**Standard Products** *Datasheet*

# ACT8506 48-Channel Analog Multiplexer Module Radiation Tolerant

**www.aeroflex.com/mux**

**May 5, 2014**

## FEATURES

- 48 channels provided by six 16-channel multiplexers
- Radiation performance
  - Total dose: 300 krads(Si), Dose rate = 50 - 300 rads(Si)/s
  - SEU: Immune up to 120 MeV-cm$^2$/mg
  - SEL: Immune by process design
- Full military temperature range
- Low power consumption < 90mW
- One address bus (A0-3) and three enable lines afford flexible organization
- Fast access time 1500ns typical
- Break-Before-Make switching
- Same *Form / Fit / Function* as ACT8502 minus channel input transorbs
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 96 leads, 1.32"Sq x 0.20"Ht quad flat pack
  - Typical Weight 15 grams
- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

## GENERAL DESCRIPTION

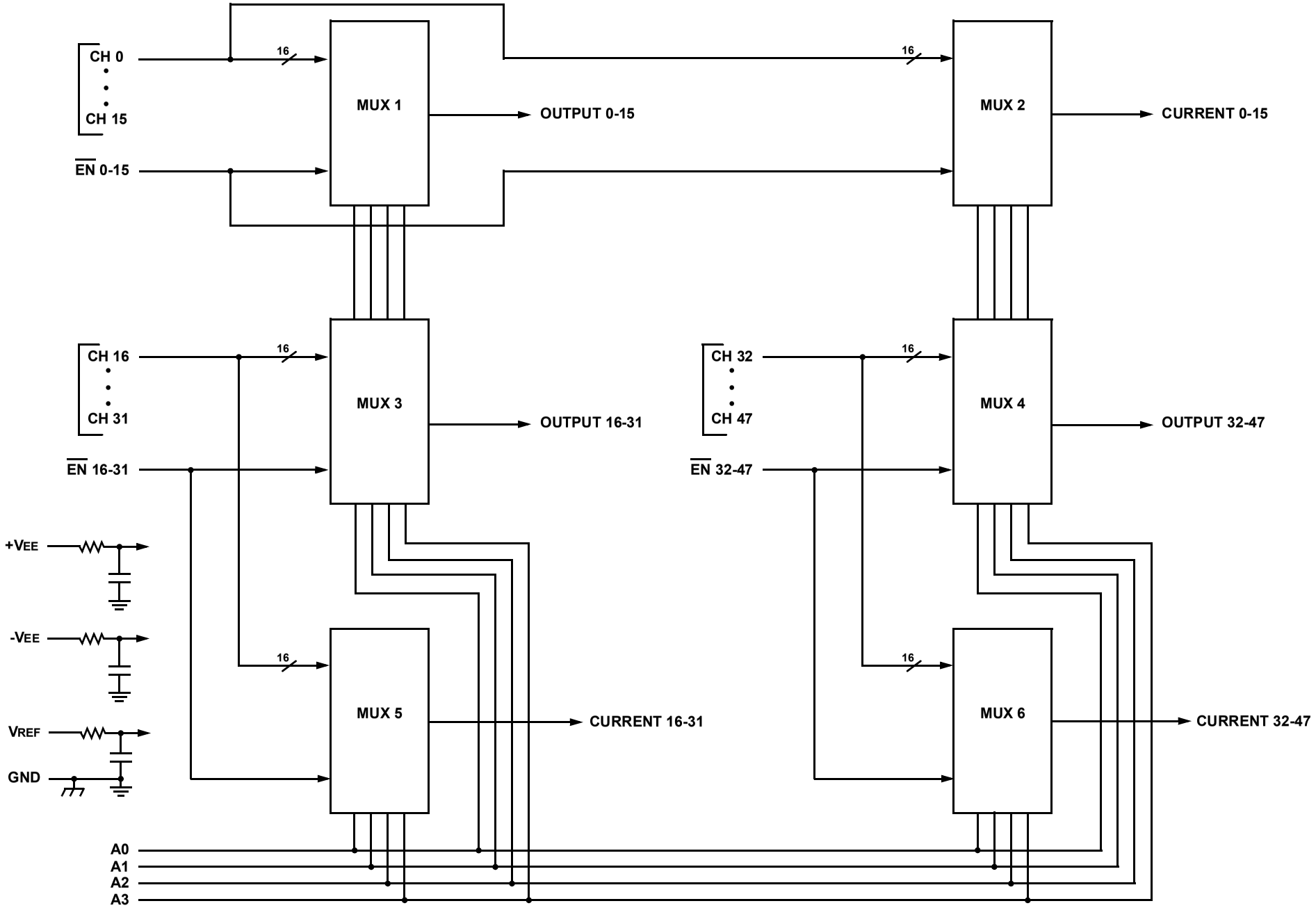
Aeroflex's ACT8506 is a radiation tolerant, 48 channel multiplexer MCM (multi-chip module).

The ACT8506 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 (CQFP). It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534, the ACT8506 is ideal for demanding military and space applications.

## ORGANIZATION AND APPLICATION

The ACT8506 consists of six 16 channel multiplexers arranged as shown in the Block Diagram. The ACT8506 design is inherently radiation tolerant.

The ACT8506 consists of forty-eight (48) channels addressable by bus $A_0$~$A_3$ 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.




## ACT8506 48 – CHANNEL ANALOG MUX BLOCK DIAGRAM

## ABSOLUTE MAXIMUM RATINGS 1/

| Parameter | Range | Units |
|---|---|---|
| Case Operating Temperature Range | -55 to +125 | °C |
| Storage Temperature Range | -55 to +150 | °C |
| Supply Voltage<br>+VEE (Pin 44)<br>-VEE (Pin 46)<br>VREF (Pin 48) | <br>+16.5<br>-16.5<br>+16.5 | <br>V<br>V<br>V |
| Digital Input Overvoltage<br>VEN (Pins 5, 91, 92), VA (Pins 1, 3, 93, 95) | <VR +4<br>>GND -4 | V<br>V |
| Analog Input Over Voltage (Power On/Off)<br>VS | ±25 | V |

Notes:
1/ All measurements are made with respect to ground.

NOTICE: Stresses above those listed under "Absolute Maximum Ratings" 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 affect device reliability.

## RECOMMENDED OPERATING CONDITIONS 1/

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

Notes:
1/ Power Supply turn-on sequence shall be as follows: +VEE, -VEE, followed by VREF.

## DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/

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

| Parameter | Symbol | Conditions | Min | Max | Units |
|---|---|---|---|---|---|
| Supply Current | +IEE | VEN(0-47) = VA(0-3) = 0 | 0.3 | 3 | mA |
| | -IEE | | -3 | -0.3 | mA |
| | +ISBY | VEN(0-47) = 4V, VA(0-3) = 0 6/ | 0.3 | 3 | mA |
| | -ISBY | | -3 | -0.3 | mA |
| Address Input Current | IAL(0-3) | VA = 0V 1/, 7/ | -6 | 6 | µA |
| | IAH(0-3) | VA = 5V 1/, 7/ | -6 | 6 | µA |
| Enable Input Current | IENL(0-15) | VEN(0-15) = 0V 7/ | -2 | 2 | µA |
| | IENH(0-15) | VEN(0-15) = 5V 7/ | -2 | 2 | µA |
| | IENL(16-31) | VEN(16-31) = 0V 7/ | -2 | 2 | µA |
| | IENH(16-31) | VEN(16-31) = 5V 7/ | -2 | 2 | µA |
| | IENL(32-47) | VEN(32-47) = 0V 7/ | -2 | 2 | µA |
| | IENH(32-47) | VEN(32-47) = 5V 7/ | -2 | 2 | µA |

## DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/ (continued)

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

| Parameter | Symbol | Conditions | | Min | Max | Units |
|---|---|---|---|---|---|---|
| Positive Input Leakage Current CH0-CH47 | ISOFFOUTPUT | VIN = +10V, VEN = 4V, output and all unused MUX inputs under test = -10V 2/, 3/, 7/ | +25°C | -20 | +20 | nA |
| | +ISOFFCURRENT | | | -200 | +200 | nA |
| Negative Input Leakage Current CH0-CH47 | -ISOFFOUTPUT | VIN = -10V, VEN = 4V, output and all unused MUX inputs under test = +10V 2/, 3/, 7/ | +25°C | -20 | +20 | nA |
| | -ISOFFCURRENT | | | -200 | +200 | nA |
| Output Leakage Current OUTPUTS (pins 25, 70 & 68) | +IDOFFOUTPUT(0-47) | VOUT = +10V, VEN = 4V, output and all unused MUX inputs under test = -10V 3/, 4/, 7/ | | -100 | +100 | nA |
| CURRENTS (pins 67 & 69) | +IDOFFCURRENT(0-47) | | | -100 | +100 | nA |
| Output Leakage Current OUTPUTS (pins 25, 70 & 68) | -IDOFFOUTPUT(0-47) | VOUT = -10V, VEN = 4V, output and all unused MUX inputs under test = +10V 3/, 4/, 7/ | | -100 | +100 | nA |
| CURRENTS (pins 67 & 69) | -IDOFFCURRENT(0-47) | | | -100 | +100 | nA |
| Switch ON Resistance OUTPUTS (pins 25, 70 & 68) | $R_{DS(ON)(0-47)_A}$ | VIN = +15V, VEN = 0.8V, IOUT = -1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |
| | $R_{DS(ON)(0-47)_B}$ | VIN = +5V, VEN = 0.8V, IOUT = -1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |
| | $R_{DS(ON)(0-47)_C}$ | VIN = -5V, VEN = 0.8V, IOUT = +1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |
| Switch ON Resistance CURRENTS (pins 26, 67 & 69) | $R_{DS(ON)(0-47)_A}$ | VIN = +15V, VEN = 0.8V, IOUT = -1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |
| | $R_{DS(ON)(0-47)_B}$ | VIN = +5V, VEN = 0.8V, IOUT = -1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |
| | $R_{DS(ON)(0-47)_C}$ | VIN = -5V, VEN = 0.8V, IOUT = +1mA 2/, 3/, 5/ | | 500 | 3000 | Ω |

Notes:
1/ Measure inputs sequentially. Ground all unused inputs of the device under test. VA is the applied input voltage to the address lines A(0-3).
2/ VIN is the applied input voltage to the input channels CH0-CH47.
3/ VEN is the applied input voltage to the enable lines EN (0-15), EN (16-31) and EN (32-47).
4/ VOUT is the applied input voltage to the output lines 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.
7/ These parameters for Tc = -55°C are guaranteed by design, characterization, or correlation to other test parameters but not production tested.

## SWITCHING CHARACTERISTICS

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

| Parameter | Symbol | Conditions | Min | Max | Units |
|---|---|---|---|---|---|
| Switching Test MUX | $t_AHL$ | RL = 10KΩ, CL = 50pF | 10 | 1500 | ns |
| | $t_ALH$ | RL = 10KΩ, CL = 50pF<br>Tc = +25°C, +125°C<br>Tc = -55°C | 10<br>10 | 2000<br>5000 | ns |
| | $t_{ON}EN$ | RL = 1KΩ, CL = 50pF | 10 | 1500 | ns |
| | $t_{OFF}EN$ | | 10 | 1000 | ns |

## TRUTH TABLE (CH0 – CH15)

| A3 | A2 | A1 | A0 | EN(0-15) | "ON" CHANNEL 1/ |
|---|---|---|---|---|---|
| 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 |

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

## TRUTH TABLE (CH16 – CH31)

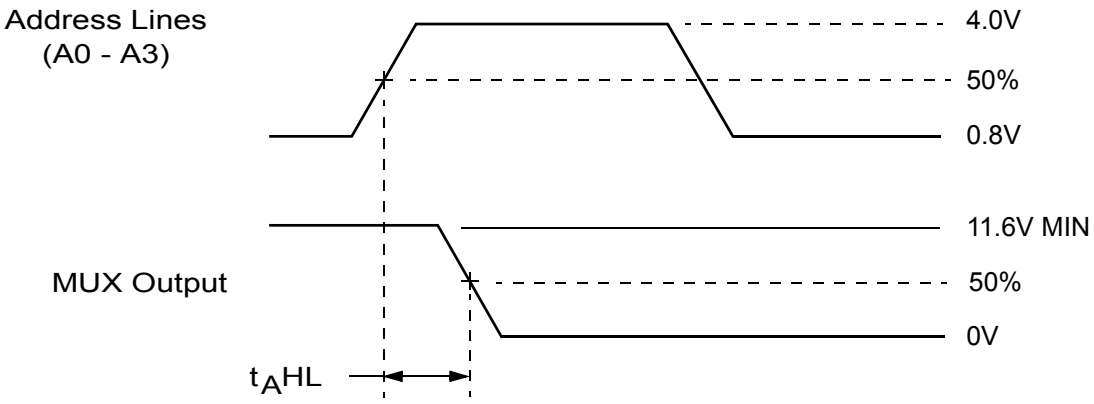
| A3 | A2 | A1 | A0 | EN(16-31) | "ON" CHANNEL 1/ |
|---|---|---|---|---|---|
| X | X | X | X | H | NONE |
| L | L | L | L | L | CH16 |
| L | L | L | H | L | CH17 |
| L | L | H | L | L | CH18 |
| L | L | H | H | L | CH19 |
| L | H | L | L | L | CH20 |
| L | H | L | H | L | CH21 |
| L | H | H | L | L | 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 |

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

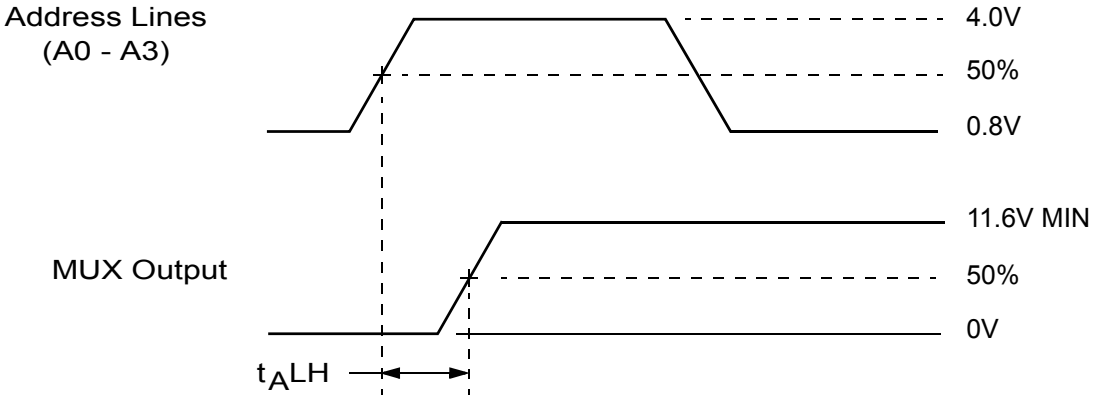
## TRUTH TABLE (CH32 – CH47)

| A3 | A2 | A1 | A0 | EN(32-47) | "ON" CHANNEL 1/ |
|---|---|---|---|---|---|
| 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 |

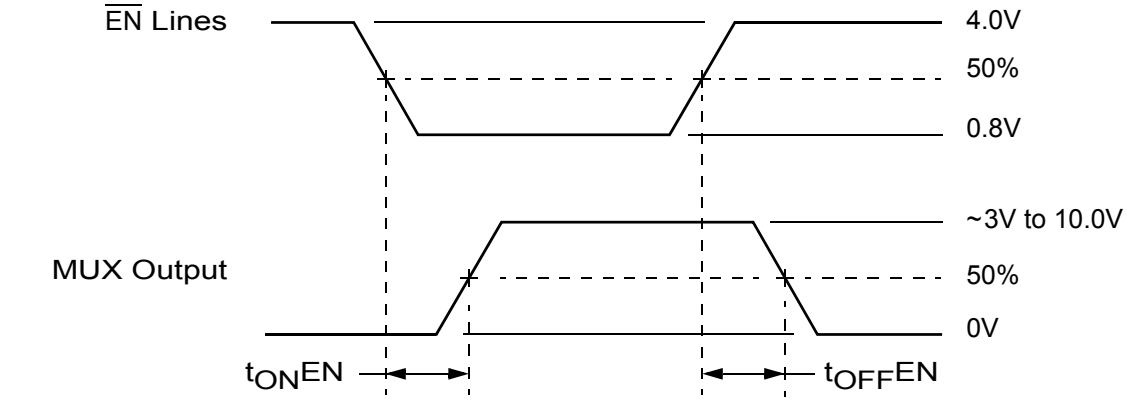
1/ Between CH32-47 and OUTPUT (32-47) and CURRENT (32-47)




Definition of $t_AHL$




Definition of $t_ALH$




Definition of $t_{ON}EN$ and $t_{OFF}EN$

NOTE: f = 10KHz, Duty cycle = 50%.

## ACT8506 SWITCHING DIAGRAMS

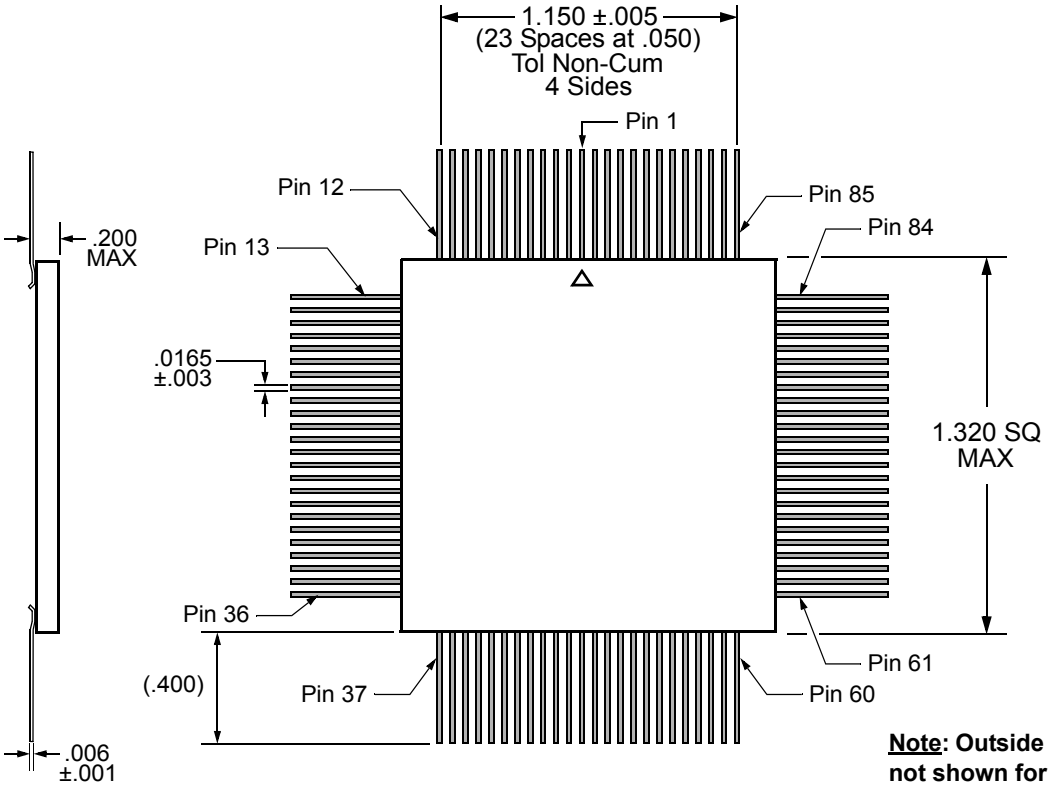
# PIN NUMBERS & FUNCTIONS

| ACT8506 – 96 Leads Ceramic QUAD Flat Pack | | | | | |
|---|---|---|---|---|---|
| **Pin #** | **Function** | **Pin #** | **Function** | **Pin #** | **Function** |
| 1 | A2 | 33 | CH11 | 65 | CH33 |
| 2 | NC | 34 | NC | 66 | CH32 |
| 3 | A3 | 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 | +VEE | 76 | CH28 |
| 13 | CH3 | 45 | NC | 77 | CH27 |
| 14 | NC | 46 | -VEE | 78 | CH26 |
| 15 | CH4 | 47 | NC | 79 | CH25 |
| 16 | NC | 48 | VREF | 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 | A0 |
| 30 | NC | 62 | CH36 | 94 | NC |
| 31 | CH10 | 63 | CH35 | 95 | A1 |
| 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 | DLA SMD # | Screening | Package |
|---|---|---|---|
| ACT8506-7 | - | Commercial Flow, +25°C testing only | QUAD Flat Pack |
| ACT8506-S | 5962-0323402KXC | In accordance with DLA SMD | |
| ACT8506-901-1S | 5962F0323402KXC | In accordance with DLA Certified RHA Program Plan to RHA Level "F", 300krads(Si) | |




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

## FLAT PACKAGE OUTLINE

***EXPORT CONTROL:***

*This product is controlled for export under the International Traffic in Arms Regulations (ITAR). A license from the U.S. Government is required prior to the export of this product from the United States.*


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*Datasheet Definitions:*

| | |
|---|---|
| *Advanced* | *Product in Development* |
| *Preliminary* | *Shipping Non-Flight Prototypes* |
| *Datasheet* | *Shipping QML and Reduced HiRel* |

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