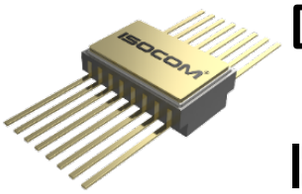
PART NUMBER CSM166



COMPONENT SPECIFICATION ISSUE 9

Component Specification For Ceramic Hermetically Sealed, Radiation-Hard Transistor Optocouplers

Features	Applications
▪ Radiation Tolerance tested up to 150 Krad(Si) ▪ High Isolation Voltage up to 1,500 V_{DC} ▪ High Current Transfer Ratio ▪ Hermetically Sealed	▪ Space Radiation Equipment ▪ Military and high reliability systems ▪ Medical instruments ▪ MOS/CMOS Applications ▪ Logic Interfacing ▪ Data Transmission ▪ Power Supply ▪ Modems

DESCRIPTION

The CSM166 is a hermetically sealed, dual or quad channel optically coupled isolator. Each channel is composed of a Gallium Arsenide infrared emitting diode and silicon phototransistor.

The series is being used in environments encountered by space applications. Package styles for this device include a 16-Pin flatpack package, with solder dip options available.

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.

ISOCOM Limited is AS9100 certified for the design and manufacture of electronic and optoelectronic components.

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STANDARDS

The following specifications have been complied with in the manufacturing of this product -

Aerospace Compliance Standards

AS9100D & ISO 9001:2015 – Design & Manufacture of Electronic and Optoelectronic Components *(Ref GB15/92780)*

Military Compliance Specifications

MIL-PRF-38534 – General Specification for Hybrid Microcircuits
MIL-PRF-19500 – General Specification for Discrete Semiconductor Devices

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 Method Standard for Semiconductor Devices

SCREENING INFORMATION

Our products can be screened to MIL-PRF-38534, applying test methods from MIL-STD-883; MIL-PRF-19500, applying test methods of MIL-STD-750; or a combination thereof. Please contact us for more information relating to the applicable screening processes.

AMENDMENT RECORD

Issue No.	Date	Description
1	December 2013	First Issue.
2	May 2018	Updated Standards Section.
3	May 2018	Updated Standards Section. Removed Screening and Group Testing Information.
4	September 2020	Updated Quality Management Logos. Removed IECQ Logos.
5	January 2021	Removed Lot Definitions.
6	May 2022	Added Radiation Testing and Electrical Testing diagrams, Updated Format, Added Render
7	June 2022	Updated Electrical Characteristic Graphs and Added Screening Flow
8	June 2023	Updated Marking Image
9	August 2023	Added pin configuration, updated screening, updated circuit drawings, updated electrical characteristics

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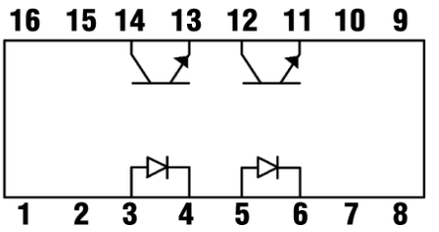
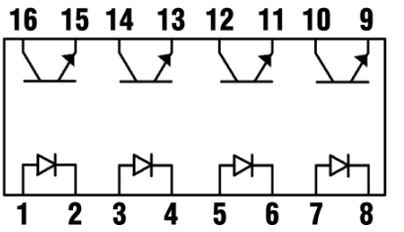
PACKAGE STYLES AND CONFIGURATION OPTIONS

Package	16-FLP	
Lead Style	-	
Channels	2	4
Common Channel Wiring	-	
Isocom Part Number and Options		
Commercial	CSM166-2	CSM166-4
Defense Screen Level	CSM166-2/L2	CSM166-4/L2
Space Screen Level	CSM166-2/L2S	CSM166-4/L2S
Standard Finish	Gold Plate	
Solder Dipped	Option #20	

FUNCTIONAL DIAGRAMS

CSM166-2	CSM166-4
16-FLP	
2 Channels	4 Channels
	

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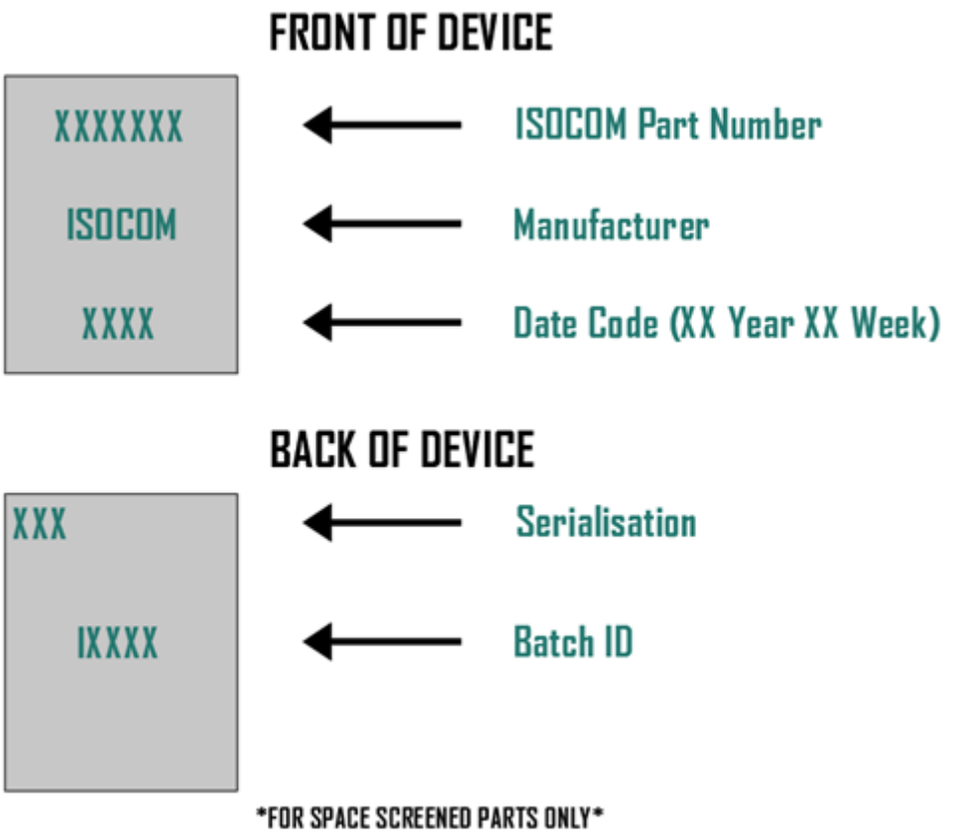
PIN OUT

	PIN NUMBER	FUNCTION
CSM166-2	1	NC
	2	NC
	3	Anode
	4	Cathode
	5	Anode
	6	Cathode
	7	NC
	8	NC
	9	NC
	10	NC
	11	Emitter
	12	Collector
	13	Emitter
	14	Collector
	15	NC
	16	NC

	PIN NUMBER	FUNCTION
CSM166-4	1	Anode
	2	Cathode
	3	Anode
	4	Cathode
	5	Anode
	6	Cathode
	7	Anode
	8	Cathode
	9	Emitter
	10	Collector
	11	Emitter
	12	Collector
	13	Emitter
	14	Collector
	15	Emitter
	16	Collector

DEVICE MARKING



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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 10 seconds	
Input-to-Output Isolation Voltage	⇧1,500 V_{DC}	
Input Diode		
Forward DC Current	50mA	
Reverse DC Voltage	7V	
Peak forward Current	1.5A	≤ 10µs
Power Dissipation	150mW	
Output Transistor		
Collector-Emitter Voltage	70V	
Emitter-Collector Voltage	7V	
Collector-Base Voltage	70V	≤ 10µs
Collector Current	100mA	t =1ms
Power Dissipation	150mW	Derate linearly above 100ºC at 1.4W/ºC
Coupled Device		
Power Dissipation	360mW	
Soldering Temperature, Soldering Iron	260.5°C	This part shall not be re-soldered until 3 minutes have elapsed.
Soldering Temperature, Vapour Phase	220.40°C	This part shall not be re-soldered until 3 minutes have elapsed.
ESD Classification	Class 2	Class 2 with minimum critical path voltage of 4,000 to 15,999V. MIL-STD-883

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ELECTRICAL CHARACTERISTICS

T_A = -55°C - 125°C U.O.S.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Input Diode Electrical Characteristics						
Forward Voltage	V_F	I_F = 10mA	0.7	1.2	1.8	V
Reverse Current	I_R	V_R = 3.0V	-	-	100	µA
Output Detector Electrical Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 0.1mA	70	100	-	V
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_B = 100µA	70	200	-	V
Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E = 0.1mA	7	9	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_B = 1mA	5	-	-	V
Collector–Emitter Leakage Current	I_{CEO}	V_{CE} = 20V, I_F = 0A	-	7	100	µA
Coupled Electrical Characteristics						
DC Current Transfer Ratio (Pre-Radiation)	I_C/I_F	I_F = 1.0mA, V_{CE} = 1V	200	-	-	%
		I_F = 3.0mA, V_{CE} = 1V	200	-	-	%
		I_F = 15.0mA, V_{CE} = 1V	100	-	-	%
		I_F = 10.0mA, V_{CE} = 5V	350	-	-	%
		I_F = 15.0mA, V_{CE} = 5V	100	-	-	%
		I_F = 1.0mA, V_{CE} = 15V	300			%
Collector-Emitter Saturation Voltage	$V_{CE(Sat)}$	I_C = 10.0 mA I_F = 20 mA	-	-	0.22	V
Isolation Voltage (1)	V in-out	T = 5s	1,500	-	-	V_{DC}
Input to Output Resistance (1)	R in-out	V_{IO} = 500V	-	10^{11}		Ω
Rise Time	t_r	R_L = 100Ω, V_{CC} = 10V, I_F = 10mA	-	6	12	µs
Fall Time	t_f	R_L = 100Ω, V_{CC} = 10V, I_F = 10mA	-	6	12	µs
Propagation Delay – H-L	t_{PHL}	R_L = 100Ω, V_{CC} = 10V, I_F = 10mA	-	-	5.0	µs
Propagation Delay – L-H	t_{PLH}	R_L = 100Ω, V_{CC} = 10V, I_F = 10mA	-	-	5.0	µs
DC Current Transfer Ratio (Post-Radiation)	I_C/I_F	I_F = 1.0mA, V_{CE} = 1V	200	-	-	%
		I_F = 3.0mA, V_{CE} = 1V	100	-	-	%
		I_F = 15.0mA, V_{CE} = 1V	66	-	-	%
		I_F = 10.0mA, V_{CE} = 5V	160	-	-	%
		I_F = 15.0mA, V_{CE} = 5V	40	-	-	%
		I_F = 1.0mA, V_{CE} = 15V	250	-	-	%

Notes:

1. Measurements with inputs shorted together and outputs shorted together.

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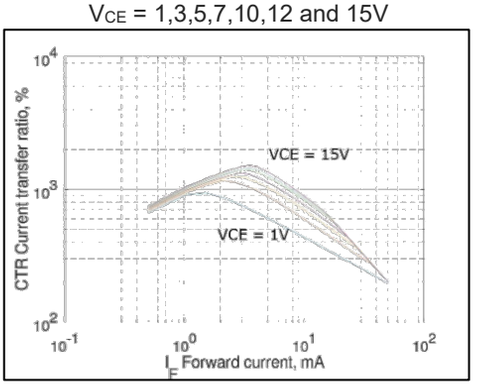
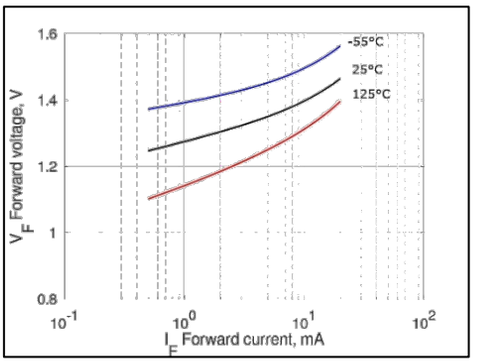
ELECTRICAL CHARACTERISTICS

Typical Graphs – Contact Office for more information

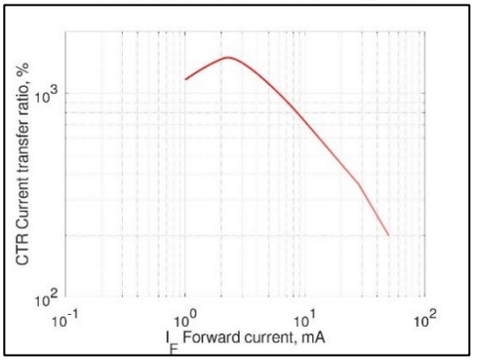
V_{CE} = 1,3,5,7,10,12 and 15V



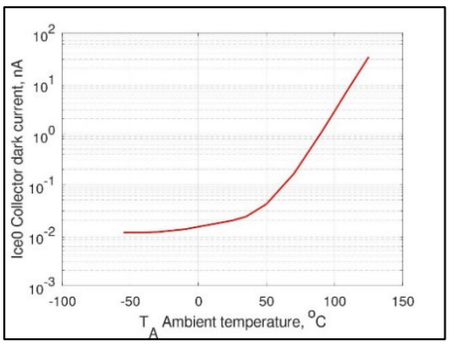
V_F Vs I_F



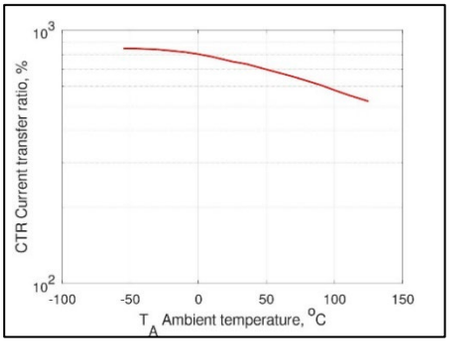
CTR vs I_F: V_{CE} = 5V T_A = 25°C



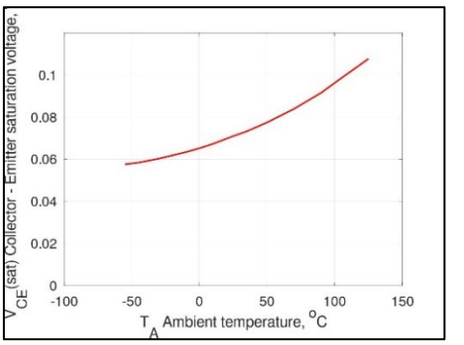
Iceo vs T_A: V_{CE} = 20V



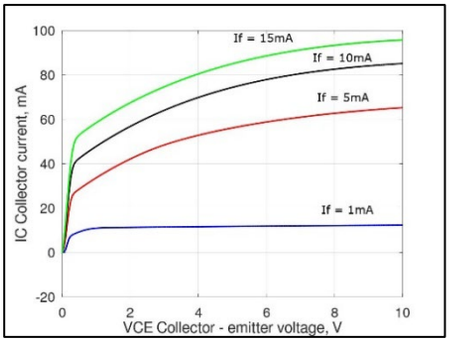
CTR vs T_A: I_F = 10mA V_{CE} = 5V



$V_{CE(sat)}$ vs T_A: I_F = 20mA I_C = 10mA



I_C vs V_{CE}: T_A = 25°C



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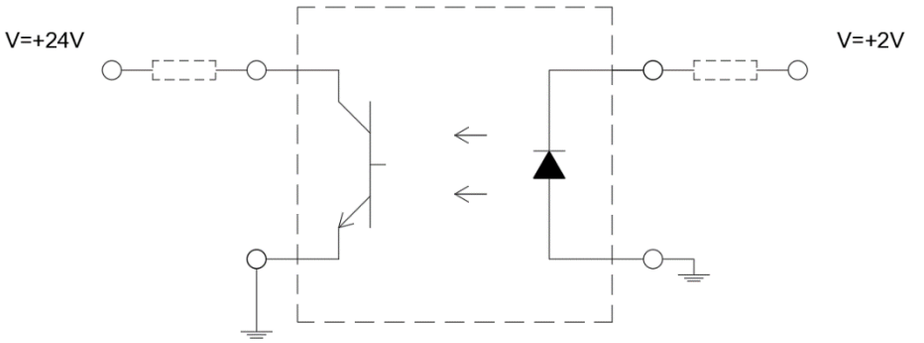
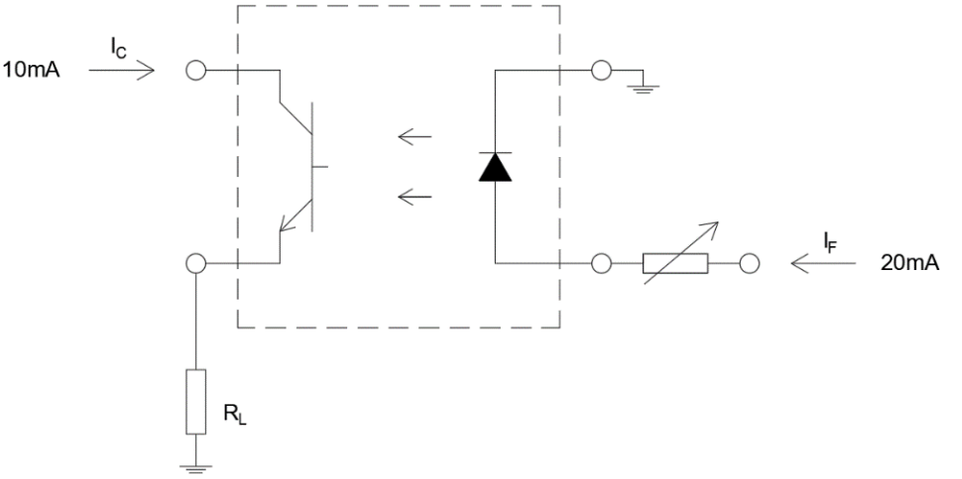
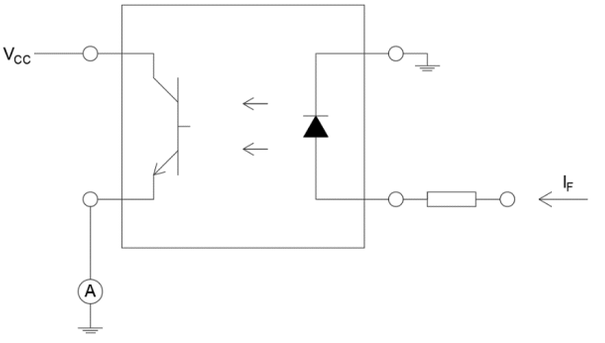
HTRB TEST CIRCUIT



ELECTRICAL CIRCUIT FOR BURN-IN AND OPERATING LIFE TESTS



ELECTRICAL MEASUREMENT OF COLLECTOR CURRENT



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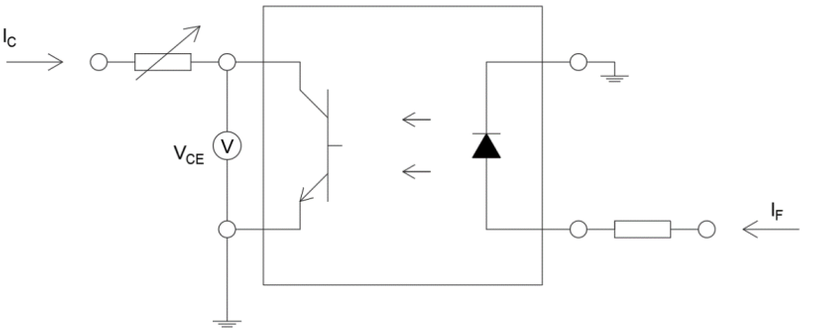
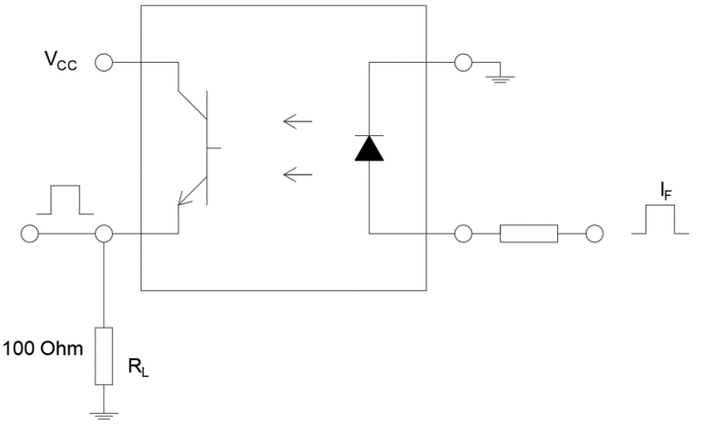
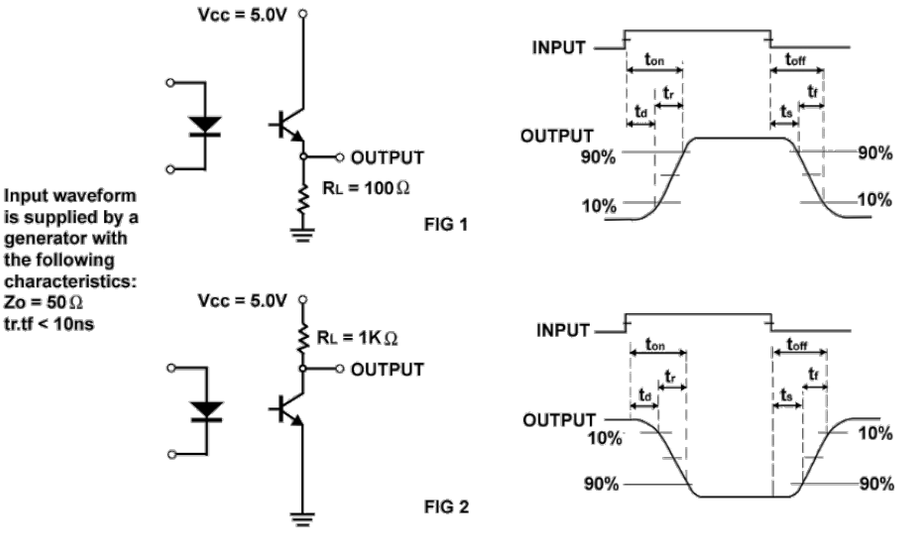
ELECTRICAL MEASUREMENT OF COLLECTOR EMITTER SATURATION VOLTAGE



ELECTRICAL MEASUREMENT OF A.C PARAMETERS



SWITCHING TIME



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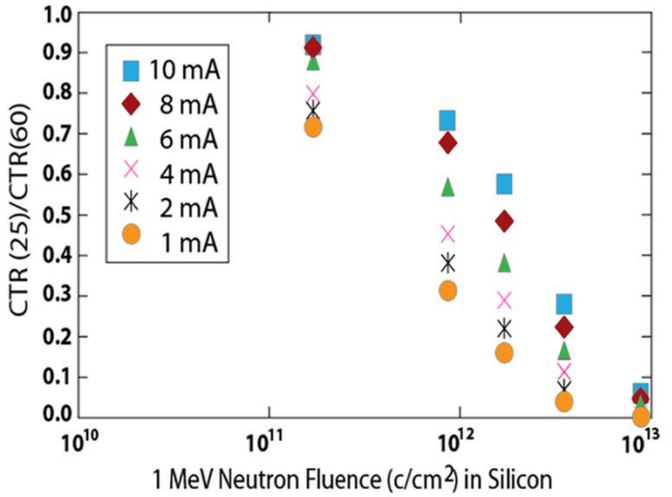
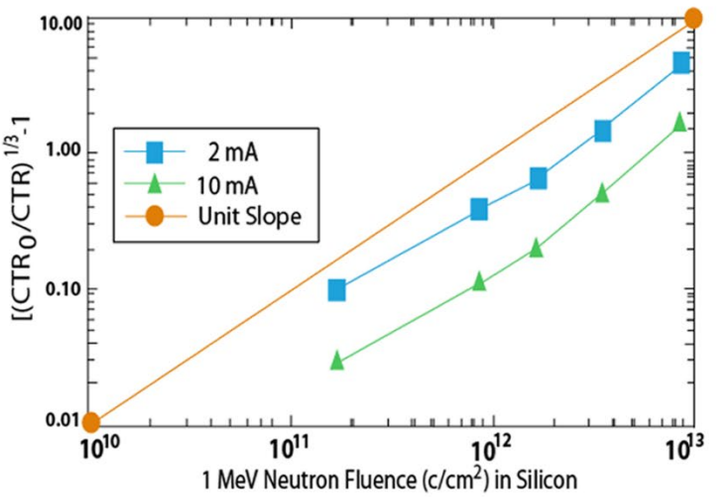
RADIATION TESTING





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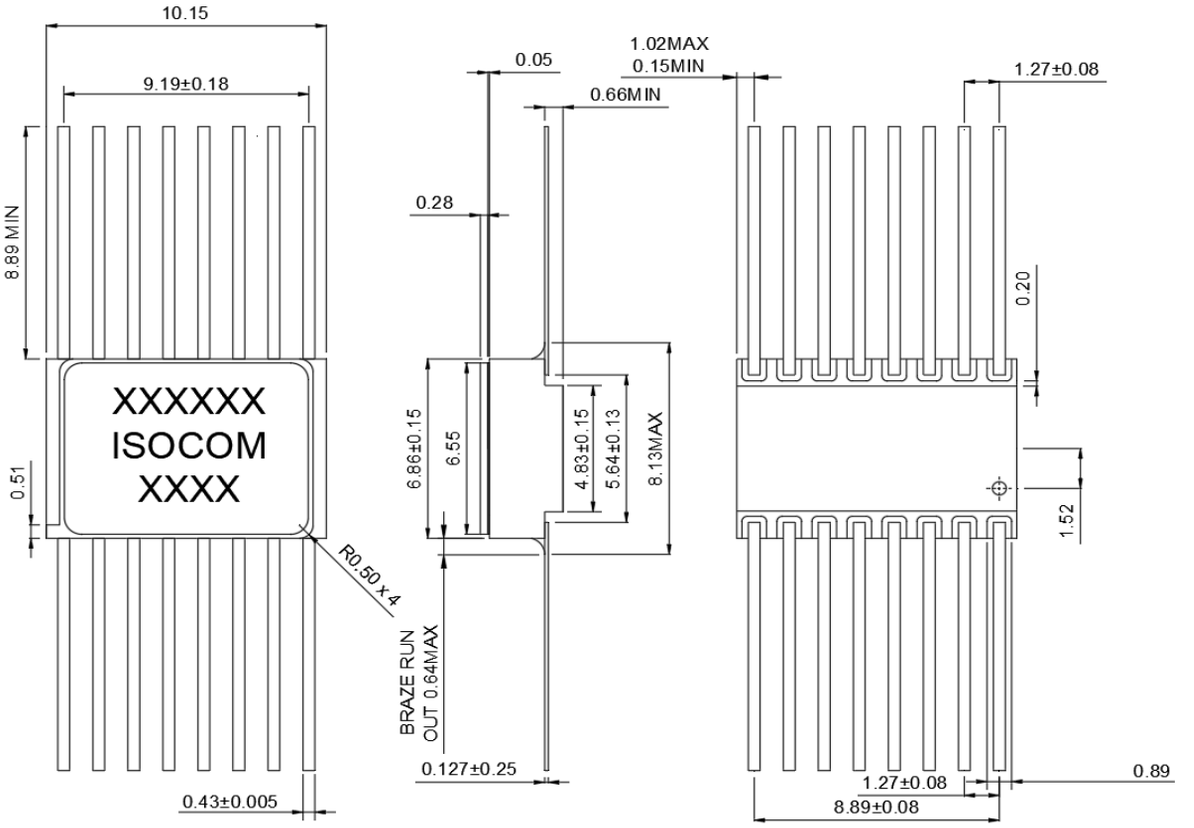
OUTLINE DRAWINGS

16-FLP



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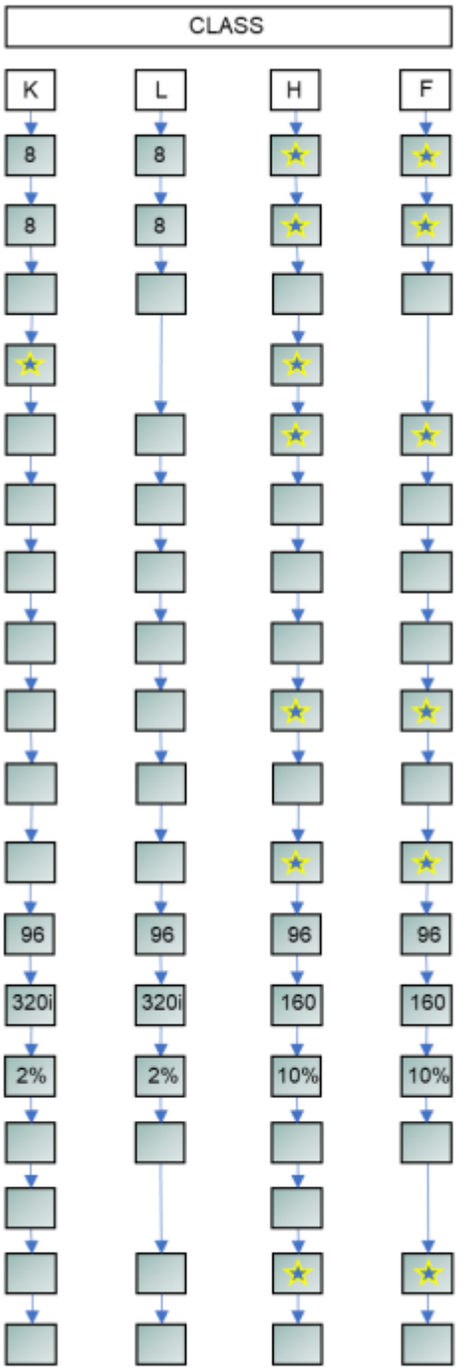
SCREENING IN ACCORDANCE WITH MIL-PRF 38534



WIRE BOND STRENGTH TEST
(DESTRUCTIVE SAMPLE BASIS, NON-DESTRUCTIVE 100% FOR SPACE)

DIE SHEAR TEST
(DESTRUCTIVE SAMPLE BASIS)

INTERNAL (PRE-CAP) VISUAL INSPECTION 100%

HERMETIC SEAL TEST (FINE & GROSS)

SERIALISATION

INITIAL DC TESTS @ 25°C

TEMPERATURE CYCLE 10 CYCLES @ -65 °C to 150°C

ACCELERATION 5000g Y1

PIND TEST

ISOLATION TEST @ 25°C

DC TEST PRE-BURN-IN @ 25°C, 125°C, -55°C AND SWITCHING

HTRB @125 °C

BURN-IN @125°C

PERCENTAGE DEFECTIVE ALLOWED – CLASS
K/L BASED ON SECOND HALF OF B.I ONLY

DC TEST POST-BURN-IN @ 25°C, 125°C, -55°C AND SWITCHING

HERMETIC SEAL TEST (FINE & GROSS)

RADIOGRAPHY

EXTERNAL VISUAL INSPECTION 100%

★ = OPTIONAL

i = INTERIM, E.G. 2 x 160 HOUR BURN-IN

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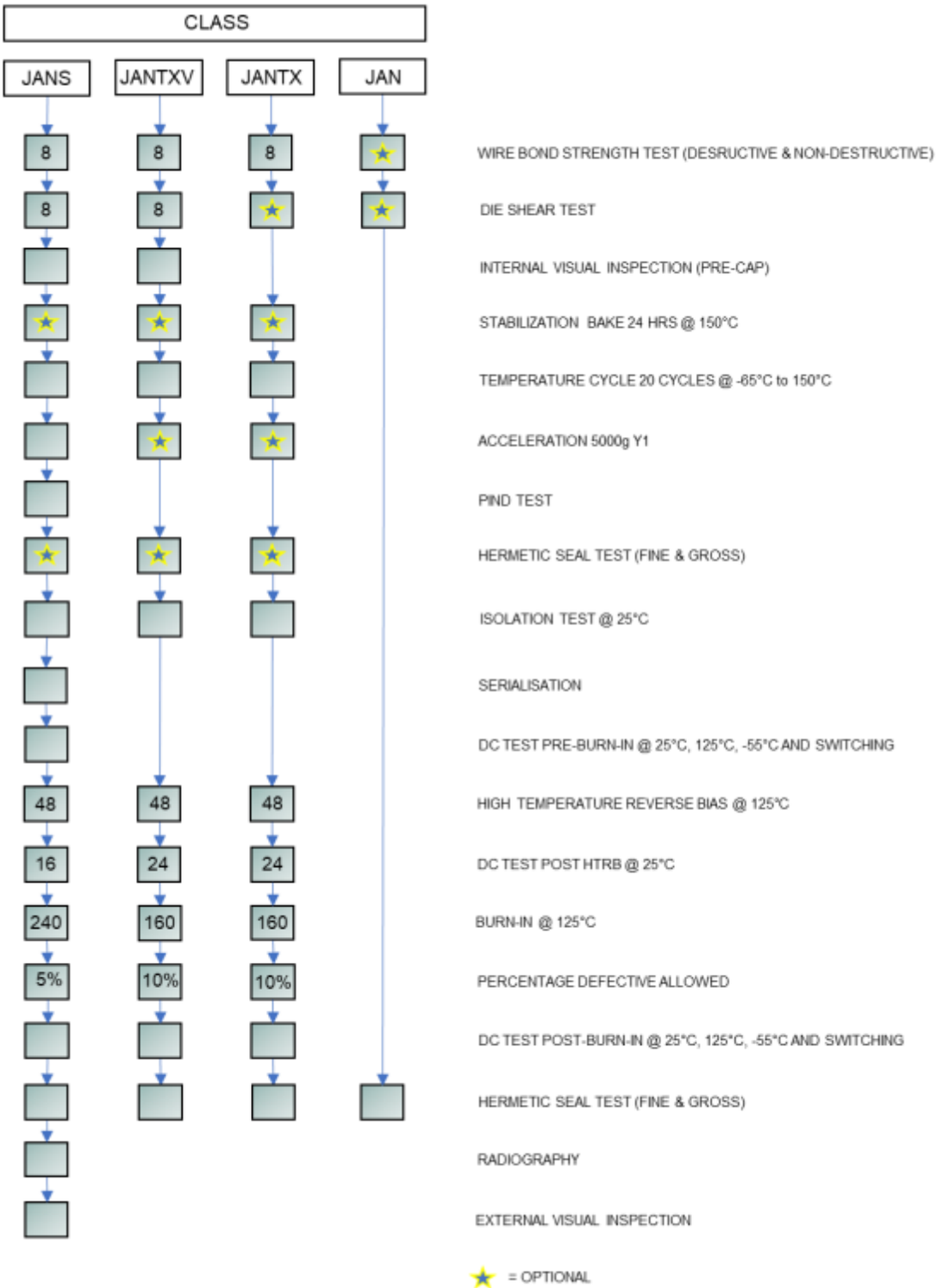
The following screening flow includes the electrical tests between each screening step, the referenced test method from MIL-STD 883 and the sample basis for Class K/L and H/F quality levels.

Operation No.	Operation	MIL-STD 883 TEST METHOD	Class	
			H/F (L2)	K/L (L2S)
1	Wire bond strength (ND)	(883) 2023	Optional	100%
2	Wire bond strength (D)	(883) 2011	Optional	8 devices
3	Die Shear	(883) 2019	Optional	8 devices
4	Internal Visual	(883) 2017	100%	100%
5	Fine leak, Helium bomb, Leak detector	(883) 1014, Con A1	Optional	Optional
6	Gross leak, Liquid bomb, -Bubble chamber	(883) 1014, Con C1	Optional	Optional
7	Serialisation of devices		Optional	100%
8	Electrical Test 25°C		100%	100%
9	Temp cycle @ -65°C to 150°C	(883) 1010, Con C, 10 cycles	100%	100%
10	Electrical Test 25°C		100%	100%
11	Constant acceleration	(883) 2001, 3000g, Y1	100%	100%
12	Electrical Test 25°C		100%	100%
13	P.I.N.D	(883) 2020, Con A	Optional	100%
14	Electrical Test 25°C		100%	100%
15	Isolation 100% @ 25°C	(MIL-STD 202) 301	100%	100%
16	Electrical Test 25°C		100%	100%
17	Electrical Test 125°C		Optional	100%
18	Electrical Test -55°C		Optional	100%
19	Switching time 100% @ 25°C		Optional	100%
20	HTRB @ 125°C - 96 hrs	(883) 1015, con A	100%	100%
21	Electrical Test 25°C		100%	100%
22	Burn in @ 125°C	(883) 1015, con B	100% 160 hours	100% 160 hrs
23	Electrical Test 25°C		100%	100%
24	Burn in @ 125°C	(883) 1015, con B	N/A	100% 160 hrs
25	Percentage defective allowable	Pre/post Burn-in electrical and delta at 25°C only	Max. 10%	Max. 2%
26	Electrical Test 25°C	Group A - SG1	100%	100%
27	Electrical Test 125°C	Group A - SG2	100%	100%
28	Electrical Test -55°C	Group A - SG3	100%	100%
29	Switching time 100% @ 25°C	Group A - SG9	100%	100%
30	Fine leak, Helium bomb, Leak detector	(883) 1014, Con A1	100%	100%
31	Gross leak, Liquid bomb, -Bubble chamber	(883) 1014, Con C1	100%	100%
32	Radiography	(883) 2012	Optional	100%
33	External Visual	(883) 2009	100%	100%

SCREENING IN ACCORDANCE WITH MIL-PRF 19500



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The following screening flow includes the electrical tests between each screening step, the referenced test method from MIL-STD 750 and the sample basis for Class JANTX, JANTXV and JANS quality levels.

Operation No.	Operation	MIL-PRF 19500	Class		
			JANTX (L2)	JANTXV (L2)	JANS (L2S)
1	Wire bond strength (ND)	(883) 2023	100%	100%	100%
2	Wire bond strength (D)	(750) 2037, Con D	4 devices	4 devices	8 devices
3	Die Shear	(750) 2017	4 devices	4 devices	8 devices
4	Internal Visual	(750) 2072	Optional	100%	100%
5	Stabilization Bake		Optional	Optional	Optional
6	Electrical Test @ 25°C		100%	100%	100%
7	Temp cycle (20 cycles @ -65°C to 150°C)	(750) 1051, Con F	100%	100%	100%
8	Electrical Test @ 25°C		100%	100%	100%
9	Constant acceleration	(750) 2006, 5000g, Y1	Optional	Optional	100%
10	Electrical Test @ 25°C		100%	100%	100%
11	P.I.N.D	(750) 2052, Con A	N/A	N/A	100%
12	Electrical Test @ 25°C		N/A	N/A	100%
13	Fine leak, Helium bomb, -Leak detector	(750) 1071 Con H1	Optional	Optional	Optional
14	Gross leak, Liquid bomb, Bubble chamber	(750) 1071, Con C	Optional	Optional	Optional
15	Serialisation of devices		N/A	N/A	100%
16	Isolation 100% @ 25°C	(MIL-STD 202) 301	100%	100%	100%
17	Electrical Test @ 25°C		100%	100%	100%
18	Electrical Test @ 125°C		100%	100%	100%
19	Electrical Test @ -55°C		100%	100%	100%
20	Switching time @ 25°C		100%	100%	100%
21	HTRB (125°C)	(750) 1039, Con A (80% VDS)	100% (48 hrs)	100% (48 hrs)	100% (48 hrs)
22	Electrical Test @ 25°C		100% (24 hrs)	100% (24 hrs)	100% (16 hrs)
23	Burn-In (125°C)	(750) 1039, Con B (80% VDS)	100% (160 hrs)	100% (160 hrs)	100% (240 hrs)
24	Percentage defective allowable	Pre/post Burn-in electrical and delta at 25°C only	100% @ 10% PDA	100% @ 10% PDA	100% @ 5% PDA
25	Electrical Test @ 25°C		100% (Group A, SG 2)	100% (Group A, SG 2)	100% (Group A, SG 2)
26	Electrical Test @ 125°C		100% (Group A, SG 3)	100% (Group A, SG 3)	100% (Group A, SG 3)
27	Electrical Test @ -55°C		100% (Group A, SG 3)	100% (Group A, SG 3)	100% (Group A, SG 3)
28	Switching time @ 25°C		100% (Group A, SG4)	100% (Group A, SG4)	100% (Group A, SG4)
29	Fine leak, Helium bomb, -Leak detector	(750) 1071 Con H1	100%	100%	100%
30	Gross leak, Liquid bomb, Bubble chamber	(750) 1071, Con C	100%	100%	100%
31	Radiography	(750) 2076	N/A	N/A	100%
32	External Visual	(750) 2071	N/A	N/A	100%

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MIL-PRF 19500 TYPICAL QCI TESTING PROCESS FLOW

Group	Sub Group	Parameters	TM	Quantity (accept number)	
				JANS	JANTX, JANTXV
A (CI)	1	Visual and mechanical inspection	750-2071	100%	100%
	2	Static tests at +25°C	Datasheet		
	3	Static tests at min and max. rated operating temp.	Datasheet		
	4	Dynamic test at +25°C	Datasheet		
		(JANS)		Large LOT (accept)	Small LOT (accept)
B (PI)	1	Physical dimension	750-2066	22 (0)	8 (0)
	2	Solderability	750-2026	15 leads (0)	6 leads (0)
	3	Temperature cycling (100 cycles)	750-1051	22 (0)	6 (0)
		Hermetic seal (fine and gross leak)	750-1071		
		Electrical measurements	GRP-A-SG2		
		Decap internal visual	750-2075	6 (0)	6 (0)
		Bond strength	750-2037	22 wires (0) or 11 (0)	12 wires (0) or 6 (0)
		SEM	750-2077	11 (0)	6 (0)
		Die shear	750-2017	11 (0)	6 (0)
	4	Intermittent operation life (2000 cycles)	750-1037	22 (0)	12 (0)
		Electrical measurements	GRP-A-SG2		
		(JANTXV, JANTX)		Large LOT (accept)	Small LOT (accept)
B (PI)	1	Solderability	750-2026	15 leads (0)	4 leads (0)
	2	Temperature cycling (45 cycles incl. screening)	750-1051	22 (0)	6 (0)
		Hermetic Seal (fine and gross leak)	750-1071		
		Electrical measurements	GRP-A-SG2		
	3	Steady state op. life (340 Hrs) or intermittent op. life (2000 cycles)	750-1026 or 750-1037	45 (0)	12 (0)
		Electrical measurements	GRP-A-SG2		
	4	Decap internal visual	750-2075	1 (0)	1 (0)

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MIL-PRF 19500 TYPICAL QCI TESTING PROCESS FLOW

Group	Sub Group	Parameters	TM	Sample plan	Small LOT (accept)
C (PI)	1	Physical dimensions (Not Req. JANS)	750-2066	15 (0)	6 (0)
	2	Thermal shock (25 cycles, con B)	750-1056	22 (0)	6 (0)
		Temperature cycling (45 cycles incl. screening)	750-1051		
		Terminal strength	750-2036		
		Hermetic seal (fine and gross leak)	750-1071		
		Electrical measurements	GRP-A-SG2		
	3	Constant acceleration (5000g, Y1 only)	750-2006	22 (0)	6 (0)
		Electrical measurements	GRP-A-SG2		
	6	Steady state op. life (1000 Hrs) or intermittent op. life (6000 cycles)	750-1026 or 750-1037	22 (0)	12 (0)
		Electrical measurements	GRP-A-SG2		
	7	Internal Gas Analysis - Moisture 10,000 ppmv limit	750-1018	3 (0)	3 (0)

MIL-PRF 38534 TYPICAL QCI TESTING PROCESS FLOW

Group	Sub Group	Parameters	Quantity (accept number)		
			TM	K	H
A (CI)	1	Static tests at +25°C	Datasheet	100%	100%
	2	Static tests at max. rated operating temp.	Datasheet	100%	100%
	3	Static tests at min. rated operating temp.	Datasheet	100%	100%
	9	Switching tests at +25°C	Datasheet	100%	100%
B (PI)	1	Physical dimension	883-2016	2 (0)	2 (0)
	4	Internal visual and mechanical	883-2014	1 (0)	1 (0)
	5	Bond strength: Ultrasonic (on hotplate)	883-2011	2 (0)	2 (0)
	6	Die shear strength	883-2019	2 (0)	2 (0)
	7	Solderability	883-2003	1 (0)	1 (0)
	8	Seal: a. Fine, b. Gross	883-1014	N/A	15 (0)
C (PI)	1	External visual	883-2009	5 (0)	5 (0)
		Temperature Cycling	883-1010	5 (0)	5 (0)
		Constant acceleration	883-2001	X	5 (0)
		Seal (fine and gross)	883-1014	5 (0)	5 (0)
		PIND	883-2020	5 (0)	5 (0)
		Visual examination	883-1010	5 (0)	5 (0)
		End-point electrical	GRP-A	5 (0)	5 (0)
	2	Steady-state life test	883-1005	22 (0) or 5 (0)	22 (0) or 5 (0)
		End-point electrical	GRP-A	22 (0) or 5 (0)	22 (0) or 5 (0)
	3	Internal gas analysis Moisture 10,000 ppmv limit	883-1018	3 (0) or 5 (1)	3 (0) or 5 (1)
D (PI)	1	Thermal shock	883-1011	5 (0)	5 (0)
		Stabilization bake	883-1008	5 (0)	5 (0)
		Lead integrity	883-2004	1 (0)	1 (0)
		Seal: a. Fine, b. Gross	883-1014	5 (0)	5 (0)

Summary of key differences between MIL-PRF 19500 and MIL-PRF 38534 for space level testing:

	MIL-PRF 19500 - JANS	MIL-PRF 38534 – Class K
No. of Operation (Screening) Steps	31	33
Optional Hermeticity Testing	Occurs post P.I.N.D	Occurs post Internal Visual
Temp cycle – No. of Temp Cycles	20	10
Acceleration - Amount of g force	5000g	3000g
HTRB – No. of hours	48	96
Burn-in – No. of hours	240 hrs in one successive burn-in	320 hrs (2 x 160 hrs with interim electrical)
PDA post burn-in	5% after 240 hrs burn-in	2% after second 160 hrs burn-in

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