

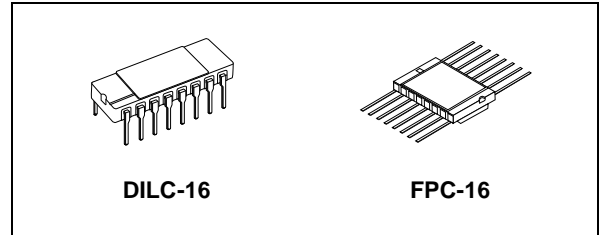
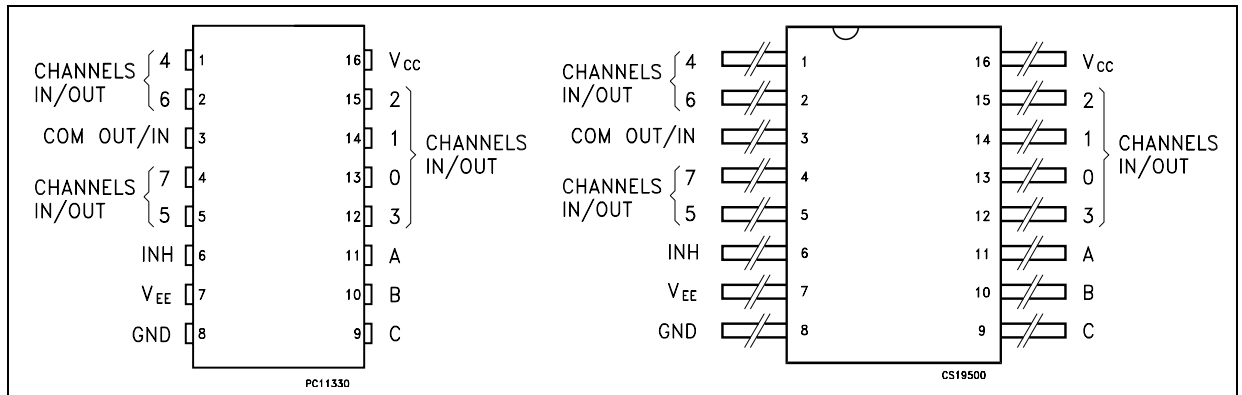
## RAD-HARD SINGLE 8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- **LOW POWER DISSIPATION:**  
 $I_{CC} = 4\mu\text{A}(\text{MAX.})$  at  $T_A = 25^\circ\text{C}$
- **LOGIC LEVEL TRANSLATION TO ENABLE 5V LOGIC SIGNAL TO COMMUNICATE WITH  $\pm 5\text{V}$  ANALOG SIGNAL**
- **LOW "ON" RESISTANCE:**  
 $70\Omega$  TYP. ( $V_{CC} - V_{EE} = 4.5\text{V}$ )  
 $50\Omega$  TYP. ( $V_{CC} - V_{EE} = 9\text{V}$ )
- **WIDE ANALOG INPUT VOLT. RANGE:  $\pm 6\text{V}$**
- **FAST SWITCHING:**  
 $t_{pd} = 15\text{ns}$  (TYP.) at  $T_A = 25^\circ\text{C}$
- **LOW CROSSTALK BETWEEN SWITCHES**
- **HIGH ON/OFF OUTPUT VOLTAGE RATIO**
- **WIDE OPERATING SUPPLY VOLTAGE RANGE ( $V_{CC} - V_{EE}$ ) = 2V TO 12V**
- **LOW SINE WAVE DISTORTION:**  
0.02% at  $V_{CC} - V_{EE} = 9\text{V}$
- **HIGH NOISE IMMUNITY:**  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- **PIN AND FUNCTION COMPATIBLE WITH 54 SERIES 4051**
- **SPACE GRADE-1: ESA SCC QUALIFIED**
- **50 krad QUALIFIED, 100 krad AVAILABLE ON REQUEST**
- **NO SEL UNDER HIGH LET HEAVY IONS IRRADIATION**
- **DEVICE FULLY COMPLIANT WITH SCC-9408-064**

### DESCRIPTION

The M54HC4051 is a single eight-channel analog MULTIPLEXER/DEMULTIPLEXER fabricated

### PIN CONNECTION



### ORDER CODES

PACKAGE	FM	EM
DILC	M54HC4051D	M54HC4051D1
FPC	M54HC4051K	M54HC4051K1

with silicon gate C<sup>2</sup>MOS technology and it is pin to pin compatible with the equivalent metal gate CMOS4000B series.

It contains 8 bidirectional and digitally controlled analog switches.

A built-in level shifting is included to allow an input range up to  $\pm 6\text{V}$  (peak) for an analog signal with digital control signal of 0 to 6V.

$V_{EE}$  supply pin is provided for analog input signals. It has an inhibit (INH) input terminal to disable all the switches when is at high level. For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND.

A, B and C control inputs select one channel out of eight.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

Figure 1: IEC Logic Symbols

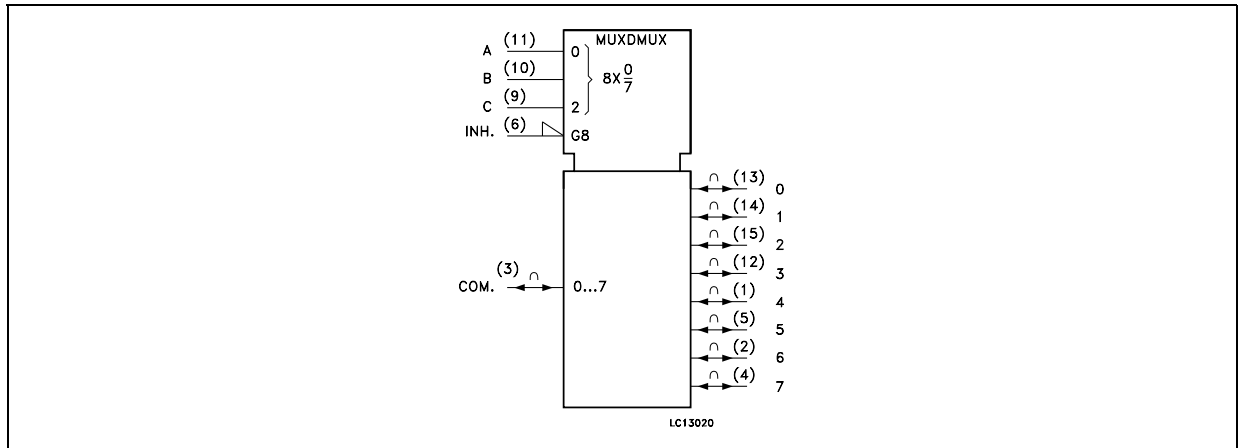


Figure 2: Control Input Equivalent Circuit

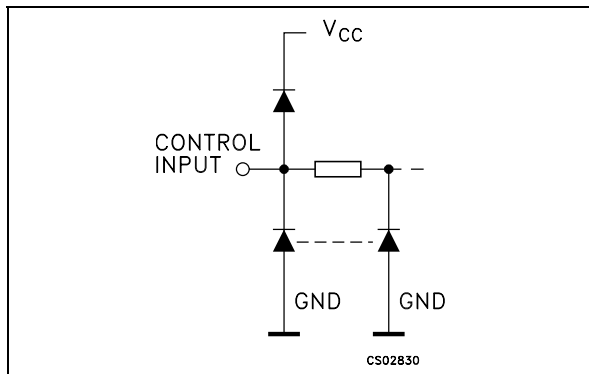


Figure 3: I/O Equivalent Circuit

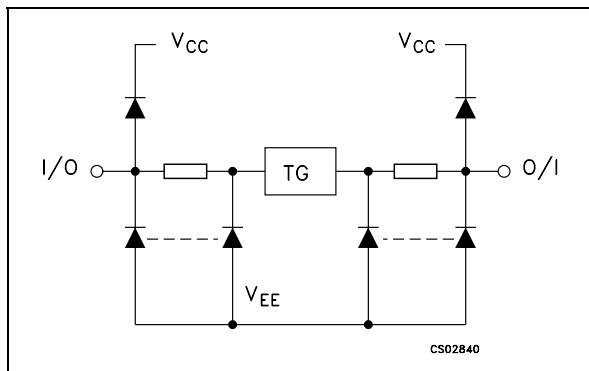


Table 1: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
3	COM OUT/IN	Common Output/Input
6	INH	INHIBIT Input
7	V <sub>EE</sub>	Negative Supply Voltage
11, 10, 9	A, B, C	Select Inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7	Independent Input/Out-puts
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

Table 2: Truth Table

INPUT STATE				ON CHANNEL
INH	C	B	A	
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	X	X	X	NONE

X: Don't care

Figure 4: Functional Diagram

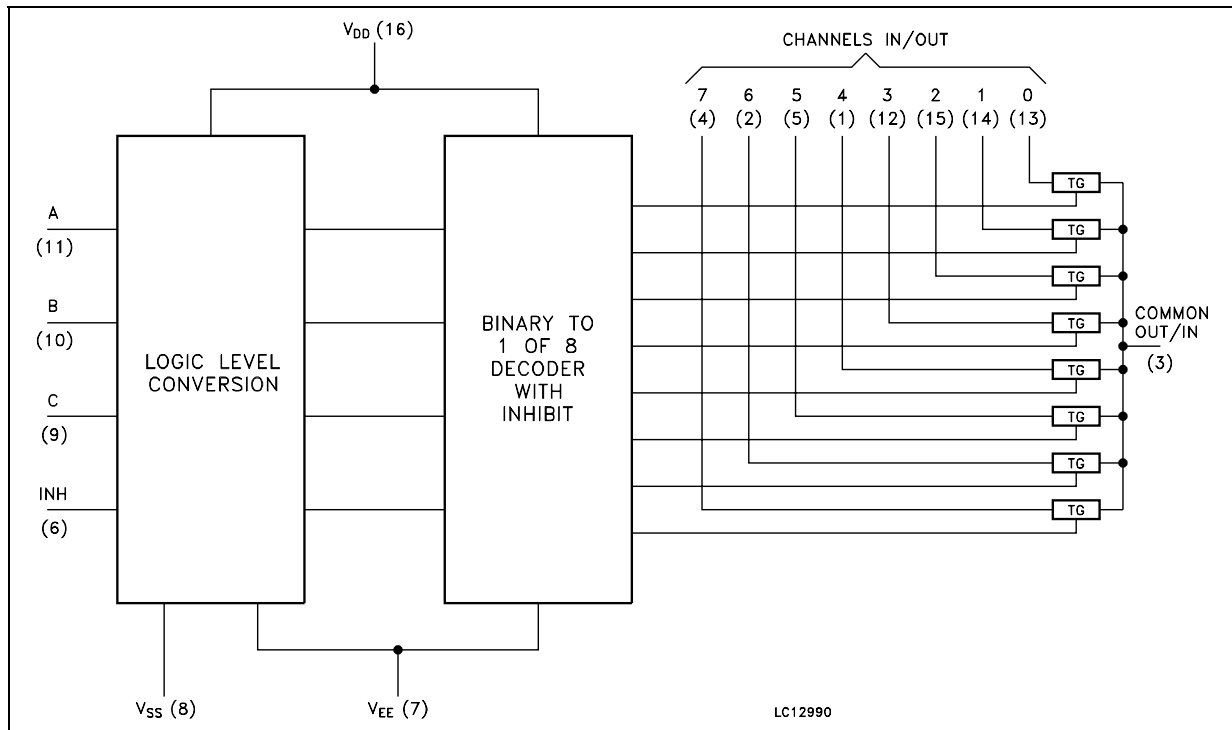


Table 3: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +7	V
$V_{CC} - V_{EE}$	Supply Voltage	-0.5 to +13	V
$V_I$	Control Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{I/O}$	Switch I/O Voltage	$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
$I_{CK}$	Control Input Diode Current	$\pm 20$	mA
$I_{I/O}$	I/O Diode Current	$\pm 20$	mA
$I_T$	Switch Through Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	300	mW
$T_{stg}$	Storage Temperature	-65 to +150	°C
$T_L$	Lead Temperature (10 sec)	265	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

**Table 4: Recommended Operating Conditions**

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	2 to 6	V	
$V_{EE}$	Supply Voltage	-6 to 0	V	
$V_{CC} - V_{EE}$	Supply Voltage	2 to 12	V	
$V_I$	Input Voltage	0 to $V_{CC}$	V	
$V_{I/O}$	I/O Voltage	$V_{EE}$ to $V_{CC}$	V	
$T_{op}$	Operating Temperature	-55 to 125	°C	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
		$V_{CC} = 4.5V$	0 to 500	
		$V_{CC} = 6.0V$	0 to 400	

**Table 5: DC Specifications**

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ C$			$-40 \text{ to } 85^\circ C$		$-55 \text{ to } 125^\circ C$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$V_{IHC}$	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
$V_{ILC}$	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
$R_{ON}$	ON Resistance	4.5	GND	$V_I = V_{IHC} \text{ or } V_{ILC}$ $V_{I/O} = V_{CC} \text{ to } V_{EE}$ $I_{I/O} \leq 2mA$		85	180		225		270	$\Omega$
		4.5	-4.5			55	120		150		180	
		6.0	-6.0			50	100		125		150	
		2.0	GND	$V_I = V_{IHC} \text{ or } V_{ILC}$ $V_{I/O} = V_{CC} \text{ or } V_{EE}$ $I_{I/O} \leq 2mA$		150						
		4.5	GND			70	150		190		230	
		4.5	-4.5			50	100		125		150	
		6.0	-6.0			45	80		100		120	
$\Delta R_{ON}$	Difference of ON Resistance between switches	4.5	GND	$V_I = V_{IHC} \text{ or } V_{ILC}$ $V_{I/O} = V_{CC} \text{ or } V_{EE}$ $I_{I/O} \leq 2mA$		10	30		35		45	$\Omega$
		4.5	-4.5			5	12		15		18	
		6.0	-6.0			5	10		12		15	
$I_{OFF}$	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	$V_{OS} = V_{CC} \text{ or } GND$ $V_{IS} = GND \text{ or } V_{CC}$ $V_I = V_{ILC} \text{ or } V_{IHC}$			$\pm 0.06$		$\pm 0.6$		$\pm 1.2$	$\mu A$
		6.0	-6.0				$\pm 0.1$		$\pm 1$		$\pm 2$	
$I_{IZ}$	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	$V_{OS} = V_{CC} \text{ or } GND$ $V_I = V_{IHC} \text{ or } V_{ILC}$			$\pm 0.06$		$\pm 0.6$		$\pm 1.2$	$\mu A$
		6.0	-6.0				$\pm 0.1$		$\pm 1$		$\pm 2$	
$I_I$	Input Leakage Current	6.0	GND	$V_I = V_{CC} \text{ or } GND$			$\pm 0.1$		$\pm 0.1$		$\pm 1$	$\mu A$
$I_{CC}$	Quiescent Supply Current	6.0	GND	$V_I = V_{CC} \text{ or } GND$			4		40		80	$\mu A$
		6.0	-6.0				8		80		160	

Table 6: AC Electrical Characteristics ( $C_L = 50$  pF, Input  $t_r = t_f = 6$  ns)

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$\Phi_{I/O}$	Phase Difference Between Input and Output	2.0	GND			25	60		75		90	ns
		4.5	GND			6	12		15		18	
		6.0	GND			5	10		13		15	
		4.5	-4.5			4						
$t_{PZL}$ $t_{PZH}$	Output Enable Time	2.0	GND	$R_L = 1\text{K}\Omega$		64	225		280		340	ns
		4.5	GND			18	45		56		68	
		6.0	GND			15	38		48		58	
		4.5	-4.5			18						
$t_{PLZ}$ $t_{PHZ}$	Output Disable Time	2.0	GND	$R_L = 1\text{K}\Omega$		100	250		315		375	ns
		4.5	GND			33	50		63		70	
		6.0	GND			28	43		54		64	
		4.5	-4.5			29						

Table 7: Capacitive Characteristics

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance	5.0				5	10		10		10	pF
$C_{I/O}$	Common Terminal Capacitance	5.0	-5.0			36	70		70		70	pF
$C_{I/O}$	Switch Terminal Capacitance	5.0	-5.0			7	15		15		15	pF
$C_{IOS}$	Feed Through Capacitance	5.0	-5.0			0.95	2		2		2	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)	5.0	GND			70						pF

1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

Table 8: Analog Switch Characteristics (GND = 0V; T<sub>A</sub> = 25°C)

Symbol	Parameter	Test Condition			Value	Unit	
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>IN</sub> (V <sub>p-p</sub> )			
	Sine Wave Distortion	2.25	-2.25	4	0.025	% rowspan="3">f <sub>IN</sub> = 1 KHz R <sub>L</sub> = 10 KΩ C <sub>L</sub> = 50 pF	
		4.5	-4.5	8			0.020
		6.0	-6.0	11			0.018
f <sub>MAX</sub>	Frequency Response (Switch ON) (*)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	120	MHz	
		4.5	-4.5		190		
		6.0	-6.0		200		
f <sub>MAX</sub>	Frequency Response (Switch ON) (**)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	45	MHz	
		4.5	-4.5		70		
		6.0	-6.0		85		
	Feed through Attenuation (Switch OFF)	2.25	-2.25	V <sub>IN</sub> is centered at (V <sub>CC</sub> - V <sub>EE</sub> )/2 Adjust input for 0 dBm R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB	
		4.5	-4.5		-50		
		6.0	-6.0		-50		
	Crosstalk (Control Input to Signal Output)	2.25	-2.25	Adjust R <sub>L</sub> at set up so that I <sub>S</sub> = 0A. R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz square wave	60	mV	
		4.5	-4.5		140		
		6.0	-6.0		200		
	Crosstalk (between any two Switches)	2.25	-2.25	Adjust V <sub>IN</sub> to obtain 0dBm at input R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB	
		4.5	-4.5		-50		
		6.0	-6.0		-50		

(\*) Input COMMON Terminal, and measured at SWITCH Terminal

(\*\*) Input SWITCH Terminal, and measured at common Terminal

NOTE: These characteristics are determined by the design of the device.

Figure 5: Switching Characteristics Test Circuit

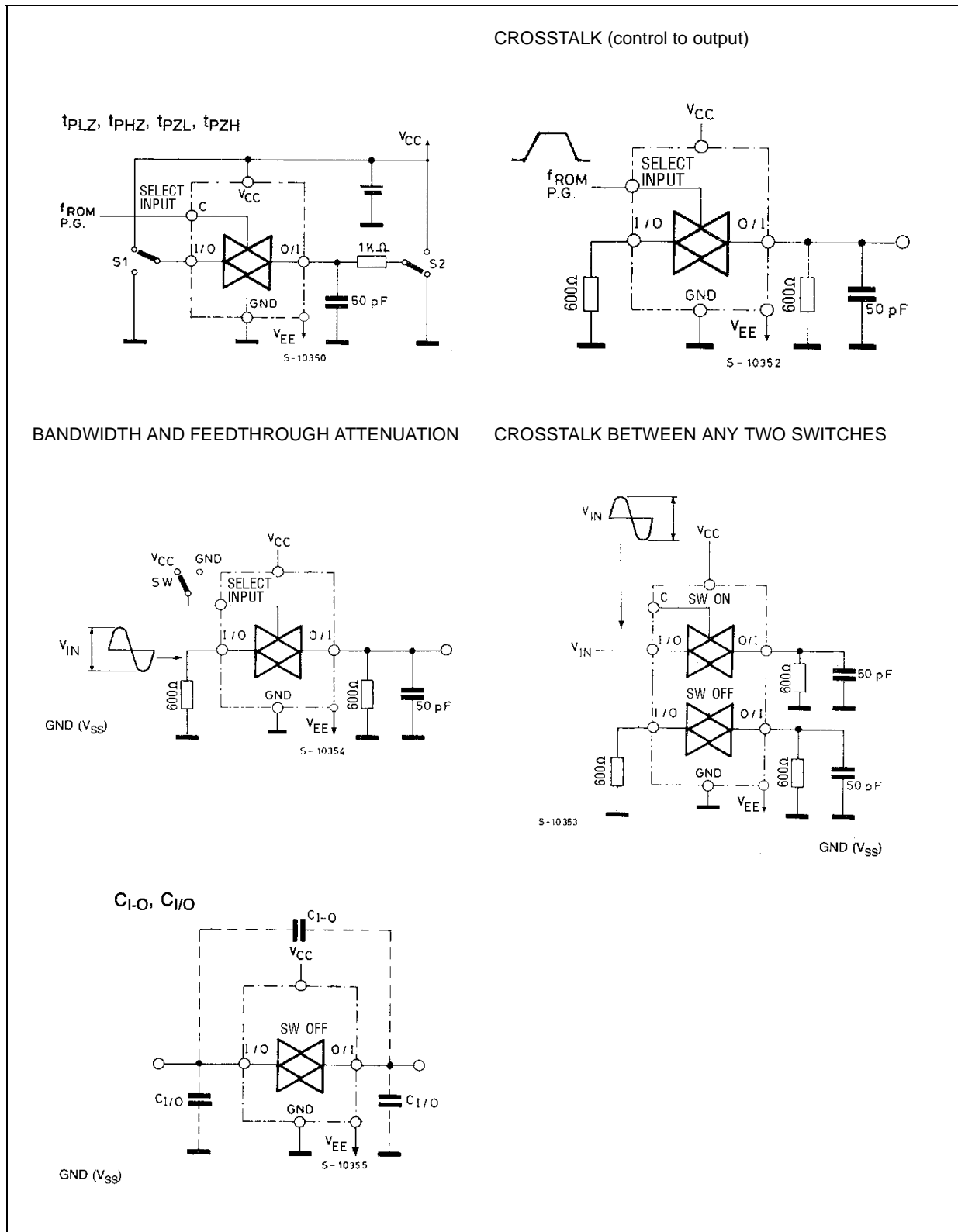


Figure 6: Switching Characteristics Waveform

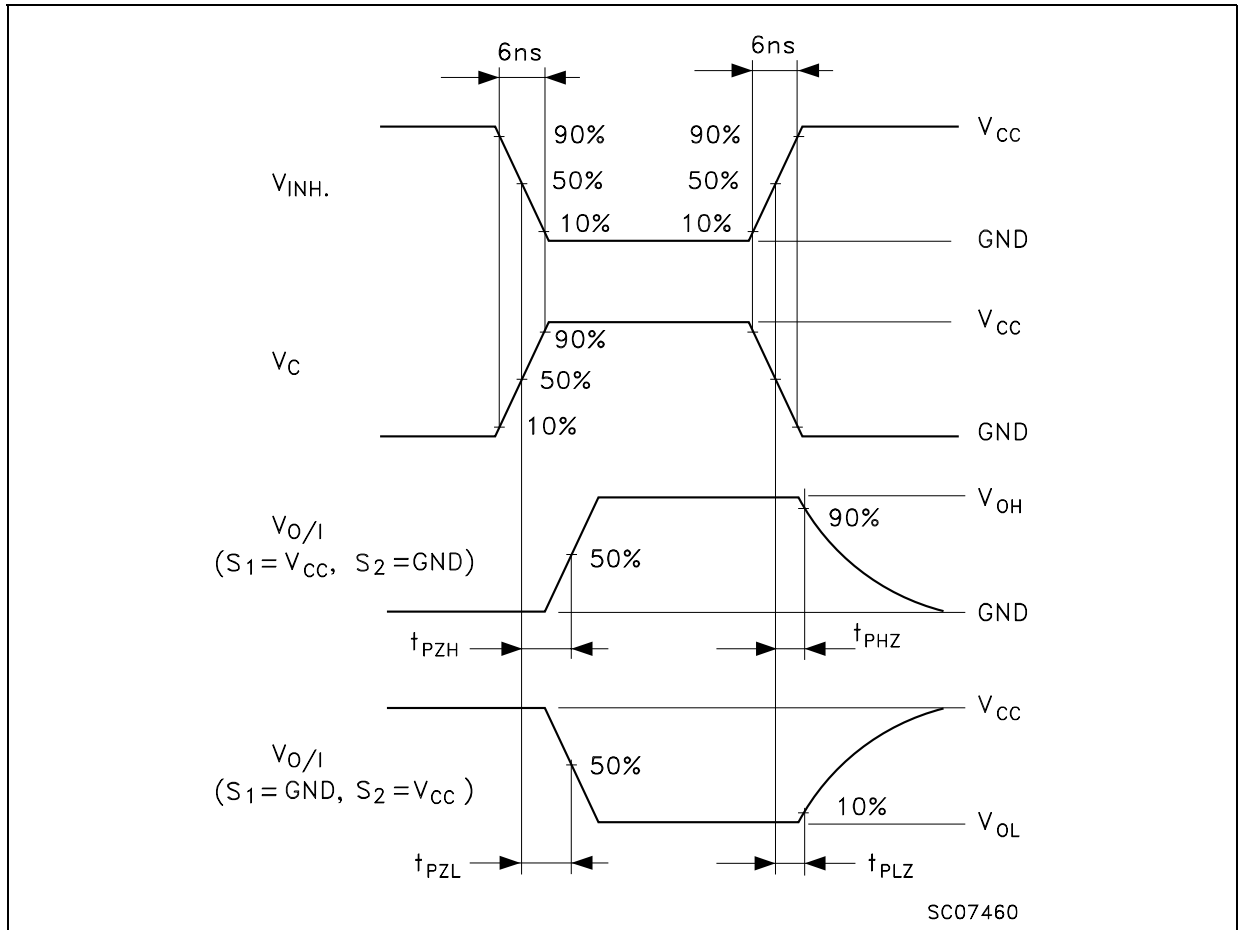


Figure 7: Channel Resistance ( $R_{ON}$ )

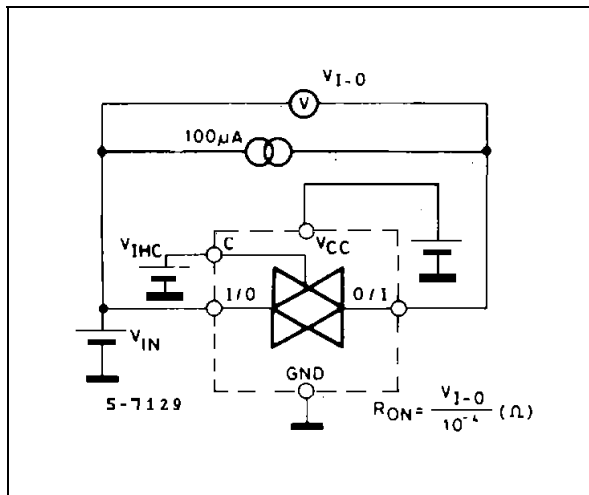
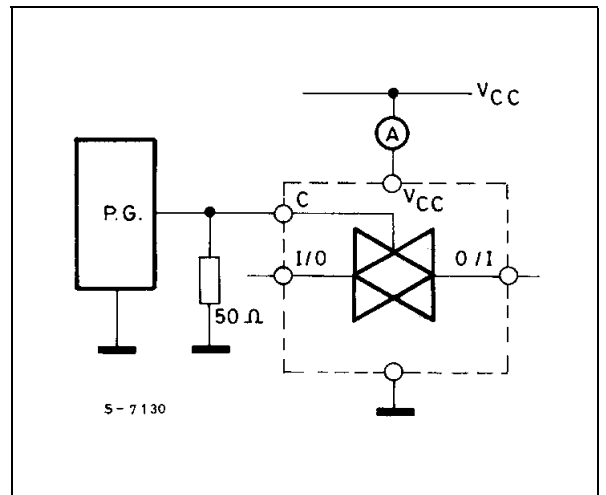


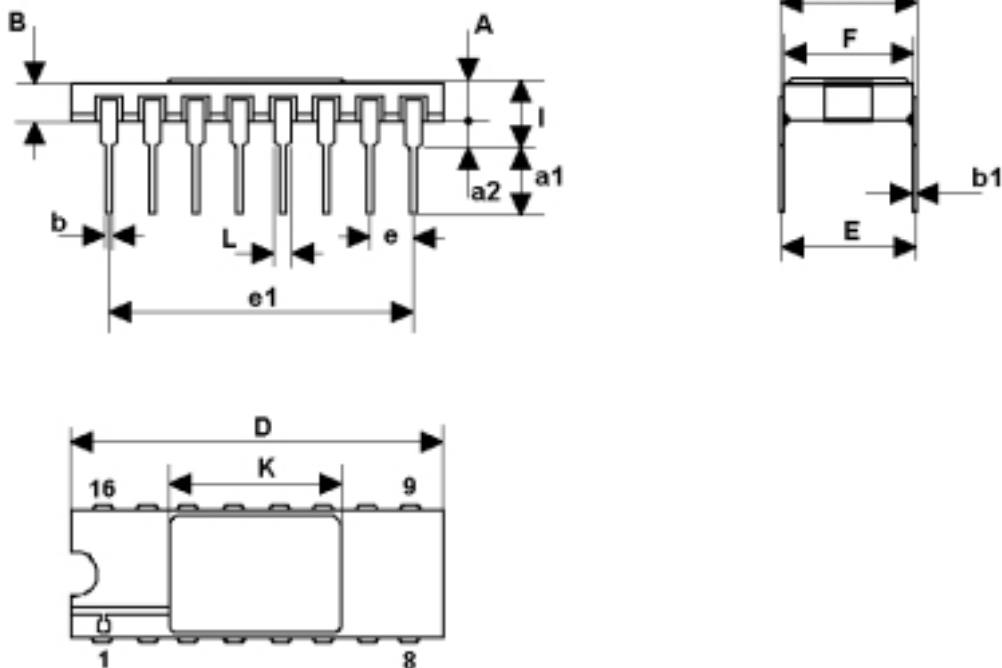
Figure 8:  $I_{CC}$  (Opr.)





## DILC-16 MECHANICAL DATA

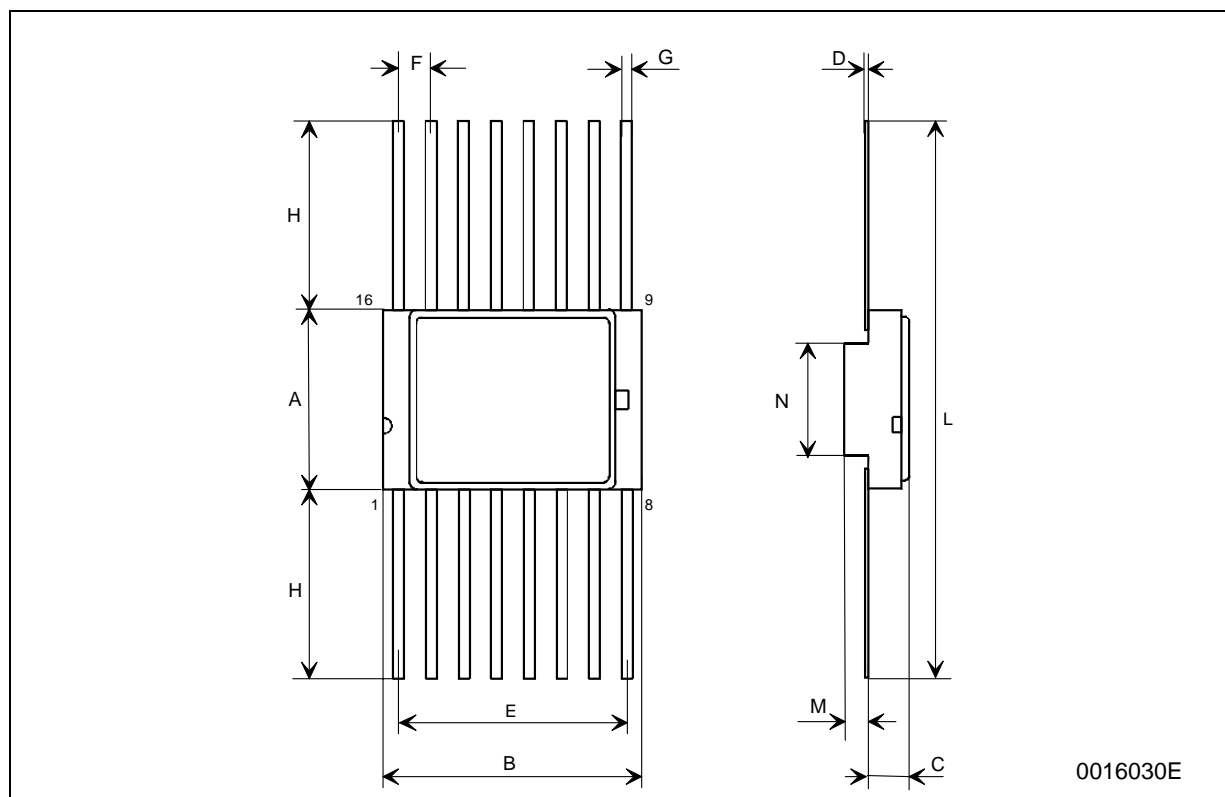
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
E	7.36	7.62	7.87	0.290	0.300	0.310
e		2.54			0.100	
e1	17.65	17.78	17.90	0.695	0.700	0.705
e2	7.62	7.87	8.12	0.300	0.310	0.320
F	7.29	7.49	7.70	0.287	0.295	0.303
I			3.83			0.151
K	10.90		12.1	0.429		0.476
L	1.14		1.5	0.045		0.059



0056437F

## FPC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	6.75	6.91	7.06	0.266	0.272	0.278
B	9.76	9.94	10.14	0.384	0.392	0.399
C	1.49		1.95	0.059		0.077
D	0.102	0.127	0.152	0.004	0.005	0.006
E	8.76	8.89	9.01	0.345	0.350	0.355
F		1.27			0.050	
G	0.38	0.43	0.48	0.015	0.017	0.019
H	6.0			0.237		
L	18.75		22.0	0.738		0.867
M	0.33	0.38	0.43	0.013	0.015	0.017
N		4.31			0.170	



0016030E

**Table 9: Revision History**

Date	Revision	Description of Changes
14-May-2004	1	First Release

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