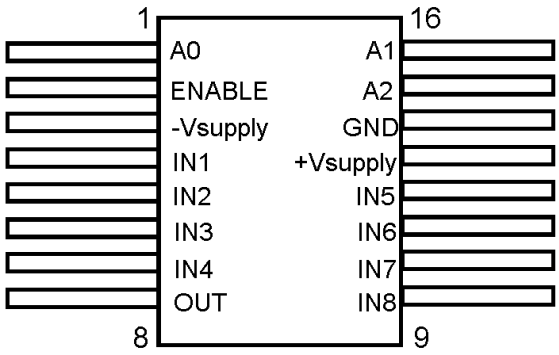
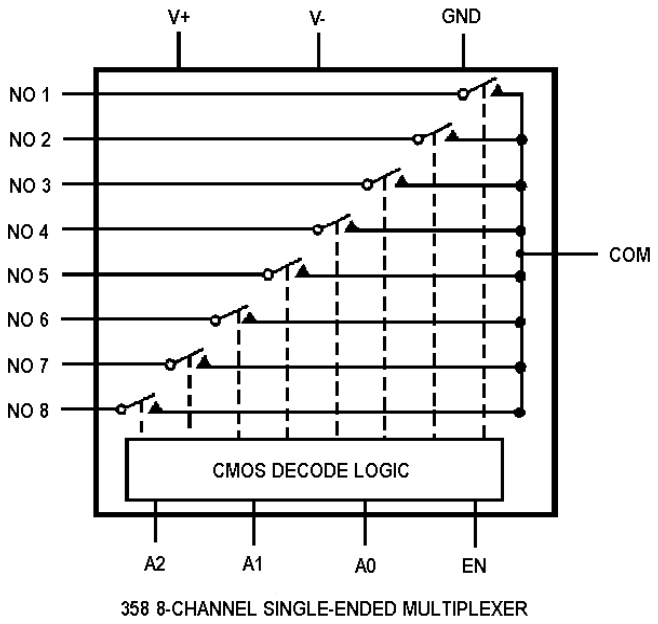
# 358
# 8-Channel Fault-Protected Analog Multiplexer




358 8-CHANNEL SINGLE-ENDED MULTIPLEXER

**Logic Diagram**

## FEATURES:

- RAD-PAK® technology-hardened against natural space radiation
- Total dose hardness:
  - > 50 krad (Si), depending upon space mission
- Excellent Single Event Effect
  - $SEL_{TH}$ > 80 MeV/mg/cm$^2$
  - $SEU_{TH}$ > 80 MeV/mg/cm$^2$
- Package:
  - 16 pin RAD-PAK® Flat Pack
- All switches off with power supplies off
- On channel turns OFF if overvoltage occurs
- Only nanoamperes of input current under all fault conditions
- Operates from ±4.5 to ±18V supplies
- All digital inputs are TTL and CMOS compatible
- Significantly reduced power consumption

## DESCRIPTION:

Maxwells's 358 8-Channel single-ended (1 of 8) multiplexers with fault protection features a greater than 50 krad (Si) total dose tolerance, depending upon space mission. Using a series N-channel, P-channel, N-channel structure, these multiplexers provide significantly improved fault protection. If the power supplies to the fault-protected multiplexer are inadvertently turned off while input voltages are still applied, all channels in the multiplexer are turned off, and only a few nanoamperes of leakage current will flow into the inputs. This protects not only the multiplexer and the circuitry driven by the multiplexer, but also protects the sensors or signal sources which drive the multiplexer. All digital inputs have logic thresholds of 0.8V and 2.4V, ensuring both TTL and CMOS compatibility without requiring pullup resistors. Break-before-make operation is guaranteed. Power supply currents have been reduced and typical power dissipation is less than 2 mW.

Maxwell Technologies' patented RAD-PAK® packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or a space mission. In a GEO orbit, Rad-Pak® provides true greater than 50 krad (Si) total radiation dose tolerance, dependent upon space mission. This product is available with packaging and screening up to Class S.



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TABLE 1. PINOUT DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1, 16, 15 | A0-A2 | Address Inputs |
| 2 | Enable | Enable Inputs |
| 3 | -V Supply | Negative Supply Voltage |
| 4-7, 12-9 | IN1-IN8 | Analog Inputs-bidirectional |
| 8 | OUT | Output-bidirectional |
| 13 | +V Supply | Positive Supply Voltage |
| 14 | GND | Ground |

TABLE 2. 358 ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MAX | UNITS |
|---|---|---|---|
| Voltage between Supply Pins<br>V+<br>V- | | +44<br>+22<br>-22 | V |
| Digital Input Overvoltage<br>VEN, VA Vsupply (+)<br>Vsupply (-) | | <br>+4<br>-4 | V |
| Analog Input Overvoltage with Multiplexer Power On:<br>VS Vsupply (+)<br>Vsupply (-) | | <br><br>+20<br>-20 | V |
| Analog Input Overvoltage with Multiplexer Power Off:<br>VS Vsupply (+)<br>Vsupply (-) | | <br><br>+35<br>-35 | V |
| Continuous Current<br>Peak Current<br>(Pulse at 1 ms, 10% duty cycle max) | | 20<br>40 | mA |
| Thermal Impedance | $\Theta_{JC}$ | 2.69 | °C/W |
| Weight | | 2.25 | Grams |
| Operating Temperature Range: | $T_A$ | -55 to +125 | °C |
| Storage Temperature Range: | $T_S$ | -65 to +150 | °C |

TABLE 3. 358 ELECTRICAL CHARACTERISTICS

($V^+$ = 15V, $V^-$ = -15V, $V_{AH}$ = 2.4V, $V_{AL}$ = 0.8V, $T_A$ = -55 TO +125°C, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | TEST CONDITIONS | SUBGROUPS | SYMBOL | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| STATIC | | | | | | | | |
| ON Resistance | $V_D$ = ±10V, $I_S$ = ±100µA<br>$V_{AL}$ = 0.8V, $V_{AH}$ = 2.4V | 1, 2, 3 | $r_{DS(ON)}$ | +25°C<br>Full | | 1.2<br>1.5 | 1.5<br>1.8 | kΩ |
| OFF Input Leakage Current | $V_S$ = ±10V, $V_D$ = ∓10V<br>$V_{EN}$ = 0.8V | 1, 2, 3 | $I_{S(OFF)}$ | +25°C<br>Full | | 0.03 | <br>50 | nA |
| OFF Output Leakage Current | $V_D$ = ±10V, $V_S$ = ∓10V<br>$V_{EN}$ = 0.8V | 1, 2, 3 | $I_{D(OFF)}$ | +25°C<br>Full | | 0.1 | <br>200 | nA |
| ON Channel Leakage Current | $V_{S(ALL)}$ = $V_D$ = ±10V[1]<br>$V_{AH}$ = $V_{EN}$ = 2.4V<br>$V_{AL}$ = 0.8V | 1, 2, 3 | $I_{D(ON)}$ | +25°C<br>Full | | 0.1 | <br>200[2] | nA |
| Analog Signal Range | [2] | 1, 2, 3 | $V_{AN}$ | Full | -15 | | 15 | V |
| FAULT | | | | | | | | |
| Output Leakage Current (with Overvoltage) | $V_D$ = 0V[1]<br>Analog Overvoltage = ±33V | 1, 2, 3 | $I_{D(OFF)}$ | +25°C<br>Full | | 4.0 | <br>2.0 | nA<br>µA |
| Input Leakage Current (with Overvoltage) | $V_{IN}$ = ±25V, $V_O$ = ±10V[1] | 1, 2, 3 | $I_{S(OFF)}$ | +25°C | | | 5.0 | µA |
| Input Leakage Current (w/ Power Supplies Off) | $V_{IN}$ = ±25V, $V_{EN}$ = $V_O$ = 0V<br>$A_O$ = $A_1$ = $A_2$ = OV or 5V | 1, 2, 3 | $I_{S(OFF)}$ | +25°C | | | 2.0 | µA |
| INPUT | | | | | | | | |
| Input Low Threshold | | 1, 2, 3 | $V_{AL}$ | Full | | | 0.8 | V |
| Input High Threshold | | 1, 2, 3 | $V_{AH}$ | Full | 2.4 | | | V |
| Input Leakage Current (High or Low) | $V_A$ = 4V or 0V[3] | 1, 2, 3 | $I_A$ | Full | | | 1.0 | µA |
| DYNAMIC | | | | | | | | |
| Access Time | | 1, 2, 3 | $t_A$ | +25°C | | 0.5 | 1.0 | µs |
| Break-Before-Make Delay | $V_{EN}$ = ±5V, $V_{IN}$ = ±10V<br>$A_O$, $A_1$, $A_2$ Strobed | 9, 10, 11 | $t_{on}$-$t_{off}$ | +25°C | 25 | 80 | | ns |
| Enable Delay (ON) | | 9, 10, 11 | $t_{on(EN)}$ | +25°C<br>Full | | 300 | 500<br>1000 | ns |
| Enable Delay (OFF) | | 9, 10, 11 | $t_{off(EN)}$ | +25°C<br>Full | | 300 | 500<br>1000 | ns |
| Setting Time: (0.1%)<br>(0.01%) | | 9, 10, 11 | $t_{sett}$ | +25°C | | 1.2<br>3.5 | | µs |
| "OFF Isolation"[4] | $V_{EN}$ = 0.8V, $R_L$ = 1kΩ<br>$C_L$ = 15pF, V = 7$V_{RMS}$<br>f = 100kHz | 4, 5, 6 | | +25°C | 50 | 68 | | db |

TABLE 3. 358 ELECTRICAL CHARACTERISTICS

($V^+$ = 15V, $V^-$ = -15V, $V_{AH}$ = 2.4V, $V_{AL}$ = 0.8V, $T_A$ = -55 TO +125°C, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | TEST CONDITIONS | SUBGROUPS | SYMBOL | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| Channel Input Capacitance[4] | | 4, 5, 6 | $C_{S(OFF)}$ | +25°C | | 5 | | pF |
| Channel Output Capacitance[4] | | 4, 5, 6 | $C_{D(OFF)}$ | +25°C | | 25 | | pF |
| Digital Input Capacitance[4] | | 4, 5, 6 | $C_A$ | +25°C | | 5 | | pF |
| Digital Output Capacitance[4] | | 4, 5, 6 | $C_{DS(OFF)}$ | +25°C | | 0.1 | | pF |
| SUPPLY | | | | | | | | |
| Positive Supply Current | $V_{EN}$ = 0.8V or 2.4V<br>$V_A$ = 0V or 5V | 1, 2, 3 | I+ | +25°C<br>Full | | 0.1<br>0.3 | 0.6<br>0.7 | mA |
| Negative Supply Current | $V_{EN}$ = 0.8V or 2.4V<br>$V_A$ = 0V or 5V | 1, 2, 3 | I- | +25°C<br>Full | | 0.01<br>0.02 | 0.1<br>0.2 | mA |
| Power Supply Range for Continuous Operation | [5] | 1, 2, 3 | $V_{OP}$ | +25°C | ±4.5 | | ±18 | V |

1. The value shown is the steady state value. The transient leakage is typically 10 µA.
2. When the analog signal exceeds +13.5V or -12V the blocking action of the gate structure goes into operation. Only leakage currents flow and the channel on resistance rises to infinity.
3. Digital input leakage is primarily due to the clamp diodes. Typical leakage is less than 1 nA @ +25°C.
4. Guaranteed by design.
5. Electrical characteristics, such as ON Resistance, will change when power supplies other than ±15V are used.

FIGURE 1. INPUT LEAKAGE VS. INPUT VOLTAGE WITH V+ = V- = 0V

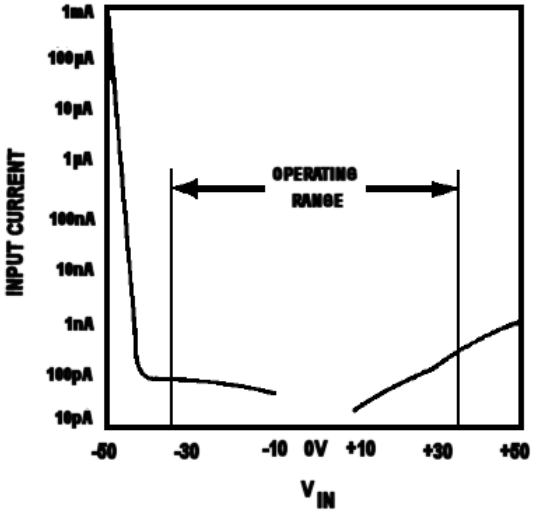



FIGURE 2. OFF CHANNEL LEAKAGE CURRENT VS. INPUT VOLTAGE WITH ±15V SUPPLIES

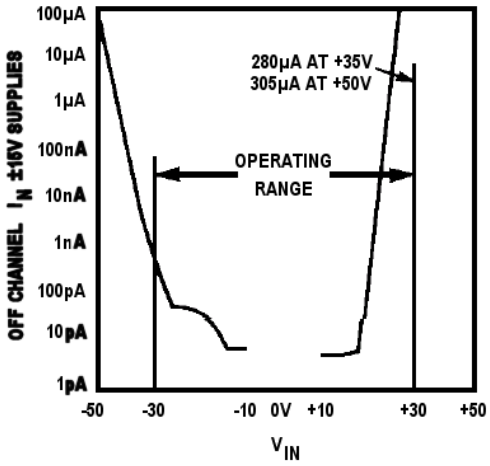



FIGURE 3. OUTPUT LEAKAGE VS. OFF CHANNEL OVERVOLTAGE WITH ±15V SUPPLIES

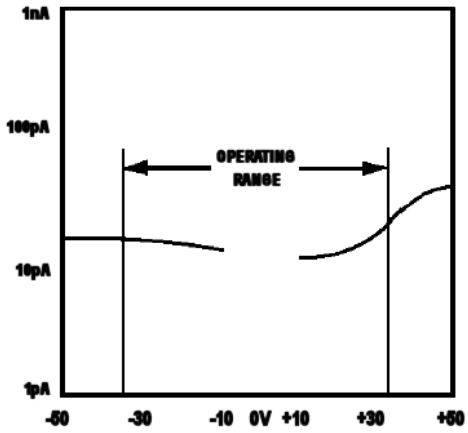
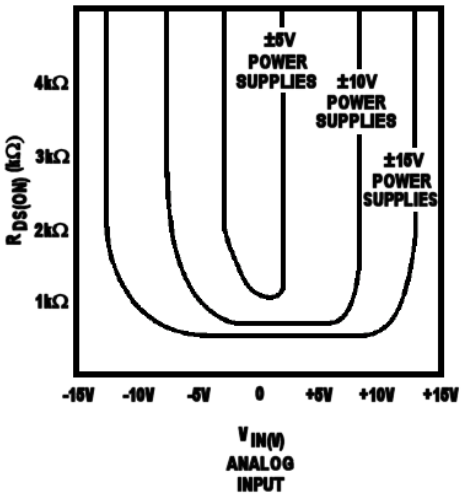


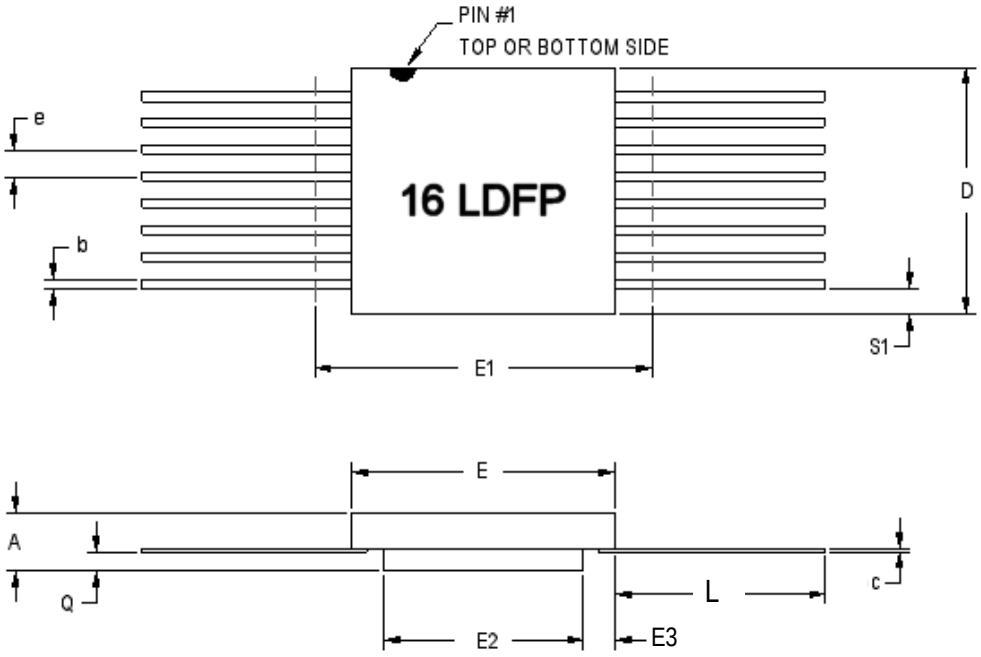
FIGURE 4. $R_{DS(ON)}$ VS. INPUT VOLTAGE




## TRUTH TABLE

| A2 | A1 | A0 | EN | ON SWITCH |
|---|---|---|---|---|
| X | X | X | 0 | NONE |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 2 |
| 0 | 1 | 0 | 1 | 3 |
| 0 | 1 | 1 | 1 | 4 |
| 1 | 0 | 0 | 1 | 5 |
| 1 | 0 | 1 | 1 | 6 |
| 1 | 1 | 0 | 1 | 7 |
| 1 | 1 | 1 | 1 | 8 |

Logic “0” = VAL $\leq$ 0.8V, Logic “1” = VAH $\geq$ 2.4V




16-PIN RAD-PAK® FLAT PACK PACKAGE

| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | .115 | .135 | .150 |
| b | .015 | .017 | .019 |
| c | .004 | .005 | .007 |
| D | 0.407 | .415 | .423 |
| E | .275 | .280 | .285 |
| E1 | -- | -- | 0.500 |
| E2 | .150 | .156 | 0.162 |
| E3 | .030 | .062 | -- |
| e | .050 BSC | | |
| L | .325 | .335 | .345 |
| Q | .020 | .033 | .045 |
| S1 | .005 | .024 | 0.045 |
| N | 16 | | |

All dimensions in inches

Important Notice:

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