

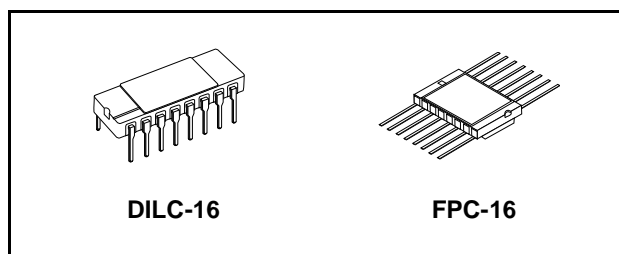
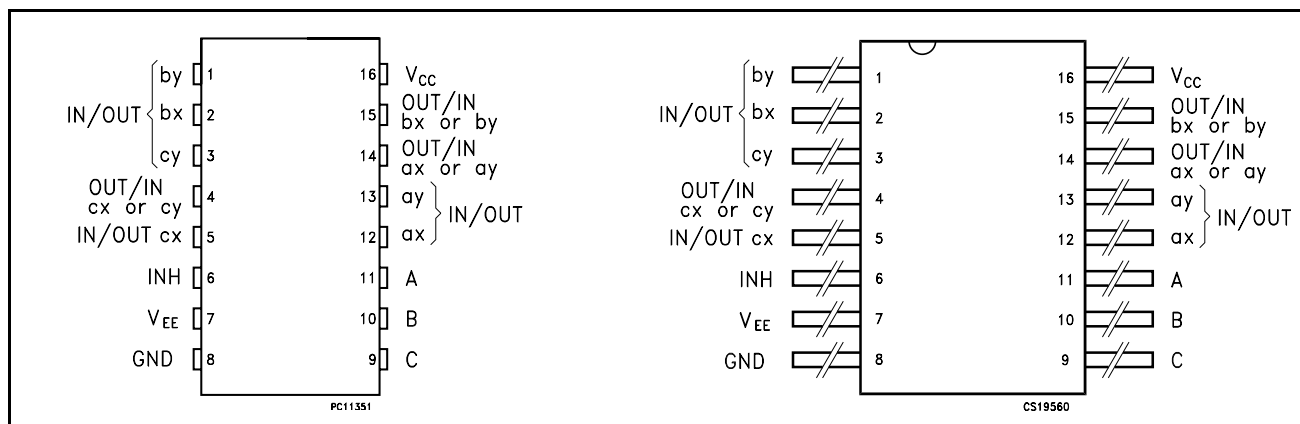
RAD-HARD TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- 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:
 70Ω TYP. ($V_{CC} - V_{EE} = 4.5\text{V}$)
 50Ω 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 ($V_{CC} - V_{EE}$) = $2\text{V TO } 12\text{V}$
- 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 4053
- 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-9408-065

DESCRIPTION

The M54HC4053 is a triple two-channel analog MULTIPLEXER/DEMULTIPLEXER fabricated

PIN CONNECTION



ORDER CODES

PACKAGE	FM	EM
DILC	M54HC4053D	M54HC4053D1
FPC	M54HC4053K	M54HC4053K1

with silicon gate C²MOS technology and it is pin to pin compatible with the equivalent metal gate CMOS4000B series.

It contains 6 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 high. For operation as a digital multiplexer/demultiplexer, V_{EE} is connected to GND.

A, B and C control inputs select one of a pair of channels.

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

Figure 1: IEC Logic Symbols

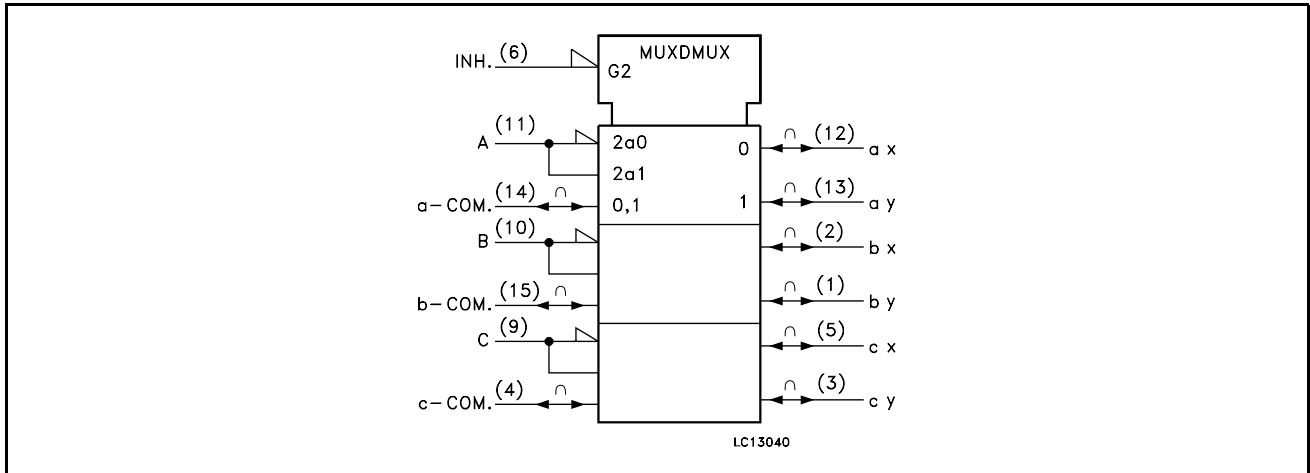


Figure 2: Control Input Equivalent Circuit

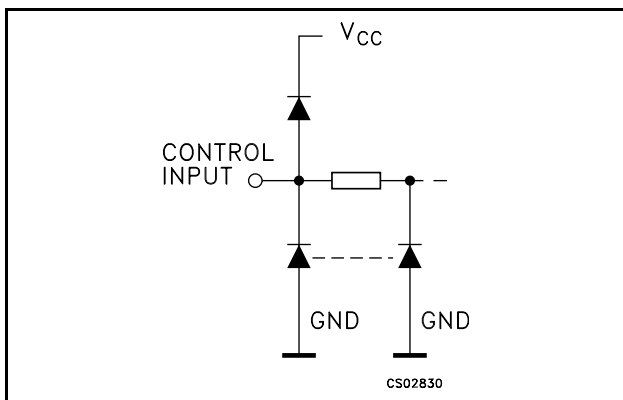


Figure 3: I/O Equivalent Circuit

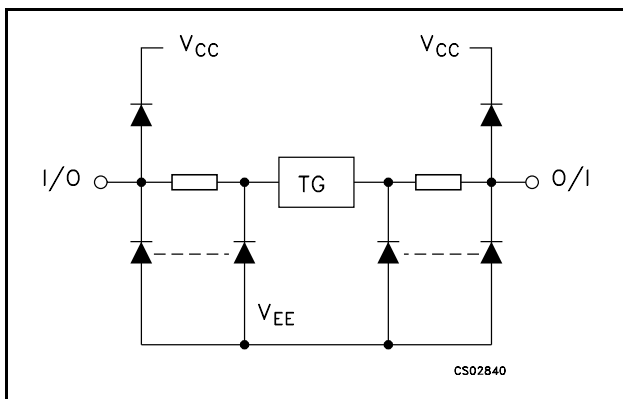


Table 1: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
2, 1	bx, by	Independent Input Outputs
5, 3	cx, cy	Independent Input Outputs
6	INH	INHIBIT Input
7	V _{EE}	Negative Supply Voltage
11, 10, 9	A, B, C	Select Inputs
12, 13	ax, ay	Independent Input Outputs
14, 15, 4	ax to cy	Common Output/Input
8	GND	Ground (0V)
16	V _{CC}	Positive Supply Voltage

Table 2: Truth Table

INPUT STATE		ON CHANNEL
INH	A or B or C	
L	L	ax or bx or cx
L	H	ay or by or cy
H	X	NONE

X: Don't care

Figure 4: Functional Diagram

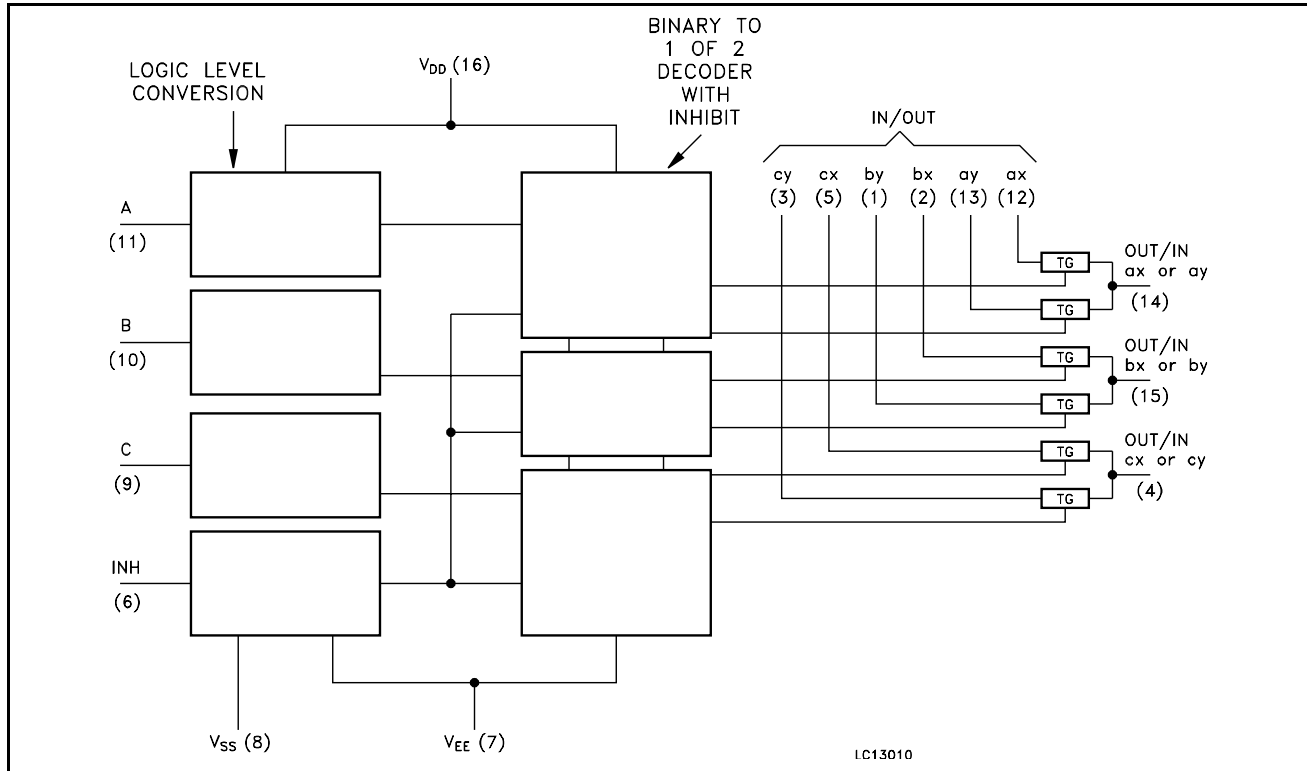


Table 3: Absolute Maximum Ratings

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	± 20	mA
$I_{I/O}$	I/O Diode Current	± 20	mA
I_T	Switch Through Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	300	mW
T_{stg}	Storage Temperature	-65 to +150	$^{\circ}\text{C}$
T_L	Lead Temperature (10 sec)	265	$^{\circ}\text{C}$

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
		$V_{CC} = 4.5V$	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 to $85^\circ C$		-55 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	$V_I = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O} \leq 2mA$	85	180		225		270	Ω
		4.5	-4.5		55	120		150		180	
		6.0	-6.0		50	100		125		150	
		2.0	GND	150							
		4.5	GND	70	150		190		230		
		4.5	-4.5	50	100		125		150		
ΔR_{ON}	Difference of ON Resistance between switches	4.5	GND	$V_I = V_{IHC}$ or V_{ILC} $V_{I/O} = V_{CC}$ or V_{EE} $I_{I/O} \leq 2mA$	10	30		35		45	Ω
		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	$V_{OS} = V_{CC}$ or GND $V_{IS} = GND$ or V_{CC} $V_I = V_{ILC}$ or V_{IHC}		± 0.06		± 0.6		± 1.2	μA
		6.0	-6.0			± 0.1		± 1		± 2	
I_{IZ}	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	$V_{OS} = V_{CC}$ or GND $V_I = V_{IHC}$ or V_{ILC}		± 0.06		± 0.6		± 1.2	μA
		6.0	-6.0			± 0.1		± 1		± 2	
I_I	Input Leakage Current	6.0	GND	$V_I = V_{CC}$ or GND		± 0.1		± 0.1		± 1	μA
I_{CC}	Quiescent Supply Current	6.0	GND	$V_I = V_{CC}$ or GND		4		40		80	μA
		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°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
Φ _{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 = 1KΩ		50	225		280		340	ns
		4.5	GND			14	45		56		68	
		6.0	GND			12	38		48		58	
		4.5	-4.5			14						
t _{PLZ} t _{PHZ}	Output Disable Time	2.0	GND	R _L = 1KΩ		95	225		280		340	ns
		4.5	GND			30	45		56		68	
		6.0	GND			26	38		48		58	
		4.5	-4.5			26						

Table 7: Capacitive Characteristics

Symbol	Parameter	Test Condition			Value						Unit	
		V _{CC} (V)	V _{EE} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°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			11	20		20		20	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			0.75	2		2		2	pF
C _{PD}	Power Dissipation Capacitance (note 1)	5.0	GND			67						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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

Table 8: Analog Switch Characteristics (GND = 0V; T_A = 25°C)

Symbol	Parameter	Test Condition			Value	Unit	
		V _{CC} (V)	V _{EE} (V)	V _{IN} (V _{p-p})			
	Sine Wave Distortion	2.25	-2.25	4	0.025	% rowspan="3">f _{IN} = 1 KHz R _L = 10 KΩ, C _L = 50 pF	
		4.5	-4.5	8			0.020
		6.0	-6.0	11			0.018
f _{MAX}	Frequency Response (Switch ON) (*)	2.25	-2.25	Adjust f _{IN} voltage to obtain 0 dBm at V _{OS} . Increase f _{IN} Frequency until dB meter reads -3dB R _L = 50Ω, C _L = 10 pF, f _{IN} = 1KHz sine wave	120	MHz	
		4.5	-4.5		190		
		6.0	-6.0		200		
f _{MAX}	Frequency Response (Switch ON) (**)	2.25	-2.25	Adjust f _{IN} voltage to obtain 0 dBm at V _{OS} . Increase f _{IN} Frequency until dB meter reads -3dB R _L = 50Ω, C _L = 10 pF, f _{IN} = 1KHz sine wave	95	MHz	
		4.5	-4.5		150		
		6.0	-6.0		190		
	Feed through Attenuation (Switch OFF)	2.25	-2.25	V _{IN} is centered at (V _{CC} - V _{EE})/2 Adjust input for 0 dBm R _L = 600Ω, C _L = 50 pF, f _{IN} = 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 _L at set up so that I _S = 0A. R _L = 600Ω, C _L = 50 pF, f _{IN} = 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 _{IN} to obtain 0dBm at input R _L = 600Ω, C _L = 50 pF, f _{IN} = 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

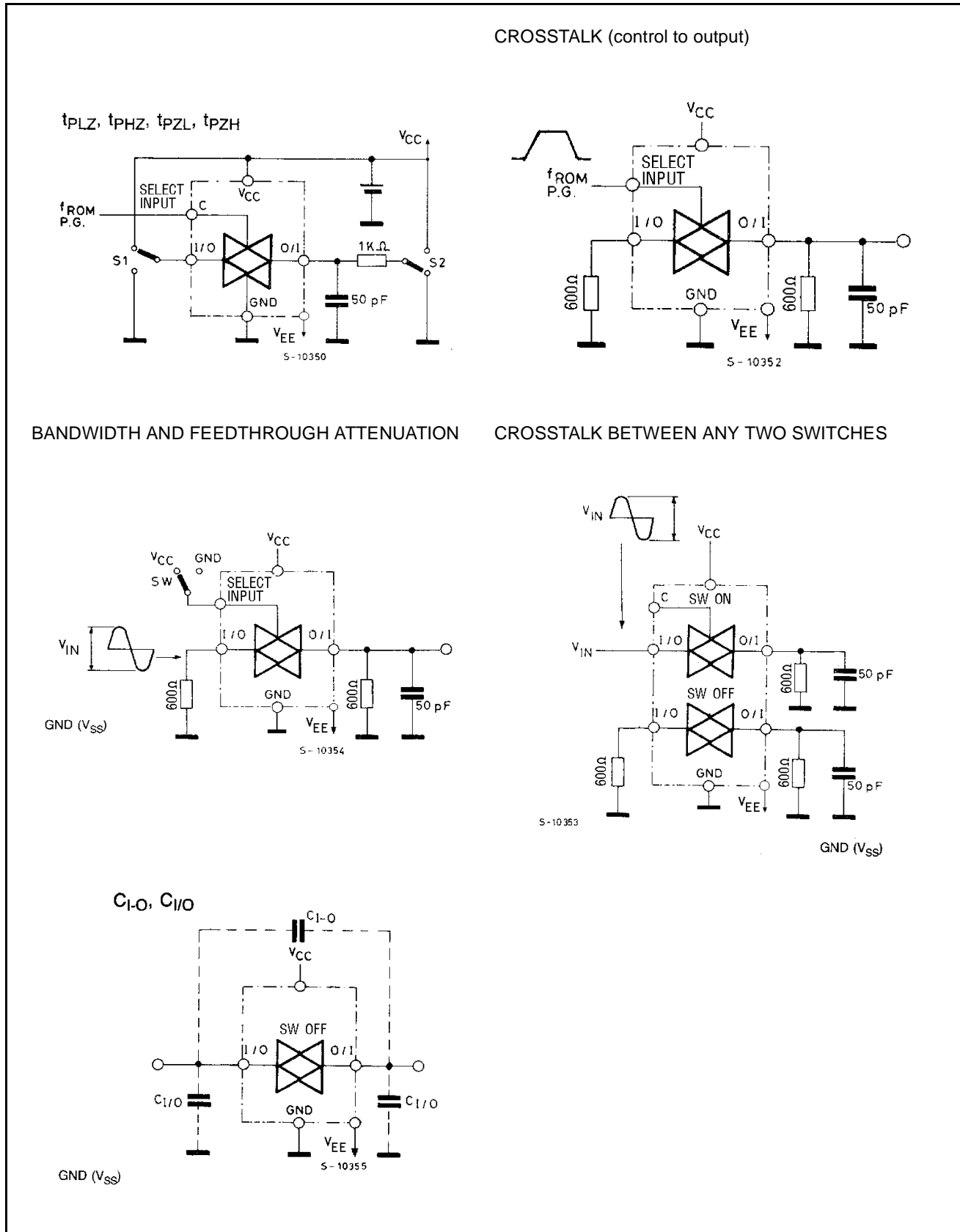


Figure 6: Switching Characteristics Waveform

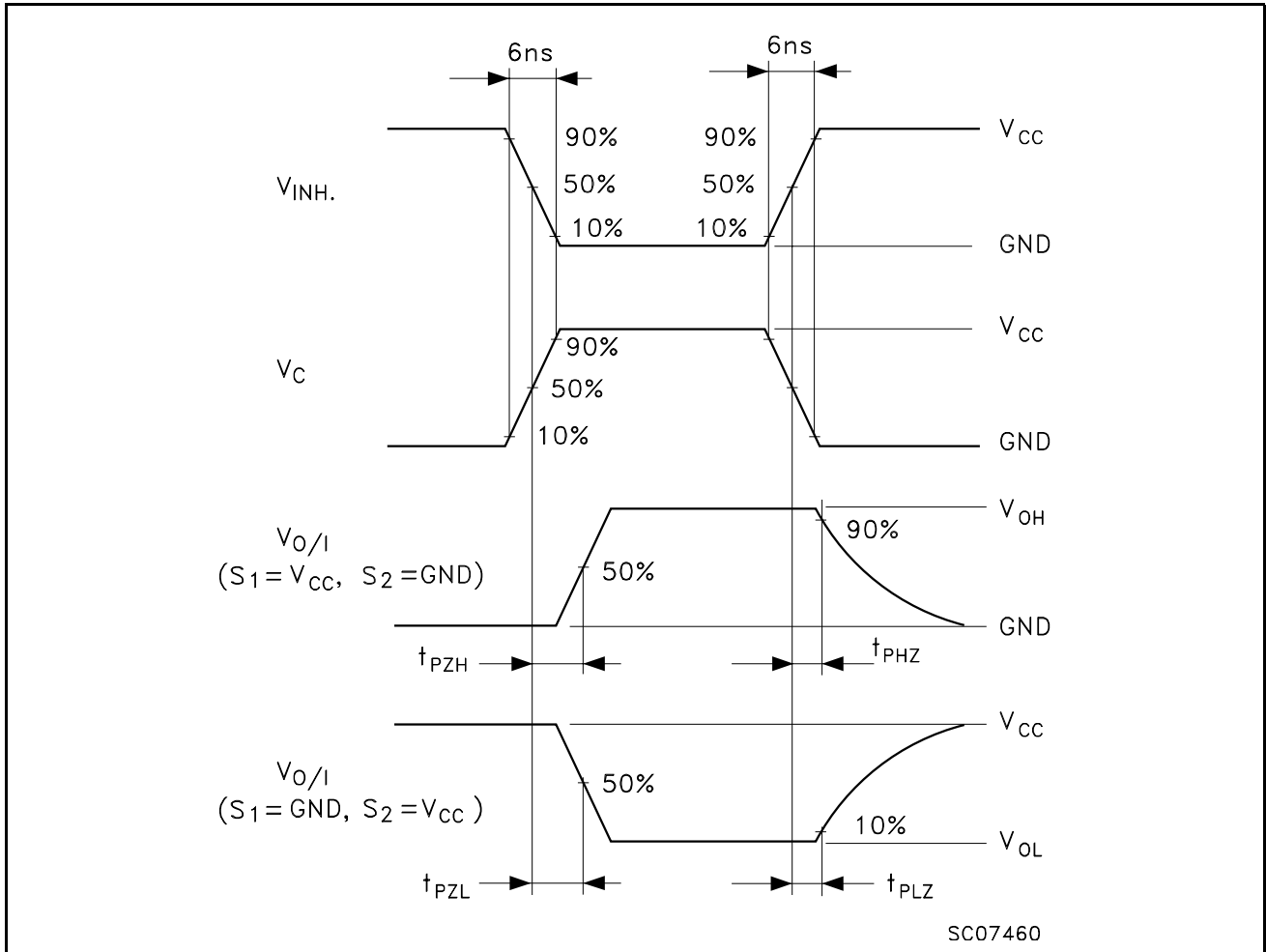


Figure 7: Channel Resistance (R_{ON})

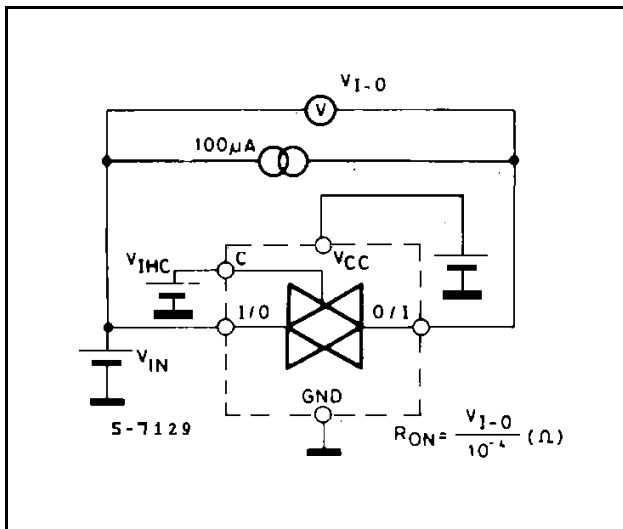
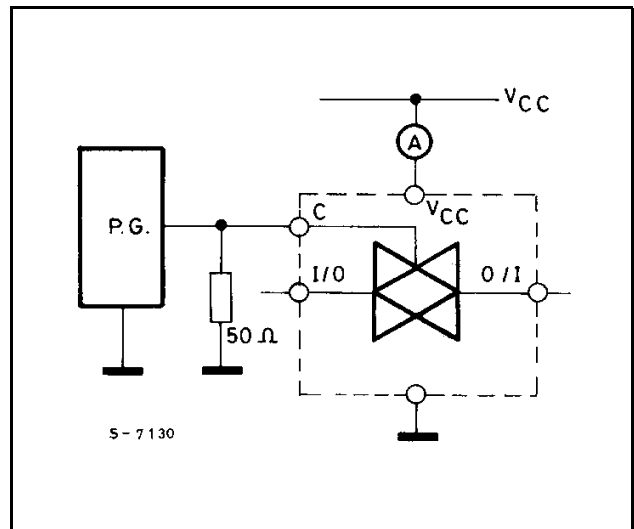
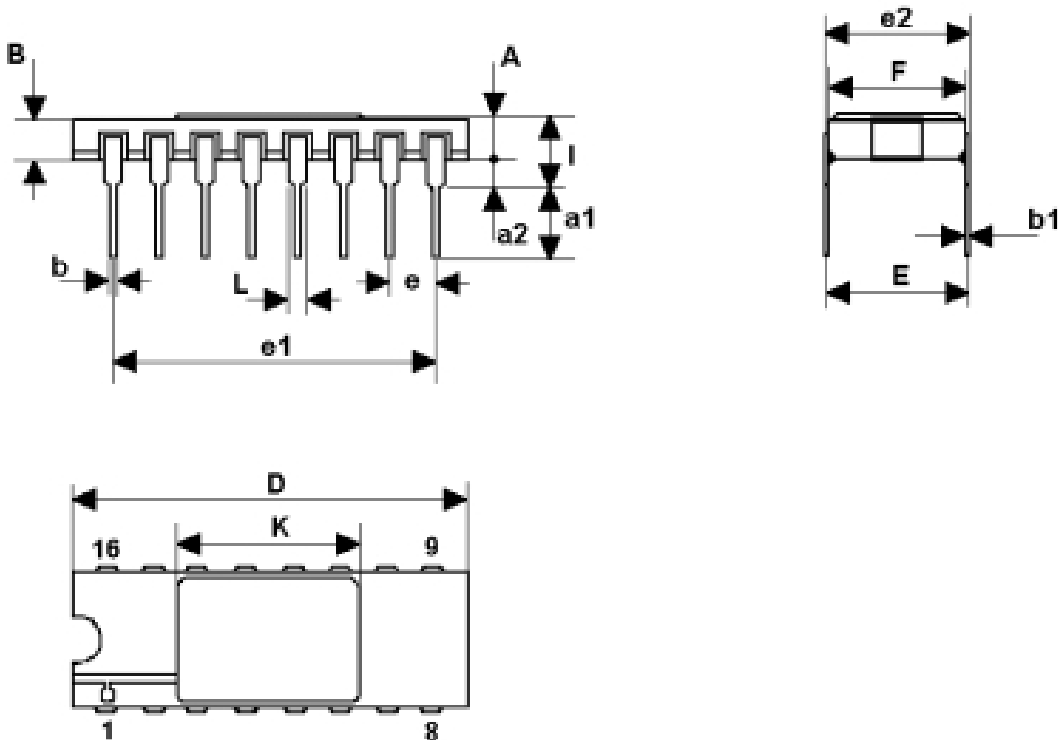


Figure 8: I_{CC} (Opr.)



DILC-16 MECHANICAL DATA

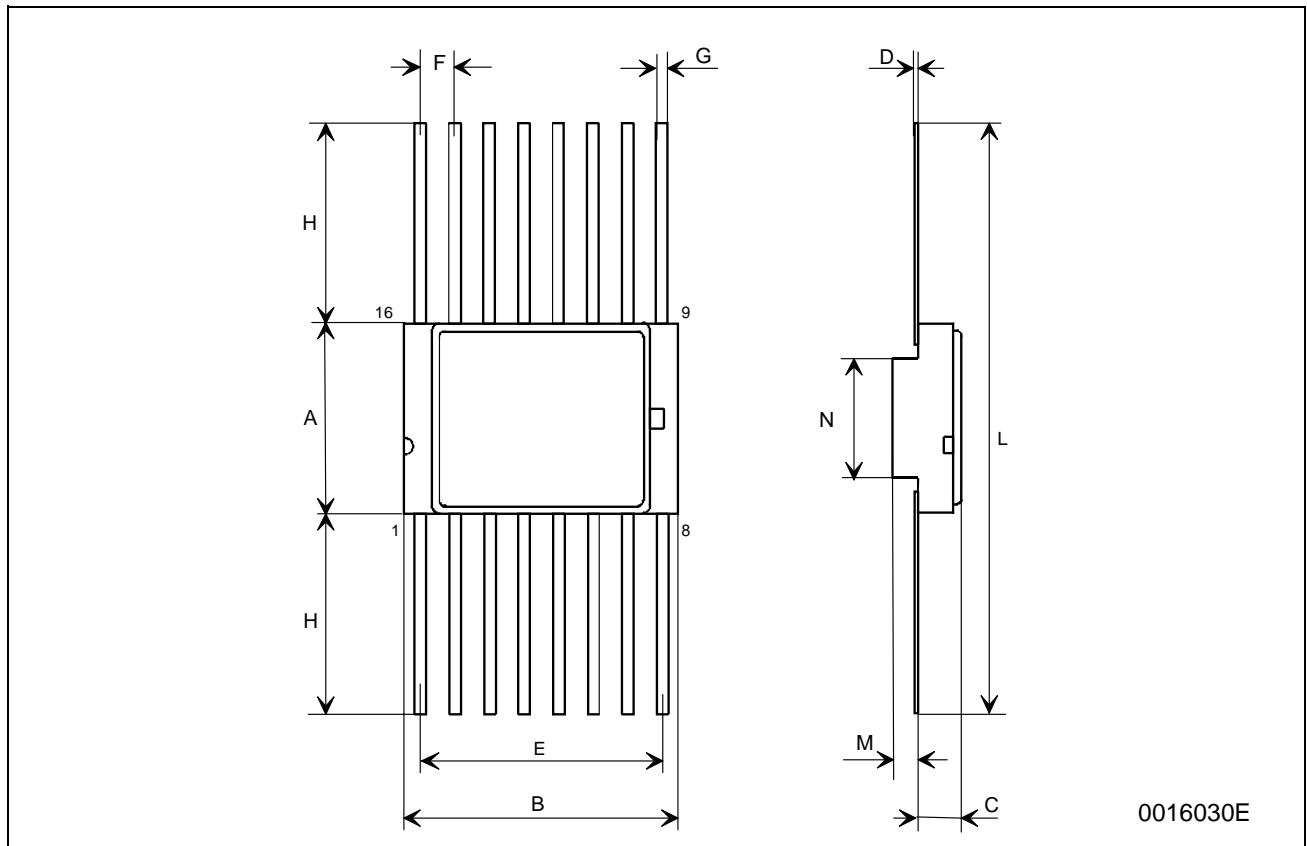
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
E	7.36	7.62	7.87	0.290	0.300	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
15-May-2004	1	First Release

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