

**4N51, 4N52**  
**67023 4N53, 4N54**      HERMETIC , NUMERIC AND HEXADECIMAL  
DISPLAYS

**Mii**  
OPTOELECTRONIC PRODUCTS  
DIVISION

**Features:**

- Conforms to MIL-PRF-87157
- Three character options  
Numeric, Hexidecimal or Over range
- 4 X 7 dot matrix character
- Memory latch/decoder/driver is TTL compatible
- Available in Red or Green
- Categorized for luminous intensity

**Applications:**

- High reliability systems
- Instrumentation panels
- Communication equipment
- Medical equipment
- Harsh environments
- IR blocking filter available

**DESCRIPTION**

The **4N51-4N54** series are solid state numeric and hexidecimal displays for use in high reliability applications. The displays feature an on-board decoder/driver and memory (except 4N53). These displays are hermetically sealed and conform to MIL-PRF-87157, the general specification for light emitting diode displays. The character height is 7.4mm (.29"). The green LED version conforms to MIL-D-87157 with exception of color.

The 4N51 is a numeric display which decodes positive BCD logic into the numbers "0-9", a "-" sign, a right-hand decimal point, and a test pattern (all LED's on).

The 4N52 is the same as the 4N51, but the decimal point is located on the left side of the device.

The 4N53 is an over range device which displays "±1" and a right-hand decimal point. This display is typically driven using external switching transistors.

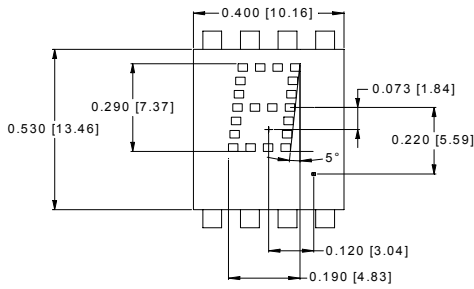
The 4N54 is a hexidecimal display which decodes positive BCD logic into 16 characters "0-9, A-F". An input is provided to blank the display (all LED's off) without losing the contents of the memory.

**ABSOLUTE MAXIMUM RATINGS**

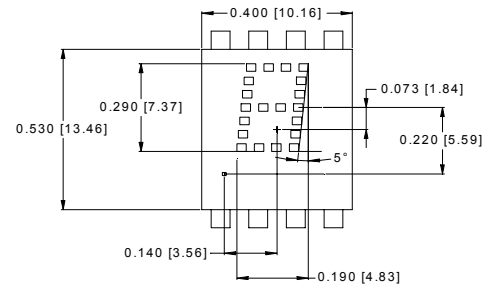
Storage Temperature.....	-65°C to +125°C
Operating Free-Air Temperature Range.....	-55°C to +100°C
Lead Solder Temperature (1/16" [1.6mm] below seating plane for 10s).....	260°C
Supply Voltage, V <sub>CC</sub> (4N51, 4N52, 4N54).....	-0.5V to 7V
Voltage Applied to Input Logic, DP and Enable Pins.....	-0.5V to 7V
Voltage Applied to Blanking Input (4N54 only).....	-0.5V to 7V
Forward Current, Each LED (4N53 only).....	10mA
Reverse Voltage, Each LED (4N53 only).....	4V

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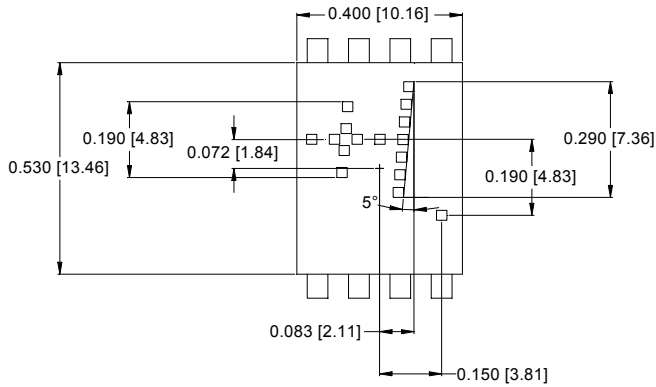
**\* HERMETIC, NUMERIC AND HEXIDECIMAL DISPLAYS**



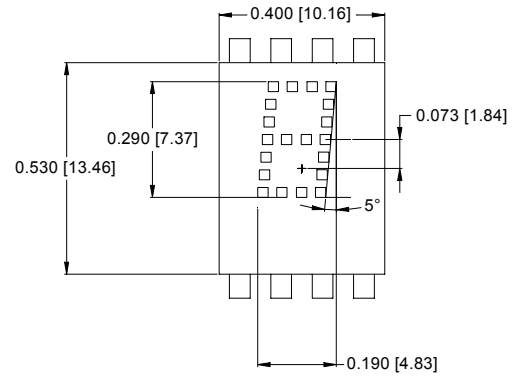
**4N51**



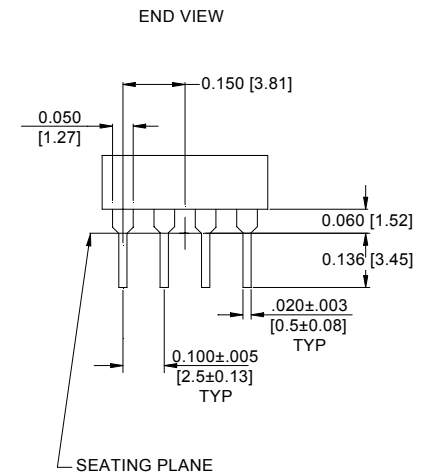
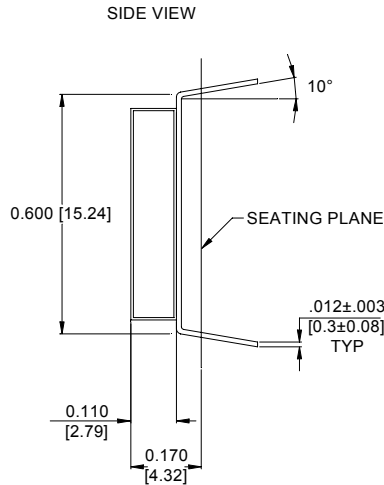
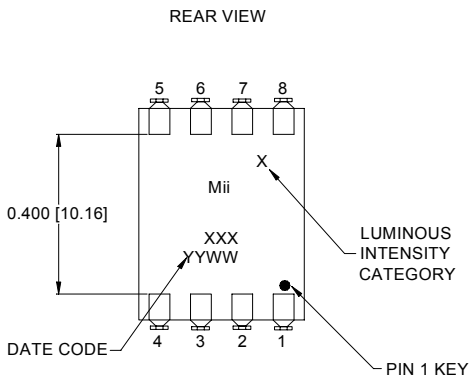
**4N52**



**4N53**



**4N54**



\*JEDEC Registered Data

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**HERMETIC, NUMERIC AND HEXIDECIMAL DISPLAYS**

**\*ELECTRICAL OPTICAL CHARACTERISTICS**

T<sub>A</sub> = -55°C to +100°C unless otherwise specified.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS	NOTE
Supply Current	4N51 4N52 4N54	I <sub>CC</sub>	112 112 112	170 170 170	mA	V <sub>CC</sub> = 5.5V Numeral 5 and DP lighted	1
Power Dissipation	4N51 4N52 4N53 4N54	P <sub>T</sub>	560 560 280 560	935 935 320 935	mW	V <sub>CC</sub> = 5.5V Numeral 5 and DP lighted	1,4
Luminous Intensity per LED	4N51 4N52 4N53 4N54	I <sub>V</sub>	40 40 45 40	85 85 85 85	μcd	V <sub>CC</sub> = 5V, T <sub>A</sub> = 25°C V <sub>CC</sub> = 5V, T <sub>A</sub> = 25°C I <sub>F</sub> = 10mA, A = 25°C V <sub>CC</sub> = 5V, A = 25°C	2
Forward Voltage per LED	4N53	V <sub>F</sub>	1.6	2.0	V	I <sub>F</sub> = 10mA	
Logic Low-Level Input Voltage	4N51 4N52 4N54	V <sub>IL</sub>		0.8 0.8 0.8	V	V <sub>CC</sub> = 4.5V	
Logic Low-Level Input Voltage	4N51 4N52 4N54	V <sub>IH</sub>	2 2 2		V	V <sub>CC</sub> = 4.5V	
Enable Low-Voltage; Data Being Entered	4N51 4N52 4N54	V <sub>EL</sub>		0.8 0.8 0.8	V	V <sub>CC</sub> = 4.5V	
Enable High-Voltage; data not being entered	4N51 4N52 4N54	V <sub>EH</sub>	2 2 2		V	V <sub>CC</sub> = 4.5V	
Blanking Low-Voltage display not blanked	4N54	V <sub>BL</sub>		0.8	V	V <sub>CC</sub> = 4.5V	
Blanking High-Voltage display blanked	4N54	V <sub>BH</sub>	3.5		V	V <sub>CC</sub> = 4.5V	
Leak Rate	ALL			5x10 <sup>-8</sup>	cc/sec		
Blanking Low-Level Input Current	4N54	I <sub>BL</sub>		50	mA	V <sub>CC</sub> = 5.5V, V <sub>BL</sub> = 0.8V	
Blanking High-Level Input Current	4N54	I <sub>BH</sub>		1.0	mA	V <sub>CC</sub> = 5.5V, V <sub>BH</sub> = 4.5V	
Logic Low-Level Input Current	4N51 4N52 4N54	I <sub>IL</sub>		-1.6	mA	V <sub>CC</sub> = 5.5V, V <sub>IL</sub> = 0.4V	
Logic High-Level Input Current	4N51 4N52 4N54	I <sub>IH</sub>		+100	μA	V <sub>CC</sub> = 5.5V, V <sub>IH</sub> = 2.4V	
Enable Low-Level Input Current	4N51 4N52 4N54	I <sub>EL</sub>		-1.6	mA	V <sub>CC</sub> = 5.5V, V <sub>EL</sub> = 0.4V	
Enable High-Level Input Current	4N51 4N52 4N54	I <sub>EH</sub>		+130	μA	V <sub>CC</sub> = 5.5V, V <sub>EH</sub> = 2.4V	
Wavelength at Peak Emission	ALL	λ <sub>P</sub>	655		nm	t <sub>A</sub> = 25°C	
Dominant Wavelength	ALL	d	640			t <sub>A</sub> = 25°C	3
Forward Voltage per LED	4N53	V <sub>F</sub>	1.6	2.0	V	I <sub>F</sub> = 10mA	
Weight	ALL		1		gm		

**NOTES:**

- All typical values at V<sub>CC</sub> = 5.0 volts, t<sub>A</sub> = 25°C.
- Luminous intensity for a specific temperature may be calculated with the following relationship: I<sub>V</sub>(t<sub>A</sub>) = I<sub>V</sub>(25°C) (.985)<sup>[t<sub>A</sub> - 25°C]</sup>.
- The dominant wavelength, λ<sub>d</sub> is a single wavelength that defines the saturated color of monochromatic light, as derived from the CIE chromaticity diagram.
- For 4N53 test conditions, I<sub>F</sub> = 10mA, all diodes lit.

\*JEDEC Registered Data

**\*RECOMMENDED OPERATING CONDITIONS:**

PARAMETER		SYMBOL	MIN	MAX	UNITS
Supply Voltage	4N51	V <sub>CC</sub>	4.5	5.5	V
	4N52		4.5	5.5	V
	4N53		NA	NA	NA
	4N54		4.5	5.5	V
Operating Temperature	ALL	t <sub>A</sub>	-55	100	°C
Enable Pulse Width	4N51	t <sub>W</sub>	100		ns
	4N52				
	4N54				
Time data must be held before positive transition of enable line	4N51	t <sub>SETUP</sub>	50		ns
	4N52				
	4N54				
Time data must be held after positive transition of enable line	4N51	t <sub>HOLD</sub>	50		ns
	4N52				
	4N54				
Enable pulse rise time	4N51	t <sub>TLH</sub>		200	ns
	4N52				
	4N54				
Forward Current	4N53	I <sub>F</sub>	5	10	mA

**SELECTION GUIDE**

67023-001	4N51 Commercial (0° to 70°C)
67023-101	4N51 Screened to TXV level (-55° to +100°C) with 100% screening.
67023-101C	4N51 marked with DSCC P/N JM87157/00101AXX (-55° to +100°C) with 100% screening.
67023-002	4N52 Commercial (0° to 70°C)
67023-102	4N52 Screened to TXV level (-55° to +100°C) with 100% screening.
67023-102C	4N52 marked with DSCC P/N JM87157/00102AXX (-55° to +100°C) with 100% screening.
67023-003	4N53 Commercial (0° to 70°C)
67023-103	4N53 Screened to TXV level (-55° to +100°C) with 100% screening.
67023-103C	4N53 marked with DSCC P/N JM87157/00103AXX (-55° to +100°C) with 100% screening.
67023-004	4N54 Commercial (0° to 70°C)
67023-104	4N54 Screened to TXV level (-55° to +100°C) with 100% screening.
67023-104C	4N54 marked with DSCC P/N JM87157/00104AXX (-55° to +100°C) with 100% screening.
67023-034	4N54, green commercial (0° to 70°C)
67023-315	4N54, green Mil-Temp (-55° to +100°C) with 100% screening.

**NOTES:**

1. When ordering DSCC part numbers, you may order by the MII part number or the DSCC part number.
2. The first X at the end of M87157/0010XA[X]X designates lead finish. In place of the X use A for hot solder dip or C for gold finish.
3. Second X at the end of the M87157/0010XAX[X] designates luminous intensity code. In place of the X use C thru K to indicate desired intensity level.

\*JEDEC Registered Data

**4N51, 4N52, 4N54 Logic**

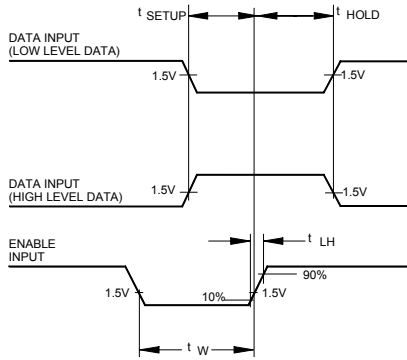


FIGURE 1 Timing Diagram of 4N51, 4N52 and 4N54 Series Logic

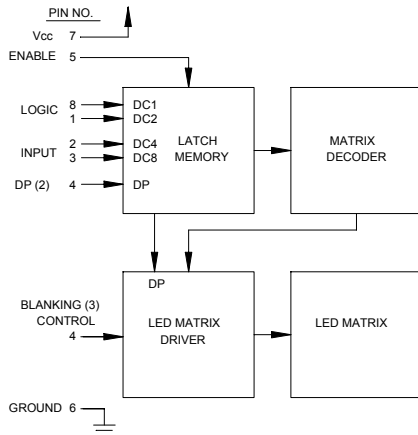


FIGURE 2 Block Diagram of 4N51, 4N52 and 4N54 Series Logic

TRUTH TABLE					
BCD DATA <sup>(1)</sup>				4N51/4N52	4N54
X <sub>8</sub>	X <sub>4</sub>	X <sub>2</sub>	X <sub>1</sub>		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	█	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	.....	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F
DECIMAL PT. <sup>(2)</sup>				ON	V <sub>DP</sub> =L
				OFF	V <sub>DP</sub> =H
ENABLE <sup>(1)</sup>				LOAD DATA	V <sub>E</sub> =L
				LATCH DATA	V <sub>E</sub> =H
BLANKING <sup>(3)</sup>				DISPLAY ON	V <sub>B</sub> =L
				DISPLAY OFF	V <sub>B</sub> =H

**NOTES:**

- H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input levels or D.P. input have no effect upon display memory, displayed character, or D.P.
- The decimal point, DP, pertains only to the 4n51 and 4n52 displays.
- The blanking control, B, pertains only to the 4n54 hexadecimal display. Blanking input has no effect upon memory.

**4N53 Over Range Character**

PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	Vcc
8	Minus/Plus

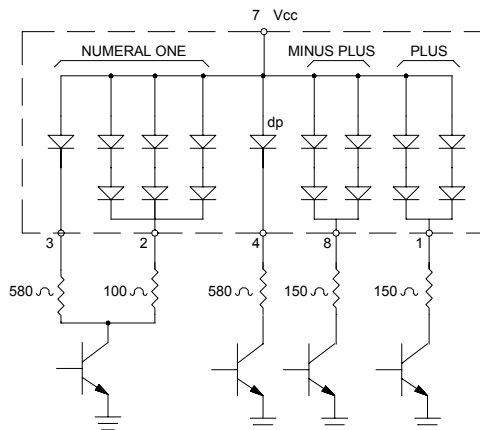


FIGURE 3  
TYPICAL DRIVING CIRCUIT

**TRUTH TABLE FOR TYPICAL DRIVING CIRCUIT**

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
-	L	X	X	H
1	X	H	X	X
DECIMAL POINT	X	X	H	X
BLANK	L	L	L	L

**NOTES:**

- L: Line switching transistor in figure 3 cutoff.
- H: Line transistor in figure 3 saturated
- X: Don't Care.

PART MARKING SYSTEM

PREFERRED PART NUMBER SYSTEM		MII PART NUMBERS		
Standard Product	With Tables I, II, III and IV	Quality Level A	TXV Tables I, II	Commercial Table II, Subgroups I, VII
4N51	M87157/00101XXX	67023-201		
4N52	M87157/00102XXX	67023-202	67023-101 67023-102	67023-001 67023-002
4N53	M87157/00103XXX	67023-203	67023-103	67023-003
4N54	M87157/00104XXX	67023-204	67023-104	67023-004

TABLE I  
100% SCREENING – CLASS A OF MIL-PRF-87157

Test Screen	MIL-PRF-750 Method	Conditions
1. Precap Visual	2072	
2. High Temperature Storage	1032	T <sub>A</sub> = 125°C, Time = 24 hours
3. Temperature Cycling	1051	Condition B, 10 Cycles, 15 Min. Dwell
4. Constant Acceleration	2006	10,000 G's at Y <sub>1</sub> orientation
5. Fine Leak	1071	Condition H
6. Gross Leak	1071	Condition C
7. Interim Electrical / Optical Tests <sup>(2)</sup>	-----	I <sub>V</sub> , I <sub>CC</sub> , I <sub>BL</sub> , I <sub>BH</sub> , I <sub>EL</sub> , I <sub>EH</sub> , I <sub>IL</sub> , and I <sub>IH</sub> T <sub>A</sub> = 25°C
8. Burn-In <sup>(1,3)</sup>	1015	Condition B at V <sub>CC</sub> = 5V and cycle through logic at 1 character per second. T <sub>A</sub> = 100°C, t = 160 hours
9. Final Electrical Test <sup>(2)</sup>	-----	Same as Step 7
10. Delta Determinations	-----	ΔI <sub>V</sub> = 20%, ΔI <sub>CC</sub> = ±10 mA, ΔI <sub>IH</sub> = ±10 μA and ΔI <sub>EH</sub> = ±13μA
11. External Visual <sup>(1)</sup>	2009	

TABLE II  
GROUP A ELECTRICAL TEST – CLASS A OF MIL-PRF-87157

Test	Parameters	LTPD
Subgroup 1 DC Electrical Test at 25°C <sup>(2)</sup>	I <sub>V</sub> , I <sub>CC</sub> , I <sub>BL</sub> , I <sub>BH</sub> , I <sub>EL</sub> , I <sub>EH</sub> , I <sub>IL</sub> , and I <sub>IH</sub> and visual function, T <sub>A</sub> = 25°C	5
Subgroup 2 DC Electrical Tests at High Temperature <sup>(2)</sup>	Same as Subgroup 1, except delete I <sub>V</sub> and visual function. T <sub>A</sub> = +100°C	7
Subgroup 3 DC Electrical Tests at Low Temperature <sup>(2)</sup>	Same as Subgroup 1, except delete I <sub>V</sub> and visual function. T <sub>A</sub> = -55°C	7
Subgroup 4, 5 and 6 not tested		
Subgroup 7 Optical and Functional Tests at 25°C.	Satisfied by Subgroup 1	5
Subgroup 8 External Visual		7

HERMETIC, NUMERIC AND HEXIDECIMAL DISPLAYS

TABLE III  
GROUP B, CLASS A AND B OF MIL-PRF-87157

Test	MIL-PRF-750 Method	Conditions	Sample Size
Subgroup 1 Resistance to Solvents Internal Visual and Mechanical <sup>(10)</sup>	1022 2075		4 Devices / 0 Failures 1 Device / 0 Failures
Subgroup 2 <sup>(1,2)</sup> Solderability	2026	T <sub>A</sub> = 245°C for 5 seconds	LTPD = 15
Subgroup 3 Thermal Shock (Temp. Cycle) Moisture Resistance <sup>(3)</sup> Fine Leak Gross Leak Electrical / Optical Endpoints <sup>(4)</sup>	1051 1021 1071 1071 -----	Condition B1, 15 Min. Dwell  Condition H Condition C I <sub>V</sub> , I <sub>CC</sub> , I <sub>BL</sub> , I <sub>BH</sub> , I <sub>EL</sub> , I <sub>EH</sub> , I <sub>IL</sub> , I <sub>IH</sub> and visual function. T <sub>A</sub> = 25°C	LTPD = 15
Subgroup 4 Operating Life Test (340 hrs.) <sup>(5)</sup>  Electrical / Optical Endpoints <sup>(4)</sup>	1027  -----	T <sub>A</sub> = 100°C, at V <sub>CC</sub> = 5.0V and cycling through logic at 1 character per second. Same as Subgroup 3	LTPD = 10
Subgroup 5 Non-operating (Storage) Life Test (340 hrs.) Electrical / Optical Endpoints <sup>(4)</sup>	1032  -----	T <sub>A</sub> = 125°C  Same as Subgroup 3	LTPD = 10

TABLE IV  
GROUP C, CLASS A AND B OF MIL-PRF-87157

Test	MIL-PRF-750 Method	Conditions	Sample Size
Subgroup 1 Physical Dimensions	2066		2 Devices / 0 Failures
Subgroup 2 <sup>(2, 10)</sup> Lead Integrity Fine Leak Gross Leak	2004 1071 1071	Condition B2 Condition H Condition C	LTPD = 15
Subgroup 3 Shock  Vibration, Variable Frequency Constant Acceleration External Visual <sup>(7)</sup> Electrical / Optical Endpoints <sup>(4)</sup>	2016  2056 2006 1010 or 1011 -----	1500G, Time = 0.5 ms, 5 blows in each orientation X <sub>1</sub> , Y <sub>1</sub> , Z <sub>1</sub>  10,000G at Y <sub>1</sub> orientation  I <sub>V</sub> , I <sub>CC</sub> , I <sub>BL</sub> , I <sub>BH</sub> , I <sub>EL</sub> , I <sub>EH</sub> , I <sub>IL</sub> , I <sub>IH</sub> and visual function. T <sub>A</sub> = 25°C	LTPD = 15
Subgroup 4 <sup>(1,6)</sup> Salt Atmosphere External Visual <sup>(7)</sup>	1041 1010 or 1011		LTPD = 15
Subgroup 5 Bond Strength <sup>(8)</sup>	2037	Condition A	LTPD = 20 (c = 0)
Subgroup 6 Operating Life Test <sup>(9)</sup> Electrical / Optical Endpoints <sup>(4)</sup>	1026  -----	T <sub>A</sub> = +100°C 1000 HRS Same as Subgroup 3	LTPD = 10

- NOTES:**
- Whenever electrical/optical tests are not required as endpoints, electrical rejects may be used.
  - The LTPD applies to the number of leads inspected, except in no case shall less than 3 displays be used to provide the number of leads required.
  - Initial conditioning should be a 15" bend inward one cycle.
  - Limits and conditions are per the electrical/optical characteristics.
  - Burn-in for the over range shall use Condition B at a nominal I<sub>F</sub> = 8 mA with "+1" illuminated for t=340 hours.
  - Solderability samples shall not be used.
  - Visual requirements shall be as specified in MIL-PRF-883, Methods 1010 or 1011.
  - Displays may be selected prior to seal.
  - If a given inspection lot, undergoing Group B inspection, has been selected to satisfy the Group C inspection requirements, the 340 hour life tests may be continued on test to 1000 hours in order to satisfy the Group C Life Test requirements. In such cases, either the 340 hour endpoint measurements shall be made a basis for Group B lot acceptance or the 1000 hour endpoint measurement shall be used as the basis for both Group B and Group C acceptance.
  - MIL-PRF-883 test method applies.