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**SPECIFICATION CONTROL DOCUMENT  
for**

**SERIES 100**

**LIGHTED PUSHBUTTON SWITCHES AND INDICATORS**

**SERIES 100 SCD**

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**SERIES 100 SCD**

**1.1**

SHEET 1 OF 44



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## 1.0 SCOPE

### 1.1 GENERAL DESCRIPTION

The Staco Systems Series 100 is a complete product line of lighted pushbutton switches, and indicators.

This Specification Control Document (SCD) covers the requirements for the Series 100 switch assemblies, pushbutton assemblies, pushbutton switch assemblies, and companion products (which are covered by their own specification control drawings).

This product line meets the general requirements of MIL-PRF-22885, and, in matrix form, MIL-S-24317. It is specifically qualified to the requirements of MIL-PRF-22885/114. As such, it is classified as a Category I switch, when completely defined by referenced specification slash sheet. Customer-specified variations may be classified as Category II products under the specified slash sheet.

The high-brightness light-emitted diodes (HB LEDs) light source is QPL listed under MIL-PRF-22885/114. Incandescent lamp light source is QPL under MIL-PRF-22885/101. Both high-brightness light-emitted diodes and incandescent lamps are qualified for NVIS under MIL-L-85762 (when applicable), MIL-STD-3009, and MIL-PRF-22885.

### 1.2 USE OF SHALL, SHOULD, MAY AND WILL

In this SCD, “shall” is used to express a provision that is binding; “should” and “may” are used to express a non-mandatory provision; and “will” is used to express a declaration of intent.

## 2.0 APPLICABLE DOCUMENTS

### 2.1 GENERAL

The following documents form a part of this document to the extent specified herein. Where specific paragraphs are called out, all subordinate paragraphs also apply. Where individual paragraphs are not specified, the document is applicable in its entirety.

### 2.2 STACOSYSTEMS DOCUMENTS

MIL-PRF-22885/114.  
SCD Series 100.

### 2.3 GOVERNMENT DOCUMENTS

#### 2.3.1 MILITARY SPECIFICATIONS

MIL-PRF-22885	General specifications for switches and illuminated push button.
MIL-S-24317	General Specification for Switches, Multistation, Pushbutton.
MIL-PRF-22885/114	Performance specification sheet – Light-Emitting Diode.
MIL-PRF-22885/101	Performance specification sheet – Incandescent Lamp.
MIL-DTL-5541	Chemicals conversion coating on aluminum alloys (chem-film).
MIL-A-8625	Anodic Coatings for Aluminum Alloys.
MIL-P-13949	Plastic Sheet, Laminated, Metal Clad for Printed Wiring Boards.
MIL-R-25988	Oil and Fuel Resistant for Rubber, Fluorosilicone Elastomer.
MIL-P-27418	Soft Nickel Plating (Electrodeposited, Sulfamate Bath).
MIL-G-45204	Gold Plating, Electrodeposited.
MIL-I-45208	Inspection Systems Requirements.
MIL-S-901	Requirements for Shock Tests, High Impact Shipboard Machinery, Equipment, and Systems.

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**2.3.2 MILITARY STANDARDS**

- MIL-STD-130 Identification and Marking of US Military Property.
- MIL-STD-202 Test Method for Electronic and Electrical Component Parts.
- MIL-STD-108 Definitions of, and Basic Requirements for Electric and Electronic Equipment Enclosure.
- MIL-STD-454 General Requirements for Electronic Equipment.
- MIL-STD-883 Test Methods and Procedures for Micro-Electronics.
- MIL-STD-889 Dissimilar Metals.
- MIL-STD-45662 Calibration System Requirements.
- MIL-STD-3009 Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible.

**2.3.3 OTHER MILITARY SPECIFICATIONS**

- Federal Standards.
- QQ-S-571
- ZZ-R765

**2.3.4 MIL-PRF-22885 / 114 SLASH NUMBER**

Standard series 100 model numbers shall have a slash number /114 following the standard coded number to indicate that the unit is identical to the coded unit except for certain specific differences. This slash number customized option is documented by its own specifications, drawings, and / or SCD.

**2.4 ORDER OF PRECEDENCE**

In the event of conflict, the requirements of the following documents shall apply in the priority shown:

- MIL-PRF-22885/114 & 101.
- MIL-PRF-22885
- Specification control document S100 (SCD 100).
- Other referenced specifications, documents and drawings.

Nothing in this document, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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### **3.0 THE SERIES 100 PRODUCT LINE**

This section provides an overview of the S100 product characteristics, features, options, standard and customized product configurations, and accessories.

### **3.1 PUSHBUTTON AND SWITCH CHARACTERISTICS**

#### **3.1.1 SWITCH CHARACTERISTICS**

##### **3.1.1.1 Termination types**

Double turrets solder.  
Printed circuit board (PCB).  
Crimp pin.

##### **3.1.1.2 Switch poles configurations**

Single Pole Double Throw (SPDT).  
Double Pole Double Throw (DPDT).  
Four Pole Double Throw (4PDT).  
Indicator.

##### **3.1.1.3 Switch contact material**

Silver.  
Gold.

##### **3.1.1.4 Common bussed configurations**

Standard – None.  
Single common bussed.  
Horizontal common bussed.  
Vertical common bussed.  
Bottom common bussed.  
Top common bussed.

#### **3.1.2 PUSHBUTTON CHARACTERISTICS**

##### **3.1.2.1 Light source**

Incandescent lamps.  
High brightness light-emitting diodes (HB LEDs), and HB LEDs with voltage dimming circuit.

##### **3.1.2.2 Common circuitry**

Single common.  
Horizontal split common.  
Vertical split common.

##### **3.1.2.3 Light-emitted diode (LED) polarity**

Current sourcing (common cathode).  
Current sinking. (common anode).

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### 3.1.2.4 Display Style

Full Screen	2-Way Display		3-Way Display				4-Way Screen
	Horizontal split	Vertical split	Horizontal Top-half	Horizontal Bottom half	Vertical Left half	Vertical Right half	
1	1 2	1 2	1 2 3	1 2 3	1 2 3	1 2 3 2	1 2 3 4

### 3.1.2.5 Display Types

Backlight condition	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
Non-illuminated	1			4	5		
Illuminated	1	2	3	4	5	6	7

Type 1 – Translucent color background with visible black legends. When illuminated, the legend remains black and the background appears in color.

Type 2 – Hidden legends. When illuminated the legends remain black and the background appears in color.

Type 3 – Hidden legends. When illuminated the legends appear in color with opaque black background.

Type 4 – Always visible white legends on an opaque black background. When illuminated the legends appear in color with opaque black background.

Type 5 – White background with visible black legends. When illuminated the legends remain black and the background appears in color.

Type 6 – Hidden legends. When illuminated, the legend is sunlight readable on an opaque black background.

Type 7 – Hidden legends. When illuminated, the legend is NVIS readable on an opaque black background.

Type Code	MIL-PRF 22885	Non-illuminated		Illuminated		Availability	
		Legends	Background	Legends	Background	Incan. Lamp	HB LED
1 <u>1/</u>	C	Black	Translucent Color	Black	Color	Yes	Yes
2	B	Hidden	Black	Black	color	Yes	No
3	H	Hidden	Black	Visible in color	Black	Yes	No
4 <u>2/</u>	N	Translucent white	Black	Visible in color	Black	Yes	Yes
5 <u>2/</u>	W	Black	Translucent white	Black	Color	Yes	Yes
6 <u>2/ 3/</u>	S	Hidden	Black	Visible in color	Black	Yes	Yes
7 <u>2/ 4/</u>	S	Hidden	Black	Visible in color	Black	Yes	Yes
Customer Replaceable Legends							
8 <u>5/</u>	B	Hidden	Black	Black	color	Yes	No
9 <u>5/</u>	W	Black	Translucent white	Black	Color	Yes	No
0 <u>2/ 5/</u>	S	Hidden	Black	Visible in color	Black	Yes	Yes

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**NOTES:**

- 1/ Type 1 – split display styles, including 2-way, 3-way, and 4-way splits, will have .026" black bars as visual split screen separators.
- 2/ Available in High Brightness with voltage dimming.
- 3/ Type 6 - Sunlight readable display applies to incandescent configurations. When illuminated, display shall be readily discernible under 10,000 foot-candles of direct light when tested per MIL-PRF-22885/114. Un-illuminated legends shall not be discernible. Recommended legend height is .100 inch. Incandescent colors Blue and Aviation Green are not recommended for displays required to operate in high-intensity sunlight environments. All LED colors are fully SLR.
- 4/ Type 7 - Night Vision Imaging System (NVIS) compatible display. When illuminated, legends are compatible with NVIS (Gen III) night vision goggles. Applies to both incandescent and LED configurations. Incandescent versions are also sunlight readable. Non-illuminated legend shall not be discernible. (Available in "sealed" version only).
- 5/ Pushbuttons with customer replaceable legends are Display Types 8, 9 and 0. Customers may specify legend text in the normal manner when ordering pushbuttons or assemblies of switches and pushbuttons. If no legend is specified by the customer, a temporary film legend with the words "Replace With Legend" will be installed at the factory in order to clarify positive/negative film type and to show the position of the legend plate within the pushbutton stack-up. Legends and faceplate assemblies which are produced in the field may not be of equal quality to those which are factory made.

Type 8 – Similar to Type 2.

Type 9 – Similar to Type 5.

Type 0 – Similar Type 6.

**3.1.2.6 Illuminated color**

Staco Code	Color Code Non-NVIS				Color Code NVIS		
	MIL-PRF-22885	High-brightness LED Color		Incandescent Color	MIL-PRF-22885	LED / Incan. Color	
		/114				/114	
0	W	WH	White	White		NB	Blue
1	R	RD	Red	Red	L	NR	Red
2	G	GR	Green	Green	J	GB	Green B
3	Y	AY	Aviation yellow	Aviation yellow		---	Yellow B
4	D	---	<b>Not available</b>	Lunar white		NW	White
5	---	LY	Lemon yellow	Lemon yellow	K	NY	Yellow A 2/
6	B	BL	Blue	Blue 1/	H	GA	Green A
7	Z	---	<b>Not available</b>	Aviation green 1/			

- 1/ May not be suitable for high intensity light applications.
- 2/ Meets both NVIS Yellow Class-A and Class-B. Type I Class-A is primarily used in Helicopters. Type II Class-B is primarily used in fixed wing aircraft. Please contact factory for additional assistance/ or refer to technical manual of MIL-STD-3009 for further information.
- 3. Colors of incandescent lamp and High Brightness LED are slightly different.

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### 3.2 STANDARD ‘CODED’ CONFIGURATIONS.

The following “coded” models are Series 100 standard assemblies:

Model A “coded” – Switch / indicator with pushbutton assembly.

Model C “coded” – Switch / indicator assembly (without pushbutton).

Model 92 “coded” – Pushbutton assembly.

Figures 1 and 2 depict a typical “coded” model A, in solder and crimp pin terminals, respectively. Bill of Materials of standard “coded” models C and 92 are shown in table A.

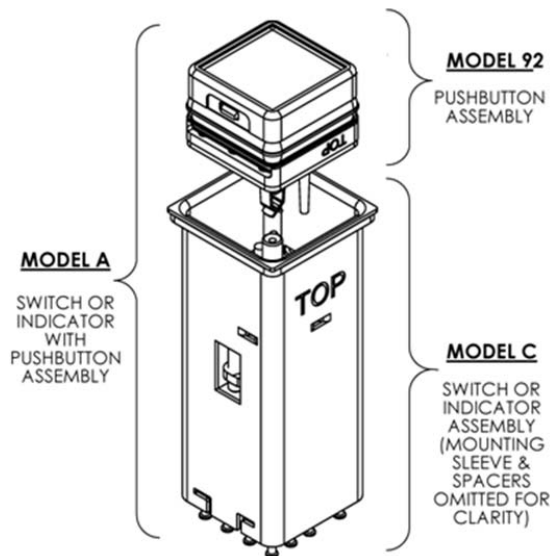


Figure 1 - Model A / Solder terminal

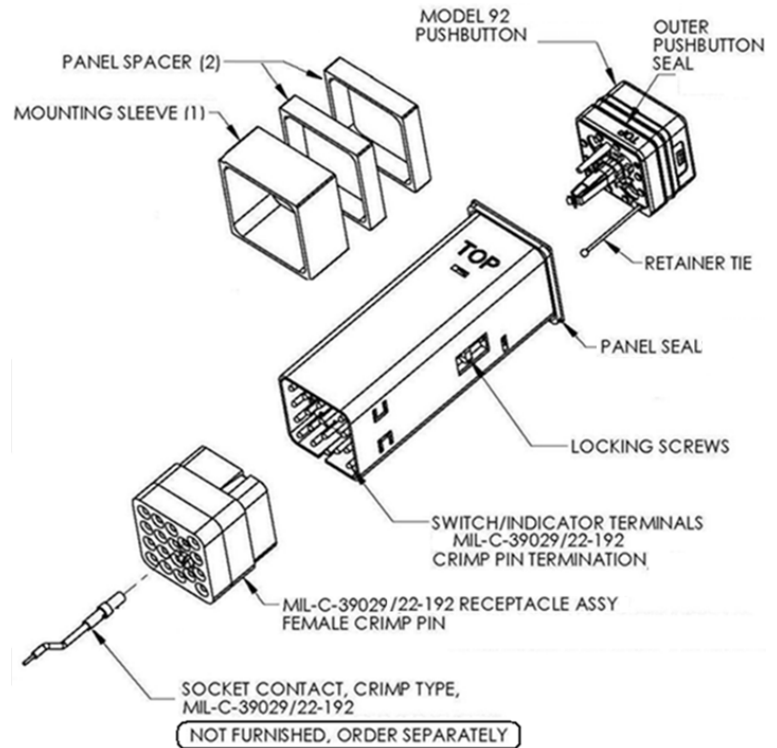


Figure 2 - Model A / crimp pin terminal - exploded view

Model 92 “coded” BOM		Model C “coded” BOM	
Pushbutton Assembly		Switch / Indicator Assembly	
Unsealed	Sealed	Solder / PCB terminal	Crimp pin terminal
1 - Pushbutton ass’y.	1 - Pushbutton ass’y. 1 - Outer seal.	1 – Switch housing ass’y. 1 – Panel seal. 2 – Panel spacers. 1 – Mounting sleeve.	1 – Switch housing ass’y 1 – Panel seal. 2 – Panel spacers. 1 – Mounting sleeve. 1 – Receptacle ass’y.

TABLE A - SWITCH and PUSHBUTTON BOM

### 3.3 CUSTOMIZED CONFIGURATIONS.

Customized configurations are unique in which they conform to a specific customer-defined configurations and / or have unique requirements for performance, marking, or both.

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Customized configuration shall be designed and manufactured to meet the general requirements of MIL-PRF-22885 whenever possible. However, specific customer-invoke design requirements may compromise certain performance characteristics and thus prevent total compliance with the details of mentioned specification.

**3.3.1 MODEL 92P PUSHBUTTON ASSEMBLY**

92PXXXX-TAB numbers shall be used when define unique pushbutton assembly with customized artworks or non-standard requirements.

The XXXX in this model number is a four-digit, sequentially assigned number. All of these numbers are tabulated and have a three-digit or, under special circumstances, a four-digit sequential TAB number. (Typical example would be 92P1234-010).

**3.3.2 MODEL 73XX PUSHBUTTON SWITCH ASSEMBLY**

73XXXX-TAB numbers shall be used when define non-standard pushbutton switch assembly. Unique requirements such as:

- a. Standard switches in use with model 92P type pushbutton; and/or
- b. Non-standard switch in use with model 92 “coded” pushbutton; and/or
- c. Switches require non-standard marking or construction; and/or
- d. When the customers/sales require that a non-coded part number to be used.

**3.4 MATRIX FRAME ASSEMBLIES**

The pushbutton switch assemblies are available in matrix frames. The matrix frames are available in the following configurations:

Model C95 – Rear mount flange matrix in solder, PCB, and crimp pin terminations.

Model C97 – Front mount dress bezel matrix in solder, PCB, and crimp pin terminations.

Details on these units are found in the Matrix Frame Assembly Specification Control Drawing, Model 94 - 97 Coded.

Matrix assemblies are designed, tested and qualified in accordance to the requirements of MIL-S-24317.

**3.5 ACCESSORIES**

**Guards**

Switch guards.  
Watertight seal switch guards.

**Seals**

Watertight seals.  
Solvent resistant seals.

**Tool**

Pushbutton extraction tool.  
Matrix switch extraction tool.  
Socket contact wire termination crimp pin.

Crimp pin tool and positioned.  
Wire connector insertion & removal tool.

**Others**

Color filter caps.  
Dummy lamps.  
Insulator plugs.  
Dress bezel mounting cleat assemblies.  
Digital dimming module.  
Panel seals.

Please refer to section 5. 1 for more information and part number.

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#### 4.0 GENERAL SPECIFICATIONS

##### 4.1 ENCLOSURE DESIGNS

The following enclosures defined in MIL-PRF-22885 are available in the Series 100 Product line, and are shown in table B.

Outline dimensions of a typical type II & V enclosure design is shown in figures 4 and 5, respectively. An extended mount of such design is shown in figure 6. Details and outline dimensions of a typical type III and VI are shown in figures 7 thru 9.

TABLE B – ENCLOSURE DESIGNS

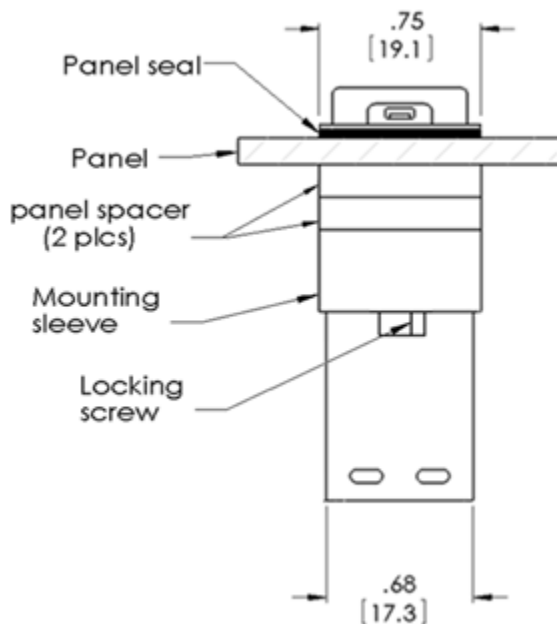
MIL-PRF-22885 Symbol	Seal Description	Enclosure type
2	Dripproof / sealed 1/	II (solder / PCB terminal) & V (Crimp pin terminal)
3	Watertight 1/	III (solder / PCB terminal) & VI (Crimp pin terminal)
4	Splashproof 1/	

1/ In accordance to MIL-STD-108.

##### 4.2 PUSHBUTTON SWITCH ASSEMBLY and OUTLINE DIMENSIONS.

Outline dimensions in various configurations are shown in figures 3 through 9. Panel thicknesses accommodated by each configuration is shown in figure 19 and table D.

The panel spacer may be used for extended mount applications. This feature is to enable the pushbutton to align with commonly used edge-lighted panels when applicable. Please note, a second panel seal is recommended for dripproof when use with extended mounted applications, and is sold separately. See figure 6, tables C and D for more details; and section 5.1.3 for panel seal's part number and ordering information.



Description	Dimension
Panel seal*	0.04" [1.0 mm]
Panel spacer	0.15" [3.8 mm]
Mounting sleeve	0.38" [9.7 mm]

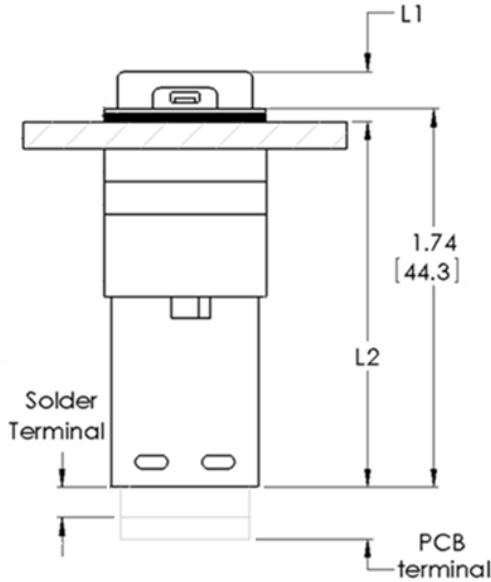
TABLE C – MOUNTING HARDWARE DIMENSION

\* When compressed / installed, panel seal = 0.03"

Figure 3 - pushbutton switch assembly  
Solder / Crimp pin terminal – type II & V

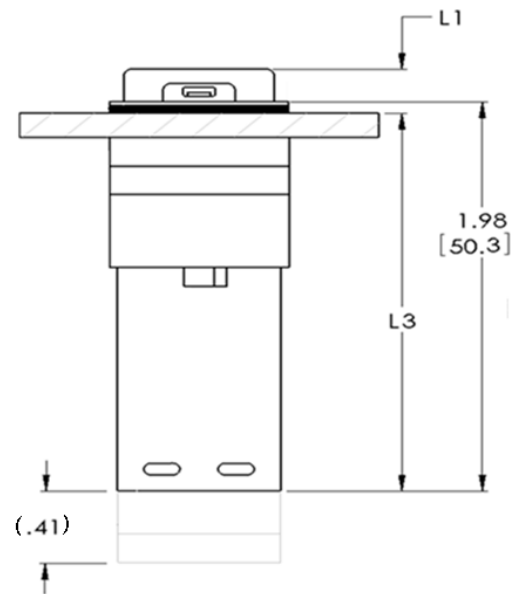
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**4.2.1 PUSHBUTTON SWITCH ASSEMBLY - Type II and V.**



**Fig. 4 Flush mount**

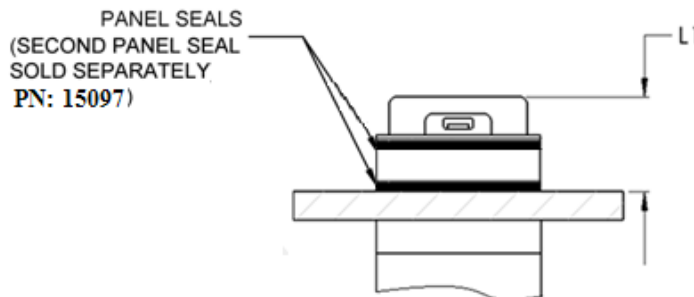
\* Solder / PCB terminal – type II



**Fig. 5 Flush mount**

\* crimp pin terminals - type V

\* See section 4.2.3 for more terminals information.



**Fig. 6 Extended mount – dripproof/sealed (type II & V)**

Description	Panel sealed / dripproof		Panel thickness Maximum	
	Flushed mount	Extended mount	Flushed mount	Extended mount
Cap protrusion <b>L1</b>	0.23" (5.8 mm)	0.41" (10.4mm)		
Switch housing height (Solder / PCB terminal) <b>L2</b>	1.69" (42.9 mm)	1.51" (38.4 mm)	0.88" (22.4mm)	0.70" (17.8 mm)
Switch housing height (Crimp pin terminal) <b>L3</b>	1.93" (49.0 mm)	1.75" (44.5 mm)		

**TABLE D - PUSHBUTTON SWITCH ASSEMBLY OUTLINE DIMENSIONS**

-Unless otherwise specified – Tolerance is ± 0.03.

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**4.2.2 WATERTIGHT / SPLASHPROOF and SOLVENT RESISTANT SEAL - Type III & VI**  
 Outline dimensions for watertight / splashproof and solvent resistant seals are shown in Figures 7 thru 9. Refer to figure 21 for minimum panel center-to-center cutout, and section 4.7 for performance capabilities. It's recommended that for installation and/or service, the center-to-center cutout is to be 1.10 inch.

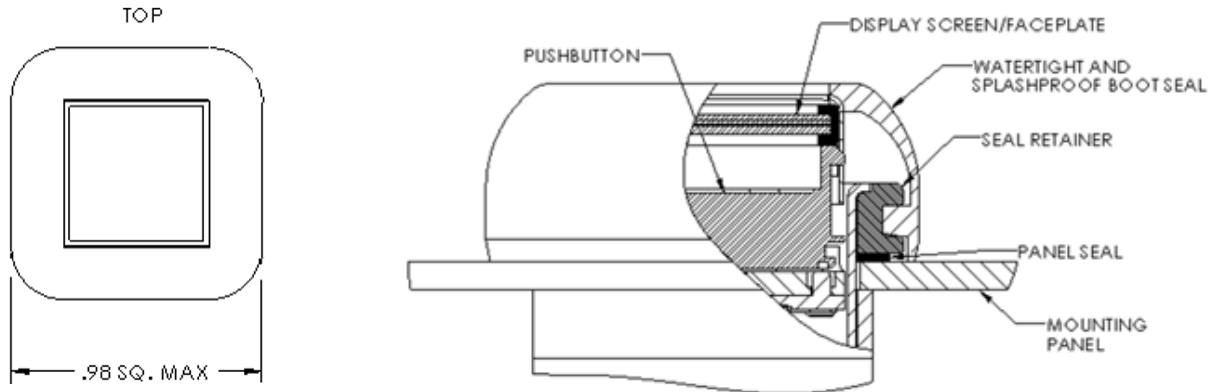


Fig. 7 - typical watertight seal pushbutton switch assembly

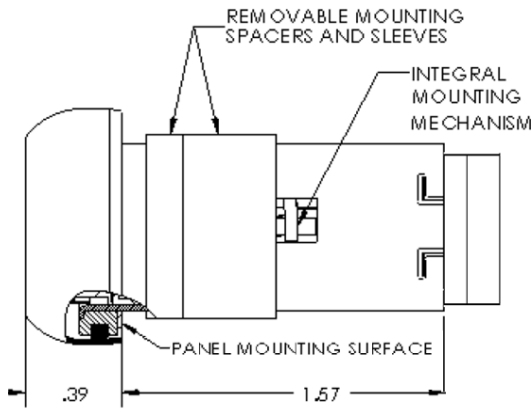


Fig. 8 Solder / PC Terminals - type III

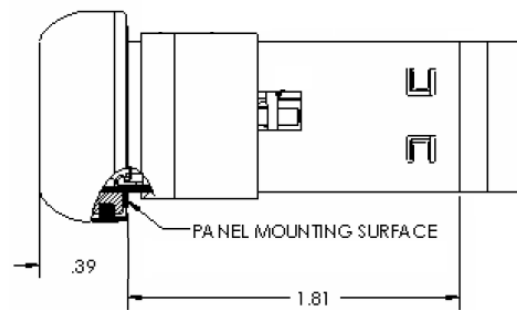


Fig. 9 Crimp pin Terminals - type VI

**4.2.3 SWITCH TERMINATION TYPES**

**Solder terminals**

Outline dimensions for double-turret solder terminal are shown in Figure 10. Refer to section 4.4.4 for information on terminal strength.

**Printed circuit board terminal**

Outline dimensions for printed circuit board terminal are shown in Figure 11. Refer to section 4.4.4 for information on terminal strength.

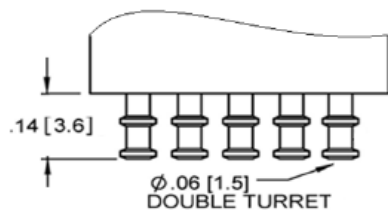


Fig. 10 solder terminals

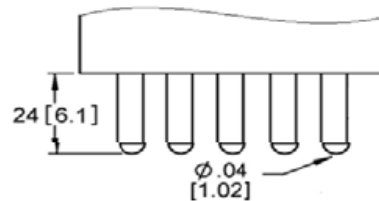


Fig. 11 PCB terminals

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>14/44</b>

### Crimp pin wire terminals

Color band identification and reference dimensions of the Socket Contact used in MIL-C-39029/22-192 crimp pin applications and crimp pin wire and receptacle assembly are shown in Figures 12 and 13, respectively. Refer to section 4.4.4 for information on terminal strength.

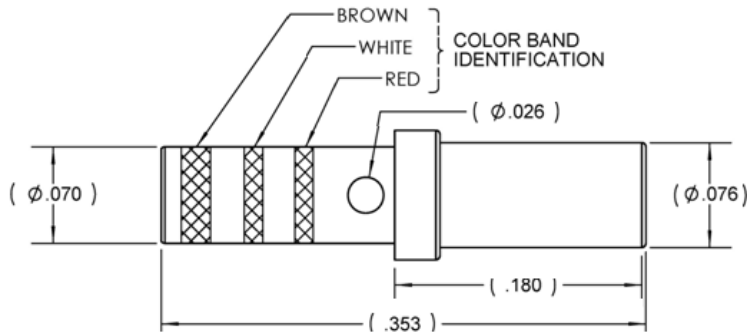


Fig. 12 - Crimp pin wire terminations

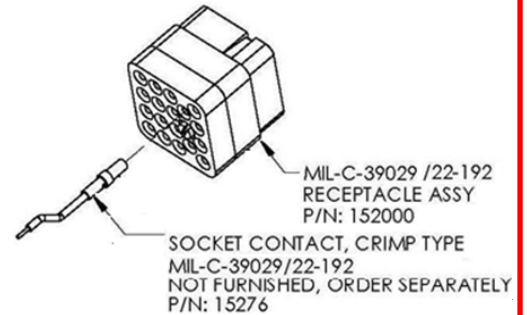


Fig. 13 - Crimp pin terminals

#### 4.2.4 PUSHBUTTON ASSEMBLY and OUTLINE DIMENSIONS

Outline dimensions and details of a typical pushbutton assembly in the sealed and unsealed designs are shown in figure 14.

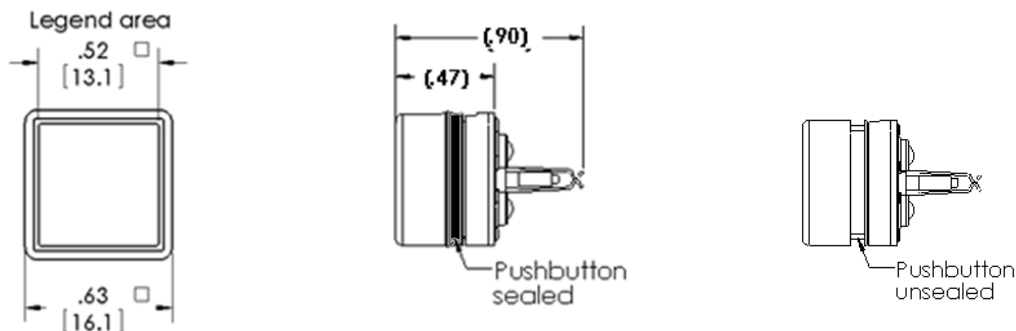


Fig. 14 – typical pushbutton assembly

#### 4.2.5 PUSHBUTTON GUARDS and OUTLINE DIMENSIONS

To prevent accidental operation of the switch, pushbutton guard (PBG) cover must be lifted to allow actuation of the switch. There are two types of guard design:

- Spring loaded guard** - guard cover remains closed until manually lifted, returns to closed position when released.
- Non-spring loaded guard** - guard cover is detent in open position where it will hold its position until manually returned to the closed position.

#### Pushbutton guards for Watertight seal.

The clear cover guard shown in Figure 15 and metal guard is shown in figure 16 are used in conjunction with watertight/splashproof seal design closure type III / VI. The minimum panel center-to-center cutout dimensions are shown in figures 23 and 24, respectively.

CAGE CODE:	DRAWING NO.	REV.	SHT.
12522	SERIES 100 SCD	1.1	15/44

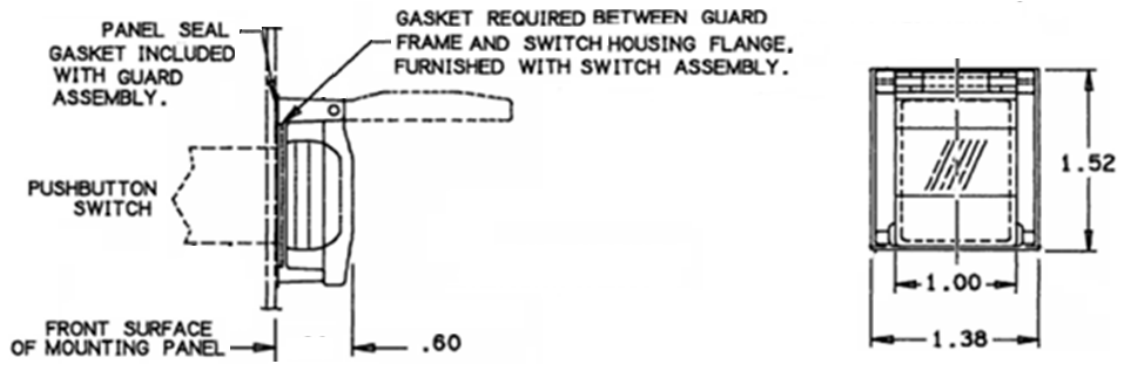


Fig. 15 - Clear cover guard (Non-spring loaded PBG), PN 15204-TAB

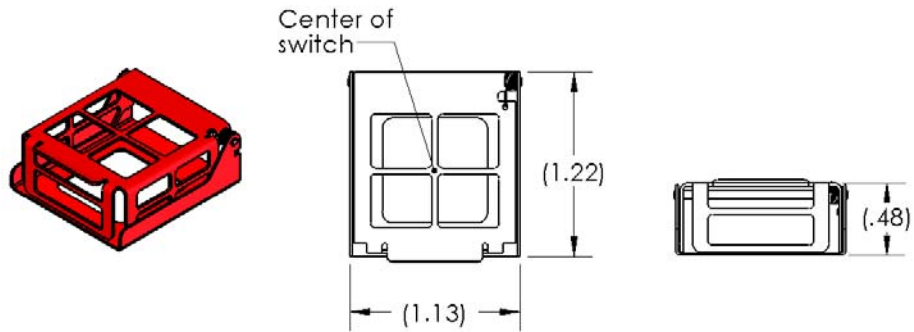


Fig. 16 - metal guard (spring loaded PBG), PN 156104-TAB

### Pushbutton guard for dripproof panel design

The clear cover guard shown in Figure 17 and metal guard shown in figure 18 are used in conjunction with dripproof enclosure type II / V. Both are spring loaded in closed position. The minimum panel center-to-center cutout dimension is shown in figure 22.

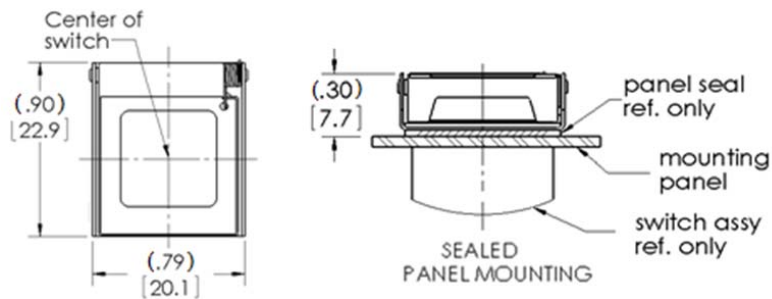


Fig. 17 - Clear cover guard (spring loaded PBG), PN 15089-TAB

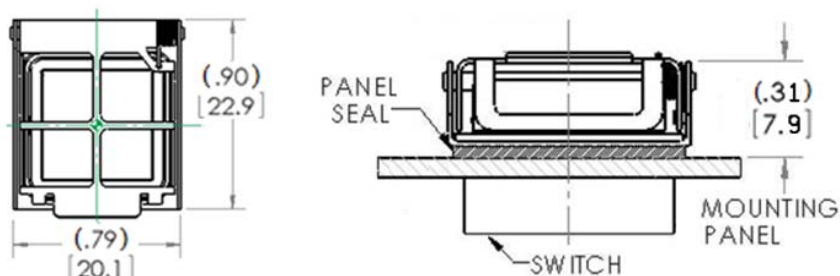


Fig. 18 - Metal guard (spring loaded PBG), PN 15600-TAB

CAGE CODE:	DRAWING NO.	REV.	SHT.
12522	SERIES 100 SCD	1.1	16/44

**4.2.6 PANEL CUTOUT DIMENSIONS**  
**Pushbutton switch assemblies**

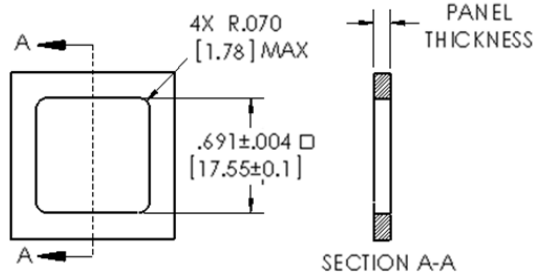


Fig 19 – panel cutout and thickness \*

\* Refer to table D for max. panel thickness.

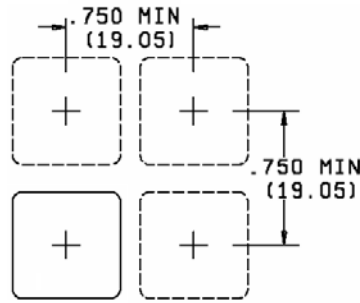


Fig 20 - Matrix mount  
Type II & VI

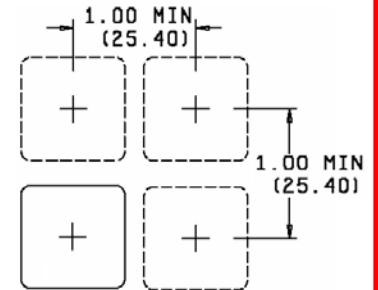


Fig 21 - Matrix mount  
Type III, & VI

**Pushbutton switch assemblies with guards**

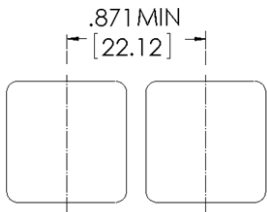


Figure 22 - Switch guards  
(PN 15089 & 156103)  
type II, V

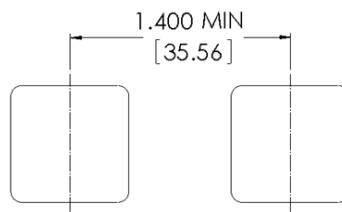


Fig. 23 - Switch guard (PN15204)  
Type III & VI

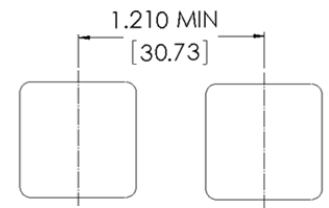


Fig. 24 - Switch guard (PN156104)  
Type III & VI

**Slot mounting**

For applications where horizontal or vertical slot mounting of two or more individual mount switch/indicator is required, the following formula provides cut-out dimensions for the slot.

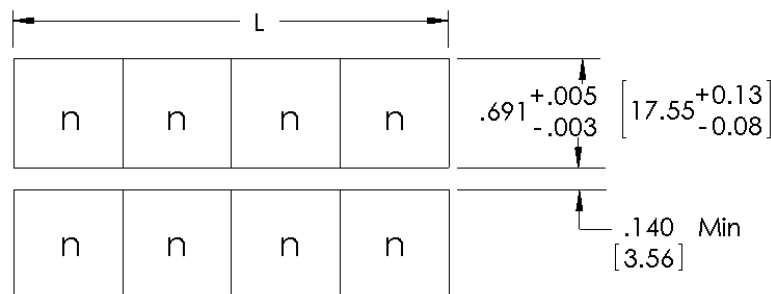
$$L \text{ (inches)} = 0.752'' \times (n-1) + 0.690''$$

$$L \text{ (mm)} = 19.10 \text{ mm} \times (n-1) + 17.53 \text{ mm.}$$

Where:

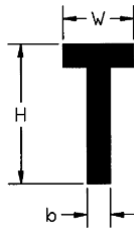
L = length of horizontal or vertical mounting slot.

N = number of units in a row or column.



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<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>17/44</b>





Recommended letter ratio.

$$\text{height-to-width ratio : } \frac{H}{W} = 2$$

$$\text{height-to-stroke width: } \frac{H}{b} = 6$$

The character height, as defined above, shall be the distance (in decimal inches) from the top to the bottom of a capital letter (no descenders) in the standard font, AG2. The standard character heights are as follow: 0.072", 0.087", 0.100", 0.125", and 0.145".

The approximate number of AG2 characters of a given size which will fit into a display area is given in Table F. Since AG2 characters are proportionally spaced (i.e., a character "M" or "W" is about three times as wide as the character "I") the actual number of characters will depend on the specific characters used. If the specific characters used in a given area exceed the space available, but by no more than 10%, the characters shall be condensed by 10%, using the same height but less width, in order to accommodate the legend as requested by the customer.

**Optional font style and size, non-roman alphabets and symbols.**

By special order, other font styles and sizes may be ordered in their normal, condensed, bold, or expanded variations. These typefaces are available in either or both upper and lower cases. Depending on the character width of the chosen fonts, the number of characters per line may be different than of AG2.

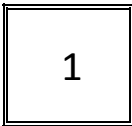
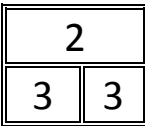
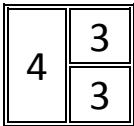
Legend display area: H - Horizontal line(s) per area. C - Characters per line.					
Standard character height	0.072"	0.087"	0.100"	0.125"	0.145"
1 - Full screen	5 X 12	4 X 10	4 X 9	3 X 7	2 X 6
2 - Horizontal split screen	2 X 12	2 X 10	1 X 9	1 X 7	1 X 6
3 - Quarterly screen	2 X 6	2 X 4	1 X 4	1 X 3	1 X 2
4 - Vertical split screen	5 X 6	4 X 4	4 X 4	3 X 3	2 X 2
	H X C				

TABLE F - RECOMMENDED LINE AND CHARACTER PER DISPLAY AREA

**Non-Roman alphabets** – Camera ready art, at 10 times the final size, is required for non-roman alphabets such as Hebrew, Russian, Japanese, Korean, Chinese, Arabic, Sanskrit, etc. A bold face character set, with a stroke ratio of 6:1 or 8:1 is recommended.

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>19/44</b>

**Standard and complex shapes** - standard shapes such as squares, rectangles, circles, and other complex shapes, icons, or graphic symbols may be generated with camera-ready artwork. It's recommended that the customers supply camera-ready artwork at 10 times the final size.

To yield an equivalent resolution of 3,000 x 3,000 DPI for the legend, a minimum resolution of 300 x 300 dots-per-inch (DPI) camera ready art is required.

#### 4.3.4 LENS and FACEPLATE ASSEMBLIES

Faceplate and LED light source assemblies can be replaced in the field if required.

The lens and faceplate assemblies for incandescent and LED light sources are shown in figures 25 and 26, respectively.

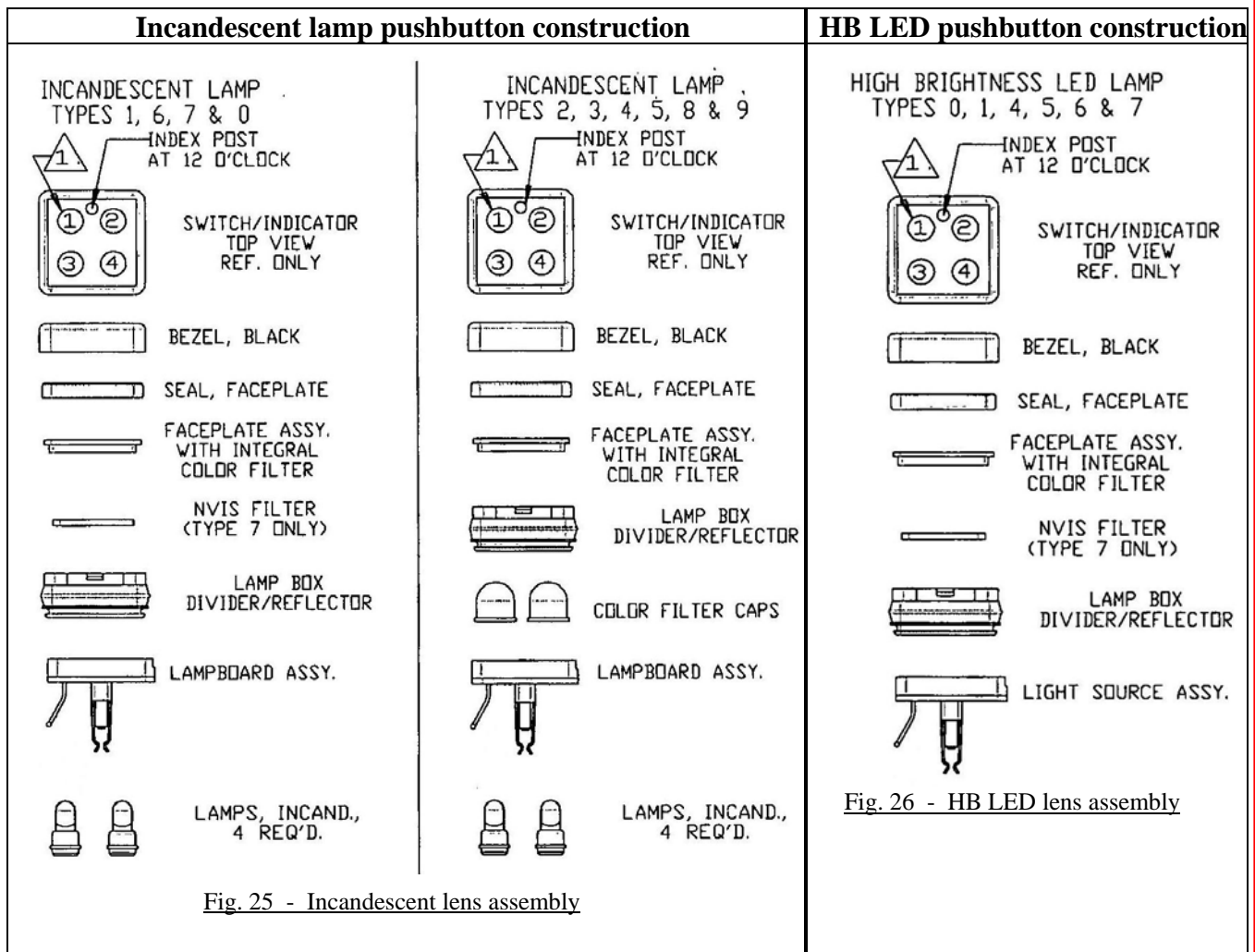


Fig. 25 - Incandescent lens assembly

Fig. 26 - HB LED lens assembly

LAMP POSITIONS SHOWN FOR REF. ONLY.

On all configurations of High Brightness LED based pushbuttons, color is derived from color filters, and in the case of type 7 displays, the color is derived from the NVG-compatible filter. High Brightness LED based pushbuttons that have display types 0, 1, 4, 5, 6, or 7 utilize flat color filters which are an integral part of the faceplate assembly and are not replaceable in the field.

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>20/44</b>

### 4.3.5 CUSTOMER REPLACEABLE LEGENDS

Display types 8, 9 and 0 allow for customer replaceable legends. Displays with customer installed legends may not be of equal quality to that of factory installed assemblies with laminated legends. Figure 27 illustrates the stack-up and surface orientation for these display types.

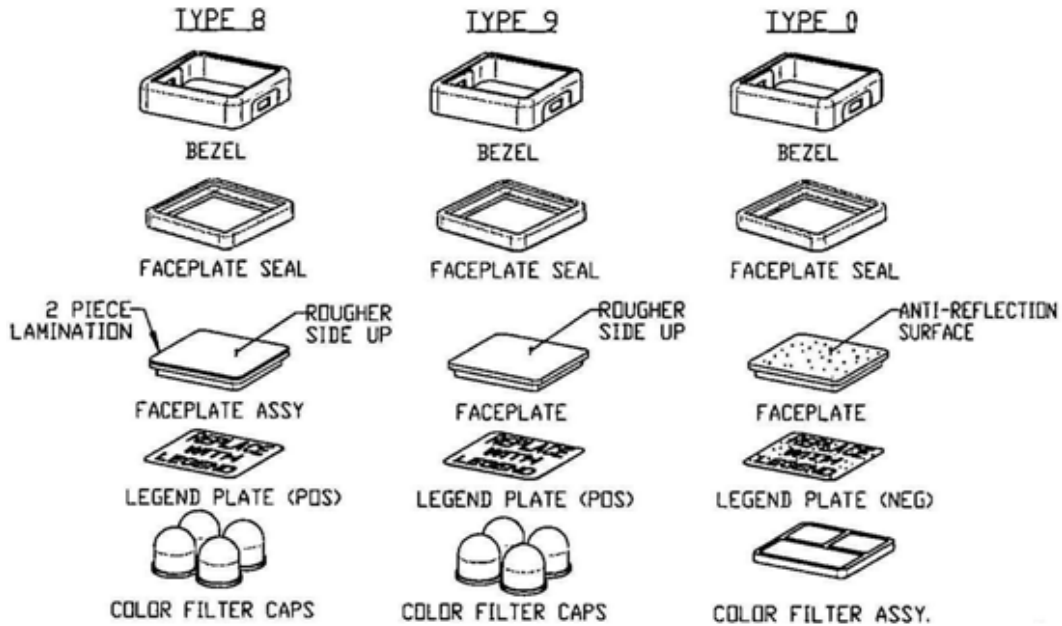


Fig. 27 – Replaceable lens assemblies

NOTE: Factory supplied replaceable legends are available by indicating the desired text in the normal manner. If no specific legend is identified, a temporary film chip (REPLACE;WITH;LEGEND) will be installed in the pushbutton at the factory.

CAGE CODE:	DRAWING NO.	REV.	SHT.
12522	SERIES 100 SCD	1.1	21/44

**4.4 MECHANICAL SPECIFICATIONS.**

**4.4.1 MECHANICAL ENDURANCE.**

The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para 4.7.29.

**Mechanical life**

Switches are tested and exceeded MIL-PRF-22885 life cycle requirement. MIL-PRF-22885 required 50,000 cycles. Staco S100 test consists of 5,000 cycles of operation at  $-55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , 10,000 cycles at  $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and 85,000 cycles at room temperature.

Note: Mechanical life tests have been completed in excess of 1,000,000 cycles.

**4.4.2 OPERATING CHARACTERISTICS**

The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.6.

On alternate action contact switches, the pushbutton is retained in the latchdown position until pushbutton is deactivated. Its displacement is shown in table G and figure 29.

Actuation force	2 to 5 pounds (9 to 22.2N)	Not applicable to type III & VI
Pushbutton extraction force	2 to 5 pounds (9 to 22.2N)	
Pushbutton displacement	$0.130'' \pm .010''$ (max)	Pushbutton latch down actuation and displacement is shown in fig. 28 thru 30
Alternate action displacement	0.065''	

**TABLE G - OPERATING CHARACTERISTICS**

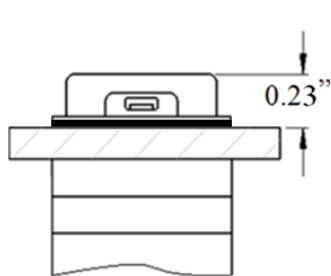


Fig. 28 - Uncompressed

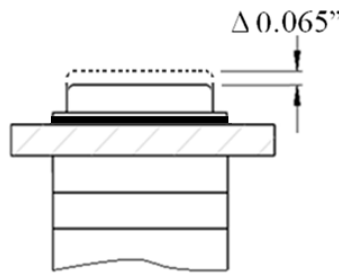


Fig. 29 - Alternate action displacement

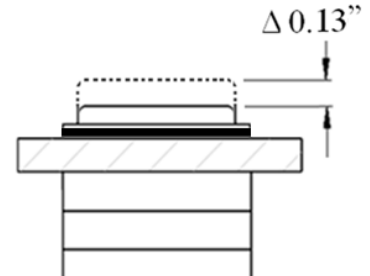


Fig. 30 - Fully depressed

**4.4.3 MOUNTING PROVISION**

**Switch / indicator mounting screw location**

The location of the mounting screws within the switch housing is shown in figure 31. Mounting instructions for switches are in technical bulletin TB-206.

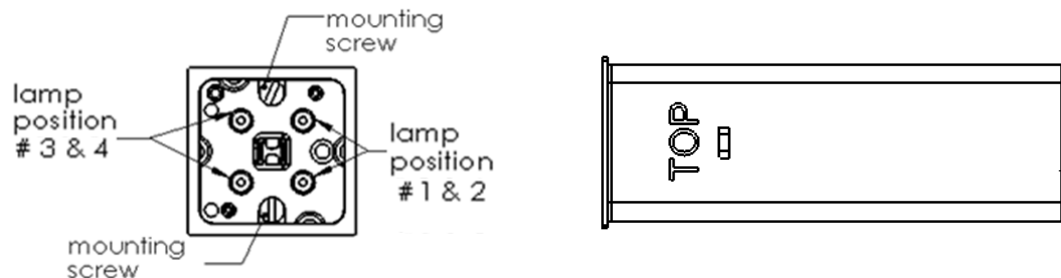


Fig 31- mounting screw location

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>22/44</b>

### Mounting hardware

Each switch or indicator assembly intended for individual mount application is provided with a set of mounting hardware. This consists of a mounting sleeve, two panel spacers, and a panel seal, which are used in conjunction with the mounting screws and cam nuts, to install the switch / indicator to the panel.

### Mounting torque

The recommended torque to be applied to the mounting screws during installation is  $10 \pm 2$  ounce-inches ( $0.071 \pm 0.014$  Nm). This torque value is applicable to both, the switch panel mounting and to receptacle assembly installation.

#### 4.4.4 TERMINAL STRENGTH.

**Solder terminals.** Switch is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.2, MIL-STD-202, Method 208. Terminal strength tests are conducted as prescribed by MIL-STD-211, test condition A. See figure 10 for details and outline dimensions.

**PCB terminals.** Printed circuit board (PCB) terminals shall be gold plated to facilitate hand, wave, or reflow soldering methods. Terminal strength is 3 pounds perpendicular to the long axis and 5 pounds parallel to the long axis. See figure 11 for details and outline dimensions.

**Crimp pin terminals.** Crimp pin terminals are gold plated per MIL-G-45204. Crimp on wire terminations per MIL-C-39029/22-129 shall withstand a pull force of 5 pounds along the axis of the terminals. See figures 12 and 13 for details and outline dimensions.

#### 4.4.5 SWITCH and PUSHBUTTON WEIGHT.

The typical weight of the switch or indicator, including mounting hardware and the pushbutton, are given in Table H.

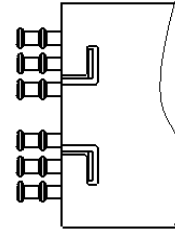
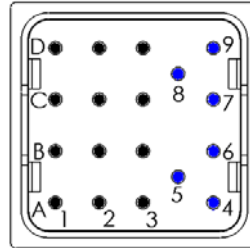
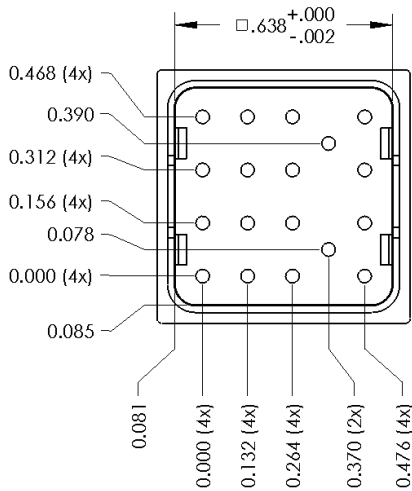
	Terminal	Ounces	Grams
<b>Model C 'coded' Switch</b>	Solder	0.70	20.0
	PCB	0.70	20.0
	Crimp pin	0.92	26.0
<b>Model C 'coded' Indicator</b>	Solder	0.60	17.0
	PCB	0.60	17.0
	Crimp pin	0.81	23.0
<b>Model 92 'coded'</b>	Incandescent Lamp	0.14	4.0
	LED	0.11	3.0
<b>Mounting hardware</b>	Panel seal, panel spacers, mounting sleeve	0.11	3.0

TABLE H – SWITCH and PUSHBUTTON WEIGHT

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>23/44</b>

**4.5 ELECTRICAL SPECIFICATIONS.**  
**4.5.1 SWITCH SCHEMATICS.**

**Switch terminal location & identification**



Notes:

1. Rows A, B, C, D and columns 1, 2, and 3, identify switch contact terminations.
2. Pins 5, 6, 8, and 9, identify backlight circuit terminations.
3. Pin 7 and 4 identify common (ground) terminations.

**Switch terminal and diagram**

Indicator		None	<p><u>Shown in normal position</u></p> <p>D2 and D3 (NC)            D1 and D3 (NO)            C2 and C3 (NC)            C1 and C3 (NO)            B2 and B3 (NC)            B1 and B3 (NO)            A2 and A3 (NC)            A1 and A3 (NO)</p>
Single pole double throw			
Double pole double throw			
4-pole double throw			

CAGE CODE:

DRAWING NO.

REV.

SHT.

**12522**

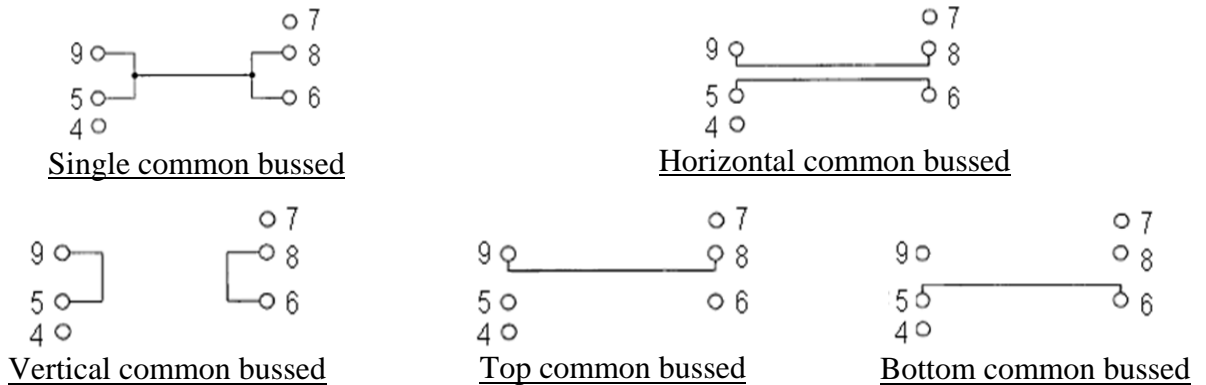
**SERIES 100 SCD**

**1.1**

**24/44**

### Switch common bus schematic

To reduce the number of input wires, a common bussed option is available for switch / indicator assembly as shown below.



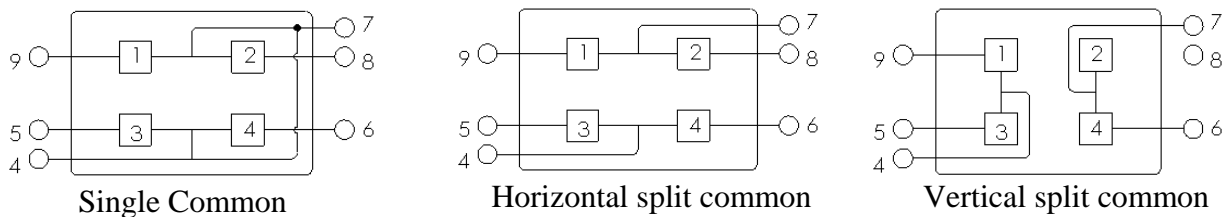
### 4.5.2 PUSHBUTTON SCHEMATICS

#### Incandescent lamps.

The following schematics depict three different standard common (ground) configurations for incandescent light sources.

- Common lamp ground for all four lamps – single common.
- Horizontally split ground plate – Horizontal split common.
- Vertically split ground plate – Vertical split common.

Unlike LED termination wiring, each incandescent lamp is lighted independently from the other three by applying power to the pin designated. The power may be DC or low-voltage AC, as long as it is within the rating of the lamp. Standard lamp selections are listed in table K.



#### High-brightness lighted-emitted diodes.

The HB LED pushbuttons have three individual LED's per quadrant. Unlike the incandescent versions, power need to be applied to only one pin to control the lighting of a half-screen LED display, if the display style is either full-screen or one which includes half-screen displays.

For common (ground) configuration, it is recommended to the end user that both ground terminals (typically pins 4 and 7) be used as the common return circuit for redundancy.

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>25/44</b>

It's to be noted that for 5 VDC applications, the LEDs are connected in parallel and uses 45 mA per quadrant when illuminated. Thus, a full-screen unit would use 180 mA, a two-way split with one half lighted would use 90 mA, etc.

For 28 VDC operating voltage applications, the LEDs are connected in series. The current requirements depend upon the configuration. When operated at 28 volts DC, either for a full-screen or two-way split configuration, the maximum forward current is 40 mA for each half screen when illuminated (80 mA with both illuminated). Maximum current usage for each configuration is shown in table J.

The following schematics show the standard LED configuration for different display style and common configuration.

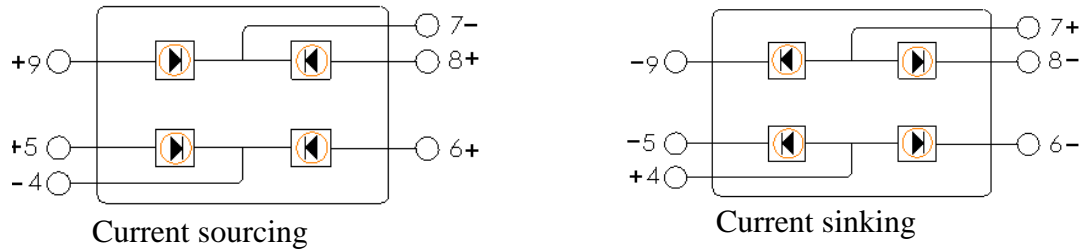
Typical high brightness LED circuit diagram		
	Single common (ground)	Split common (ground)
Full or Horizontal split screen		
3-way horizontal bottom-half		
3-way horizontal top-half		
4-way split		
2-way vertical split		

### LED polarity

LED light sources may be configured for either current sourcing or current sinking. In current sourcing, the LED is energized by applying current to the LED anode (positive) terminals, LED cathode (negative) leads are in common. In current sinking, the LED is energized by applying current to the LED cathode (negative) terminals and the LED anode

CAGE CODE:	DRAWING NO.	REV.	SHT.
12522	SERIES 100 SCD	1.1	26/44

(positive) leads are in common. Current sourcing and sinking are shown in the following schematics.



One characteristic of current sourcing is that it can be used to isolate the lamp load from direct power connection if desired. For this, the cathode side of the LED is always grounded through a current-regulating resistor. The driving circuits supply voltage to the anode side of the LEDs to illuminate them.

Current sinking, on the other hand, enables the controlling circuits to switch the cathodes to ground to light the LEDs. This is a simpler control circuit to implement if MOSFET logic is being used. Also multi-channel output driver ICs with common grounded emitters are readily available.

#### 4.5.3 SWITCH CONTACT RATING.

The switch contacts shall be make and break the currents as listed in table I.

		Sea level	50,000 feet
Silver contacts 28VDC	Resistive	7.0 Amps	4.0 Amps
	Inductive	4.0 Amps	2.5 Amps
	Lamp	2.5 Amps	2.5 Amps
Silver contacts 115VAC 60 Hz	Resistive	7.0 Amps	
	Inductive	7.0 Amps	
	Lamp	2.0 Amps	
Gold plated contacts 28VDC	Resistive	1.0 Amps	
	Inductive	0.5 Amps	

TABLE I - CONTACT RATING

#### 4.5.4 LIGHT-EMITTED DIODES CURRENT PERFORMANCE

Display style	5 V DC	28 V DC
Full screen	180 mA	80 mA
2-way split screen		
3-way split screen		
4-way split screen		

TABLE J - LED CURRENT PERFORMANCE

#### Voltage dimming control

Applicable to 28VDC lighting circuits with dimming device only. These control circuits allow to adjust LED backlight luminance with variable voltage, similar to incandescent lamps light source. Visible luminance starts at about 7.6 V where LED current is approximately 0.020 mA and continues to 28 V where current reaches 20 mA ± 2 mA.

CAGE CODE:	DRAWING NO.	REV.	SHT.
<b>12522</b>	<b>SERIES 100 SCD</b>	<b>1.1</b>	<b>27/44</b>

#### 4.5.5 INCANDESCENT LAMP OPTION

Lamp type	Voltage Max.	Maximum (mA)	Power (W)	Average M.S.C.P.	Life (Hr)
3071	5	240	1.2	0.15	5,000
718	5	460	2.3	0.15	40,000
3335 2/, 1/	28	64	1.8	0.08	10,000
3042 1/	6	240	1.4	0.13	3,000
1099	12	240	2.9	0.15	16,000
3229	14	160	2.2	0.15	16,000
6839	28	96	2.7	0.15	16,000

TABLE K – INCANDESCENT LAMP OPTION

Notes:

- 1/. SLR performance may be degraded with these lamps.
- 2/. Recommended for low faceplate temperature.
3. Unless otherwise specified, M.S.C.P. values are  $\pm 25\%$ .
4. When lamps are not furnished with pushbuttons, a removable fiberboard plate is installed at the factory in order to insure that the pushbutton returns to full normal position. This plate is removed and discarded when lamps are installed.
5. Caution: Do not install pushbutton without lamps or dummy lamps in all four positions, or a fiberboard plate in place. Otherwise, when power is connected, a short circuit will result.

#### 4.5.6 OTHER ELECTRICAL SPECIFICATIONS.

**Contact resistance** - The switches are tested in accordance to the requirements of MIL-PRF-22885 4.7.4 and MIL-STD-202F, Method 307.

**Low level circuit** - The switches are tested in accordance to the requirements of MIL-PRF-22885, section 4.7.31 and ML-STD-202, Method 311.

**Electrical endurance** - The switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.28 and Para 4.7.28.3.

**Overload cycling** - The switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.27.

**Contact bounce** - The switches are tested in accordance to the requirements of MIL-PRF-22885, para. 4.7.5. Simultaneity is under 2 milliseconds.

**Dielectric strength** - Tests are performed at both sea level and at a reduced barometric pressure simulating 70,000 feet altitude.

**Dielectric withstanding voltage at atmospheric pressure** – the switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.19.1, MIL-STD-202F, Method 301.

**Dielectric withstanding voltage at reduced pressure** - the switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.19.2, MIL-STD-202F, Method 105C, Cond. C.

**Insulation resistance** - The switches are tested in accordance to the requirements of MIL-STD-202F, Method 302, Cond. B.

**Short circuit** - The switches are tested in accordance to the requirements of MIL-PRF-22885, 4.7.24 Method I.

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#### 4.6 OPTICAL PERFORMANCE

The pushbuttons illuminated color is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.34.

##### 4.6.1 HB LED and INCANDESCENT LUMINANCE PERFORMANCE

The pushbutton luminance is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.35, for Non-NVIS colors and Para.4.7.37, for NVIS colors.

Luminance measurements for a given legend type may vary depending on the shape of the lamp filament required for its design voltage, the orientation of the filament within the lampbox, and the legend used in the test. QPL tests are conducted with a standard test legend, AG2, the specified lamp box configuration and utilize lamp type 3071 (5 volt, with a Kelvin temperature of 2350 °K). Results with other legends, lampbox configurations or lamps may be different. See tables L and M for the minimum average luminance for LEDs and incandescent light sources.

<b>High-brightness LED - Minimum average luminance (fL)</b>					
Display type					
M22885 Symbol	C	N	W	S	S
S100 Code	1	4	5	6	7
White	240	530		740	600
Red	40	75		180	180
Green	180	170		490	---
Aviation yellow	185	410		630	---
Lemon yellow	350	850		990	---
Blue	165	85		220	180
Green A	---				350
Green B	---				180
Yellow A	---				250
Yellow B	---				350

TABLE L - LED LUMINANCE PERFORMANCE

<b>Incandescent - Minimum average luminance (fL) (EMI/without EMI)</b>					
Display type					
M22885 Symbol	C	N	W	S	S
S100 Code	1	4	5	6	7
White	300/175	300/150	350/175	275/225	---
Red	80/40	50/25	70/35	185/150	80/80
Green	60/30	40/20	50/25	185/150	---
Aviation yellow	350/175	200/100	350/175	275/225	---
Lunar white	300/175	250/150	300/175	250/200	---
Blue	40/20	25/12	30/12	185/---1/	---
Aviation green	60/30	40/20	50/25	250/200	---
Green A	---				100/100
Green B	---				150/150
Yellow	---				150/150

TABLE M - INCANDESCENT LUMINANCE PERFORMANCE

Notes: 1/ not recommended in blue.

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### Chromaticity diagram and illuminated color limits chart.

The chromaticity of illuminated colors is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.34, Method II, for Non-NVIS colors; and Para. 4.7.37, for NVIS colors.

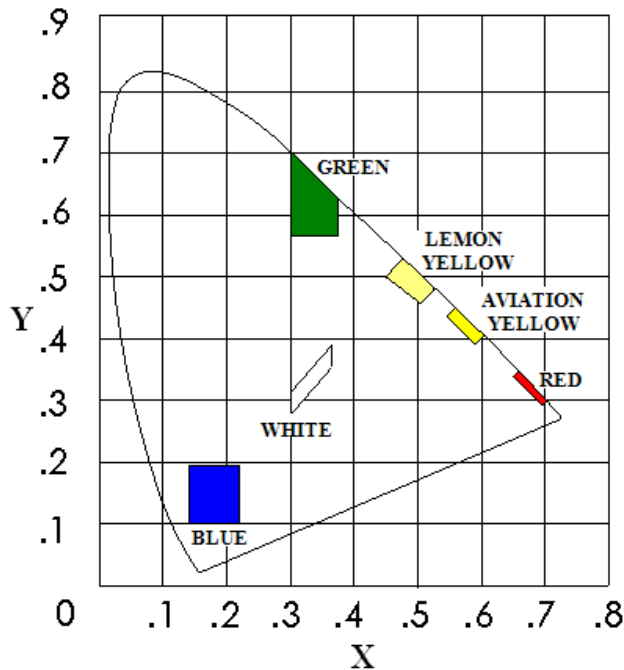


Figure 32 - CIE 1931 chromaticity diagram - LED

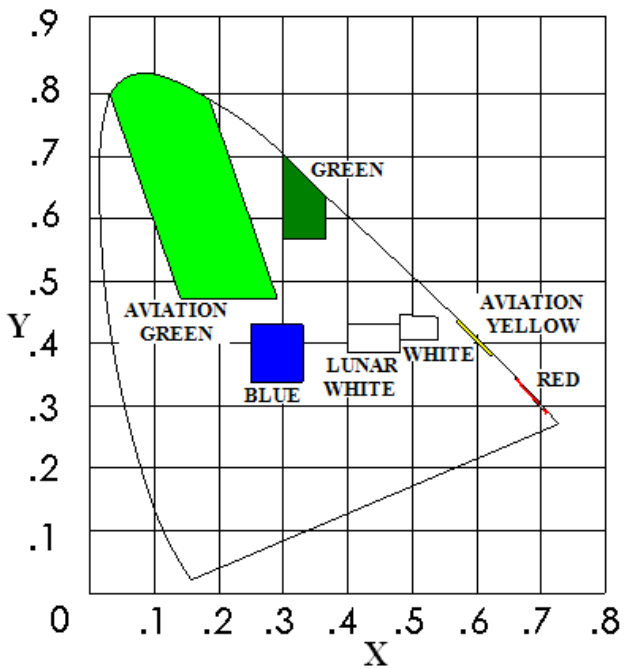


Figure 33 - CIE 1931 chromaticity diagram  
Incandescent lamp

	High brightness LED		Incandescent lamp	
	x	y	x	y
White	0.300	0.270	0.480	0.395
	0.300	0.305	0.480	0.435
	0.365	0.395	0.540	0.431
	0.365	0.360	0.540	0.391
Red	0.695	0.285	0.665	SL 2/
	0.705	SL 2/	0.659	0.335
	0.650	0.330	0.707	0.287
	0.660	SL 2/	0.713	SL 2/
Green	0.300	0.560	0.300	0.560
	0.300	SL 2/	0.300	SL 2/
	0.375	0.560	0.365	0.560
	0.375	SL 2/	0.365	SL 2/
Aviation Yellow	0.545	0.425	0.568	0.425
	0.560	SL 2/	0.575	SL 2/
	0.590	0.382	0.630	SL 2/
	0.604	SL 2/	0.623	0.370
Lunar White	---	---	0.400	0.375
	---	---	0.400	0.420
	---	---	0.480	0.375
	---	---	0.480	0.420
Lemon Yellow	0.450	0.500	---	---
	0.475	SL 2/	---	---
	0.505	0.445	---	---
	0.530	SL 2/	---	---
Blue	0.140	0.100	0.250	0.330
	0.140	0.190	0.250	0.420
	0.220	0.100	0.330	0.330
	0.220	0.190	0.330	0.420
Aviation Green	---	---	0.140	0.470
	---	---	0.290	0.470
	---	---	0.030	SL 2/
	---	---	0.185	SL 2/

TABLE N - COLOR LIMITS

**Notes:**

1. The colors are expressed as "x" and "y" coordinates on the standard 1931 CIE chromaticity diagram. Illuminated colors, measured as specified herein, shall be within the limits bounded by the coordinates listed for each color (see figures 32 and 33).
- 2/ The term "SL" indicates where intersections occur with the spectrum locus on the CIE chromaticity diagram.

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#### 4.6.1.1 Voltage dimming control Luminance performance.

Dimming the brightness of LED light source to the desired level can be accomplished by using either Staco's LED light source with built-in voltage dimming circuit Stacosystems' Digital Dimming Module (see section 5.1.3 for more info).

Staco's LED light source with built-in voltage dimming circuit, adjusting the brightness to the desired level can be accomplished by simply vary the applied voltage between 28 V (where current is reaches  $20\text{mA} \pm 2 \text{ mA}$ ) down to 7.6V (where the current is approximately 0.020 mA).

The output normalized luminance vs. input voltage of a voltage dimming circuit is shown in figure 33.

Note, voltage dimming control is only available in 28 V DC option.

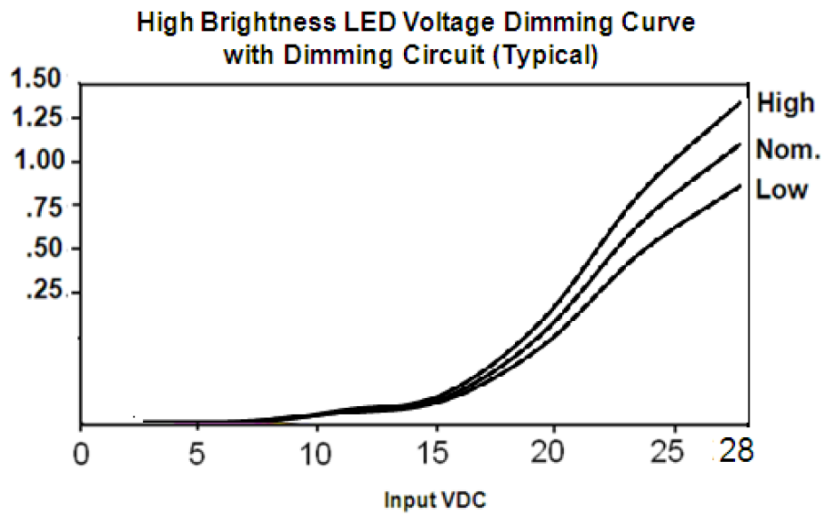


Fig. 34 Voltage dimming curve

Following is an example of how dimming voltage control luminance is calculated.

Example:

Using the luminance data of NVIS yellow from table L.

Minimum average luminance = 250 fL.

$250 \text{ fL} \times 1.5 \text{ (high)} = 375 \text{ fL.}$

$250 \text{ fL} \times .75 \text{ (low)} = 188 \text{ fL.}$

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#### 4.6.2 NVIS COMPATIBILITY

NVIS compatibility is tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.37, MIL-STD-3009, and MIL-L-85762 (when applicable).

NVIS-compatible colors are tested in accordance with MIL-STD-3009. Available NVIS colors are Green A, Green B, Yellow, and Red for incandescent. Green A, green B, yellow, white, blue and red are available in high-brightness LEDs light sources.

NVIS Green A and Green B are used for illuminated controls, caution and advisory signals. NVIS Yellow is used for master caution and warning signals. NVIS Red is only applicable to Class B systems and is used as a warning signal. NVIS blue and white are used for advisory and identification.

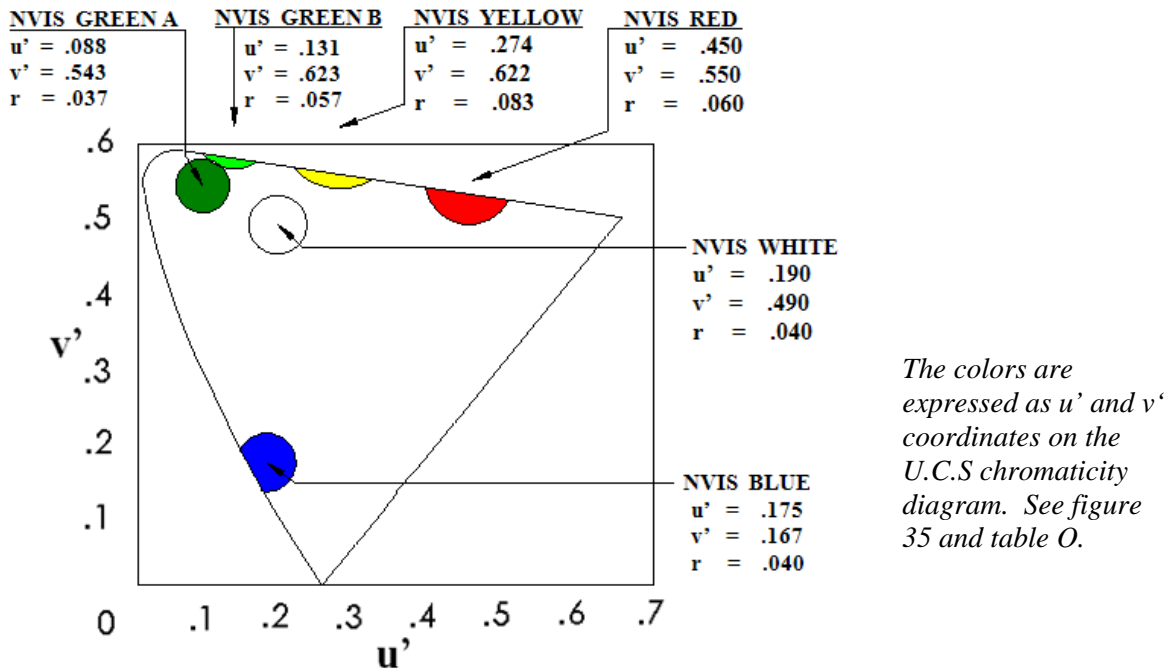


Fig. 35 - U.C.S. chromaticity diagram

NVIS Color	Chromaticity Coordinates			Luminance fL
	$u'$	$v'$	$r$	
Blue	0.175	0.167	0.040	0.1
Red	0.450	0.550	0.060	15
Green B	0.131	0.623	0.057	0.1
Yellow	0.274	0.622	0.083	15
White	0.190	0.490	0.040	0.1
Green A	0.088	0.543	0.037	0.1

TABLE O - COLOR LIMIT CHART

Where:  $u'$  and  $v'$  = 1976 UCS chromaticity coordinates of the center point of the color area.  
 $r$  = radius of the allowable circular area for the color.  
 All values are per MIL-STD-3009.

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**Night Vision Imaging System Classes** - Two NVIS classes have been defined, based on the cut-off frequency of the filters used in the goggles. Class A NVIS uses the 625 nanometer (nm) minus blue objective lens filter while Class B uses the 665 nm filter. The lower cut-off of the Class A filters allows for maximum near-IR response to tree bark, grass and other green vegetation, a general requirement for helicopter applications operating below tree-top level. The Class B filter, with the higher cut-off, allows the goggles to be used in conjunction with orange and red warning indicators in the cockpit, and is intended for aircraft which are operating above tree level.

**NVIS Radiance** - The NVIS radiance (NR) is measured for Class A (NRA) for compatibility with 625 nm applications, and for Class B (NRB) for 665 nm systems. Both are the result of spectral radiance measurements, in 5 nm increments, from 450 to 930 nm. The readings are automatically scaled by the spectroradiometer system to a selected brightness level given in footlamberts.

NVIS spectral radiance measurements for the Series 100 shall be made on a calibrated spectroradiometer. The luminance setting for these measurement shall be  $15 \pm 0.5$  fL (or full rated drive condition, whichever is less) as determined either by photometer or spectroradiometer measurement. The NVIS radiance value shall then be scaled from the NR value at the measured luminance to the NR at the specified luminance level.

Table P has the summary of the NVIS radiance specification for configurations which are applicable to the Series 100 Product Line.

Radiance Requirements								
NVIS color	TYPE I SYSTEM				TYPE II SYSTEM			
	Class A		Class B		Class A		Class B	
	Min NRa	Max NRa	Min NRb	Max NRb	Min NRa	Max NRa	Min NRb	Max NRb
<b>Blue</b>	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10
<b>Red</b>	N/A		4.7x10-8	1.4x10-7	N/A	4.7x10-8	1.4x10-7	
<b>Green B</b>	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10
<b>Yellow</b>	5.0x10 <sup>-8</sup>	1.5x10-7	4.7x10-8	1.4x10-7	---	1.5x10-7	---	1.5x10-7
<b>White</b>	---	2.3x10-9	---	2.3x10-9	---	2.3x10-9	---	2.3x10-9
<b>Green A</b>	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10	---	1.7x10-10

TABLE P - RADIANCE REQUIREMENTS

### Performance of NVGC Light Sources

Table Q, compares the performance of incandescent, and High Brightness LED lighted pushbuttons to the values of Table P.

#### 4.6.3 SUNLIGHT READABILITY

The Sunlight Readability is tested in accordance to the requirements of MIL-PRF-22885, Para 4.7.36. The contrast ratio of each lighted legend character to the background exceeded the 0.6 minimum requirements, and for unlighted legend character to the background, the average contrast ration is  $\ll 0.1$ .

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Sunlight readable displays in the Series 100 Product Line provide a black, non-reflective, dead-front appearance when not lighted and brightly lighted legend characters, in the specified colors, when the displays are energized. This display (type 6) protects the crew station viewer from false indications in direct sunlight at high altitude. The design overcomes two problems associated with high-intensity light directed at the instrument panel. First, when lighted, it enables the viewer to read the legend despite the intense brightness of direct sunlight at 70,000 feet altitude. Secondly, the design prevents this high intensity light from causing the legends to falsely appear to be lighted when they are actually unlighted. The measure of its effectiveness is by means of calculating two sets of contrast ratios based on laboratory measurements conducted under very specific conditions.

**Contrast ratio**

As specified in MIL-PRF-22885, the contrast ratios CL and Cul, calculate for each character is as follow:

The lighted contrast (ON/BACKGROUND) is defined by  $CL = (B2 - B1)/B1$

The unlighted contrast (OFF/BACKGROUND) is defined by  $CUL = (B3 - B1)/B1$

B1 = Average background luminance

B2 = Average character luminance, legend lighted

B3 = Average character luminance, legend unlighted

SLR performance of sealed switches - SLR performance shall not be degraded for standard Dripproof, Splashproof or Watertight seals. SLR requirements do not apply to Solvent Resistant or Hazardous Environment Seals.

Parameter		Incandescent – NVIS light source				High-brightness LED – NVIS light source					
		Green A	Green B	Yellow	Red	Green A	Green B	Yellow	Red	White	Blue
Chromaticity		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Type I	Class A										
	Min NRa	---	---	PASS	N/A	---	---	PASS	N/A	PASS	PASS
	Max NRa	PASS	PASS	PASS	N/A	PASS	PASS	PASS	N/A		
	Class B										
Type II	Min NRb	---	---	PASS	---	---	---	PASS	---		
	Max NRb	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
	Class A										
	Min NRa	---	---	---	N/A	---	---	---	N/A	PASS	PASS
Type II	Max NRa	PASS	PAS	PASS	N/A	PASS	PASS	PASS	N/A		
	Class B										
Type II	Min NRb	---	---	---	---	---	---	---	---	PASS	PASS
	Max NRb	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS		
SLR		PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

TABLE Q – PERFORMANCE OF NVGC LIGHT SOURCES

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## 4.7 ENVIRONMENTAL SPECIFICATIONS

### TEMPERATURE CHARACTERISTICS

The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para 1.2.2.

#### Operating Temperature range

Condition	Temperature
Operating with lamps un-	-55 °C to +85 °C
Operating with lamps energized	-55 °C to +71 °C

TABLE R - OPERATING TEMPERATURE RANGE

**Salt Spray.** The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.22, MIL-STD-202F, Method 101D, Cond. A.

**Thermal Shock** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.14, MIL-STD-202, Method 107, Test Condition A.

**Vibration** – The pushbutton switches are tested in accordance to the requirements of MIL-STD-202, and MIL-PRF-22885, Para 4.7.15, vibration grade 3.

**Acceleration** - The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para 4.7.17.

**Shock** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para 4.7.16, Method I & II, MIL-STD-202, method 213.

**High Impact Shock** – The pushbutton switch shall meet the requirements of MIL-S-901, Grade A, Class II.

**Moisture Resistance** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para 4.7.18, MIL-STD-202F, Method 106F.

**Splash Proof Seal** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.20.1, MIL-STD-108.

**Drip Proof Seal** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.20.3, MIL-STD-108.

**Watertight seal** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.20.2, MIL-STD-108.

**Solvent Resistance Seal** –The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.20.1 & .2, MIL-STD-108.

**Explosion** - The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.25, MIL-STD-202F, Method 109B.

**Sand & Dust** - The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.26, MIL-STD-202, Method 110, Cond. B.

**EMI/RFI Shielding** – The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 4.7.33.1 and 4.7.33.2.

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#### 4.8 MATERIAL REQUIREMENTS.

Materials and processes specified herein. Detailed part drawings, bills of material, bills of operation, process specifications and other manufacturing documentation are subordinate to this specification. In case of conflict, this document shall prevail. When a definite material is not specified herein, material or process shall be used which will enable the switches to meet the performance requirements of this specification.

**Dissimilar Metals** – The pushbutton switches are manufactured in accordance to the requirements of MIL-PRF-22885, Para. 3.5.1.2. Refer to Staco Systems Engineering Design Standard on Dissimilar Metals and MIL-STD-889 for guidance.

**Corrosion Resistance** – All metal components, including current carrying components, shall be of corrosion-resistant material, or shall be suitably protected to resist corrosion.

**Flame Retardant** – Insulation materials used in the pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Para. 3.5.2, which meet flammability requirements of 94V-0 in accordance with UL 94.

**Non-Toxic** – All components contained in S100 product lines are classified as non-toxic materials.

**Front Panel Exposure** – Parts designed to be exposed at the front of the panel after assembly shall have a black lusterless finish. These include pushbutton housings, panel spacers, pushbutton guards, and other associated mounting hardware designed to be exposed at the front of the panel after assembly.

**Finish** – Black anodize over aluminum alloy per MIL-A-8625, Type II, Class 2. Chemical film finishes per MIL-DTL-5541F, Type II, Class 3.

**Terminal Plating** – Gold plating per MIL-G-45204. PCB terminals for are plated to facilitate hand, wave or flow soldering methods. Crimp pin terminals s per MIL-G-45204.

**Silicon Rubber** – Silicone rubber per ZZ-R-765.

**Fungus** –The pushbutton switches are tested in accordance to the requirements of MIL-STD-454, Requirement 4.

**Fluorosilicone** – Fluorosilicone Rubber and Elastomer, Oil and Fuel Resistant per MIL-R-25988.

**Tin Plated Finish** – Lead content is 3% minimum.

**Ozone Depleting Chemicals and Cadmium plated finishes** – Neither Cadmium plating nor ozone depleting chemicals (ODC's) are used in any products or manufacturing processes for this product line. ODC's include chlorofluorocarbons (CFC's), hydrochlorofluorocarbons (HCFC's), methyl chloroform, carbon tetrachloride and halons.

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## 4.9 OTHER REQUIREMENTS.

### 4.9.1 MARKING

Pushbutton and Switch are marked in accordance to MIL-STD-22885, Para 4.7.21. and MIL-STD-130.

**Identification of terminal** – Lamp and switch terminal numbers shall be identified on header base and receptacle assembly.

**Identification of product** – Switches and/or individual packaging shall be permanently and legibly marked per MIL-STD-130, spec 73112. For non-MIL specification parts, the following shall be provided as a baseline:

- a. Stacosystems.
- b. Irvine, CA.
- c. Cage code (12522).
- d. Switch part number (Cxxxxx).
- e. Date code (YYWW).
- f. Switch schematic.
- g. Pushbutton schematic.
- h. Assembly part number (or customer P/N).

For MIL specification parts, the following shall be provided as a baseline:

- a. Stacosystems.
- b. Irvine, CA.
- c. Cage code (12522).
- d. Date code (YYWW).
- e. Switch schematic.
- f. Pushbutton schematic.
- g. MIL SPEC Part number.

Refer to Staco drawing 73112 for additional information and custom marking specs.

**Switch / indicator housings** – Unless otherwise specified, switch and indicator housings shall be marked as specified above with the switch or indicator part number marked on the housing.

**Pushbuttons** – Unless otherwise specified, pushbuttons shall be marked as follows:

- a. Incandescent configuration - date code (and slash number if applicable, and/or TAB number if specified).
- b. LED configurations - date code and rated voltage (and slash number if applicable, and/or TAB number if specified).
- c. All pushbuttons shall have the word TOP marked on the same side as the index post as an orientation aid when installing the pushbutton into the switch.
- d. High Brightness LED lighted pushbutton is identified by "H.B.".
- e. High Brightness LED lighted pushbuttons with dimming features are marked as H.B.D.

**Permanency of marking** – Pushbutton Switches are marked in accordance to MIL-STD-22885, Para 4.7.8, MIL-STD-202, method 215.

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**4.9.2 USER INSTRUCTIONS and QUALITY.**

Each over pack containing switches or indicators shall contain a copy of Panel Mounting Instructions (Staco Systems document 88101, sheet 4 only). Each over pack containing Pushbutton Types 8, 9 or 0 (pushbuttons with user replaceable legends) shall contain a copy of the text and figures from the Legend Replacement Procedure, Staco Systems document 88105.

**WORKMANSHIP**

Products shall be manufactured in such a manner as to be uniform in quality and free from cracked or displaced parts, sharp edges, burrs, and other defects which would be detrimental to their serviceability or performance.

**QUALITY**

Material and products shall be controlled and inspected per the requirements of MIL-I-45208. The maintenance of the calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662. Inspection of product for delivery shall consist of Group A inspections per MIL-PRF-22885 and the applicable slash sheet.

**CHANGES IN SPECIFICATIONS**

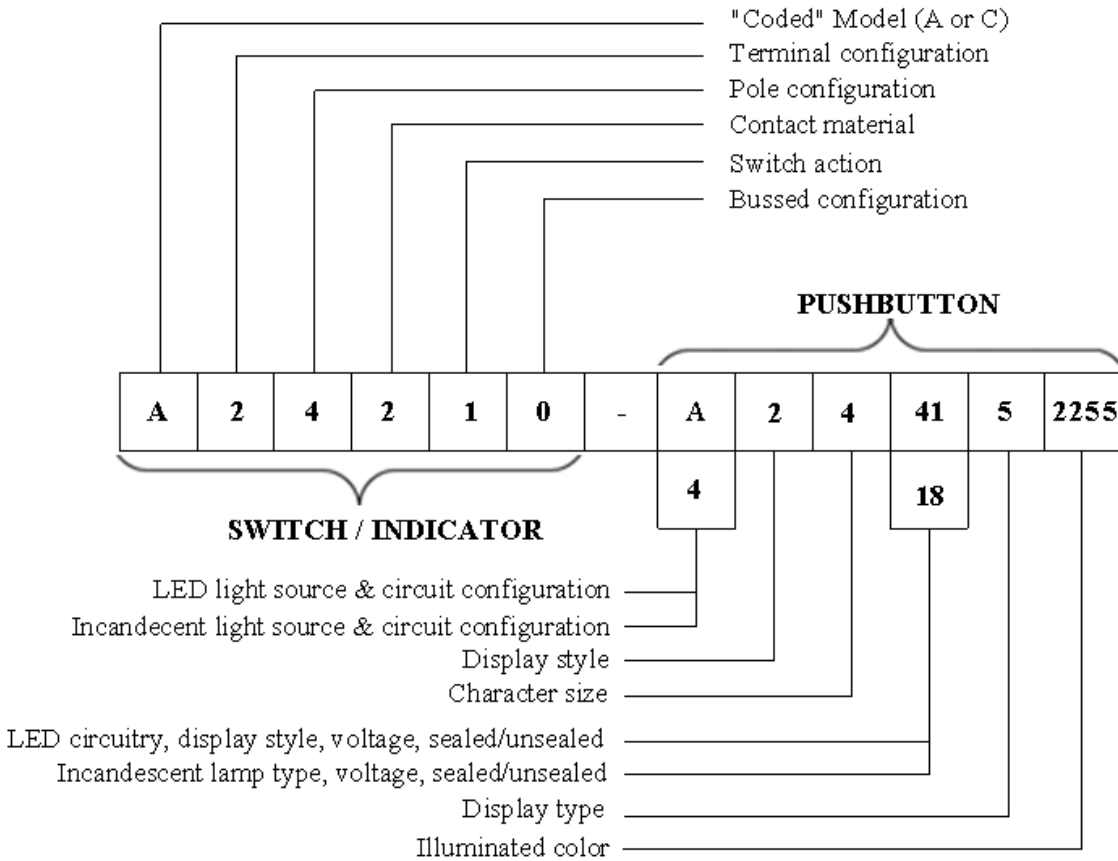
Specifications defined herein are accurate at the time of release and publication of this revision of this document. Staco Systems reserves the right to make changes without prior notice.

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## 5.0 ORDER INFORMATION.

This section contains the information necessary to order the standard Series 100 pushbutton switch configurations and its features described in this specification.

### PART NUMBER MODEL



**WATERTIGHT OR SOLVENT RESISTANT SEAL** - When ordering a model A 'coded' or model C 'coded' with watertight or solvent resistant seal, it's required to add /005 (for watertight seal), or /006 (for solvent resistant), at the end of the final assembly part number.

Example: A24210-A244152255/005 (for model A 'coded') or C24210/005 (for Model C 'coded')

TABLE 5.1 - SWITCH / SWITCH NUMBER CONFIGURATION

'Coded Model'	Terminal config.	Pole config.	Contact material	Switch action	Buss config.
A – Switch & pushbutton Assembly	1 – Crimp	0 – Indicator	0 – Indicator	0 – Indicator	0 – Standard
	2 – Solder	1 – Single pole	1 – Gold	1 – Momentary	1 – Single buss
C – Switch / Indicator (without pushbutton)	3 – PCB	2 – Double pole	2 – Silver	2 – Alternate	2 – Horiz. buss
		4 – Four pole			3 – Vert. buss
				4 – Bottom buss	
				5 – Top buss	

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TABLE 5.2.1 - LIGHT SOURCE and CIRCUIT CONFIGURATION

High-brightness LED						Incandescent Lamp			
			Voltage Dimming <u>1/</u>						
PN code	Common circuit config	LED polarity	PN code	Common circuit config	LED polarity	PN code	Common circuit config	EMI	
A	Single common	Sourcing	E	Single common	Sourcing	1	Single common	No	
B		Sinking	F		Sinking	2	Vertical split		
C	Split common	Sourcing	G	Split common	Sourcing	3	Horizontal split	Yes	
D		Sinking	H		Sinking	4	Single common		
						5	Vertical split		
						6	Horizontal split		

1/ Available for 28 V DC only.

TABLE 5.2.2 - DISPLAY STYLE CONFIGURATION

Part number code							
1	2	3	4	7	6	8	5
1	1 2	1 2	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3 4
<b>Full Screen</b>	Horizontal split	Vertical split	Horizontal Top-half	Horizontal Bottom half	Vertical Left half	Vertical Right half	<b>4-Way Screen</b>
	<b>2-Way Display</b>		<b>3-Way Display</b>				

Table 5.2.3 - CHARACTERISTIC SIZE CONFIGURATION

Part number code						
0	1	2	3	4	5	6
None	0.072"	0.087"	0.100"	0.125"	0.145"	Combinations

Note: See table F for recommended number of characters and line(s) per display area.

Table 5.2.4 - OPERATING VOLTAGE and PUSHBUTTON ENCLOSURE DESIGN

High-brightness LED					Incandescent Lamp *				
Part number code				Display style	Operating voltage	Part number code		Lamp type	Operating voltage
Current sourcing		Current sinking				Unsealed	Sealed		
Unsealed	Sealed	Unsealed	Sealed			Fiberboard plate <u>1/</u>			
31	41	51	61	Full or 2-way	5	01	11	3071	5
32	42	52	62		28	02	12	718	5
33	43	53	63	3-way	5	03	13	Blank	
34	44	54	64		28	04	14	3335	28
35	45	55	65	4-way	5	05	15	3042	6
36	46	56	66		28	06	16	1099	12
						07	17	3229	14
						08	18	6829	28
						09	19	Dummy lamp plug <u>2/</u>	

\* See section 4.5.7 notes.

\* See section 4.5.5 notes.

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- 1/. When lamps are not furnished with pushbuttons, a removable fiberboard plate is installed at the factory in order to insure that the pushbutton returns to full normal position. This plate is removed and discarded when lamps are installed. Applies to Codes 00 and 10.
- 2/. Caution: Do not install pushbutton without lamps or dummy lamps in all four positions, or a fiberboard plate (discard) in place. Otherwise, when power is connected, a short circuit will result.

Table 5.2.5 - DISPLAY TYPE CONFIGURATIONS *					
PN code	MIL-PRF-22885	Non-illuminated	Illuminated	Availability	
				Incand. lamp	HB LEDs
1	C	1	1	Yes	Yes
2	B		2	Yes	No
3	H		3	Yes	No
4	N	4	4	Yes	Yes
5	W	5	5	Yes	Yes
6	S		6	Yes	Yes
7	S		7	Yes	Yes
<b>Customer replaceable legends</b>					
8	B		8	Yes	No
9	W	9	9	Yes	No
0	H		0	Yes	Yes

\* See section 3.1.2.5 notes.

Table 5.2.6 - COLOR OPTIONS			
Part number code	Color Code Non-NVIS		Color Code NVIS
	LED Illuminated Color	Incandescent Illuminated Color	LED / Incandescent Illuminated Color
0	White	White	Blue
1	Red	Red	Red
2	Green	Green	Green B
3	Aviation yellow	Aviation yellow	Yellow B
4	Not available	Lunar white	White
5	Lemon yellow	Lemon yellow	Yellow A
6	Blue	Blue	Green A
7	Not available	Aviation green	

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**5.1 ACCESSORIES and PART NUMBER**

Accessories which apply to pushbutton switch assembly products are identified by 15XXX-TAB numbers. Following is the list of all standard accessory products and their part numbers.

**5.1.1 GUARDS**

Switch Guard (enclosure types II,V)			
Transparent Guard		Metal Guard	
Cover color	Part number	Color	Part number
Clear	15089	Black anodize finish	15600-001
Red	15089-1	Red finish	15600-002
Clear with red border	15089-2		

Watertight switch Guard (enclosure types III & VI)			
Transparent Guard		Metal Guard	
Clear color	Part number	Color	Part number
Watertight	15204-005	Black anodize finish	156104-001
Solvent resistant	15204-006	Red finish	156104-002

Refer to section 4.2.5 for outline dimensions and details.

**5.1.2 TOOLS**

**Pushbutton extraction tool (15193)**

It facilitates the removal of display pushbuttons. See figure 5.2.

**Matrix switch extraction tool (15056)**

It facilitates and eases the removal of switch/indicator assemblies from matrix housing. After removing the pushbutton and loosening the two locking cams, the tool is inserted in the front of the assembly and its rubber block expanded by tightening the looped handle.

**Crimp pin tools and positioners (15278 and 15279)**

Part Number 15278 (Crimping Tool) and 15279 (Positioner) are to be used with MIL-C-39029/22-192 socket contact wire termination crimp pins. The following table shows StacoSystems part number and the corresponding military standard part number.

Part Number	Standard Military Part
15278	M22520/7-01
15279	M22520/7-12

Crimping Tool and Turret are used for attaching socket contact crimp to #20-24 wires for all crimp pins switches / indicators.

**Wire connector insertion and removal tool (15190)**

Standard M81969/16-01 Insertion and Removal Tool used for inserting or removing of wire connectors with crimp pins receptacle, MIL-C-39029/22-192 pins. See figure 5.1.

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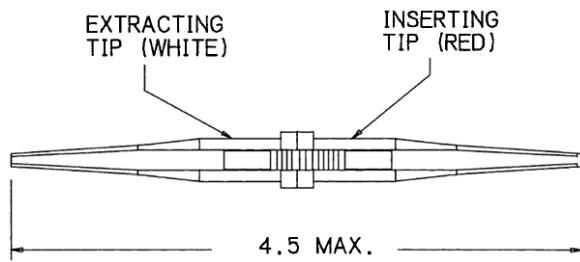


Fig. 5.1 - wire connector insertion/ removal tool (15190)

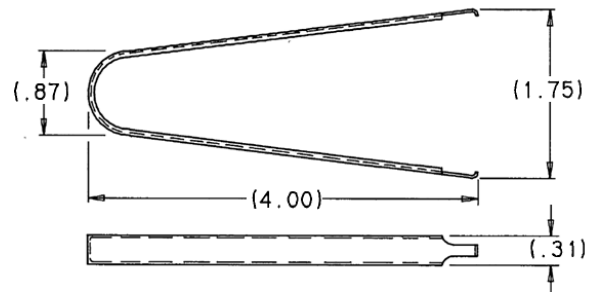


Fig. 5.2 - pushbutton extraction tool (15193)

### 5.1.3 OTHERS

#### Color filter caps (15194-TAB)

The color filter caps shown figure 5.3, are utilized with display types 2, 3, 4, 5, 8 and 9. For these configurations, the color filter cap of any quadrant may be changed without tools. See figure 5.3.

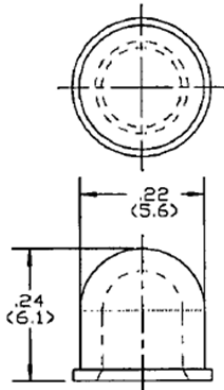


Fig. 5.3 - filter cap (15194)

Part number	Color
15194-0	White (clear transparent)
15194-1	Red
15194-2	Green
15194-3	Aviation yellow
15194-4	Lunar white
15194-5	Lemon yellow
15194-6	Blue
15194-7	Aviation green

#### Dummy lamp (15091)

The dummy lamp is designed as a substitute for the T-1 flange base lamp. When less than four incandescent lamps are required, the dummy lamp must be installed in the unused positions. They also ensure that a uniform actuation force is maintained. See figure 5.4.

#### Insulator plug (15177)

Unused terminal openings in termination receptacles of all crimp pins switches can be closed off by inserting standard MS27488- A20 plastic insulator plugs. The insulator plugs can be used with MIL-C-39029/22-192 compliant receptacles. See figure 5.5.

#### Dress bezel mounting cleat assembly (15098)

The mounting cleat assemblies are supplied as standard parts with the matrix housing. Additional cleat assemblies may be ordered, if desired, for applications of severe vibration or shock. They are packaged 5 to a plastic envelope.

#### Crimp pin wire termination receptacle (152000)

Additional receptacles may be ordered separately as replacement parts for use with S100 crimp pin switches/ indicators. See figure 13.

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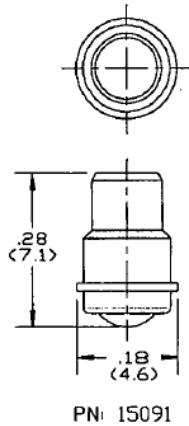


Fig. 5.4 - dummy lamp (15091)

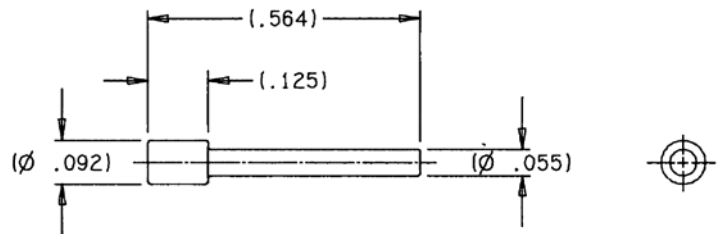


Fig. 5.5 - insulator plug (15177)

### Digital dimming module (DDM111 and DDM111A)

The DDM111 and DDM111A are a solid state dimmer which is highly recommended for the brightness control of HB LED-lighted pushbutton switches and indicators. It may also be used for incandescent lighting. The DDM111 or DDM111A provides up to 15 levels of brightness control with a range of .025% to 100% of rated brightness. The level of brightness may be set by a 4-bit parallel input such as from a digital switch or an electronic device. Alternately, an internal counter allows display brightness to be controlled by "up/down" command lines from a three-position toggle switch or an electronic controller. Other commands include "full brightness over-ride" and "blinking override." One DDM111 or DDM111A controls up to 10 amps of lamp current.

### Crimp pin wire termination (15276)

Addition crimp pin wire termination can be ordered separately as replacement parts for use with crimp pin termination. See figure 12.

### Panel Seals (15097)

Additional panel seals may be ordered separately as replacement parts or for use with extended mount applications. See figure 6.

## 6.0 TECHNICAL BULLETINS.

Technical Bulletin Number	Description
TB-206	Pushbutton switch assembly - mounting procedure
TB-207	Receptacle assembly installation procedure
TB-208	Crimp pin contact terminated wiring system installation procedure
TB-209	Wire crimping procedure
TB-210	Crimp contact installation & removal procedures
TB-211	Cleaning instructions
TB 167	Pushbutton and Incandescent lamp removal procedure.
TB 12 A 29A	Legend replacement procedure

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