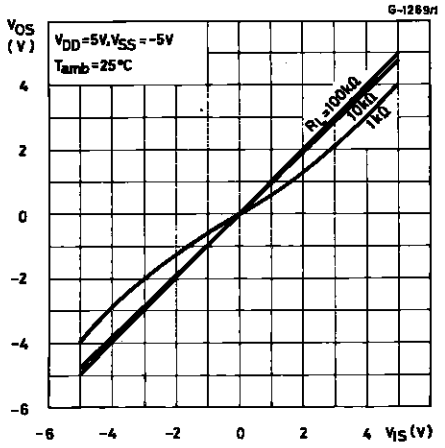


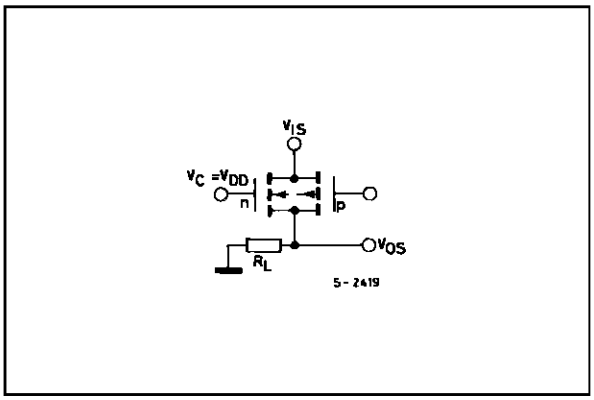
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 7.5V, V_{SS} = – 7.5V, and Test Circuit.



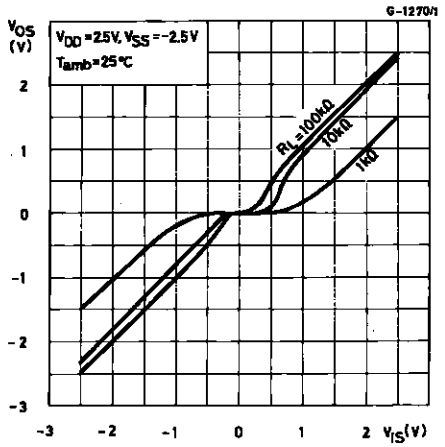


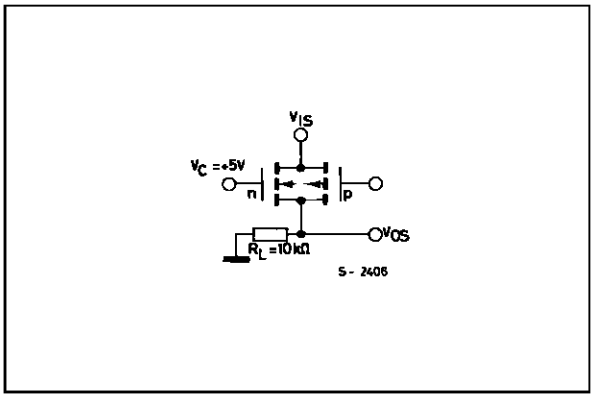
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 5V, V_{SS} = – 5V, and Test Circuit.



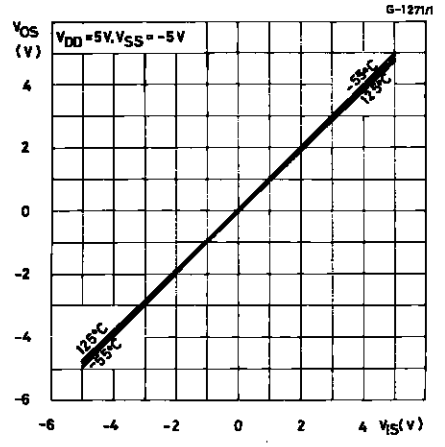


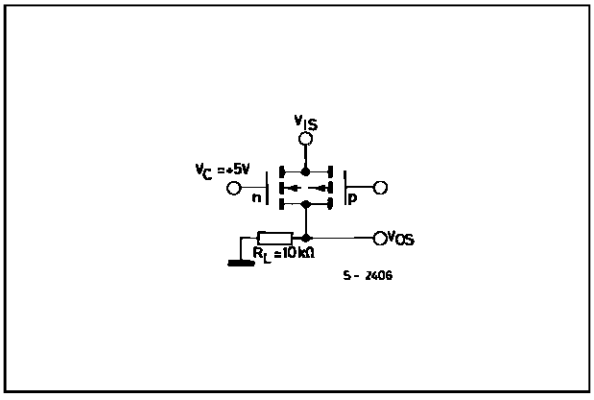
Typical "ON" Characteristics for 1 of 4 switches with V_{DD} = + 2.5V, V_{SS} = – 2.5V, and Test Circuit.



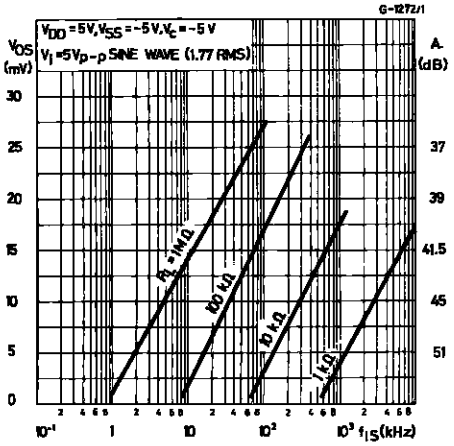


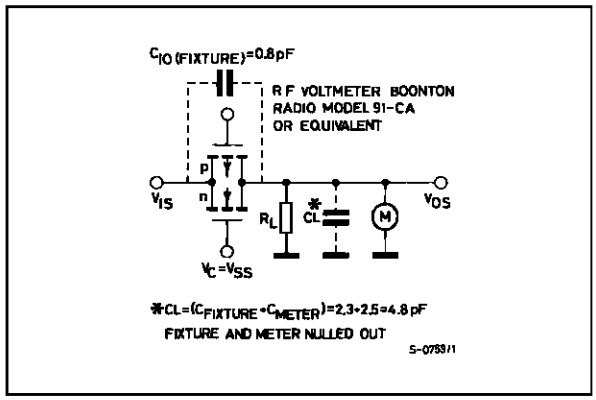
Typical "ON" Characteristics as function of temp.for 1 of 4 switches with V_{DD} = + 5V and Test Circuit.



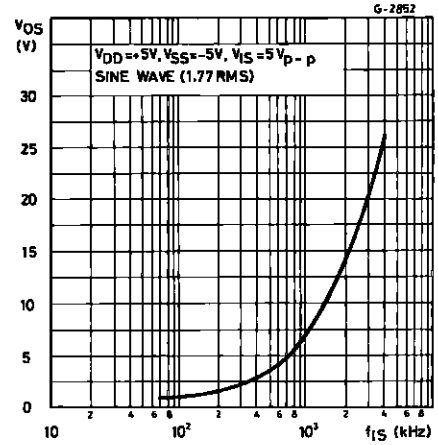


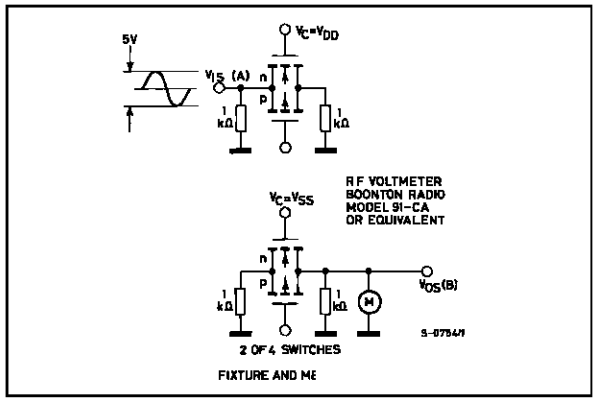
Typical feedthru vs. frequency-switch "OFF" and Test Circuit.



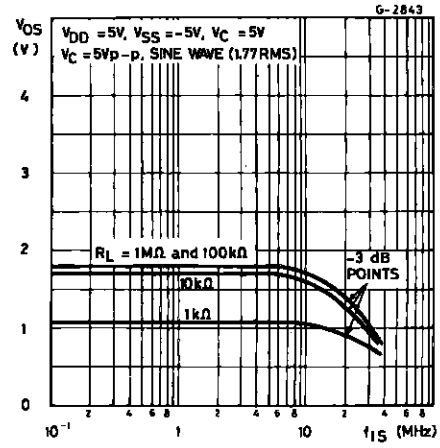


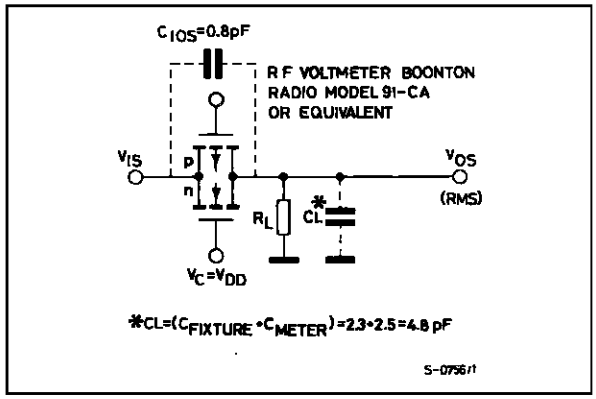
Typical Crosstalk between Switch Circuits in the Same Package.





Typical Switch Frequency response-switch " ON" and Test Circuit.





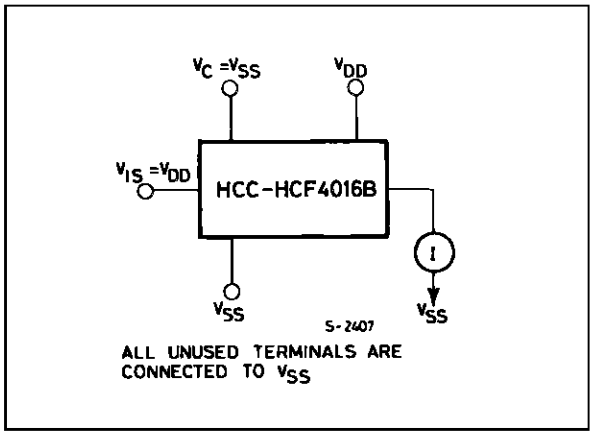
TYPICAL "ON" RESISTANCE CHARACTERISTICS, T_{amb} = 25°C

Characteristic*	Supply Conditions		Load Conditions					
			R_L = 1 kΩ		R_L = 10 kΩ		R_L = 100 kΩ	
	V_{DD} (V)	V_{SS} (V)	Value (Ω)	V_{is} (V)	Value (Ω)	V_{is} (V)	Value (Ω)	V_{is} (V)
R_{ON}	+ 15	0	200	+ 15	200	+ 15	180	+ 15
			200	0	200	0	200	0
R_{ON} (max)	+ 15	0	300	+ 11	300	+ 9.3	320	+ 9.2
R_{ON}	+ 10	0	290	+ 10	250	+ 10	240	+ 10
			290	0	250	0	300	0
R_{ON} (max)	+ 10	0	500	+ 7.4	560	+ 5.6	610	+5.5
R_{ON}	+ 5	0	860	+ 5	470	+ 5	450	+ 5
			600	0	580	0	800	0
R_{ON} (max)	+ 5	0	1.7k	+ 4.2	7k	+ 2.9	33k	+2.7
R_{ON}	+ 2.5	– 2.5	590	+ 2.5	450	+ 2.5	490	+ 2.5
			720	– 2.5	520	– 2.5	520	– 2.5
R_{ON} (max)	+ 2.5	– 2.5	232k	± 0.25	300k	± 0.25	870k	± 0.25

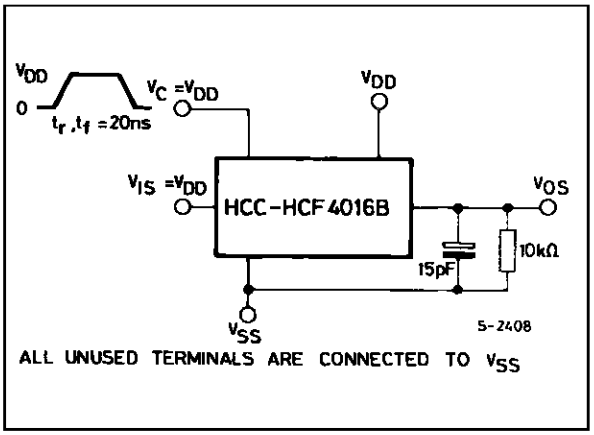
* Variation from a perfect switch, R_{ON}= 0Ω.

TEST CIRCUITS

"OFF" Switch Input or Put Leakage Current.

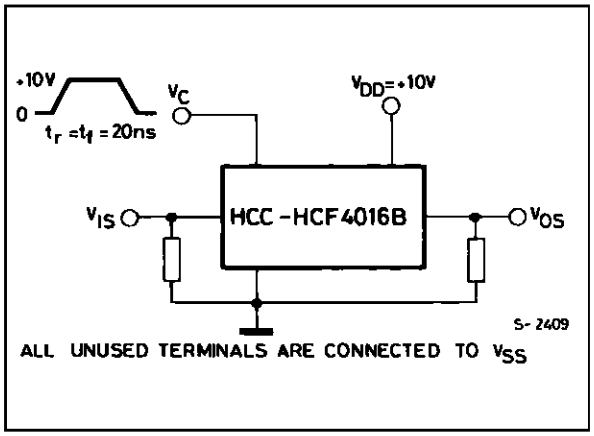


Square-Wave Response.

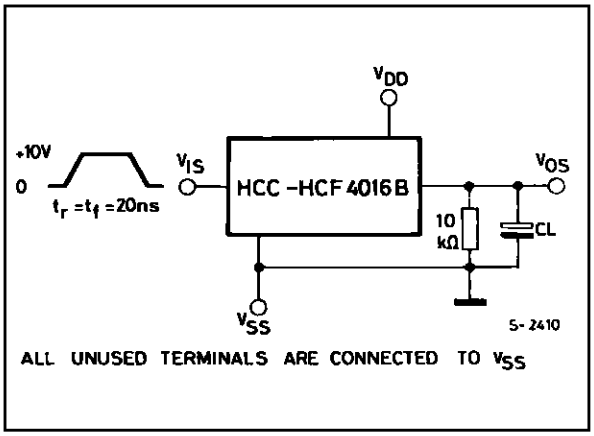


TEST CIRCUITS (continued)

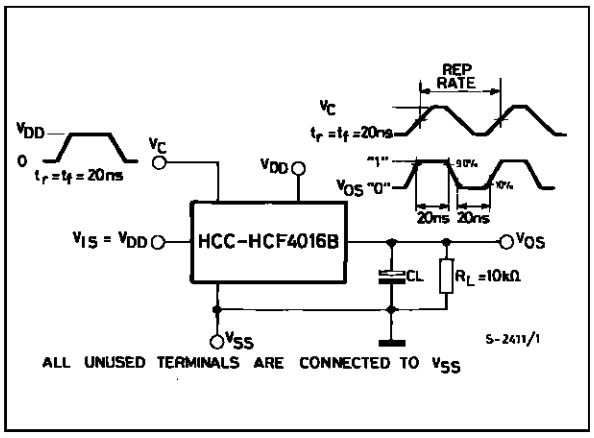
Crosstalk-control Input to Signal Output.



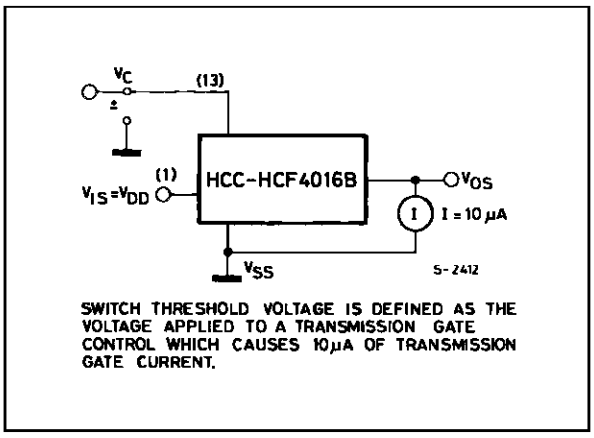
Propagaton Delay Time Signal Input (V_{IS}) to Signal Output (V_{OS}).



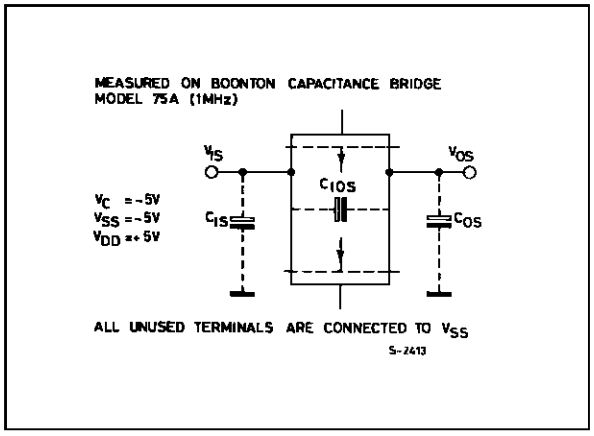
Max Allowable Control-input Repetition Rate.



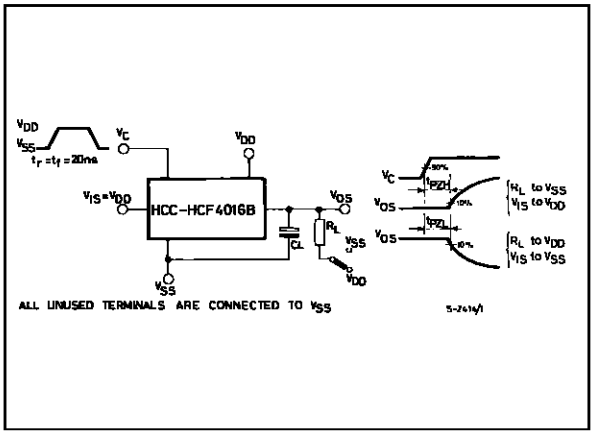
Switch Treshold Voltage.



Capacitance C_{IOS} and C_{OS}.

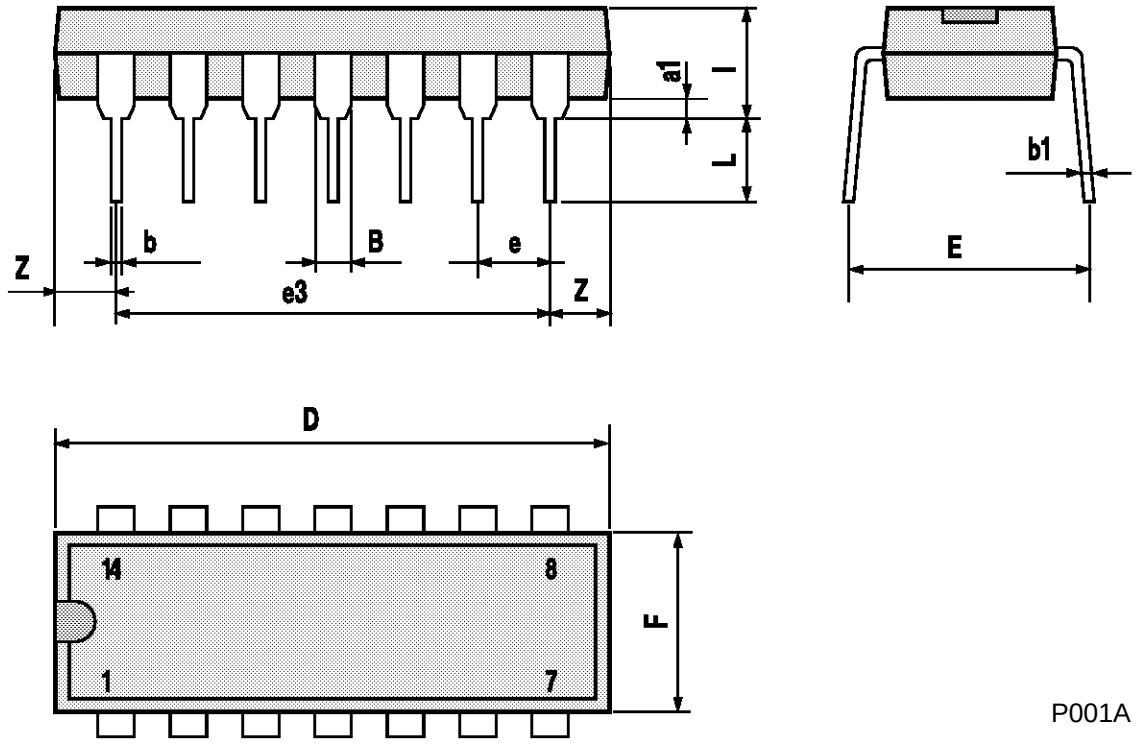


Turn-On Propagation Delay-control Input to Output.



Plastic DIP14 MECHANICAL DATA

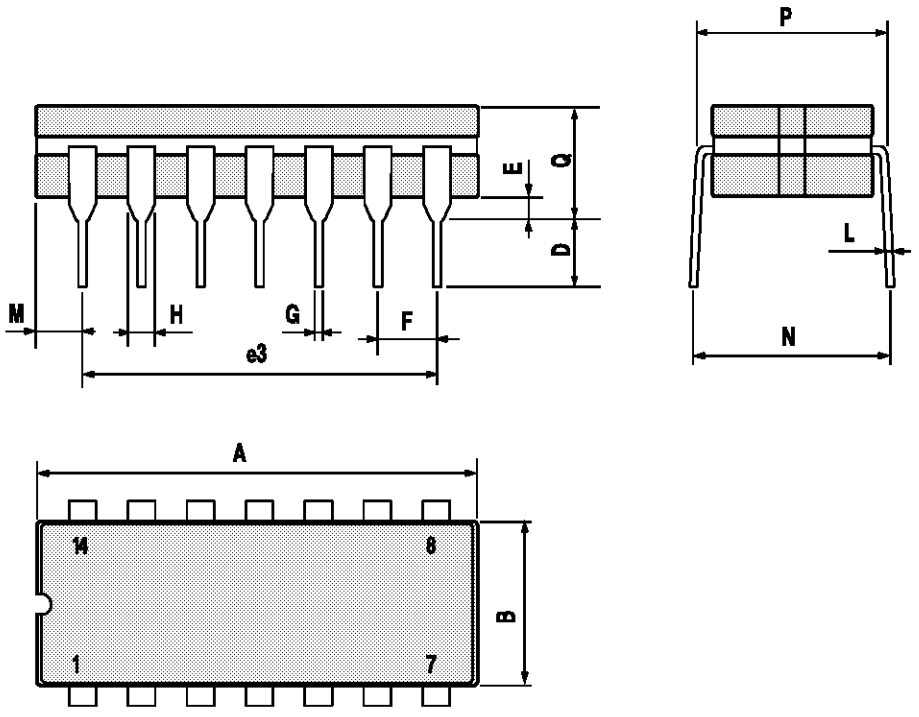
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

Ceramic DIP14/1 MECHANICAL DATA

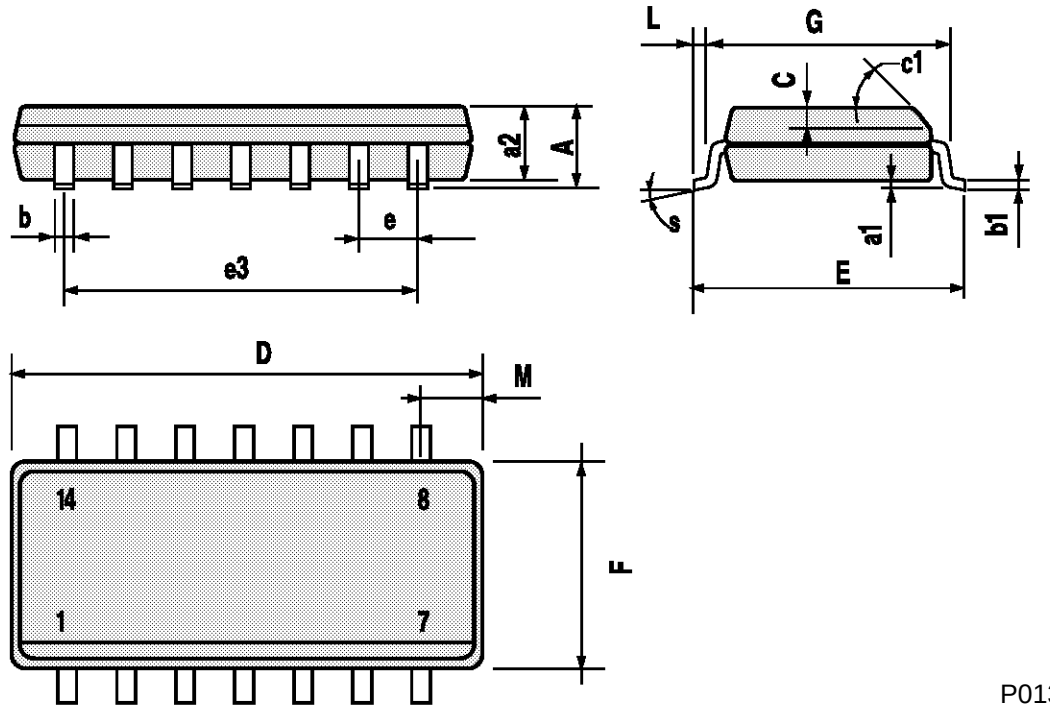
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053C

SO14 MECHANICAL DATA

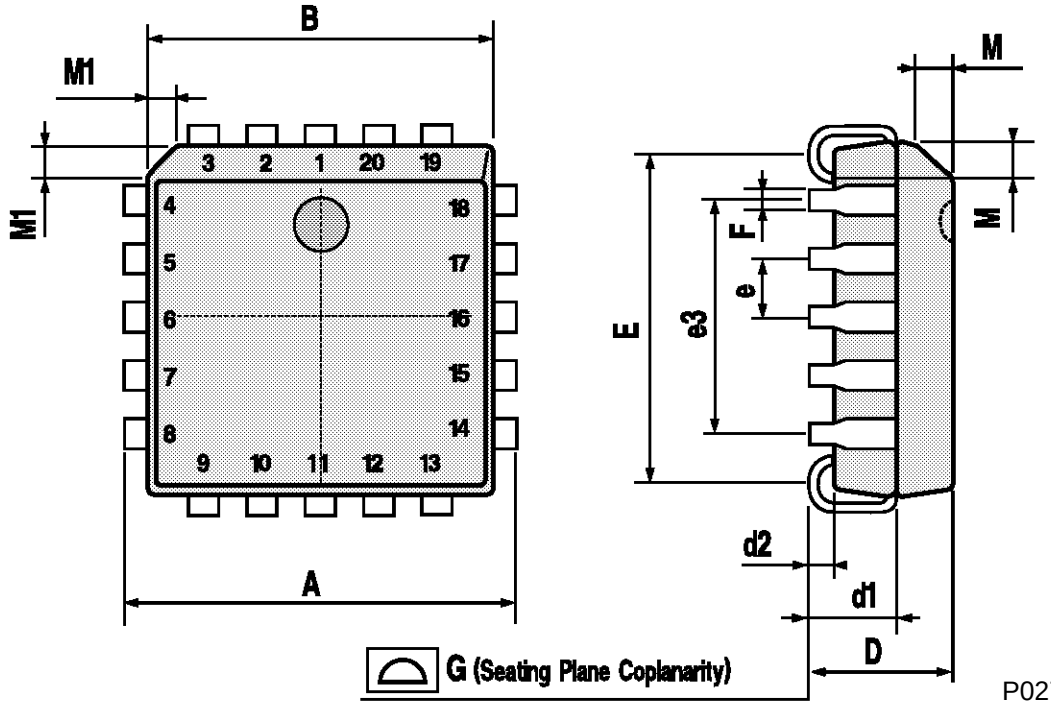
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



P013G

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

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