

# ACT8502

## Radiation Hardened & ESD Protected 48-Channel Analog Multiplexer Module

### Features

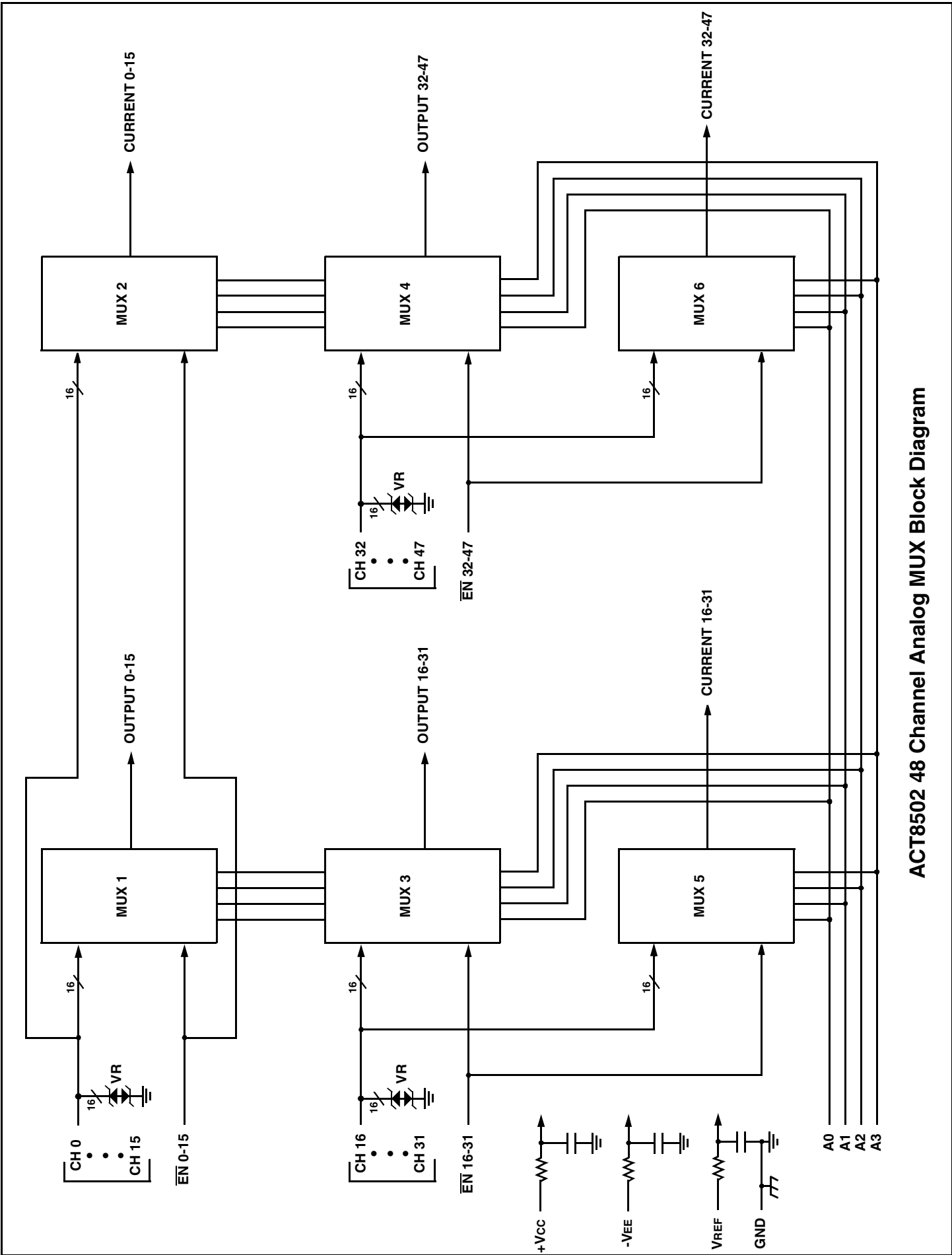
- **Radiation Environment**
  - Radiation 300K(Si) Total Dose
  - No Latch-Up or SEE to 120MeV/cm<sup>2</sup>/mg
- **Full Military Temperature Range**
- **Low Power Consumption < 90mW**
- **48 Channels Provided by Six (6) HS-1840RH Multiplexers**
- **One Address Bus (A0-3) and Three Enable Lines**
- **All Channel Inputs protected by ±20V Transorbs**
- **Fast Access Time 1500ns**
- **±35V Input Over Voltage Protection (Power On or Off)**
- **Break-Before-Make Switching**
- **High Analog Input Impedance (Power On or Off)**
- **Dielectrically Isolated Device Islands**
- **No Latch-Up**
- **Packaging – Hermetic Ceramic Quad Flat Pack**
  - 96 Leads, 1.32" Sq x .20" Ht Quad Flat Pack
  - Typical Weight 15 grams
- **DESC SMD Pending**



### General Description

Aeroflex's ACT8502 is a radiation hardened, multi-chip 48 channel multiplexer MCM (multi-chip module) with ESD protection for use in space applications. All channel inputs have electrostatic discharge protection.

The ACT8502 has been specifically designed to meet exposure to radiation environments. The multiplexer is available in a 96 lead High Temperature Co-Fired Ceramic (HTCC) Quad Flatpack (QFP) and is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534, the ACT8502 is ideal for demanding military and space applications.



ACT8502 48 Channel Analog MUX Block Diagram

## Organization and Application

The ACT8502 consists of six 16 channel muxes arranged as shown in the Block Diagram. The ACT8502 design is inherently Radiation Hard due to the HS1840RH Multiplexers as well as Microsemi Corp. Transient Suppressors (Reference Microsemi MicroNotes Series 050 - page 14).

48 channels addressable by Bus  $A_0 \sim A_3$ , in Three 16 channel blocks, each block enabled separately. Each block connects the addressed channel to two outputs, "Output" and "Current". This technique enables selecting and reading a remote resistive sensor without the MUX resistance being part of the measurement. For grounded sensors, this is done by passing current to the sensor by means of the "Current" pin and reading the resultant voltage (proportional to the sensor resistance) at the "Output" pin.

NOTE: It is recommended that all "NC" or "no connect pin", be grounded. This eliminates or minimizes any ESD or static buildup.

## Absolute Maximum Ratings <sup>1/</sup>

| Parameter   | Range               | Units       |
|---|---------------------|-------------|
| Case Operating Temperature Range  | -55 to +125         | °C          |
| Storage Temperature Range   | -55 to +150         | °C          |
| Supply Voltage<br>+VCC (Pin 44)<br>-VEE (Pin 46)<br>VREF (Pin 48)         | +20<br>-20<br>+20   | V<br>V<br>V |
| Digital Input Overvoltage<br>VEN (Pins 5, 91, 92), VA (Pins 1, 3, 95, 93) | < VR +4<br>> GND -4 | V<br>V      |
| Analog Input Over Voltage<br>Vs   | ±18                 | V           |

Notes:

<sup>1/</sup> All measurements are made with respect to ground.

NOTICE: Stresses above those listed under "Absolute Maximums Rating" may cause permanent damage to the device. These are stress rating only; functional operation beyond the "Operation Conditions" is not recommended and extended exposure beyond the "Operation Conditions" may effect device reliability.

## Recommended Operating Conditions

| Symbol | Parameter                 | Typical | Units |
|--------|---------------------------|---------|-------|
| +VCC   | +15V Power Supply Voltage | +15.0   | V     |
| -VEE   | -15V Power Supply Voltage | -15.0   | V     |
| VREF   | Reference Voltage         | +5.00   | V     |
| VAL    | Logic Low Level           | +0.8    | V     |
| VAH    | Logic High Level          | +4.0    | V     |

## DC Electrical Performance Characteristics <sup>1/</sup>

(Tc = -55°C to +125°C, +VCC = +15V, -VEE = -15V, VREF = +5.0V, Unless otherwise specified)

| Parameter                                  | Symbol                   | Conditions  | Min  | Max  | Units |
|--|--------------------------|---|------|------|-------|
| Supply Current                             | I+                       | VEN(0-47) = VA(0-3) = 0   | 0.3  | 3    | mA    |
|  | I-                       | VEN(0-47) = VA(0-3) = 0   | -3   | -0.3 | mA    |
|  | +ISBY                    | VEN(0-47) = 4V, VA(0-3) = 0 <sup>6/</sup>   | 0.3  | 3    | mA    |
|  | -ISBY                    | VEN(0-47) = 4V, VA(0-3) = 0 <sup>6/</sup>   | -3   | -0.3 | mA    |
| Address Input Current                      | I <sub>AL</sub> (0-3)    | VA = 0V <sup>1/</sup>   | -6   | 6    | μA    |
|  | I <sub>AH</sub> (0-3)    | VA = 5V <sup>1/</sup>   | -6   | 6    | μA    |
| Enable Input Current                       | I <sub>ENL</sub> (0-15)  | VEN(0-15) = 0V  | -2   | 2    | μA    |
|  | I <sub>ENH</sub> (0-15)  | VEN(0-15) = 5V  | -2   | 2    | μA    |
|  | I <sub>ENL</sub> (16-31) | VEN(16-31) = 0V   | -2   | 2    | μA    |
|  | I <sub>ENH</sub> (16-31) | VEN(16-31) = 5V   | -2   | 2    | μA    |
|  | I <sub>ENL</sub> (32-47) | VEN(32-47) = 0V   | -2   | 2    | μA    |
|  | I <sub>ENH</sub> (32-47) | VEN(32-47) = 5V   | -2   | 2    | μA    |
| Positive Input Leakage Current<br>CH0-CH47 | +ISOFFOUTPUT(ALL)        | VIN = +10V, VEN = 4V, output and all unused<br>MUX inputs under test = -10V <sup>2/</sup> , <sup>3/</sup> | -100 | +700 | nA    |
|  | +ISOFFCURRENT(ALL)       |   | -100 | +700 | nA    |

## DC Electrical Performance Characteristics 1/ (con't)

(Tc = -55°C to +125°C, +VCC = +15V, -VEE = -15V, VREF = +5.0V, Unless otherwise specified)

| Parameter  | Symbol                     | Conditions   | Min                      | Max                     | Units                   |             |
|--|----------------------------|--|--------------------------|-------------------------|-------------------------|-------------|
| Negative Input Leakage Current<br>CH0-CH47   | -ISOFFOUTPUT(ALL)          | VIN = -10V, VEN = 4V, output and all unused MUX inputs under test = +10V 2/, 3/  | -100                     | +700                    | nA                      |             |
|  | -ISOFFCURRENT(ALL)         |  | -100                     | +700                    | nA                      |             |
| Output Leakage Current OUTPUTS<br>(pins 25, 70 & 68)<br>CURRENTS<br>(pins 67 & 69) | +IDOFFOUTPUT(ALL)          | VOUT = +10V, VEN = 4V, output and all unused MUX inputs under test = -10V 3/, 4/ | -100                     | +100                    | nA                      |             |
|  | +IDOFFCURRENT(ALL)         |  | -100                     | +100                    | nA                      |             |
| Output Leakage Current OUTPUTS<br>(pins 25, 70 & 68)<br>CURRENTS<br>(pins 67 & 69) | -IDOFFOUTPUT(ALL)          | VOUT = -10V, VEN = 4V, output and all unused MUX inputs under test = +10V 3/, 4/ | -100                     | +100                    | nA                      |             |
|  | -IDOFFCURRENT(ALL)         |  | -100                     | +100                    | nA                      |             |
| Input Clamped Voltage CH0 - CH47   | +VCLMP(0-47)               | VEN = 4V, all unused MUX inputs under test are open. 3/                          | +25°C<br>+125°C<br>-55°C | 18.0<br>18.0<br>17.5    | 23.0<br>23.5<br>22.5    | V<br>V<br>V |
| Input Clamped Voltage CH0 - CH47   | -VCLMP(0-47)               |  | +25°C<br>+125°C<br>-55°C | -23.0<br>-23.5<br>-22.5 | -18.0<br>-18.0<br>-17.5 | V<br>V<br>V |
| Switch ON Resistance OUTPUTS<br>(pins 25, 70 & 68)                                 | RDS(ON)(0-47) <sub>A</sub> | VIN = +15V, VEN = 0.8V, IOUT = -1mA<br>2/, 3/, 5/                                | 500                      | 3000                    | Ω                       |             |
|  | RDS(ON)(0-47) <sub>B</sub> | VIN = +5V, VEN = 0.8V, IOUT = -1mA<br>2/, 3/, 5/                                 | 500                      | 3000                    | Ω                       |             |
|  | RDS(ON)(0-47) <sub>C</sub> | VIN = -5V, VEN = 0.8V, IOUT = +1mA<br>2/, 3/, 5/                                 | 500                      | 3000                    | Ω                       |             |
| Switch ON Resistance CURRENTS<br>(pins 26, 67 & 69)                                | RDS(ON)(0-47) <sub>A</sub> | VIN = +15V, VEN = 0.8V, IOUT = -1mA<br>2/, 3/, 5/                                | 500                      | 3000                    | Ω                       |             |
|  | RDS(ON)(0-47) <sub>B</sub> | VIN = +5V, VEN = 0.8V, IOUT = -1mA<br>2/, 3/, 5/                                 | 500                      | 3000                    | Ω                       |             |
|  | RDS(ON)(0-47) <sub>C</sub> | VIN = -5V, VEN = 0.8V, IOUT = +1mA<br>2/, 3/, 5/                                 | 500                      | 3000                    | Ω                       |             |

**Notes:**

- 1/ Measure inputs sequentially. Ground all unused inputs of the MUX under test. VA is the applied input voltage to the MUXes' address lines A(0-3).
- 2/ VIN is the applied input voltage to the MUXes' input channel CH0-CH47.
- 3/ VEN is the applied input voltage to the MUXes' enable line En(0-15), En(16-31) and En(32-47).
- 4/ VOUT is the applied input voltage to the MUXes' output line OUTPUT(0-15), OUTPUT(16-31), OUTPUT(32-47), CURRENT(0-15), CURRENT(16-31) and CURRENT(32-47).
- 5/ Negative current is the current flowing out of each of the MUX pins. Positive current is the current flowing into each MUX pin.
- 6/ If not tested, shall be guaranteed to the specified limits.

## Switching Characteristics

(Tc = -55°C to +125°C, VDD = +15V, VEE = -15V, VR = +5.0V, Unless otherwise specified)

| Parameter          | Symbol             | Conditions           | Min | Max  | Units |
|--------------------|--------------------|----------------------|-----|------|-------|
| Switching Test MUX | t <sub>ONA</sub>   | RL = 10KΩ, CL = 50pF | 10  | 1500 | ns    |
|                    | t <sub>OFFA</sub>  | RL = 10KΩ, CL = 50pF | 10  | 2000 | ns    |
|                    | t <sub>ONEN</sub>  | RL = 1KΩ, CL = 50pF  | 10  | 1500 | ns    |
|                    | t <sub>OFFEN</sub> | RL = 1KΩ, CL = 50pF  | 10  | 1000 | ns    |

### Truth Table (CH0 – CH15)

| A3 | A2 | A1 | A0 | EN(0-15) | "ON" CHANNEL <sup>1/</sup> |
|----|----|----|----|----------|----------------------------|
| X  | X  | X  | X  | H        | NONE                       |
| L  | L  | L  | L  | L        | CH0                        |
| L  | L  | L  | H  | L        | CH1                        |
| L  | L  | H  | L  | L        | CH2                        |
| L  | L  | H  | H  | L        | CH3                        |
| L  | H  | L  | L  | L        | CH4                        |
| L  | H  | L  | H  | L        | CH5                        |
| L  | H  | H  | L  | L        | CH6                        |
| L  | H  | H  | H  | L        | CH7                        |
| H  | L  | L  | L  | L        | CH8                        |
| H  | L  | L  | H  | L        | CH9                        |
| H  | L  | H  | L  | L        | CH10                       |
| H  | L  | H  | H  | L        | CH11                       |
| H  | H  | L  | L  | L        | CH12                       |
| H  | H  | L  | H  | L        | CH13                       |
| H  | H  | H  | L  | L        | CH14                       |
| H  | H  | H  | H  | L        | CH15                       |

<sup>1/</sup> Between CH0-15 and OUTPUT (0-15) and CURRENT (0-15).

### Truth Table (CH16 – CH31)

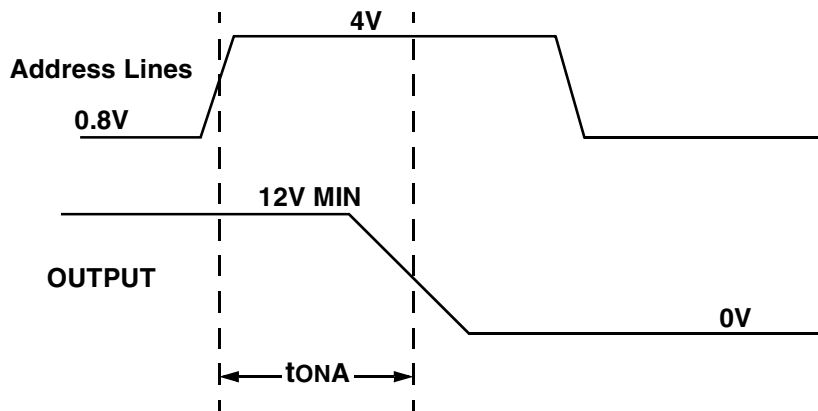
| A3 | A2 | A1 | A0 | EN(16-31) | "ON" CHANNEL <sup>1/</sup> |
|----|----|----|----|-----------|----------------------------|
| X  | X  | X  | X  | H         | NONE                       |
| L  | L  | L  | L  | L         | CH16                       |
| L  | L  | L  | H  | L         | CH17                       |
| L  | L  | H  | L  | L         | CH18                       |
| L  | L  | H  | H  | L         | CH19                       |
| L  | H  | L  | L  | L         | CH20                       |
| L  | H  | L  | H  | L         | CH21                       |
| L  | H  | H  | L  | L         | CH22                       |
| L  | H  | H  | H  | L         | CH23                       |
| H  | L  | L  | L  | L         | CH24                       |
| H  | L  | L  | H  | L         | CH25                       |
| H  | L  | H  | L  | L         | CH26                       |
| H  | L  | H  | H  | L         | CH27                       |
| H  | H  | L  | L  | L         | CH28                       |
| H  | H  | L  | H  | L         | CH29                       |
| H  | H  | H  | L  | L         | CH30                       |
| H  | H  | H  | H  | L         | CH31                       |

<sup>1/</sup> Between CH16-31 and OUTPUT (16-31) and CURRENT (16-31).

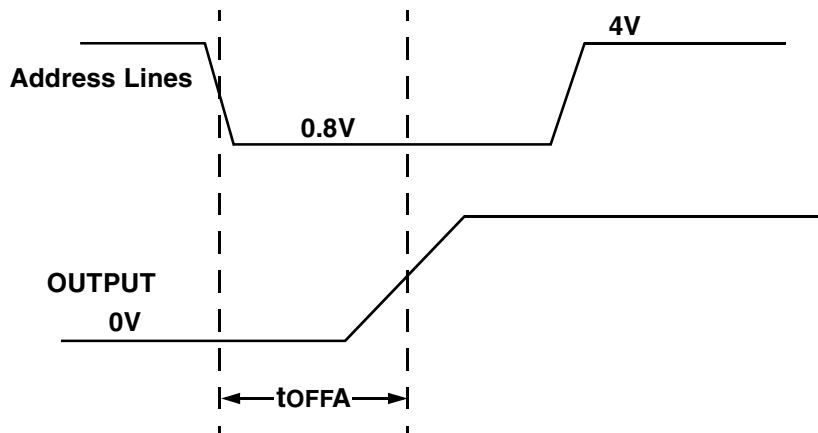
### Truth Table (CH32 – CH47)

| A3 | A2 | A1 | A0 | EN(32-47) | "ON" CHANNEL <sup>1/</sup> |
|----|----|----|----|-----------|----------------------------|
| X  | X  | X  | X  | H         | NONE                       |
| L  | L  | L  | L  | L         | CH32                       |
| L  | L  | L  | H  | L         | CH33                       |
| L  | L  | H  | L  | L         | CH34                       |
| L  | L  | H  | H  | L         | CH35                       |
| L  | H  | L  | L  | L         | CH36                       |
| L  | H  | L  | H  | L         | CH37                       |
| L  | H  | H  | L  | L         | CH38                       |
| L  | H  | H  | H  | L         | CH39                       |
| H  | L  | L  | L  | L         | CH40                       |
| H  | L  | L  | H  | L         | CH41                       |
| H  | L  | H  | L  | L         | CH42                       |
| H  | L  | H  | H  | L         | CH43                       |
| H  | H  | L  | L  | L         | CH44                       |
| H  | H  | L  | H  | L         | CH45                       |
| H  | H  | H  | L  | L         | CH46                       |
| H  | H  | H  | H  | L         | CH47                       |

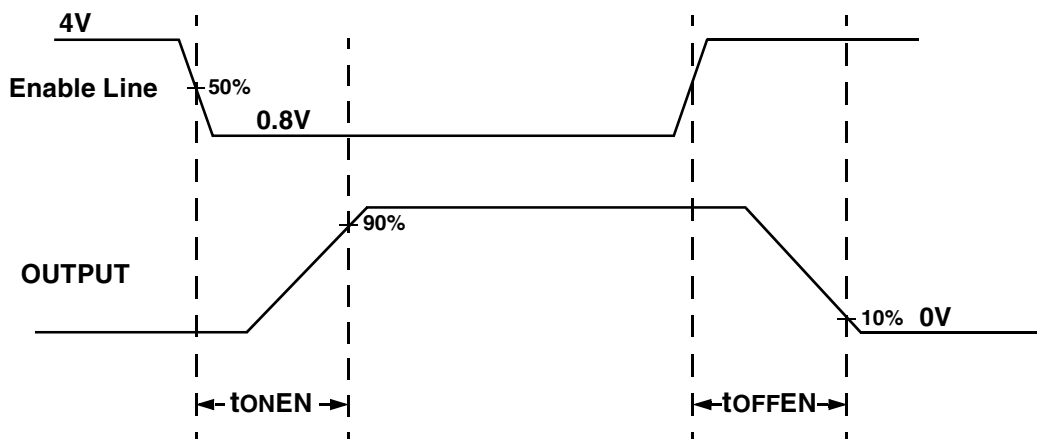
<sup>1/</sup> Between CH32-47 and OUTPUT (32-47) and CURRENT (32-47) and CURRENT (32-47).



Definition of tONA



Definition of toFFA



Definition of tONEN and toFFEN



## Lead Numbers & Functions

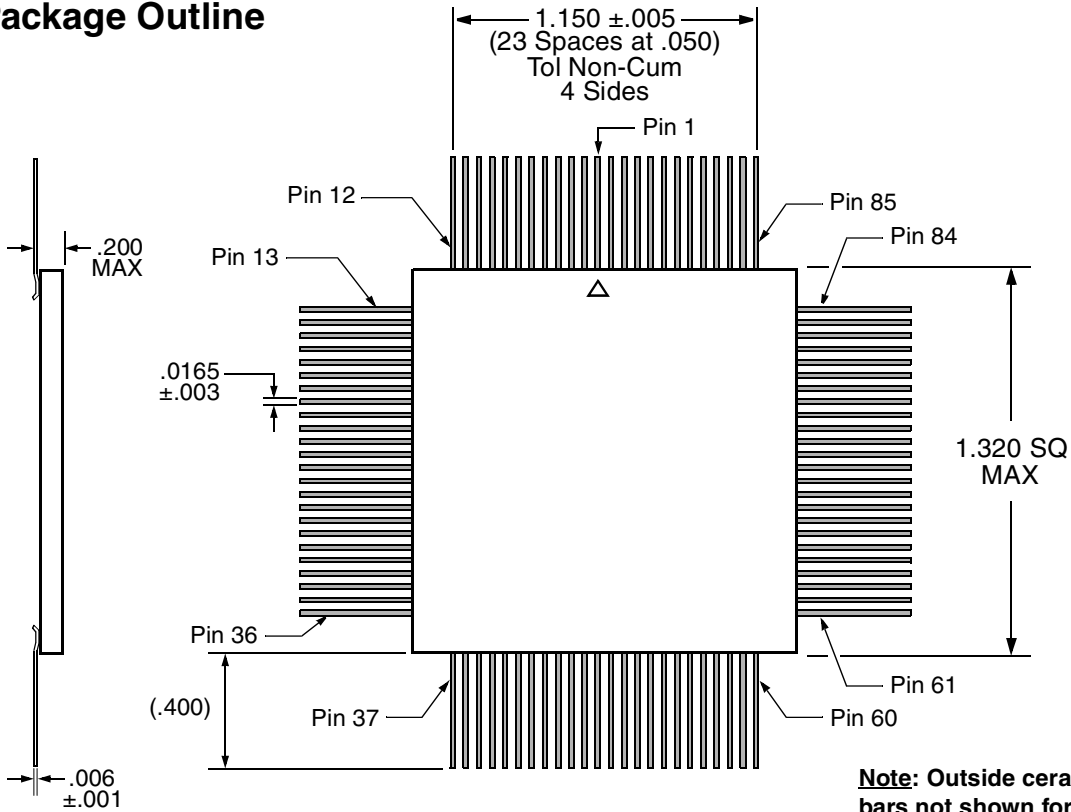
| <b>ACT8502 – 96 Leads Ceramic QUAD Flat Pack</b> |                      |              |                  |              |                       |
|--|----------------------|--------------|------------------|--------------|-----------------------|
| <b>Pin #</b>                                     | <b>Function</b>      | <b>Pin #</b> | <b>Function</b>  | <b>Pin #</b> | <b>Function</b>       |
| 1  | A <sub>2</sub>       | 33           | CH11             | 65           | CH33                  |
| 2  | NC                   | 34           | NC               | 66           | CH32                  |
| 3  | A <sub>3</sub>       | 35           | CH12             | 67           | Output I(32-47)       |
| 4  | NC                   | 36           | NC               | 68           | Output V(32-47)       |
| 5  | $\overline{EN}$ 0-15 | 37           | CH13             | 69           | Output I(16-31)       |
| 6  | NC                   | 38           | NC               | 70           | Output V(16-31)       |
| 7  | CH0                  | 39           | CH14             | 71           | GND                   |
| 8  | NC                   | 40           | NC               | 72           | GND                   |
| 9  | CH1                  | 41           | CH15             | 73           | CH31                  |
| 10   | NC                   | 42           | NC               | 74           | CH30                  |
| 11   | CH2                  | 43           | NC               | 75           | CH29                  |
| 12   | NC                   | 44           | +V <sub>CC</sub> | 76           | CH28                  |
| 13   | CH3                  | 45           | NC               | 77           | CH27                  |
| 14   | NC                   | 46           | -V <sub>EE</sub> | 78           | CH26                  |
| 15   | CH4                  | 47           | NC               | 79           | CH25                  |
| 16   | NC                   | 48           | V <sub>REF</sub> | 80           | CH24                  |
| 17   | CH5                  | 49           | NC               | 81           | CH23                  |
| 18   | NC                   | 50           | CASE GND         | 82           | CH22                  |
| 19   | CH6                  | 51           | CH47             | 83           | CH21                  |
| 20   | NC                   | 52           | CH46             | 84           | CH20                  |
| 21   | CH7                  | 53           | CH45             | 85           | CH19                  |
| 22   | NC                   | 54           | CH44             | 86           | CH18                  |
| 23   | GND                  | 55           | CH43             | 87           | CH17                  |
| 24   | GND                  | 56           | CH42             | 88           | CH16                  |
| 25   | Output V(0-15)       | 57           | CH41             | 89           | GND                   |
| 26   | Output I(0-15)       | 58           | CH40             | 90           | GND                   |
| 27   | CH8                  | 59           | CH39             | 91           | $\overline{EN}$ 32-47 |
| 28   | NC                   | 60           | CH38             | 92           | $\overline{EN}$ 16-31 |
| 29   | CH9                  | 61           | CH37             | 93           | A <sub>0</sub>        |
| 30   | NC                   | 62           | CH36             | 94           | NC                    |
| 31   | CH10                 | 63           | CH35             | 95           | A <sub>1</sub>        |
| 32   | NC                   | 64           | CH34             | 96           | NC                    |

NOTE: It is recommended that all "NC" or "no connect pin", be grounded. This eliminates or minimizes any ESD or static buildup.

### Ordering Information

| Model Number | Screening   | DESC SMD # | Package        |
|--------------|---|------------|----------------|
| ACT8502-S    | Military Temperature, -55°C to +125°C,<br>Screened to the individual test methods of MIL-STD-883 IAW<br>MIL-PRF-38534 Class K | Pending    | QUAD Flat Pack |
| ACT8502      | Military Temperature, -55°C to +125°C,<br>Screened to the individual test methods of MIL-STD-883 IAW<br>MIL-PRF-38534 Class H |            |                |
| ACT8502-7    | Commercial Flow, +25°C testing only   | NA         |                |
| ACT8502-T    | Commercial Flow, -55°C to +125°C testing only   |            |                |
| ACT8502-I    | Commercial Flow, -40°C to +85°C testing only  |            |                |
| ACT8502-C    | Commercial Flow, -0°C to +70°C testing only   |            |                |

### Flat Package Outline



Specifications subject to change without notice

**Note:** Outside ceramic tie bars not shown for clarity. Contact factory for details

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