

INCH-POUND

MIL-DTL-28803/1E
4 September 2013
SUPERSEDING
MIL-D-28803/1D
11 July 1988

DETAIL SPECIFICATION SHEET

DISPLAY, OPTOELECTRONIC, SEGMENTED READOUT, BACKLIGHTED, STYLE II
(LIGHT EMITTING DIODE), RFI SHIELDED, MOISTURE SEALED, HIGH IMPACT SHOCK, TYPE R01

This specification sheet is approved for use by all Departments
and Agencies of the Department of Defense.

The requirements for acquiring the product described herein
shall consist of this specification sheet and [MIL-DTL-28803](#).

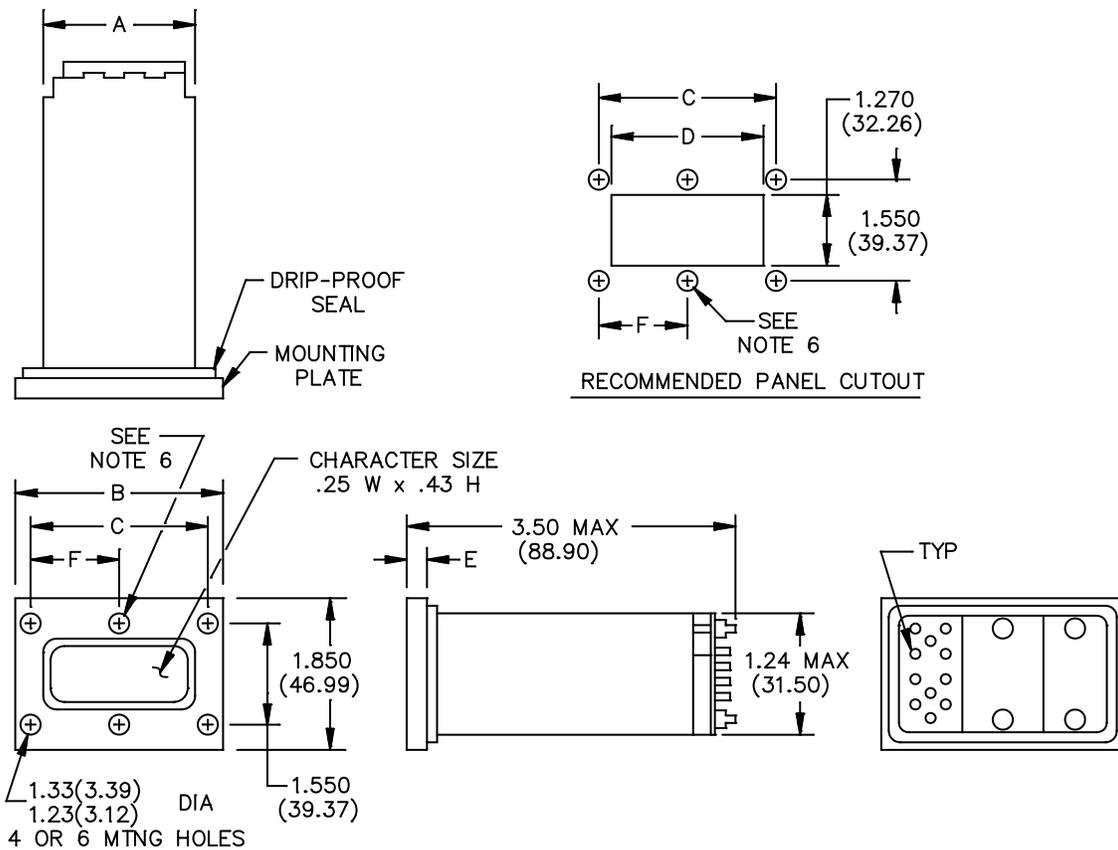


FIGURE 1. Type R01 display and panel cutout.

NOTES:

1. Dimensions are in inches. Millimeter equivalents are given for general information only.
2. Unless otherwise specified, tolerances are ± 0.02 inch (0.51 mm) for two place decimals and ± 0.010 inch (0.25 mm) for three place decimals.
3. Design configuration optional within envelope as shown.
4. The values for dimensions A, B, C, D, and F are listed in table I. The depth of the mounting plate (dimension E) is listed in table II.
5. Dimension F is for immersion seal displays only.
6. The two center mounting holes (located by dimension F) are required in designated immersion seal displays only.

FIGURE 1. Type R01 display and panel cutout – Continued.

TABLE I. Display assembly dimensions. 1/ 2/ 3/

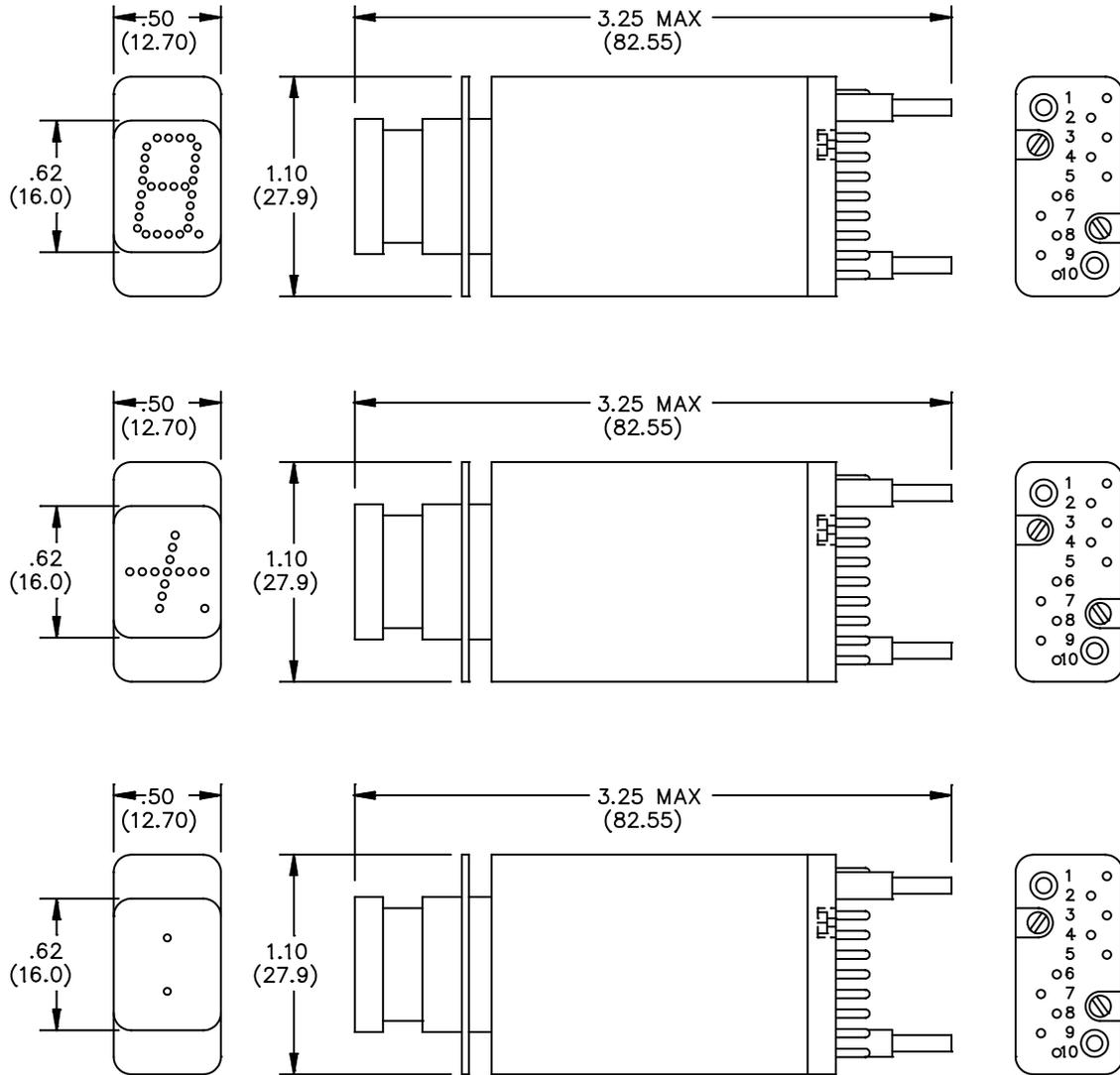
Number of modules per assembly	Dimensions					Weight maximum
	A	B	C	D	F 4/	
1	.62 (15.7)	1.187 (30.15)	.867 (22.02)	.67 (17.0)	---	3.5 (99.2)
2	1.12 (28.4)	1.687 (42.85)	1.367 (34.72)	1.17 (29.7)	---	5.0 (141.7)
3	1.62 (41.1)	2.187 (55.55)	1.867 (47.42)	1.67 (42.4)	---	7.0 (198.4)
4	2.12 (53.8)	2.687 (68.25)	2.367 (60.12)	2.17 (55.1)	---	8.5 (240.9)
5	2.62 (66.5)	3.187 (80.95)	2.867 (72.82)	2.67 (67.8)	1.433 (36.40)	10.5 (297.7)
6	3.12 (79.2)	3.687 (93.65)	3.367 (85.52)	3.17 (80.5)	1.683 (42.75)	12.0 (340.2)
7	3.62 (91.9)	4.187 (106.35)	3.867 (98.22)	3.67 (93.2)	1.933 (49.10)	14.0 (396.9)
8	4.12 (104.6)	4.687 (119.05)	4.367 (110.92)	4.17 (105.9)	2.183 (55.45)	16.5 (467.8)

- 1/ Dimensions are in inches. Millimeter equivalents are given for general information only.
- 2/ Unless otherwise specified, tolerances are ± 0.02 inch (0.51 mm) for two place decimals and ± 0.010 inch (0.25 mm) for three place decimals.
- 3/ Weights are in ounces. Gram equivalents are given for general information only.
- 4/ Dimension F is for immersion seal readouts only.

TABLE II. Seal type dimension.

Seal type	Dimension E
Dripproof	.22 (5.6)
Immersion	.32 (8.1)

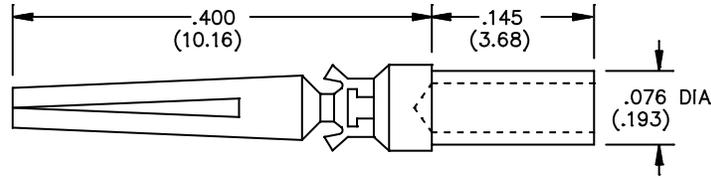
- 1/ Dimensions are in inches. Millimeter equivalents are given for general information only.
- 2/ Unless otherwise specified, tolerances are ± 0.02 inch (0.51 mm) for two place decimals and ± 0.010 inch (0.25 mm) for three place decimals.



NOTES:

1. Dimensions are in inches. Millimeter equivalents are given for general information only.
2. Unless otherwise specified, tolerances are ± 0.02 inch (0.51 mm) for two place decimals.
3. Design configuration optional within envelope as shown.

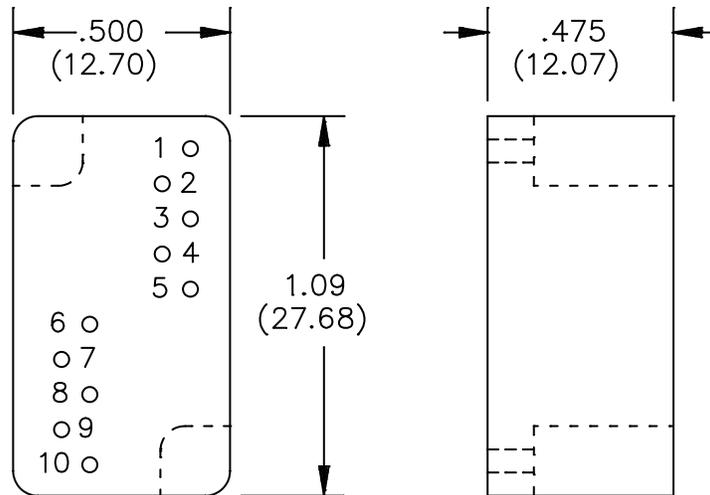
FIGURE 2. Seven segment, four segment, and colon display modules.



NOTES:

1. Dimensions are in inches. Millimeter equivalents are given for general information only.
2. Unless otherwise specified, tolerances are ± 0.010 inch (0.25 mm) for three place decimals.
3. Design configuration optional within envelope as shown.
4. Terminal part number (package of 25 terminals): M22885/80-50 of MIL-PRF-22885/80.
5. Application information:
 - Crimp tool: M22520/1-01 of MIL-C-22520/1.
 - Positioner: M22520/1-02 of MIL-C-22520/1.
 - Insertion tool: Eaton Aerospace (CAGE 96182) 800-3191
 - Extraction tool: Eaton Aerospace 800-P7
Astro Tool Corp. (CAGE 58164) ATMS 2062
 - Locator tool: Eaton Aerospace 800-3191-L20

FIGURE 3. Terminal, crimp type.



NOTES:

1. Dimensions are in inches. Millimeter equivalents are given for general information only.
2. Unless otherwise specified, tolerances are ± 0.010 inch (0.25 mm) for three place decimals.
3. Design configuration optional within envelope as shown.
4. Connector block part number: M28803/1-ZZ.

FIGURE 4. Connector block.

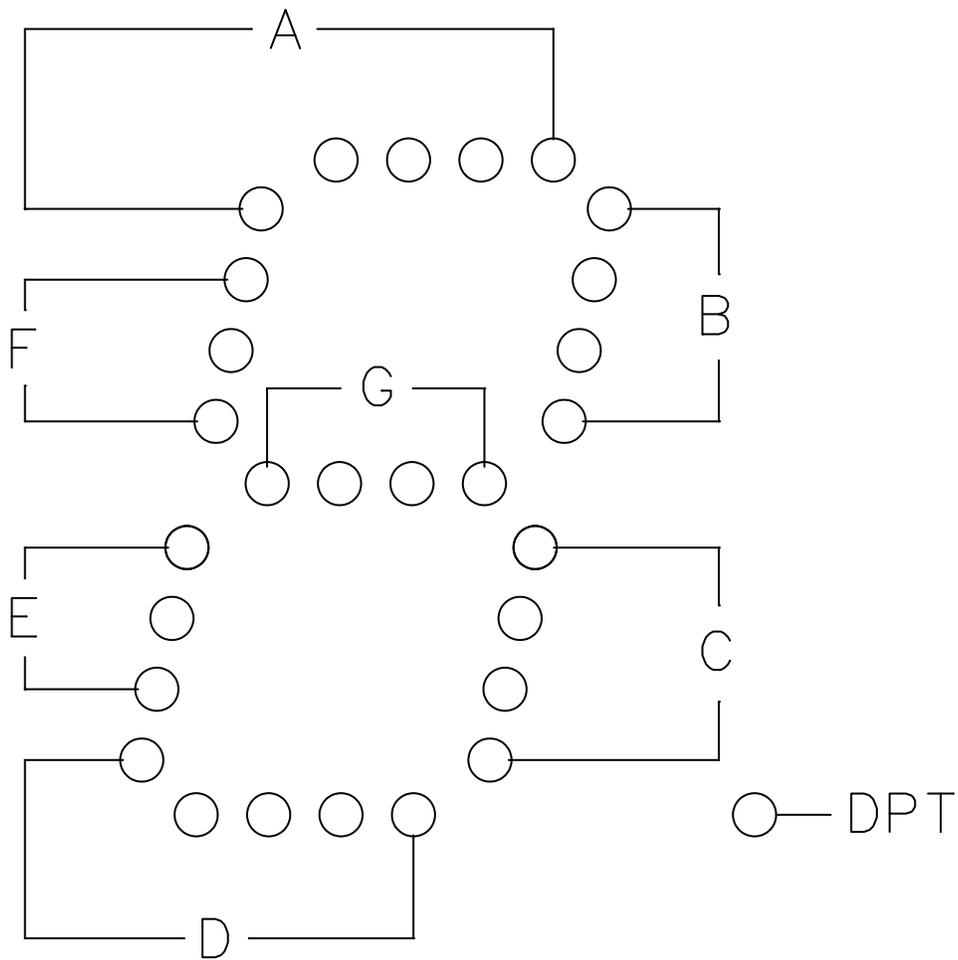


FIGURE 5. Truth table letter assignments for seven segment numeric display with decimal point.

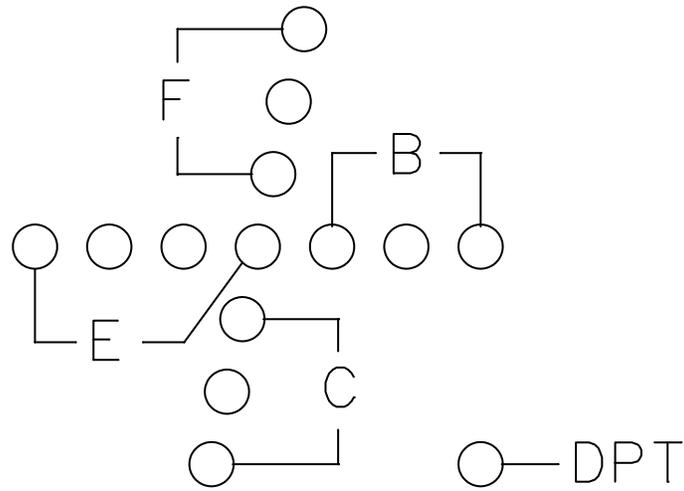


FIGURE 6. Truth table letter assignments for four segment sign display with decimal point.

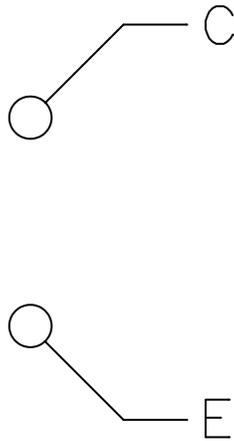


FIGURE 7. Truth table letter assignments for colon display.

REQUIREMENTS:

Design and construction:

Dimensions and configurations. See figures 1 through 4.

Display assembly. The display assembly shall consist of the following:

- a. Display module and if applicable, conversion logic circuit assembly (circuit configurations 1, 2, 5, and 6 only).
- b. Insertable crimp-type terminals (see figure 3) (packaged separately).
- c. Multistation matrix frame. Includes connector blocks, fasteners, front lens plate, and mounting flange.
 1. Connector block (see figure 4).
 2. Front lens plate: Shall appear obscured in the unlighted condition. In the lighted condition, characters shall be red in accordance with MIL-DTL-28803 on a black background.
 3. Mounting flange: Front face of mounting flange shall be a black, lusterless color.
- d. RFI shielding screen. A grounded lens screen shall be provided.
- e. Light emitting diodes.

Display truth table letter assignments: See figures 5 through 7 and tables III through IX.

Operating:

Dot to dot ratio (per character): 5 to 1 maximum after life (electrical).

Circuit configurations: See figure 8 for terminal block connections.

Circuit configuration 1 is a seven segment numeric display with decimal point that has conversion logic encoders with latching.

Circuit configuration 2 is a four segment sign display with decimal point that has conversion logic encoders with latching.

Circuit configuration 3 is a direct wired seven segment numeric display with decimal point.

Circuit configuration 4 is a direct wired four segment sign display with decimal point.

Circuit configuration 5 is a seven segment numeric display with decimal point that has conversion logic encoders without latching.

Circuit configuration 6 is a four segment sign display with decimal point that has conversion logic encoders without latching.

The colon sign display is a direct wired circuit configuration only.

Optical:

Chromaticity: Method II in accordance with [MIL-DTL-28803](#), color red (Y = .355 maximum, Z = .002 maximum).

Contrast ratio: 20 to 1 minimum at 110 foot-candles (1184 lux) incidental illumination.

Luminance: Luminance shall be in accordance with [MIL-DTL-28803](#).

Physical and mechanical:

Mechanical endurance and solderability: Not applicable.

Terminal strength: The terminals shall be tested in accordance with Method 211 of [MIL-STD-202](#), with the following details and exceptions: Test condition A and the applied force shall be 5 pounds (2.27 Kg).

Electrical:

Circuit configuration display characteristics: See [figures 5](#) through [7](#).

Conventions for truth tables. The following conventions are used in the truth tables ([tables III](#) through [IX](#)) herein:

"0" = Logic low level, represents ground potential (0.0 V dc).

"1" = Logic high level.

"X" = Logical "0" or "1".

"DPT" = Decimal point.

"EN" = Enable.

"LT" = LED test.

"BI" = Blanking input.

"Δ" = Segment lit.

Truth tables with latching: The truth tables shown are for when enable (EN) is at logic low level. Segments energized prior to enable going to logic high level will remain lit.

Conversion logic encoders verification: The conversion logic encoders used in the fabrication of displays shall be screened in accordance with the class B requirements of method 5004 of [MIL-STD-883](#) and tested in accordance with the class B requirements of method 5005 of [MIL-STD-883](#).

Conversion logic electrical characteristics: See [tables X](#) and [XI](#).

Environmental:

Seal (immersion): [MIL-STD-810](#), method 512, procedure I. Following the test, there shall be no evidence of leakage and displays shall meet the dielectric withstanding voltage requirements in accordance with [MIL-DTL-28803](#).

Shock: Method II (high impact) in accordance with [MIL-DTL-28803](#).

Vibration grade 2: Displays shall be tested in accordance with Method 204, test condition A (10-500 Hz) of [MIL-STD-202](#).

Operating temperature range: -50°C to +85°C.

PIN code letters for module combinations, type, arrangement, circuit configuration, and seal: See [tables XII](#) and [XIII](#).

TABLE III. Truth table for seven segment numeric display, with latch (circuit configuration 1).

Input							Display	Output							
DPT	EN	BCD				BI		$\Delta = \text{Segment lit } 1/$							
		8	4	2	1			A	B	C	D	E	F	G	DPT
	0	0	0	0	0	1	0	Δ	Δ	Δ	Δ	Δ	Δ		
	0	0	0	0	1	1	1		Δ	Δ					
	0	0	0	1	0	1	2	Δ	Δ		Δ	Δ			Δ
	0	0	0	1	1	1	3	Δ	Δ	Δ	Δ				Δ
	0	0	1	0	0	1	4		Δ	Δ				Δ	Δ
	0	0	1	0	1	1	5	Δ		Δ	Δ			Δ	Δ
	0	0	1	1	0	1	6			Δ	Δ	Δ	Δ	Δ	Δ
	0	0	1	1	1	1	7	Δ	Δ	Δ					
	0	1	0	0	0	1	8	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	0	1	0	0	1	1	9	Δ	Δ	Δ				Δ	Δ
	0	1	0	1	0	1	Blank								
	0	1	0	1	1	1	Blank								
	0	1	1	0	0	1	Blank								
	0	1	1	0	1	1	Blank								
	0	1	1	1	0	1	Blank								
	0	1	1	1	1	1	Blank								
	X	X	X	X	X	0	Blank								
1	X	X	X	X	X	X	.								Δ 2/

1/ See figure 5 for seven segment numeric display output letter assignments.

2/ The decimal point (DPT) operates independently of the conversion logic. To illuminate, connect to 5.0 V dc.

TABLE IV. Truth table for four segment sign display, with latch (circuit configuration 2).

Input							Display	Output							
DPT	EN	BCD				BI		$\Delta = \text{Segment lit } 1/$							
		8	4	2	1			A	B	C	D	E	F	G	DPT
	0	0	0	0	0	1	+		Δ	Δ		Δ	Δ		
	0	0	0	0	1	1		Δ			Δ			
	X	X	X	X	X	0	Blank								
1	X	X	X	X	X	X	.								Δ 2/

1/ See figure 6 for four segment sign display output letter assignments.

2/ The decimal point (DPT) operates independently of the conversion logic. To illuminate, connect to 5.0 V dc.

TABLE V. Truth table for seven segment direct wired numeric display (circuit configuration 3).

Input								Display	Output (Δ = Segment lit) ^{1/}							
DPT	A	B	C	D	E	F	G		A	B	C	D	E	F	G	DPT
	0	0	0	0	0	0		0	Δ	Δ	Δ	Δ	Δ	Δ		
		0	0					1		Δ	Δ					
	0	0		0	0		0	2	Δ	Δ		Δ	Δ			Δ
	0	0	0	0			0	3	Δ	Δ	Δ	Δ				Δ
		0	0			0	0	4		Δ	Δ			Δ	Δ	
	0		0	0		0	0	5	Δ		Δ	Δ		Δ	Δ	
			0	0	0	0	0	6	Δ		Δ	Δ	Δ	Δ	Δ	Δ
	0	0	0					7	Δ	Δ	Δ					
	0	0	0	0	0	0	0	8	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	0	0	0			0	0	9	Δ	Δ	Δ			Δ	Δ	
0								.								Δ

^{1/} See figure 5 for seven segment numeric display output letter assignments.

TABLE VI. Truth table for four segment direct wired sign display (circuit configuration 4).

Input								Display	Output (Δ = Segment lit) ^{1/}							
DPT	A	B	C	D	E	F	G		A	B	C	D	E	F	G	DPT
		0	0		0	0		+/-		Δ	Δ		Δ	Δ		
		0			0				Δ			Δ			
0								.								Δ

^{1/} See figure 6 for four segment sign display output letter assignments.

TABLE VII. Truth table for colon direct wired sign display.

Input								Display	Output (Δ = Segment lit) ^{1/}							
DPT	A	B	C	D	E	F	G		A	B	C	D	E	F	G	DPT
			0		0			:			Δ		Δ			

^{1/} See figure 7 for colon output letter assignments.

TABLE VIII. Truth table for seven segment numeric display, without latch (circuit configuration 5).

Input							Display	Output							
DPT	LT	BCD				BI		Δ = Segment lit ^{1/}							
		8	4	2	1			A	B	C	D	E	F	G	DPT
	1	0	0	0	0	1	0	Δ	Δ	Δ	Δ	Δ	Δ		
	1	0	0	0	1	1	1		Δ	Δ					
	1	0	0	1	0	1	2	Δ	Δ		Δ	Δ		Δ	
	1	0	0	1	1	1	3	Δ	Δ	Δ	Δ			Δ	
	1	0	1	0	0	1	4		Δ	Δ			Δ	Δ	
	1	0	1	0	1	1	5	Δ		Δ	Δ		Δ	Δ	
	1	0	1	1	0	1	6			Δ	Δ	Δ	Δ	Δ	
	1	0	1	1	1	1	7	Δ	Δ	Δ					
	1	1	0	0	0	1	8	Δ	Δ	Δ	Δ	Δ	Δ	Δ	
	1	1	0	0	1	1	9	Δ	Δ	Δ			Δ	Δ	
	1	1	0	1	0	1	c				Δ	Δ		Δ	
	1	1	0	1	1	1	d			Δ	Δ			Δ	
	1	1	1	0	0	1	e		Δ				Δ	Δ	
	1	1	1	0	1	1	f	Δ			Δ		Δ	Δ	
	1	1	1	1	0	1	Blank				Δ	Δ	Δ	Δ	
	X	X	X	X	X	0	Blank								
0	X	X	X	X	X	X	.								Δ ^{2/}
	0	X	X	X	X	1	Blank	Δ	Δ	Δ	Δ	Δ	Δ	Δ	

^{1/} See figure 5 for seven segment numeric display output letter assignments.

^{2/} The decimal point (DPT) operates independently of the conversion logic. To illuminate, connect to GND (0.0 V dc).

TABLE IX. Truth table for four segment sign display, without latch (circuit configuration 6).

Input							Display	Output				
DPT	LT	BCD				BI		Δ = Segment lit ^{1/}				
		8	4	2	1			B	C	E	F	DPT
	1	0	0	0	0	1		Δ	Δ	Δ	Δ	
	1	0	0	0	1	1		Δ		Δ		
0	X	X	X	X	X	X						Δ ^{2/}
	X	X	X	X	X	0	Blank					
	0	X	X	X	X	1		Δ	Δ	Δ	Δ	

^{1/} See [figure 6](#) for four segment sign display output letter assignments.

^{2/} The decimal point (DPT) operates independently of the conversion logic. To illuminate, connect to GND (0.0 V dc).

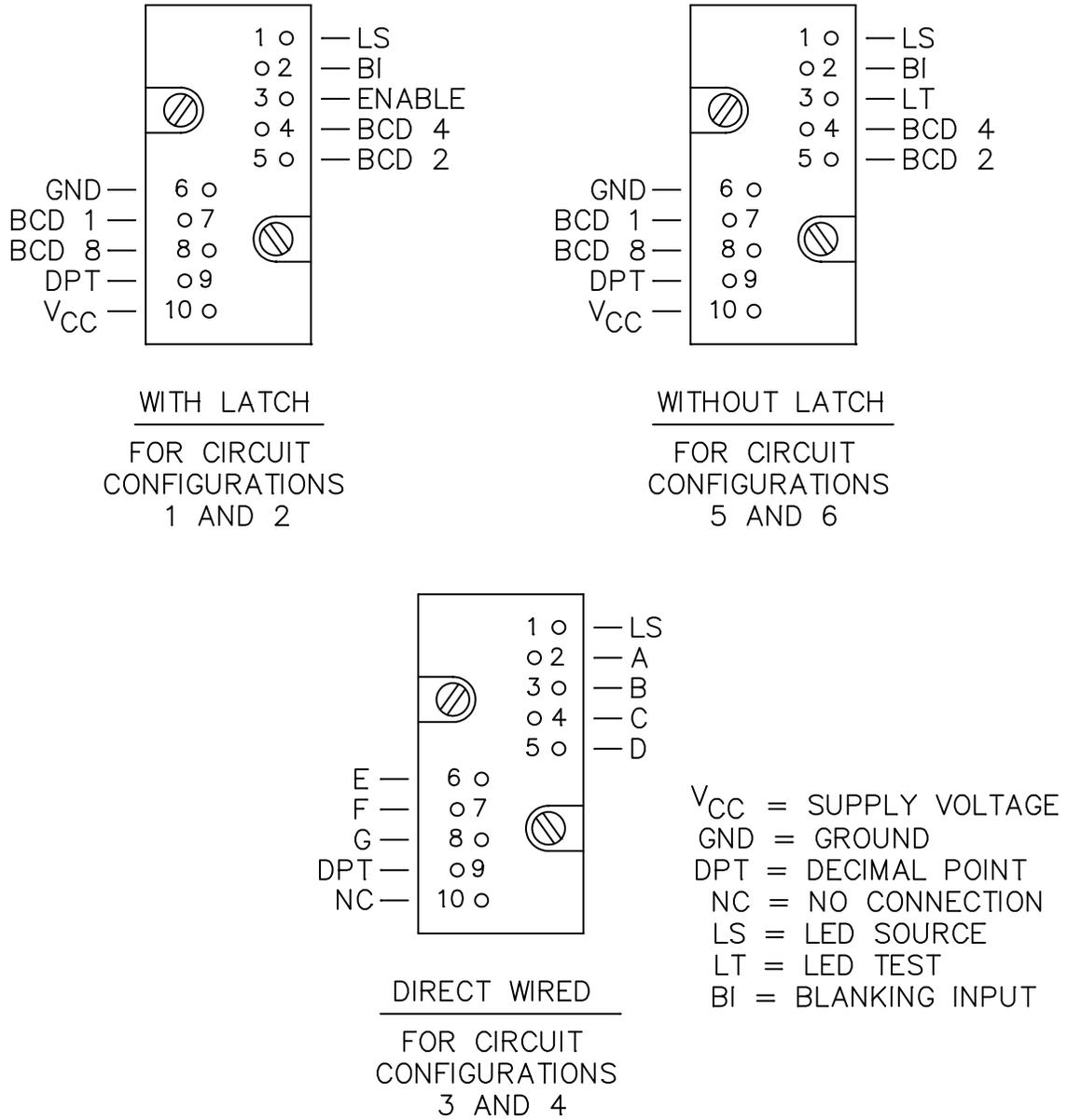


FIGURE 8. Terminal designation for circuit configurations (rear view).

TABLE X. Electrical specifications for circuit configurations 1 and 2.

Symbol	Characteristic	Limits			Unit	Condition
		Minimum	Typical	Maximum		
V_{CC} <u>1/</u>	Supply voltage	4.75	5.0	5.25	V	$T_A = +25^\circ\text{C}$
V_{IL}	Logical "0" low input voltage			1.50	V	$V_{CC} = 5\text{ V}$
V_{IH}	Logical "1" high input voltage	3.50			V	$V_{CC} = 5\text{ V}$
I_{IN}	Input current		10		pA	
t_{setup}	Setup time		90		ns	
t_{hold}	Hold time		90		ns	$V_{CC} = 5\text{ V}$
PW_{LE}	Minimum latch enable pulse width		260	520	ns	$V_{CC} = 5\text{ V}$
V_{LS}	LED supply voltage	2.5		0	V	<u>1/</u> <u>2/</u> <u>3/</u>
I_{LS}	LED supply current			200	mA	$V_{CC} = 5\text{ V}$

1/ The conversion logic requires a constant supply voltage to operate. Device should not be connected with power on. A separate LED supply is required.

2/ GND (0.0 V dc) is maximum intensity, increasing the voltage will decrease intensity.

3/ Use of LED supply to regulate brightness is not recommended as display uniformity cannot be maintained. Pulse width modulation of the blanking input (BI) is the preferred method of brightness regulation.

TABLE XI. Electrical specification for circuit configurations 5 and 6.

Symbol	Characteristic	Limits			Unit	Condition
		Minimum	Typical	Maximum		
V_{CC}	Supply voltage	4.75	5.0	5.25	V	$T_A = +25^\circ\text{C}$
V_{IH}	Input high voltage	2.0			V	Guaranteed input high voltage for all inputs
V_{IL}	Input low voltage			0.8	V	Guaranteed input low voltage for all inputs
I_{IH}	Input high current			40	μA	Logical "1" level input current at any except BI/RBO. $V_{CC} = \text{maximum}$ $V_{IN} = 2.4 \text{ V}$
I_{IL}	Input low current			-1.6	mA	Logical "0" level input current at any input except BI/RBO. $V_{CC} = \text{maximum}$ $V_{IN} = 0.4 \text{ V}$
				-4.0	mA	Logical "0" level input current at any input except BI/RBO. $V_{CC} = \text{maximum}$ $V_{IN} = 0.4 \text{ V}$
I_{CC}	Power supply current		64	85	mA	$V_{CC} = \text{maximum less LED's}$
V_{LS}	LED supply voltage	2.5		5.0	V	1/ 2/ 3/
I_{LS}	LED supply current			200	mA	$V_{CC} = \text{maximum}$

- 1/ The conversion logic requires a constant supply voltage to operate. Device should not be connected with power on. A separate LED supply is required.
- 2/ +5.0 V dc is maximum intensity. Decreasing the voltage will decrease intensity.
- 3/ Use of LED supply to regulate brightness is not recommended, as display uniformity cannot be maintained. Pulse width modulation of the blanking input (BI) is the preferred method of brightness regulation.

TABLE XII. Code letters for number, types and arrangements of modules.

Code letter	Number of modules	Type of module(s) and arrangement
A	Module only <u>1/</u>	4 Segment (see figure 2)
B	Module only <u>1/</u>	7 Segment (see figure 2)
C	1 module assembly	One 4 segment module
D	1 module assembly	One 7 segment module
E	2 module assembly	All 7 segment modules
F	3 module assembly	All 7 segment modules
G	4 module assembly	All 7 segment modules
H	5 module assembly	All 7 segment modules
J	6 module assembly	All 7 segment modules
K	7 module assembly	All 7 segment modules
L	8 module assembly	All 7 segment modules
M	2 module assembly	One 4 segment followed by one 7 segments
N	3 module assembly	One 4 segment followed by two 7 segments
P	4 module assembly	One 4 segment followed by three 7 segments
Q	5 module assembly	One 4 segment followed by four 7 segments
R	6 module assembly	One 4 segment followed by five 7 segments
S	7 module assembly	One 4 segment followed by six 7 segments
T	8 module assembly	One 4 segment followed by seven 7 segments
U <u>2/</u>	5 module assembly	Two 7 segments; one colon; two 7 segments
V <u>2/</u>	8 module assembly	Two 7 segments; one colon; two 7 segments; one colon; two 7 segment
W <u>2/</u>	Module only <u>1/</u>	Colon (see figure 2)

1/ Insertable crimp type terminal (see [figure 3](#)) and connector blocks (see [figure 4](#)) are to be furnished with modules.

2/ Available only as direct wired circuit configurations.

TABLE XIII. Code letters for type of circuitry and seal.

Code letter	Type of circuitry	Type of seal
A	Direct wired	Dripproof
B <u>1/</u>	Conversion logic without latching	
C <u>1/</u>	Conversion logic with latching	
D	Direct wired	Immersion
E <u>1/</u>	Conversion logic without latching	
F <u>1/</u>	Conversion logic with latching	

1/ Not available with colon module. Colon portion of display assembly supplied with direct wired circuitry only.

QUALIFICATION:

Extent of qualification: See table XIV.

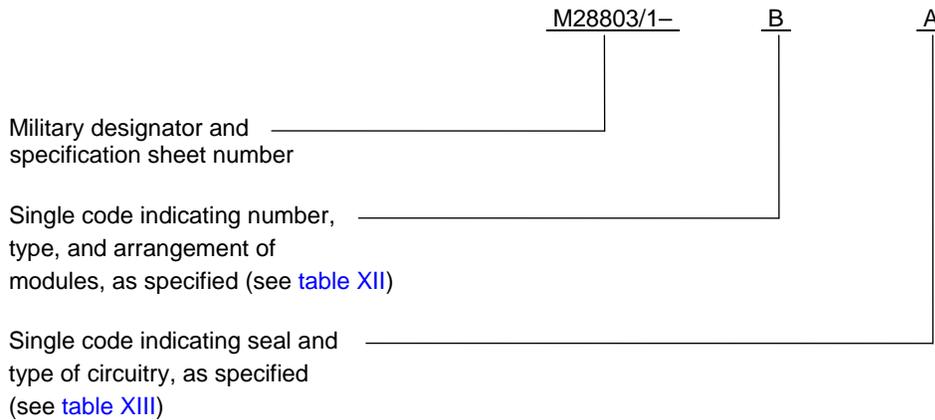
TABLE XIV. Extent of qualification.

Dash letters	Number of samples required	Tests	Qualifies
GA	4	Complete in accordance with qualification inspection of MIL-DTL-28803 <u>2/</u>	All
GB	4 <u>1/</u>		
PF	4		

1/ 2 sample units for the group II (qualification and group B) tests of MIL-DTL-28803, 1 sample unit for group III (qualification and group B) tests, and 1 sample unit for group IV (qualification and group B) tests.

2/ When applicable, immersion seal test shall be performed in lieu of dripproof seal test.

Part or Identifying Numbers (PIN): The PIN shall consist of the letter "M" followed by the basic number of the specification sheet, and a coded two digit dash letters indicating the number, type, and arrangement of the modules, and type of circuitry and seal, as specified. See example below:



PIN for crimp style terminals (see figure 3) (package of 25 terminals): M22885/80-50.

PIN for connector block (see figure 4): M28803/1-ZZ.

Reference documents. In addition to MIL-DTL-28803, this document references the following:

- MIL-STD-202
- MIL-STD-810
- MIL-STD-883

- MIL-C-22520/1
- MIL-PRF-22885/80

The margins of this specification sheet are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army – CR
Navy – EC
Air Force – 85
DLA – CC

Preparing activity:
DLA – CC

Project 5980–2013–001

Review activities:

Army– AR, AT, AV, CR4, MI
Navy – AS, MC, OS
Air Force – 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.