PART NUMBER	**6N140A/L2/L2S**
COMPONENT	**Issue 1**
SPECIFICATION	**September 2013**

CERAMIC HERMETICALLY SEALED, RADIATION HARD HIGH GAIN OPTOCOUPLER

FEATURES

- Released to European Standard and complies to Mil-Std
- Total Ionizing Dose Tested to 30Krad(si)*
- Withstand Test Voltage 2500vdc
- 16-pin DIL Package
- Low Input Requirements 0.5mA
- Displacement Damage Tested to 3 MEV $x10^{12}$
- High Current Transfer Ratio (Typically 1000%)
- Hermetically Sealed

APPLICATIONS

- Space Radiation Equipment
- Military/High Reliability Systems
- Medical Instruments
- MOS/CMOS Applications
- Logic Interfacing
- Power Supply
- Data Transmission
- Modems

DESCRIPTION

These devices are single, hermetically sealed optically coupled isolators. Each channel is composed of a Gallium Arsenide infra-red emitting diode and a high gain photon detector. The high gain output stage features an open collector output providing both lower output saturation and higher speed of operation than is possible with conventional photo-darlington type couplers.

The 6N140A series are being used in environments encounted by space applications. It is manufactured to meet the JANS standard in conjunction with MIL-PRF-19500 procedures (please see next page for all other applicable specifications). Package styles for this device include 16-pin DIL package with surface mount and solder dip options available. These packages have a shield effect to cut off ambient light as they are designed for high density mounting applications.

Absolute maximum ratings, recommended operating conditions, electrical specifications and performance characteristics are identical for all units. Any exceptions, due to packaging variations and limitations, are as noted.

STANDARDS

The following specifications have been included in the manufacturing of this product:

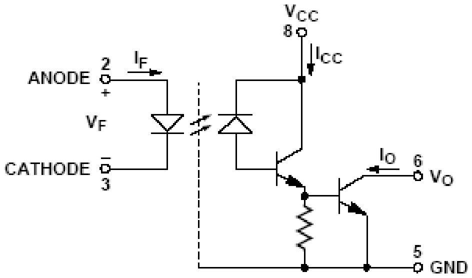
Military Compliance Specifications

MIL-PRF-19500 – General Specification for Discrete Semiconductor Devices
IECQ – M1077

Military Compliance Standards

MIL-STD-202 – Test Method Standard Electronic and Electrical Component Parts
MIL-STD-883 – Test Method Standard Microcircuits
MIL-STD-750 – Test Methods for Semiconductor Devices
ISO 9001:2008 – Manufacturing of Optocouplers and Optoelectronic components.

SINGLE CHANNEL SCHEMATIC



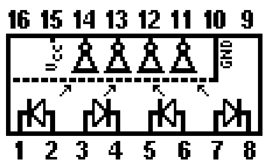
SELECTION GUIDE PACKAGE STYLES AND CONFIGURATION OPTIONS

Package	16-pin DIL
Channels	4
Isocom Part Number and Options	
Commercial	6N140A
Defense Screen Level	6N140A/L2
Space Screen Level	6N140A/L2S
Standard Gold Plate Finish	Gold Plate
Butt Joint	Option 10
Solder Dipped	Option 20
Gull Wing	Option 30
Butt Joint	Option 60

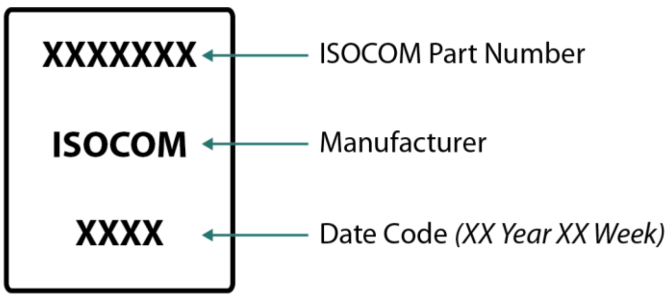
Changes to lead formation style and common channel wiring is available upon request

FUNCTIONAL DIAGRAMS

6N140A
16-pin DIL
4 Channel



DEVICE MARKING



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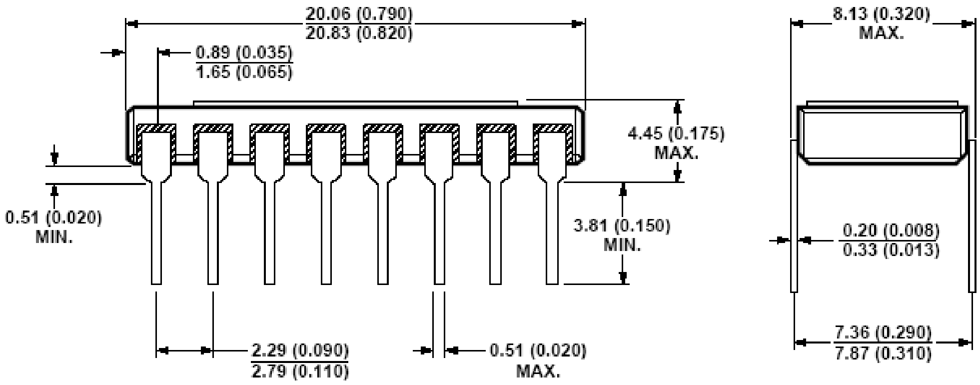
OUTLINE DRAWINGS



ABSOLUTE MAXIMUM RATINGS

T_A = 25°C U.O.S.

Storage Temperature	-65°C to +150°C
Operating Temperature	-55°C to +125°C
Lead Soldering Temperature	260°C 1.6mm from case for 10S
Input-to-Output Isolation Voltage	⇧2500VDC

Input Diode

Peak Forward Current	20mA	≤ 1 mS duration, 500pps
Average Forward Current	10mA	(see note 3)
Reverse Voltage	5V	
Power Dissipation	35mW	

Output Detector

Supply Voltage	0.5V to 20V	Vcc (see note 1)
Average Current	40mA	
Collector Power Dissipation	50mW	(see note 2)

ELECTRICAL CHARACTERISTICS

T_A = -55°C to +125°C U.O.S.

Parameter	Symbol	Test Conditions	Min	Type	Max	Units
Current Transfer Ratio (see notes 4&5)	CTR	V_{CC} =4.5V, V_O=0.4V, I_F = 0.5mA	300	700	-	%
		V_{CC} =4.5V, V_O=0.4V, I_F = 1.6mA	200	1000	-	%
		V_{CC} =5V, V_O=0.4V, I_F = 5mA	200	600	-	%
Logic low output voltage (see note 4)	V_{OL}	V_{CC} =4.5V, I_F = 1.0mA, I_{OL}=1.5mA	-	-	0.4	V
		V_{CC} =4.5V, I_F = 5mA, I_{OL}=10mA	-	0.15	0.4	V
Logic high output current (see notes 3,5 & 6)	I_{OH}	V_F =0.7V , V_O= V_{CC}=18V, (channel under test) V_F=8mA (other channel)	-	0.001	250	µA
Logic high supply current	I_{CCH}	I_F = 0, V_{CC}=18V	-	0.1	40	µA
Logic low supply current (see note 4)	I_{CCL}	V_{CC}=18V, I_F = 1.6mA	-	-	1.0	mA
Input forward voltage (see note 4)	V_F	I_F = 1.6mA, T_A = 25°C	-	1.45	1.7	V
Input-Output Insulation Leakage Current (see note 7 & 13)	I_{I-O}	RH=45%, t=5S, T_A = 25°C, V_{I-O}= 1500vdc	-	-	1.0	µA
Input reverse breakdown (see note 4)	V_{BR}	I_R = 10µA, T_A = 25°C	5	-	-	V
Propagation Delay H-L (see note 4)	t_{PHL}	R_L = 4.7KΩ, V_{CC} = 5V,I_F =1.0mA	-	35	100	µS
		R_L = 680Ω, V_{CC} = 5V,I_F = 5mA	-	3	12	µS
Propagation Delay L-H (see note 4)	t_{PLH}	R_L = 4.7KΩ, V_{CC} = 5V,I_F =1.0mA	-	8.0	20	µS
		R_L = 680Ω, V_{CC} = 5V,I_F = 5mA	-	-	60	µS
Common Mode Transient Immunity at Logic High Output (see note 4, 10 &12)	CM_H	V_{CC} =5V, I_F = 0mA, V_{cm} =50V_{p-p}, R_L = 1.5KΩ	500	-1000	-	V/µS
Common Mode Transient Immunity at Logic Low Output (see note 4, 10 &12)	CM_L	V_{CC} =5V, I_F = 0mA, V_{cm} =50V_{p-p}, R_L = 1.5KΩ	-500	-1000	-	V/µS

TYPICAL CHARACTERISTICS

$T_A = 25°C$

Parameter	Symbol	Test Conditions	Notes	Min	Type	Max	Units
Resistance	R_{IO}	V_{10} = 500Vdc	4 & 8	-	10^{12}	-	Ω
Capacitance	C_{IO}	f = 1MHz	4 & 8	-	1.5	-	pF
Input Capacitance	C_{IN}	f = 1MHz, V_F = 0	4	-	60	-	pF
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$	I_F = 1.6mA	1	-	-1.8	-	mV/°C
Input-Input Insulation Leakage Current	I_{I-I}	45% Relative Humidity V_{II} = 500Vdc, t = 5S, T_A = 25°C	9	-	0.5	-	nA
Resistance (input-output)	R_{I-O}	V_{Io} = 500Vdc	9	-	10^{12}	-	Ω
Resistance (input-input)	R_{I-I}	V_{Io} = 500Vdc, T_A = 25°C	9	-	10^{12}	-	Ω
Capacitance(input-output)	C_{I-O}	f = 1MHz, T_A = 25°C	9	-	1.5	-	pF
Capacitance(input-input)	C_{I-I}	f = 1MHz, T_A = 25°C	9	-	1.0	-	pF

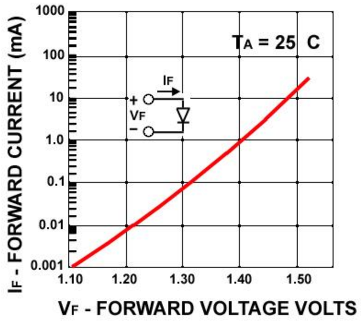
Notes:

1. The ground pin should be the most negative voltage at the detector side. Keeping V_{CC} as low as possible, but greater than 2.0V, will provide lowest total I_{OH} over temperature.
2. Output power is collector output plus one fourth of total supply power. Derate at 1.66mW/°C above 110°C.
3. Derate I_F at 0.33mA/°C above 110°C.
4. Each channel.
5. Current Transfer Ratio is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. I_{OHX} is the leakage current resulting from channel to channel optical crosstalk. I_F = 2µA for channel under test. For all other channels, I_F = 10mA.
7. Input pins are shorted together, and output pins are shorted together.
8. Measured between the LED anode and cathode shorted together and pins at output shorted together.
9. Measured between adjacent input pairs shorted together.
10. CM_H is the maximum tolerable common mode transient to assure that the output will remain in a high logic state (i.e., $V_O > 2.0V$).
11. CM_L is the maximum tolerable common mode transient to assure that the output will remain in the logic low state (i.e., $V_O < 0.8V$).
12. In applications where dV/dt may exceed 50,000V/µS (such as a static discharge), a series resistor, R_{CC}, should be included to protect the detector IC's from destructively high surge currents. The recommended value is:

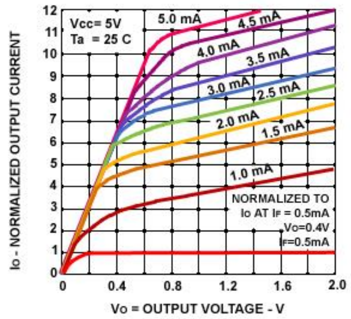
$$R_{CC} = \frac{1V}{0.6 I_F(mA)} k\Omega$$

13. This is a momentary withstand test, not an operating condition.

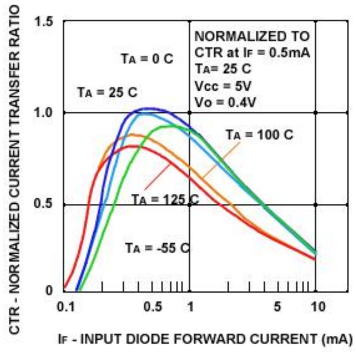
ELECTRICAL CHARACTERISTICS



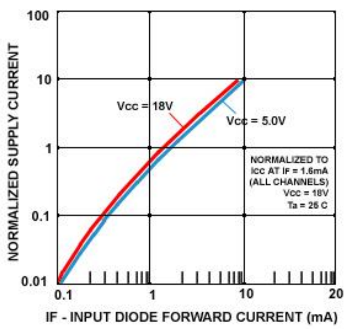
INPUT DIODE FORWARD CURRENT vs FORWARD VOLTAGE



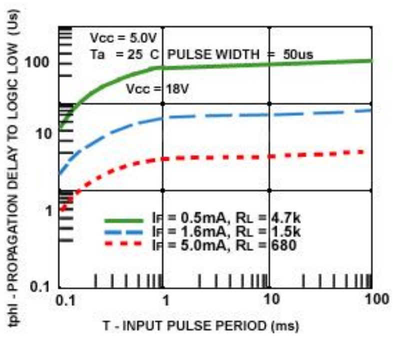
Normalized DC Transfer Characteristics



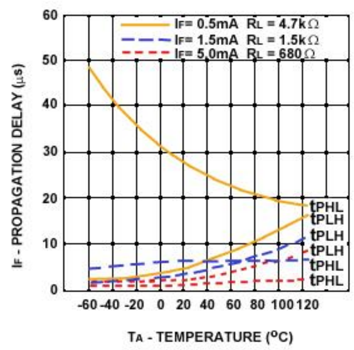
NORMALIZED CURRENT TRANSFER RATIO vs INPUT DIODE FORWARD CURRENT



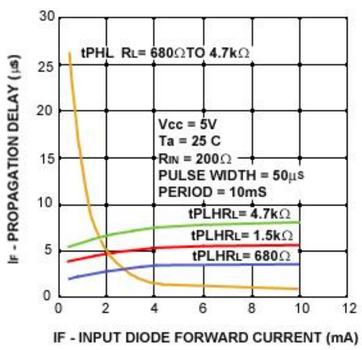
NORMALIZED SUPPLY CURRENT vs INPUT DIODE FORWARD CURRENT



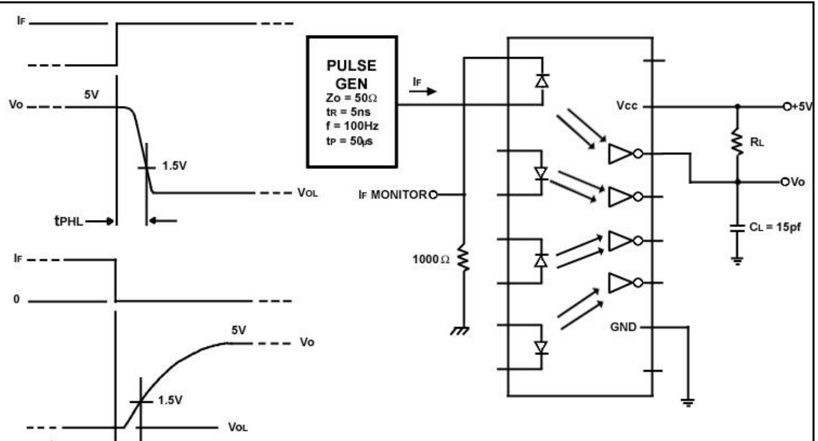
PROPAGATION DELAY TO LOGIC LOW vs INPUT PULSE PERIOD



PROPAGATION DELAY vs TEMPERATURE



PROPAGATION DELAY vs INPUT DIODE FORWARD CURRENT



SWITCHING TEST CIRCUIT

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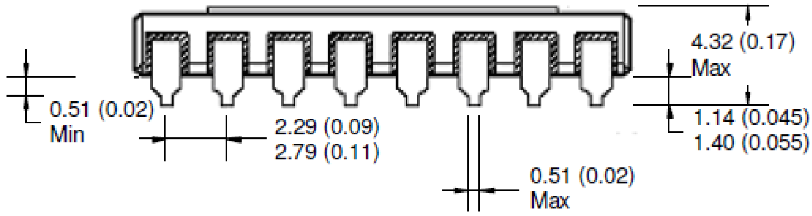
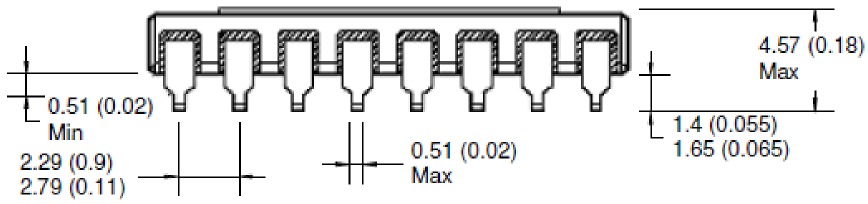
HERMETIC OPTOCOUPLER OPTIONS

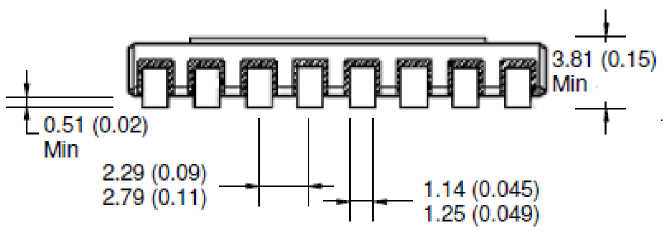
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>10</td><td>Surface mountable hermetic optocoupler with leads trimmed for butt joint assembly. This option is available on commercial hi-rel product in 16-pin DIL



</td></tr>
<tr><td>20</td><td>Solder Dipped</td></tr>
<tr><td>30</td><td>Surface mountable hermetic optocoupler with leads cut and bent for gull wing assembly. This option is available on commercial and hi-rel product in 16-pin DIL



</td></tr>
<tr><td>60</td><td>Surface mountable hermetic optocoupler with leads trimmed for butt joint assembly. This option is available on commercial hi-rel product in 16-pin DIL



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</table>

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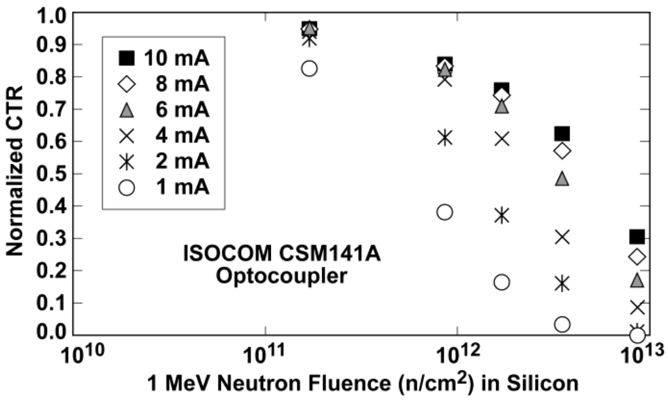
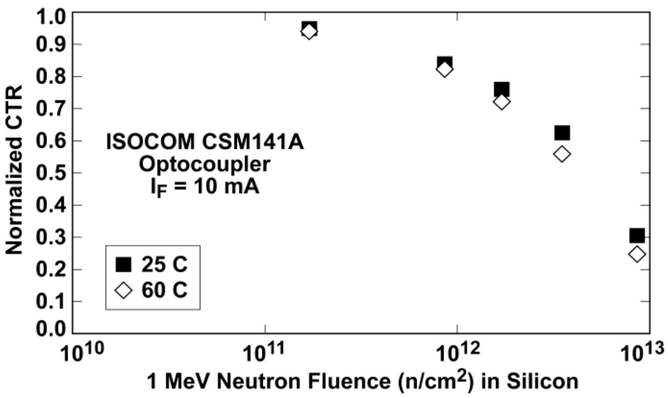
A. *ISOCOM HIGH Gain Optoisolators family using samples of* ***6N140A***

Displays the average normalized CTR for four samples versus the neutron equivalence fluencies for each tested value of I_F (1, 2, 4, 6, 8 and 10 mA).



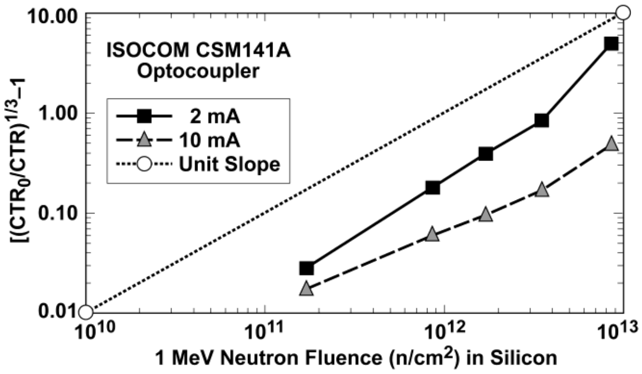
Normalized CTR versus the radiation level for the 6N140A.

In Figure below we compare the measured CTR at room temperature and elevated temperature of 60° C for the 6N140A. Contrary to our expectations, the measurements show very little temperature dependence. The small dependence that is seen is in the expected direction; that is, the CTR is lower at 60˚ C compare to CTR at room temperature.



Normalized CTR versus the radiation level for room temperature and 60° C for 6N140A.

The plotting format explained in the discussion of Fig. 4 using n = 1/3 for the 6N140A, produces



Values of $[(CTRo/CTR)^{1/3} – 1]$ for I_F = 2 and 10 mA for 6N140A.

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GROUP TESTING to MIL-STD 750

GROUP	TEST	MIL-STD-750	READ AND RECORD
Group A			
SG1	Visual inspection & mechanical dimensions	Method 2071	
SG2	DC static test at 25°C		yes
SG3	DC static test at 125°C and -55°C		yes
SG4	Dynamic test at 25°C		yes
Group B			
SG 1	Physical dimensions	Method 2066	
SG 2	Solderability	Method 2026	
	Resistance to solvents	Method 1022	
SG 3	Thermal Shock	Method 1056 Cond. B, 25 cycles	
	Temperature cycling	Method 1051 -55/+125°C	
	Hermetic seal fine and gross leak	Method 1071, Cond. H (fine), Cond. C (gross)	
	Electrical measurement	pre and post	yes
	Decap internal visual inspection	2075	
	Bond strength	Method 2037, Cond. D	yes
	Die shear	Method 2017	yes
SG 4	Intermittent operation life	Method 1037, 1042, Cond D, Tab.5-5	
	Hermetic seal fine and gross leak	Method 1071, Cond. H (fine), Cond. C (gross)	
	Electrical measurement	pre and post	yes
	Bond strength	Method 2037, Cond. D	yes
SG 5	Acc. steady-state operation life	Method 1027	
	Electrical measurement	pre and post	yes
	Bond strength	Method 2037, Cond. D	yes
Group C			
SG 2	Thermal Shock	Method 1056, Cond. B, 25 shocks	
	Temperature cycling	Method 1051, Cond. C, -55/+125°C , 25 cycles (total 45 cycles including screening)	
	Hermetic seal fine and gross leak	Method 1071, Cond. H (fine), Cond. C (gross)	
	Moisture resistance	Method 1021	
	Electrical measurement	pre and post	yes
SG 3	Mechanical shock	Method 2016, non-operating, 1500 G, 0.5 ms, 5 blows in each orientation (X1,Y1,Z1)	
	Vibration	Method 2056	
	Constant acceleration	Method 2006, at a peak level of 5000 G	
	Electrical measurement	pre and post	yes
SG 6	Steady state operating life Not required as B5 is available on same lot		

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100% SCREENING to MIL-STD 750

TEST	MIL-STD-750	READ AND RECORD
Internal Visual	2072	
Sealing		
(Fine Leak)	1071, Condition H1	
(Gross Leak)	1071, Condition C	
Temp Cycling	1051, Condition B-55/+125°C, 20 Cycles.	
Const. Acceler	2006, 5000G, Y1 only.	
PIND	2052, Condition A	
Radiography	2076	
Initial Electrical	125°C, -55°C, 25°C	R & R
HTRB	1039	
Interim Electrical	25°C only	R & R
Burn-In	1039	
Final Electrical	125°C, -55°C, 25°C	R & R
PDA	Max. 5%, pre/post B1 electrical and delta at RT only	Calculate & R
(Fine Leak)	1071, Condition H1	
(Gross Leak)	1071, Condition C	
Solder Dip		
Fine Leak	1071, Condition H1	
Gross Leak	1071, Condition C	

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Space Qualification

PROCESS FLOW CHART FOR PACKAGED DEVICES

- QA INSPECTION
- 100% DC PROBE
- WAFER SCRIBE & BREAK
- BOND PULL TEST
- DIE SHEAR TEST
- HIGH TEMPERATURE BAKE
- WAFER SELECTION
- VISUAL INSPECTION
- ANALYSIS
- MIL QA VISUAL INSPECTION & SPACE ONLY
- SERIALISATION
- ASSEMBLE
- 100% RTH MEASUREMENT
- 100% PRE-CAP VISUAL INSPECTION
- PACKAGE SEAL
- MARKING
- 100% TEMP CYCLE - 20 CYCLES
- 100% CONSTANT ACCELERATION 5000G
- HERMETIC SEAL TEST 100% FINE & GROSS
- 100% GROUP A ELECTRICAL TEST R&R
- 100% HTRB
- 100% GROUP A ELECTRICAL TEST R&R
- 100% DC POWER BURN-IN: 240hr @ Tch=125˚C
- 100% ELECTRICAL DELTA EVALUATION
- PDA ONLY SAMPLES
- 100% QA FINAL INSPECTION
- SHIP

M1077 & E1280/F

UKAS MANAGEMENT SYSTEMS 0005

aerospace sector certification scheme

GB15/92780

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Space Qualification

PROCESS FLOW CHART FOR PACKAGED DEVICES

Group B Testing	*MIL-STD-883	*MIL-STD-750
Physical Dimensions	Method 2016	Method 2066
Solderability	Method 2003	Method 2023
Resistance to Solvents	Method 2015	Method 1022
Temperature Cycling	Method 1010	Method 1051
• *Military Grade*	25 cycles	25 cycles
• *Space Grade*	50 cycles	50 cycles
Steady State Life (Tch 175°C / 340hr minimum)	Method 1005	Method 1027
DPA	*MIL-STD-1580A	*MIL-STD-1580A
	*Unless otherwise indicated	*Unless otherwise indicated

Environmental & Mechanical Testing Specifications		
	***MIL-STD-883**	***MIL-STD-750**
Hermetic Seal Test	Method 1014	Method 1071
• *Fine Leak*	Condition A1	Condition G or H
• *Gross Leak*	Condition C	Method 1051
Temperature Cycle *(Standard Military Level)*	Method 1010, Condition C	Method 1051, Condition C
Temperature Cycle *(Standard Space Level)*	Method 1010, Condition C	Method 1051, Condition C
Constant Acceleration	Method 2001	Method 2006
PIND Test	Method 2020	Method 2052, Condition A
RTH Measurement	Method 1012	
HTRB *(High Temperature Reverse Bias)*	Method 1015, Condition A	Method 1042, Condition B
DPA	*MIL-STD-1580A	*MIL-STD-1580A
	*Unless otherwise indicated	*Unless otherwise indicated

Inspection Table		
COMMERCIAL	**MILITARY**	**HI-REL / SPACE**
AQL Sampling Plan	MIL-STD-883, Method 2010, Class Level B	MIL-STD-883, Method 2010, Class Level S
Isocom Internal Specifications	MIL-STD-750, Method 2070, 2071,2072	MIL-STD-750, Method 2070, 2071,2072

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