



# MUX-08/MUX-24

## 8-CHANNEL/DUAL 4-CHANNEL JFET ANALOG MULTIPLEXERS (OVERVOLTAGE AND POWER SUPPLY LOSS PROTECTED)

Precision Monolithics Inc.

### FEATURES

- JFET Switches Rather Than CMOS
- Low "ON" Resistance ..... 220Ω Typ
- Highly Resistant to Static Discharge Damage
- No SCR Latch-Up Problems
- Digital Inputs Compatible With TTL and CMOS
- 125° C Temperature Tested Dice Available
- MUX-08 Pin Compatible With DG508, HI-508A, IH5108, IH6108, LF11508/12508/13508, AD7506
- MUX-24 Pin Compatible With DG509, HI-509A, IH5208, IH6208, LF11509/12509/13509, AD7507
- Available in Surface Mount Packages
- Available in Die Form

### ORDERING INFORMATION †

25°C ON RESISTANCE	PACKAGE				OPERATING TEMPERATURE RANGE
	CERDIP 16-PIN	PLASTIC 16-PIN	LCC 20-CONTACT		
220Ω	MUX08AQ*	—	—	MIL	
	MUX08EQ	—	—	IND	
	—	MUX08EP	—	COM	
300Ω	MUX08BQ*	—	MUX08BRC/883	MIL	
	MUX08FQ	—	—	IND	
	—	MUX08FP	—	XIND	
—	—	MUX08FS††	—	XIND	
220Ω	MUX24AQ*	—	—	ML	
	MUX24EQ	—	—	IND	
	—	MUX24EP	—	COM	
300Ω	MUX24BQ*	—	—	ML	
	MUX24FQ	—	—	IND	
	—	MUX24FP	—	XIND	
—	—	MUX24FS††	—	XIND	

\* For devices processed in total compliance to MIL-STD-883, add /883 after part number. Consult factory for 883 data sheet.

† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages. For ordering information, see PMI's Data Book, Section 2.

†† For availability and burn-in information on SO and PLCC packages, contact your local sales office.

### GENERAL DESCRIPTION

The MUX-08 is a monolithic eight-channel analog multiplexer which connects a single output to one of the eight analog inputs depending upon the state of a 3-bit binary address.

The MUX-24 is a monolithic four-channel differential analog multiplexer configured in a double pole, four-position (plus OFF) electronic switch array. A two-bit binary input address connects a pair of independent analog inputs from each four-channel input section to the corresponding pair of independent analog outputs.

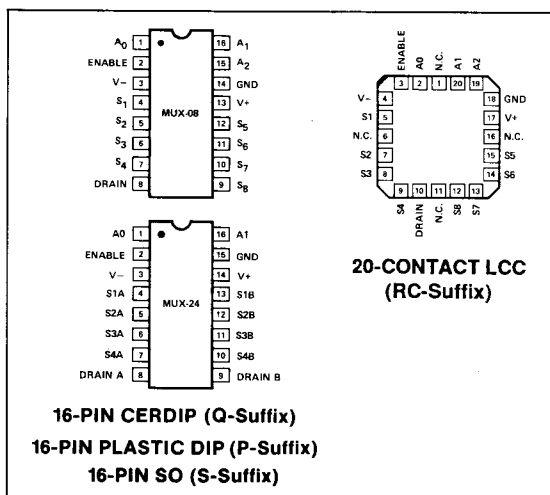
All switches in the MUX-08/MUX-24 are turned OFF by applying logic "0" to the ENABLE pin, thereby providing a package select function.

Fabricated with Precision Monolithics' high performance Bipolar-JFET technology, these devices offer low, constant "ON" resistance, low leakage currents and fast settling time

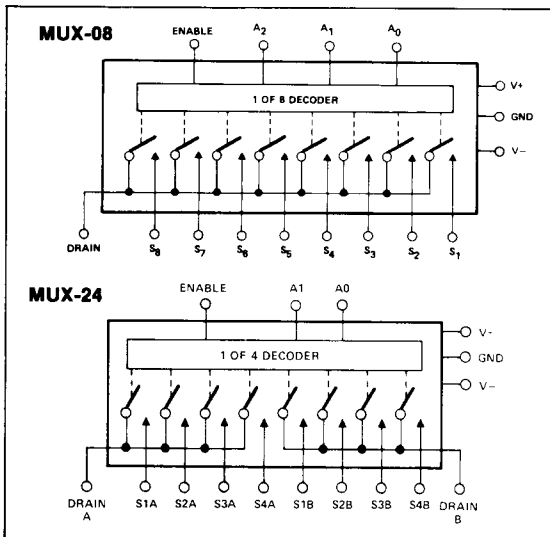
with low crosstalk to satisfy a wide variety of applications. These multiplexers do not suffer from latch-up or static charge blow-out problems associated with similar CMOS parts. The digital inputs are designed to operate from both TTL and CMOS levels while always providing a definite break-before-make action without the need for external pull-up resistors over the full operating temperature range.

For single sixteen-channel and dual eight-channel models, refer to the MUX-16/MUX-28 data sheet.

### PIN CONNECTIONS



### FUNCTIONAL DIAGRAMS



**ABSOLUTE MAXIMUM RATINGS (Note 1)**

Operating Temperature Range	
MUX-08/24-AQ, BQ, BRC	-55°C to +125°C
MUX-02/24-EQ, FQ	-25°C to +85°C
MUX-08/24-EP	0°C to +70°C
MUX-08/24-FP, FS	-40°C to +85°C
Junction Temperature (T <sub>J</sub> )	-65°C to +150°C
Storage Temperature Range	-65°C to +150°C
P-Suffix	-65°C to +125°C
Lead Temperature (Soldering, 60 sec)	300°C
Maximum Junction Temperature	150°C
V+ Supply to V- Supply	36V
Logic Input Voltage	(-4V or V-) to V+ Supply

Analog Input Voltage ..... V- Supply -20V to V+ Supply +20V  
 Maximum Current Through Any Pin ..... 25mA

PACKAGE TYPE	$\theta_{JA}$ (Note 2)	$\theta_{JC}$	UNITS
16-Pin Hermetic DIP (Q)	100	16	°C/W
16-Pin Plastic DIP (P)	82	39	°C/W
20-Contact LCC (RC)	98	36	°C/W
16-Pin SO (S)	111	35	°C/W

**NOTES:**

- Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.
- $\theta_{JA}$  is specified for worst case mounting conditions, i.e.,  $\theta_{JA}$  is specified for device in socket for CerDIP, P-DIP, and LCC packages;  $\theta_{JA}$  is specified for device soldered to printed circuit board for SO package.

**ELECTRICAL CHARACTERISTICS at V+ = +15V, V- = -15V and T<sub>A</sub> = 25°C, unless otherwise noted.**

PARAMETER	SYMBOL	CONDITIONS	MUX-08A/E MUX-24A/E			MUX-08B/F MUX-24B/F			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
"ON" Resistance	R <sub>ON</sub>	V <sub>S</sub> ≤ 10V, I <sub>S</sub> ≤ 200μA	—	220	300	—	300	400	Ω	
ΔR <sub>ON</sub> With Applied Voltage	ΔR <sub>ON</sub>	-10V ≤ V <sub>S</sub> ≤ 10V, I <sub>S</sub> = 200μA	—	1	5	—	3	7	%	
R <sub>ON</sub> Match Between Switches	R <sub>ON</sub> Match	V <sub>S</sub> = 0V, I <sub>S</sub> = 200μA	—	7	15	—	9	20	%	
Analog Voltage Range	V <sub>A</sub>	(Note 6)	+10	+10.4	—	+10	+10.4	—	V	
Source Current (Switch "OFF")	I <sub>S(OFF)</sub>	V <sub>S</sub> = 10V, V <sub>D</sub> = -10V (Note 1)	—	0.01	1.0	—	0.01	2.0	nA	
Drain Current (Switch "OFF")	I <sub>D(OFF)</sub>	V <sub>S</sub> = 10V, V <sub>D</sub> = -10V (Note 1)	MUX-08 MUX-24	—	0.1 0.05	1.0 1.0	—	0.1 0.05	2.0 2.0	nA
Leakage Current (Switch "ON")	I <sub>D(ON)</sub> + I <sub>S(ON)</sub>	V <sub>D</sub> = 10V (Note 1)	MUX-08 MUX-24	—	0.1 0.05	1.0 1.0	—	0.1 0.05	2.0 2.0	nA
Digital Input Current	I <sub>IN</sub>	V <sub>IN</sub> = 0.4V to 15V	—	1	10	—	1	10	μA	
Digital "0" Enable Current	I <sub>INL(EN)</sub>	V <sub>EN</sub> = 0.4V	—	4	10	—	4	10	μA	
Digital Input Capacitance	C <sub>DIG</sub>		—	3	—	—	3	—	pF	
Switching Time (t <sub>TRAN</sub> )	t <sub>PHL</sub> t <sub>PLH</sub>	(Notes 2, 5) Figure 1 (Test Circuit)	—	1.5 1.0	2.1 1.3	—	1.5 1.0	2.1 1.3	μs	
Output Settling Time	t <sub>S</sub>	10V Step to 0.10% 10V Step to 0.05% 10V Step to 0.02%	—	2.2 2.7 3.4	— — —	—	2.2 2.7 3.4	— — —	μs	
Break-Before-Make Delay	t <sub>OPEN</sub>	Figure 3 (Test Circuit)	—	0.8	—	—	1.0	—	μs	
Enable Delay "ON"	t <sub>ON(EN)</sub>	(Note 5) Figure 2 (Test Circuit)	—	1	2	—	1	2	μs	
Enable Delay "OFF"	t <sub>OFF(EN)</sub>	(Note 5) Figure 2 (Test Circuit)	MUX-08 MUX-24	—	0.1 0.2	0.4 0.5	—	0.2 0.3	0.4 0.6	μs
"OFF" Isolation	ISO <sub>OFF</sub>	(Note 4) Figure 5 (Test Circuit)	MUX-08 MUX-24	—	60 66	— —	—	60 66	— —	dB
Crosstalk	CT	(Note 3) Figure 4 (Test Circuit)	MUX-08 MUX-24	—	70 76	— —	—	70 76	— —	dB
Source Capacitance	C <sub>S(OFF)</sub>	Switch "OFF", V <sub>S</sub> = 0V, V <sub>D</sub> = 0V	MUX-08 MUX-24	—	2.5 2	— —	—	2.5 2	— —	pF
Drain Capacitance	C <sub>D(OFF)</sub>	Switch "OFF", V <sub>S</sub> = 0V, V <sub>D</sub> = 0V	MUX-08 MUX-24	—	7 4	— —	—	7 4	— —	pF
Input to Output Capacitance	C <sub>DS(OFF)</sub>	(Note 4)	MUX-08 MUX-24	—	0.3 0.15	— —	—	0.3 0.15	— —	pF
Positive Supply Current (All Digital Inputs Logic "0" or "1")	I <sub>+</sub>	V <sub>+</sub> = 15V V <sub>+</sub> = 5V	—	10 8	12 —	—	6 5	12 —	mA	
Negative Supply Current (All Digital Inputs Logic "0" or "1")	I <sub>-</sub>	V <sub>+</sub> = -15V V <sub>+</sub> = -5V	—	3.0 2.5	3.8 —	—	2.0 1.8	3.8 —	mA	

**ELECTRICAL CHARACTERISTICS** at  $V_+ = 15V$ ,  $V_- = -15V$  and  $-55^\circ C \leq T_A \leq 125^\circ C$ , unless otherwise noted.

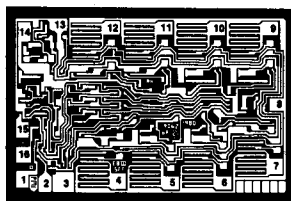
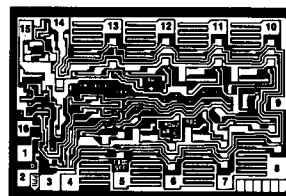
PARAMETER	SYMBOL	CONDITIONS	MUX-08A/ MUX-24A			MUX-08B/ MUX-24B			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
"ON" Resistance	$R_{ON}$	$V_S \leq 10V$ , $I_S \leq 200\mu A$	—	—	400	—	—	500	$\Omega$
$\Delta R_{ON}$ With Applied Voltage	$\Delta R_{ON}$	$-10V \leq V_S \leq 10V$ , $I_S = 200\mu A$	—	1.5	—	—	4.5	—	%
$R_{ON}$ Match Between Switches	$R_{ON}$ Match	$V_S = 0V$ , $I_S = 200\mu A$	—	10	—	—	15	—	%
Analog Voltage Range	$V_A$	(Note 6)	+10	+10.4	—	+10	+10.4	—	V
Source Current (Switch "OFF")	$I_{S(OFF)}$	$V_S = 10V$ , $V_D = -10V$ (Notes 1, 7)	—	—	25	—	—	50	nA
Drain Current (Switch "OFF")	$I_{D(OFF)}$	$V_S = 10V$ , $V_D = -10V$ (Notes 1, 7)	MUX-08	—	100	—	—	500	nA
			MUX-24	—	50	—	—	500	nA
Leakage Current (Switch "ON")	$I_{D(ON)}$ $+I_{S(ON)}$	$V_D = 10V$ (Notes 1, 7)	MUX-08	—	100	—	—	500	nA
			MUX-24	—	50	—	—	500	nA
Digital "1" Input Voltage	$V_{INH}$	(Note 6)	—	2	—	—	2	—	V
Digital "0" Input Voltage	$V_{INL}$	(Note 6)	—	—	0.7	—	—	0.7	V
Digital Input Current	$I_{IN}$	$V_{IN} = 0.4V$ to $15V$	—	—	20	—	—	20	$\mu A$
Digital "0" Enable Current	$I_{INL(EN)}$	$V_{EN} = 0.4V$	—	—	20	—	—	20	$\mu A$
Positive Supply Current	I+	All Digital Inputs Logic "0" or "1"	—	—	15	—	—	15	mA
Negative Supply Current	I-	All Digital Inputs Logic "0" or "1"	—	—	5	—	—	5	mA

**ELECTRICAL CHARACTERISTICS** at  $V_+ = 15V$ ,  $V_- = -15V$  and  $-25^\circ C \leq T_A \leq 85^\circ C$  for MUX-08EQ/FQ and MUX-24EQ/FQ;  $0^\circ C \leq T_A \leq +70^\circ C$  for MUX-08EP and MUX-24EP;  $-40^\circ C \leq T_A \leq +85^\circ C$  for MUX-08FP/FS and MUX-24FP/FS, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	MUX-08E/ MUX-24E			MUX-08F/ MUX-24F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
"ON" Resistance	$R_{ON}$	$V_S \leq 10V$ , $I_S \leq 200\mu A$	—	—	400	—	—	500	$\Omega$
$\Delta R_{ON}$ With Applied Voltage	$\Delta R_{ON}$	$-10V \leq V_S \leq 10V$ , $I_S = 200\mu A$	—	1.5	—	—	4.5	—	%
$R_{ON}$ Match Between Switches	$R_{ON}$ Match	$V_S = 0V$ , $I_S = 200\mu A$	—	10	—	—	15	—	%
Analog Voltage Range	$V_A$	(Note 6)	+10	+10.4	—	+10	+10.4	—	V
Source Current (Switch "OFF")	$I_{S(OFF)}$	$V_S = 10V$ , $V_D = -10V$ (Notes 1, 7)	—	—	10	—	—	10	nA
Drain Current (Switch "OFF")	$I_{D(OFF)}$	$V_S = 10V$ , $V_D = -10V$ (Notes 1, 7)	MUX-08	—	100	—	—	100	nA
			MUX-24	—	50	—	—	50	nA
Leakage Current (Switch "ON")	$I_{D(ON)}$ $+I_{S(ON)}$	$V_D = 10V$ (Notes 1, 7)	MUX-08	—	100	—	—	100	nA
			MUX-24	—	50	—	—	50	nA
Digital "1" Input Voltage	$V_{INH}$	(Note 6)	—	2	—	—	2	—	V
Digital "0" Input Voltage	$V_{INL}$	(Note 6)	—	—	0.8	—	—	0.8	V
Digital Input Current	$I_{IN}$	$V_{IN} = 0.4V$ to $15V$	—	—	20	—	—	20	$\mu A$
Digital "0" Enable Current	$I_{INL(EN)}$	$V_{EN} = 0.4V$	—	—	20	—	—	20	$\mu A$
Positive Supply Current	I+	All Digital Inputs Logic "0" or "1"	—	—	15	—	—	15	mA
Negative Supply Current	I-	All Digital Inputs Logic "0" or "1"	—	—	5	—	—	5	mA

**NOTES:**

- Conditions applied to leakage tests insure worst case leakages. Exceeding 11V on the analog input may cause an "OFF" channel to turn "ON".
- $R_L = 10M\Omega$ ,  $C_L = 10pF$ .
- Crosstalk is measured by driving channel 8 with channel 4 "ON".  
 $R_L = 1M\Omega$ ,  $C_L = 10pF$ ,  $V_S = 5V$  RMS,  $f = 500kHz$ .
- "OFF" isolation is measured by driving channel 8 with ALL channels "OFF".  
 $R_L = 1k\Omega$ ,  $C_L = 10pF$ ,  $V_S = 5V$  RMS,  $f = 500kHz$ .  $C_{DS}$  is computed from the OFF isolation measurement.
- Sample tested.
- Guaranteed by leakage current and  $R_{ON}$  tests.
- Leakage tests are performed only on military temperature grades at  $125^\circ C$ .

**DICE CHARACTERISTICS (125°C TESTED DICE AVAILABLE)**

**MUX-08**
**MUX-24**

**DIE SIZE 0.093 × 0.059 inch, 5487 sq. mils  
(2.362 × 1.500 mm, 3543 sq. mm)**

- |                   |         |
|-------------------|---------|
| 1. A0             | 9. S8   |
| 2. ENABLE         | 10. S7  |
| 3. V- (SUBSTRATE) | 11. S6  |
| 4. S1             | 12. S5  |
| 5. S2             | 13. V+  |
| 6. S3             | 14. GND |
| 7. S4             | 15. A2  |
| 8. DRAIN          | 16. A1  |

- |                   |            |
|-------------------|------------|
| 1. A0             | 9. DRAIN B |
| 2. ENABLE         | 10. S4 B   |
| 3. V- (SUBSTRATE) | 11. S3 B   |
| 4. S1 A           | 12. S2 B   |
| 5. S2 A           | 13. S1 B   |
| 6. S3 A           | 14. V+     |
| 7. S4 A           | 15. GND    |
| 8. DRAIN A        | 16. A1     |

For additional DICE ordering information,  
refer to 1990/91 Data Book, Section 2.

**WAFER TEST LIMITS** at  $V_+ = 15V$ ,  $V_- = -15V$ ,  $T_A = 25^\circ C$ , unless otherwise noted. (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MUX-08/ MUX-24NT LIMIT	MUX-08/ MUX-24N LIMIT	MUX-08/ MUX-24G LIMIT	UNITS
"ON" Resistance	$R_{ON}$	$V_S = 0V$ , $I_S = 200\mu A$ , $T_A = 125^\circ C$	300 400	300 —	400 —	$\Omega$ MAX
Digital "1" Input Voltage	$V_{INH}$	(Note 2)	2	2	2	V MIN
Digital "0" Input Voltage	$V_{INL}$	(Note 2)	0.8	0.8	0.8	V MAX
Digital "0" Input Current	$I_{INL}$	$V_{IN} = 0.4V$ , $T_A = 125^\circ C$	10 20	10 —	10 —	$\mu A$ MAX
Digital "0" Enable Current	$I_{INL(EN)}$	$V_{IN} = 0.4V$ , $T_A = 125^\circ C$	10 20	10 —	10 —	$\mu A$ MAX
Positive Supply Current (All Digital Inputs Logic "0")	$I_+$	$T_A = 125^\circ C$	12 15	12 —	12 —	mA MAX
Negative Supply Current (All Digital Inputs Logic "0")	$I_-$	$T_A = 125^\circ C$	3.8 5	3.8 —	3.8 —	mA MAX
Analog Input Range	$V_A$	(Note 2)	$\pm 10$	$\pm 10$	$\pm 10$	V MIN

**NOTE:**

Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualification through sample lot assembly and testing.

**TYPICAL ELECTRICAL CHARACTERISTICS** at  $V_+ = 15V$ ,  $V_- = -15V$  and  $T_A = 25^\circ C$  for MUX-08/24N & G,  $T_A = 125^\circ C$  for MUX-08/24NT, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	MUX-08/ MUX-24NT TYPICAL	MUX-08/ MUX-24N TYPICAL	MUX-08/ MUX-24G TYPICAL	UNITS
Switching Time ( $t_{TRAN}$ )	$t_{PHL}$ $t_{PLH}$	(Note 1)	1.7 1.1	1.3 0.9	2.1 1.3	$\mu s$
Output Settling Time	$t_S$	10V Step to 0.1% (Note 1)	2.1	1.5	1.9	$\mu s$
Break-Before-Make Delay	$t_{OPEN}$	(Note 1)	0.8	0.8	1.0	$\mu s$
Crosstalk	CT	(Note 1)	70	70	70	dB
$\Delta R_{ON}$ With Applied Voltage	$\Delta R_{ON}$	$-10V \leq V_S \leq 10V$ , $I_S = 200\mu A$	2	2	6	%
Leakage Current (Switch "ON")	$I_{D(ON)}$	$V_D = 10V$ (Note 1)	20	0.5	0.5	nA
Analog Input Range	$V_A$		+10.4/-15	+10.4/-15	+10.4/-15	V

**NOTES:**

1. The data shown is extrapolated from measurements made on the packaged devices.

2. Guaranteed by leakage current and  $R_{ON}$  tests.

**MUX-08  
LOGIC STATE**

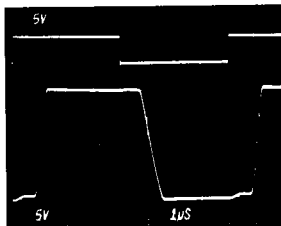
A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	EN	"ON" CHANNEL
X	X	X	L	NONE
L	L	L	H	1
L	L	H	H	2
L	H	L	H	3
L	H	H	H	4
H	L	L	H	5
H	L	H	H	6
H	H	L	H	7
H	H	H	H	8

**MUX-24  
LOGIC STATE**

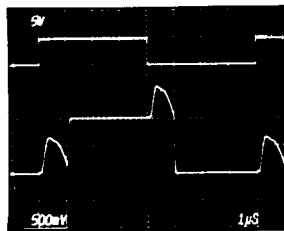
A <sub>1</sub>	A <sub>0</sub>	EN	"ON" CHANNEL
X	X	L	NONE
L	L	H	1
L	H	H	2
H	L	H	3
H	H	H	4

**TYPICAL PERFORMANCE CHARACTERISTICS (Applies to all grades, unless otherwise noted.)**
**MUX-08  
BREAK-BEFORE-MAKE  
SWITCHING**


R<sub>L</sub> = 1kΩ, C<sub>L</sub> = 10pF, V<sub>1</sub>, 8 = 10V  
VOLTAGE = 2V/DIV  
TIME = 200ns/DIV

**MUX-08  
LARGE-SIGNAL SWITCHING**


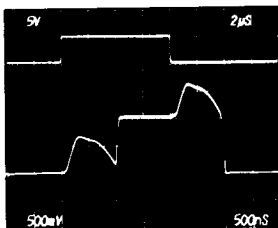
R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 10pF, V<sub>1</sub> = -10V, V<sub>8</sub> = +10V  
VOLTAGE = 5V/DIV  
TIME = 1μs/DIV

**MUX-08  
SMALL-SIGNAL SWITCHING**


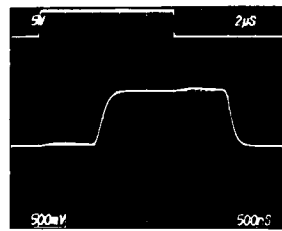
R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 10pF, V<sub>1</sub> = -500mV, V<sub>8</sub> = +500mV  
VOLTAGE = 500mV/DIV  
TIME = 1μs/DIV

**MUX-08  
SMALL-SIGNAL SWITCHING  
WITH FILTERING**


R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 500pF, V<sub>1</sub> = 500mV, V<sub>8</sub> = +500mV  
VOLTAGE = 500mV/DIV  
TIME = 1μs/DIV

**MUX-08  
SMALL-SIGNAL SWITCHING  
WITH 2μs SAMPLE TIME**


R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 10pF, V<sub>1</sub> = -500mV, V<sub>8</sub> = +500mV  
VOLTAGE = 500mV/DIV  
TIME = 500ns/DIV

**MUX-08  
SMALL-SIGNAL SWITCHING  
WITH FILTERING AND  
2.5μs SAMPLE TIME**


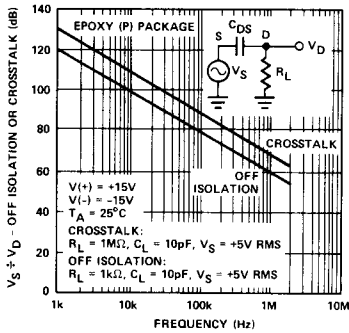
R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 500pF, V<sub>1</sub> = -500mV, V<sub>8</sub> = +500mV  
VOLTAGE = 500mV/DIV  
TIME = 500ns/DIV

**NOTE:**

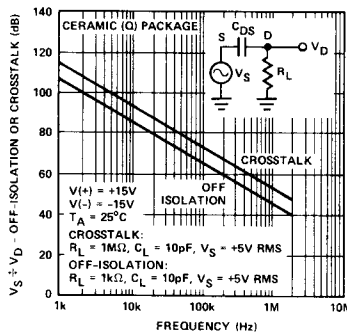
Top waveforms: Digital Input 5V/DIV  
Bottom waveforms: Multiplexer Output

TYPICAL PERFORMANCE CHARACTERISTICS (Applies to all grades, unless otherwise noted.)

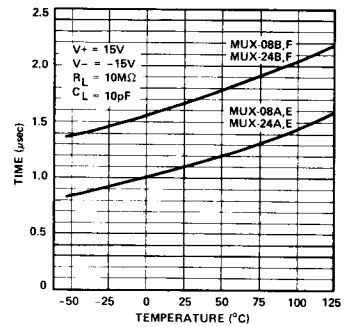
MUX-08 CROSSTALK AND OFF ISOLATION PERFORMANCE OF CHANNEL 8



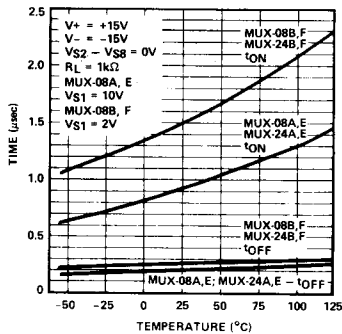
MUX-08 CROSSTALK AND OFF ISOLATION PERFORMANCE OF CHANNEL 8



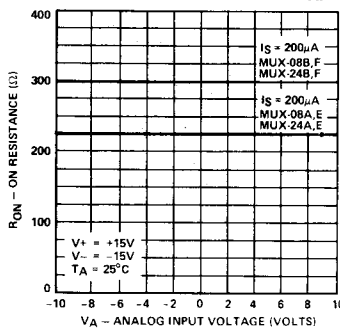
TRANSITION TIMES vs TEMPERATURE



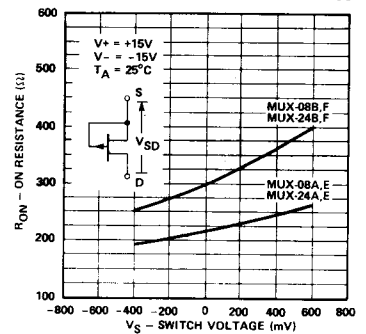
ENABLE DELAY TIMES vs TEMPERATURE



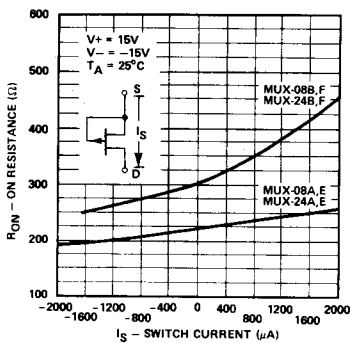
"ON" RESISTANCE (R\_ON) vs ANALOG VOLTAGE (V\_A)



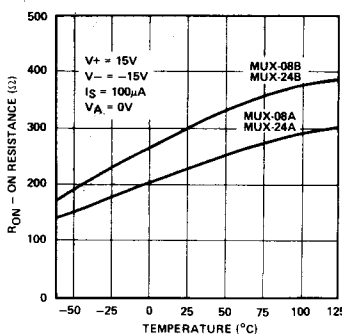
R\_ON vs SWITCH VOLTAGE (V\_SD)



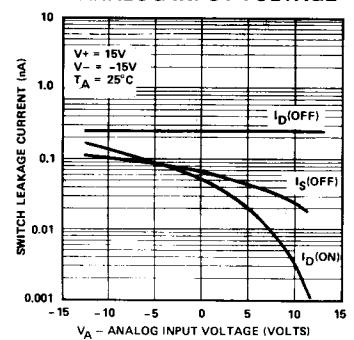
R\_ON vs SWITCH CURRENT (I\_S)

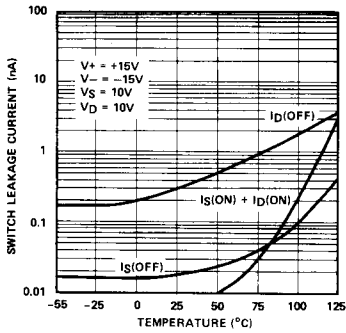
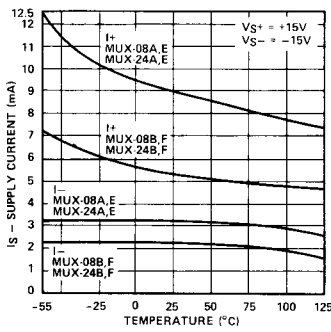
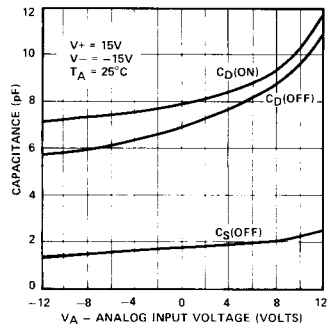
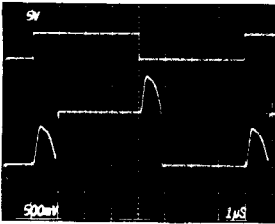


R\_ON vs TEMPERATURE

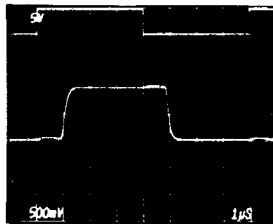


SWITCH LEAKAGE CURRENTS vs ANALOG INPUT VOLTAGE

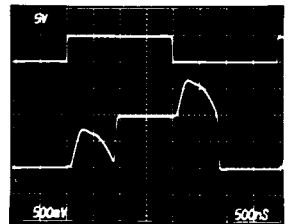


**TYPICAL PERFORMANCE CHARACTERISTICS (Applies to all grades, unless otherwise noted.)**
**SWITCH LEAKAGE CURRENTS vs TEMPERATURE**

**SUPPLY CURRENTS vs TEMPERATURE**

**MUX-08 SWITCH CAPACITANCES vs ANALOG INPUT VOLTAGE**

**MUX-24 SMALL-SIGNAL SWITCHING**


$R_L = 1M\Omega$ ,  $C_L = 10pF$ ,  $V_1 = -500mV$ ,  
 $V_4 = +500mV$   
 VOLTAGE = 500mV/DIV, TIME = 1µs/DIV

**MUX-24 SMALL-SIGNAL SWITCHING WITH FILTERING**


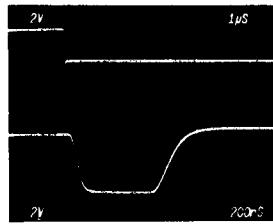
$R_L = 1M\Omega$ ,  $C_L = 500pF$ ,  $V_1 = -500mV$ ,  
 $V_4 = +500mV$   
 VOLTAGE = 500mV/DIV, TIME = 1µs/DIV

**MUX-24 SMALL-SIGNAL SWITCHING WITH 2µs SAMPLE TIME**


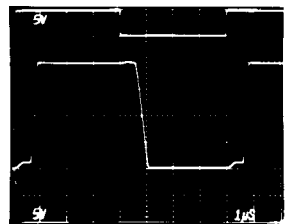
$R_L = 1M\Omega$ ,  $C_L = 10pF$ ,  $V_1 = -500mV$ ,  
 $V_4 = +500mV$   
 VOLTAGE = 500mV/DIV, TIME = 500ns/DIV

**MUX-24 SMALL-SIGNAL SWITCHING WITH FILTERING AND 2.5µs SAMPLE TIME**


$R_L = 1M\Omega$ ,  $C_L = 500pF$ ,  $V_1 = -500mV$ ,  
 $V_4 = +500mV$   
 VOLTAGE = 500mV/DIV, TIME = 500ns/DIV

**MUX-24 BREAK-BEFORE-MAKE SWITCHING**


$R_L = 1k\Omega$ ,  $C_L = 10pF$ ,  $V_1, 4 = 10V$   
 VOLTAGE = 2V/DIV, TIME = 200ns/DIV

**MUX-24 LARGE-SIGNAL SWITCHING**


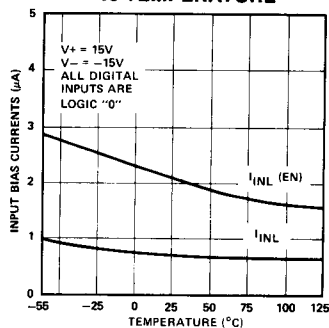
$R_L = 1M\Omega$ ,  $C_L = 10pF$ ,  $V_1 = -10V$ ,  $V_4 = +10V$   
 VOLTAGE = 5V/DIV, TIME = 1µs/DIV

**NOTE:**

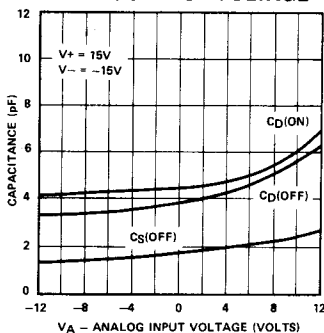
Top waveforms: Digital Input 5V/DIV  
 Bottom waveforms: Multiplexer Output

TYPICAL PERFORMANCE CHARACTERISTICS (Applies to all grades, unless otherwise noted.)

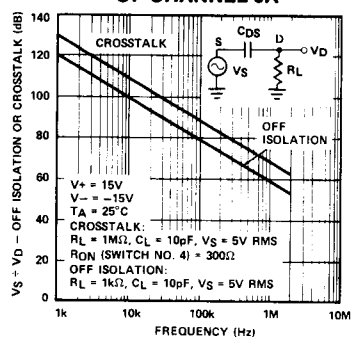
DIGITAL INPUT CURRENTS vs TEMPERATURE



MUX-24 SWITCH CAPACITANCES vs ANALOG INPUT VOLTAGE

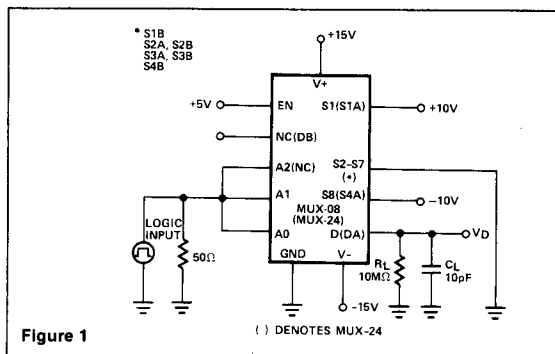


MUX-24 CROSSTALK AND OFF ISOLATION PERFORMANCE OF CHANNEL 3A

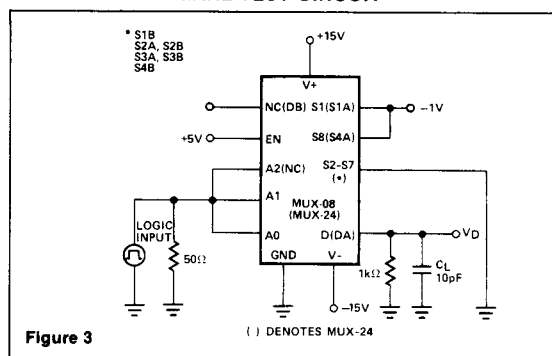


A.C. TEST CIRCUITS

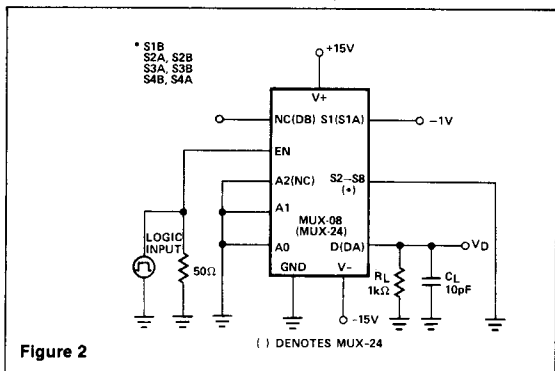
TRANSITION TIME TEST CIRCUIT



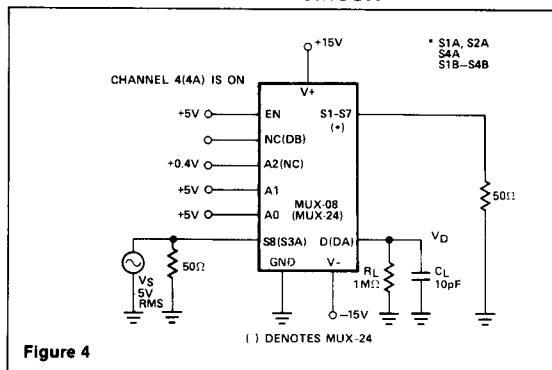
BREAK-BEFORE-MAKE TEST CIRCUIT



ENABLE DELAY TIME TEST CIRCUIT



CROSSTALK MEASUREMENT CIRCUIT





## A.C. TEST CIRCUITS

### OFF-ISOLATION MEASUREMENT CIRCUIT

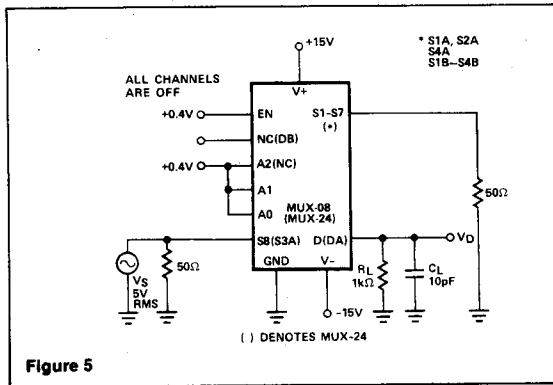
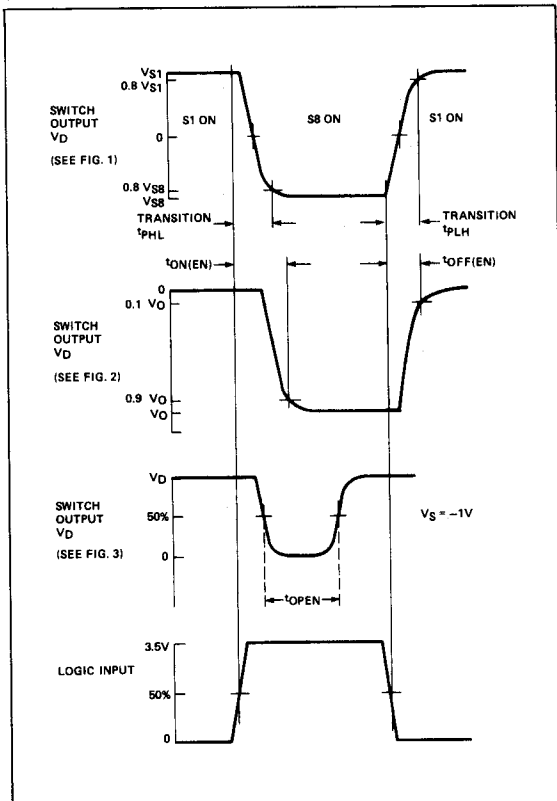


Figure 5

### SWITCHING TIME WAVEFORMS



## APPLICATIONS INFORMATION

These analog multiplexers employ ion-implanted JFETs in a switch configuration designed to assure break-before-make action. The turn-off time is much faster than the turn-on time to guarantee this feature over the full operating temperature and input voltage range. Fabricated with Bipolar-JFET processing, **special handling as required with CMOS devices, is not necessary to prevent damage to this multiplexer.** Because the digital inputs only require a 2.0V logic "1" input level, power-consuming pull-up resistors are not required for TTL compatibility to insure break-make switching as is most often the case with CMOS multiplexers. The digital inputs utilize PNP input transistors where input current is maximum at the logic "0" level and drops to that of a reverse-biased diode (about 10nA) as the input voltage is raised above  $\approx 1.4V$ .

The "ON" resistance,  $R_{ON}$ , of the analog switches is constant over the wide input voltage range of  $-15V$  to  $+11V$  with  $V_{SUPPLY} = \pm 15V$ . Higher input voltage is tolerable provided that some form of current limiting is employed (such as that of an op-amp output stage) to avoid exceeding junction temperature and power dissipation requirements. For normal operation, however, positive input voltages should be restricted to 11V (or 4V less than the positive supply). This assures that the  $V_{GS}$  of an "OFF" switch remains greater than its  $V_p$ , and prevents that channel from being falsely turned "ON". When operating with negative input voltages, the gate-to-channel diode will be turned on if the voltage drop across an "ON" switch exceeds  $-0.6V$ . While this condition will cause an error in the output, it will not damage the switch. In lab tests, the multiplexer output has been loaded with a  $0.01\mu F$  capacitor in the circuit of Figure 1. With  $V_1 = -10V$  and  $V_2 = +10V$ , the logic input was driven at a 1kHz rate. The positive-going slew rate was  $0.3V/\mu s$  which is equivalent to a normal  $I_{DSS}$  of 3mA. The negative-going slew rate was  $0.7V/\mu s$  which is equivalent to a "reverse"  $I_{DSS}$  of 7mA. Note that when switch 1 is first turned "ON" it has a drop of  $-20V$  across its terminals. In spite of that fact, the current is limited to approximately twice its normal  $I_{DSS}$ .

### CROSSTALK AND OFF-ISOLATION

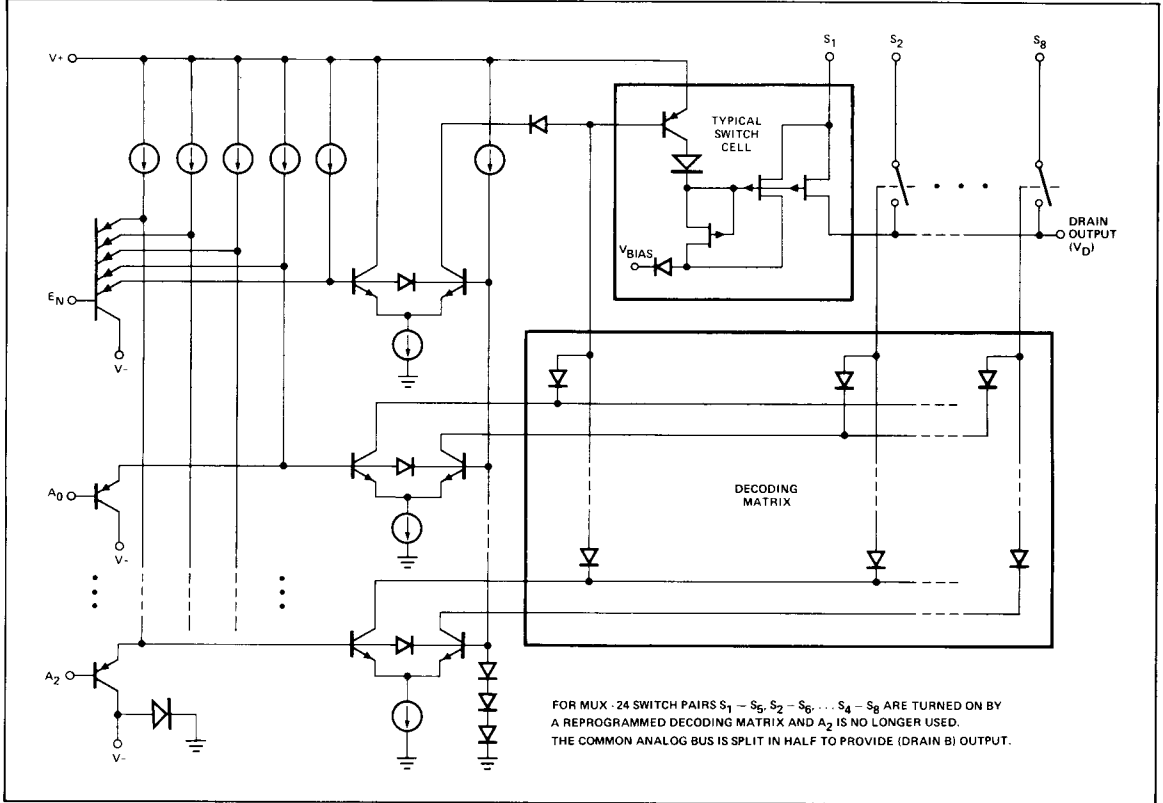
Crosstalk and off-isolation performance is influenced by the type of package selected. Epoxy (P) packaged devices typically exhibit a 12dB improvement in off-isolation ( $f = 500kHz$ ) performance when compared to ceramic (Q) packaged devices. Epoxy packaged devices typically exhibit a 15dB improvement in crosstalk ( $f = 500kHz$ ) performance when compared to ceramic (Q) packaged devices.

### SINGLE SUPPLY OPERATION OF JFET MULTIPLEXERS

PMI's JFET multiplexers will operate from a single positive supply voltage with the negative supply pin at ground potential. The analog signal range will include ground.

For complete single supply operation information, refer to application note, AN-32.

**SIMPLIFIED MUX-08 SCHEMATIC**

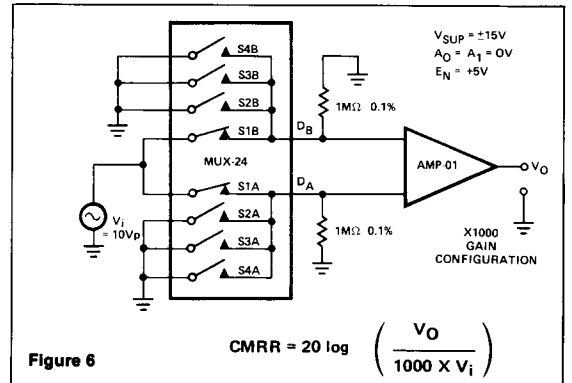


The simplified MUX-08/MUX-24 schematic shows that logic trip points are determined by two forward diode drops. An internal clamping diode between V- and ground prevents excessive current flow between V+ and ground in the event that V- becomes open circuit. The decoding matrix is accomplished by a programmed diode array. The switch cell consists of P channel JFET's with appropriate blocking diodes which ruggedizes the circuit's overvoltage and supply loss characteristics.

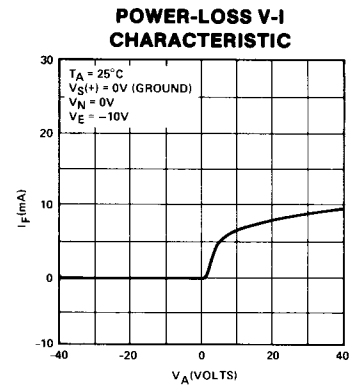
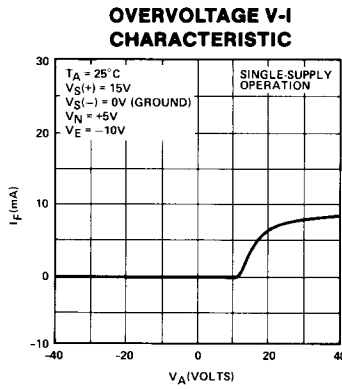
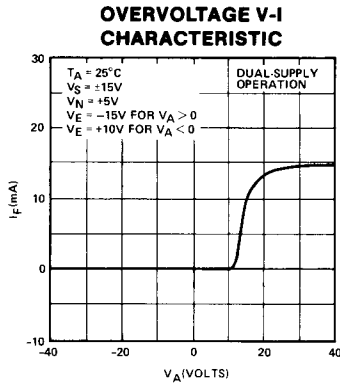
**DIFFERENTIAL MULTIPLEXERS**

One characteristic unique to differential multiplexers (MUX-24) is the ability to reject common-mode signals from becoming differential error signals. Common-mode rejection is a parameter which defines the amount of rejection in terms of dB. The MUX-24 exhibits a 106dB at 60Hz and 101dB at 400Hz of CMRR using the test circuit of Figure 6.

**CMRR TEST CIRCUIT**



## TYPICAL PERFORMANCE CHARACTERISTICS



## OVERVOLTAGE/POWER-LOSS MEASUREMENT TEST CIRCUIT

