REVISION HISTORY				
REV.	**DESCRIPTION**	**ER NUMBER**	**DATE**	**APPROVAL**
1.1	REVISED PER	ER-47497	03/31/17	A.LETSO
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SPECIFICATION CONTROL DOCUMENT, SERIES 300, LIGHT-EMITTING DIODE (LED) LIGHTED PUSHBUTTON SWITCHES AND INDICATORS

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TITLE: SPECIFICATION CONTROL DOCUMENT, SERIES 300, LIGHT-EMITTING DIODE (LED) LIGHTED PUSHBUTTON SWITCHES AND INDICATORS

SIZE	CAGE CODE	DWG NO	REV
A	12522	SERIES 300 SCD	1.1
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SIZE	CAGE CODE	DWG NO	REV
A	12522	SERIES 300 SCD	1.1

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Table of Contents

Section Page

Figures

Figure Page

Tables

Table Page

1.0 SCOPE

This Specification Control Document (SCD) defines the requirements for the Series 300 pushbutton switch assemblies and companion products. Companion products are covered by their respective SCD's.

The Stacosystems Series 300 is a complete product line of high brightness light-emitting diodes (HB LED) lighted pushbutton switches and indicators.

This product line meets the general requirements of MIL-PRF-22885G, and, in matrix form, MIL-S-24317.

The high-brightness LED light source is qualified for NVIS under MIL-L-85762A (when applicable) and MIL-STD-3009.

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2.0 APPLICABLE DOCUMENTS

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.

2.1. Staco Systems Documents

Series 300 SCD	Specification Control Document, Series 300, Light-Emitting Diode (LED) Lighted Pushbutton Switches and Indicators
ICD-F3H	Interface Control Drawing, Front Mount Matrix, S300
ICD-R3H	Interface Control Drawing, Rear Mount Matrix, S300

2.2. Government Documents

Military Specifications

MIL-PRF-22885	General specification for switches and illuminated push button.
MIL-S-24317	General Specification for Switches, Multi-station, Pushbutton.
MIL-DTL-5541	Chemicals conversion coating on aluminum alloys (chemical-film).
MIL-A-8625	Anodic Coatings for Aluminum Alloys.
MIL-R-25988	Oil and Fuel Resistant for Rubber, Fluor silicone Elastomer.
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.
MIL-L-85762	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible.

Military Standards

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-889	Dissimilar Metals.
MIL-STD-45662	Calibration System Requirements.
MIL-STD-3009	Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible.

2.3. Order of Precedence

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

MIL-PRF-22885G

Specification control document S300 (SCD 300).

Other referenced specifications, documents and drawings.

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

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.

3.0 THE SERIES 300 PRODUCT LINE

This section provides an overview of the S300 standard product characteristics, plus features, options, configurations, and accessories.

3.1. Characteristics and Standard Features

The Series 300 Ultra-compact line of switches represents an integration of 2-pole switching capabilities, advanced LED lighting performance, and Military grade reliability in a subcompact package.

Series 300 switches are unique in that the pushbutton is an attached integral part to the switch by means of flex circuit (see Figure 1: Pushbutton switch – exploded view (Drip-proof and PC termination version shown), and shall not be separated from the switch's main body. The pushbutton should only be extracted from switch's main body, when necessary, to access the mounting screws.

Other standard features of the Series 300 include:

- Shortest switch on the market
- Non-reflective surface
- Lowest operating temperature
- Uniform LED illumination
- Lightest weight: 6 grams
- Clarity of legends
- Lowest power consumption
- LED polarity insensitive
- Gold plated fine silver switch contacts for low and/or high current applications
- Electromagnetic interference (EMI) shielding for EMC requirement applications
- High brightness light-emitting diode (HB LED) light source.

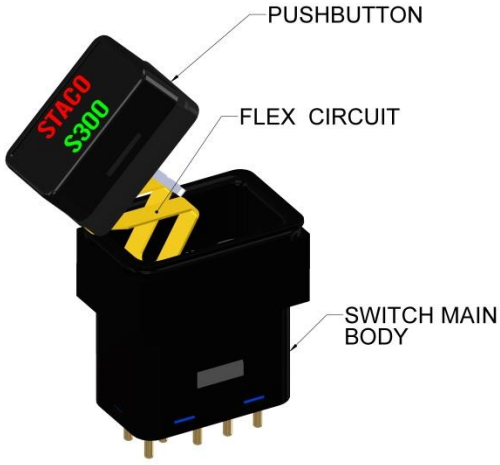

Figure 1: Pushbutton switch – exploded view (Drip-proof and PC termination version shown)

3.1.1. Standard Options

3.1.1.1. Mechanical

Mechanical options include action (indicator, momentary and alternate), termination (solder and PCB) and number of poles (1-pole and 2-pole). See Table XVIII: Mechanical Option for part number codes.

3.1.1.2. Electrical

Electrical options include voltage (5VDC linear dimming, 28VDC linear dimming and 28VDC non-linear dimming), ground (common), polarity insensitive and bussing (single and vertical). See Table XIX: Electrical Option for part number codes.

3.1.1.3. Enclosure Design

Enclosure design includes both drip-proof and splash-proof options. See Table XX: Enclosure Design for part number codes.

3.1.1.4. Display

Display options include display style and character size. See Table XXI: Display Style and Character Size Option for part number codes.

Legend Style and Size options include font style (Alternate gothic number II) and font height (0.072", 0.087", 0.100", 0.125", and 0.145"). See Table XXI: Display Style and Character Size Option for part number codes.

3.1.1.5. Optical

Display type options include MIL-PRF-22885G display types (C, B, H, N, W, and S). Also include are Staco non-standard display types (A, E, F and G). See Table XXII: Display type option for part number codes.

Illuminated Color optios include Non-NVIS colors (white, red, green, aviation yellow, lunar white, blue and aviation green) and NVIS colors (blue, red, Green B, yellow B, white, Yellow A and green A). See Table XXIII: Illuminating color option for part number codes.

3.2. Coded Configuration

Coded configurations defined in this section are to identify various characteristics and options which are available with standard Series 300 switches.

3.2.1. Standard Coded Configuration

The following enclosure designs defined in MIL-PRF-22885G are available in the Series 300 product line, as shown in Table XX: Enclosure Design.

The coded part number for splash-proof (type I and III) is as follows:

3Hxxx-xx1xxxxx	S300 splash-proof pushbutton switch / indicator.

Figure 2: Drip-proof (solder termination version shown) and Figure 4: Detail A: Locking mechanism (drip-proof version shown) depict a typical splash-proof enclosure designs, in various terminations.

Each switch or indicator assembly intended for individual mount application is provided with a set of mounting hardware, which consists of a panel spacer and two mounting sleeves. These are used in conjunction with the mounting screw and cam nut (located on the side of switch's main body) to install the switch/indicator to the panel. Refer to Figure 4: Detail A: Locking mechanism (drip-proof version shown). Bill of materials (BOM) for each configuration is shown in Table I: Pushbutton switch assembly BOM.

Each splash-proof pushbutton switch assembly is provided with a splash-proof panel seal to meet the splash-proof requirements of MIL-PRF-22885G. Refer to Figure 2: Drip-proof (solder termination version shown) and Figure 4: Detail A: Locking mechanism (drip-proof version shown).

For extended mount applications, the panel spacer may be used. This feature is to enable the pushbutton to align with commonly used edge-lighted panels when applicable. For flushed mount application, the panel spacer can be discarded. Refer to Figure 12: Flushed mount – Splash-proof design, and Figure 13: Extended mount – Splash-proof design for flushed and extended mounts outline dimensions.

A keying feature is designed to ensure that pushbutton can only fit into the switch's main body one way. Similarly, a snap-retainer mechanism is designed into the pushbutton to ensure that it cannot become separated from the body unexpectedly due to shock, vibration, or sudden hand movement, whatever the position of the pushbutton. See Figure 4: Detail A: Locking mechanism (drip-proof version shown) for snap-retainer mechanism.

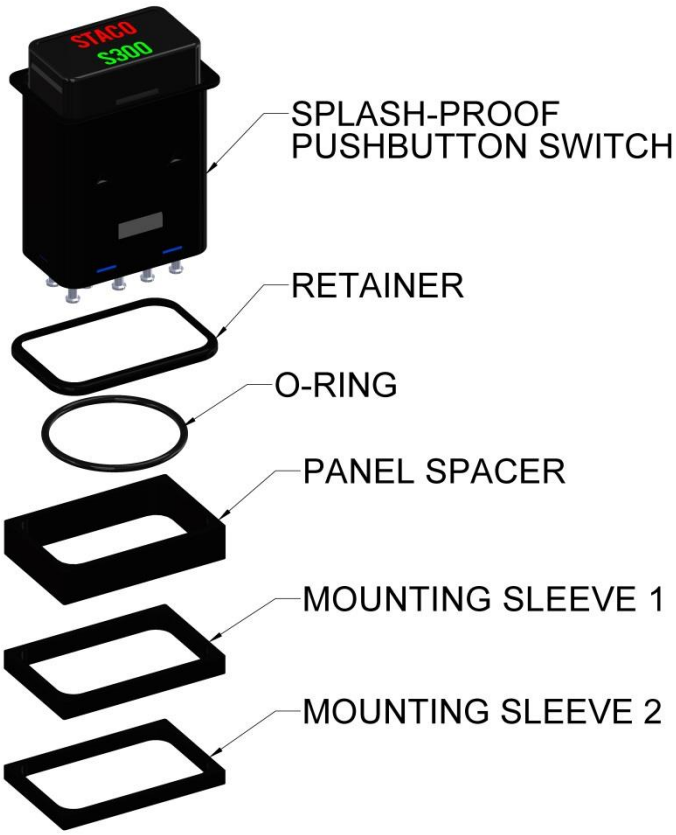

Figure 2: Drip-proof (solder termination version shown)

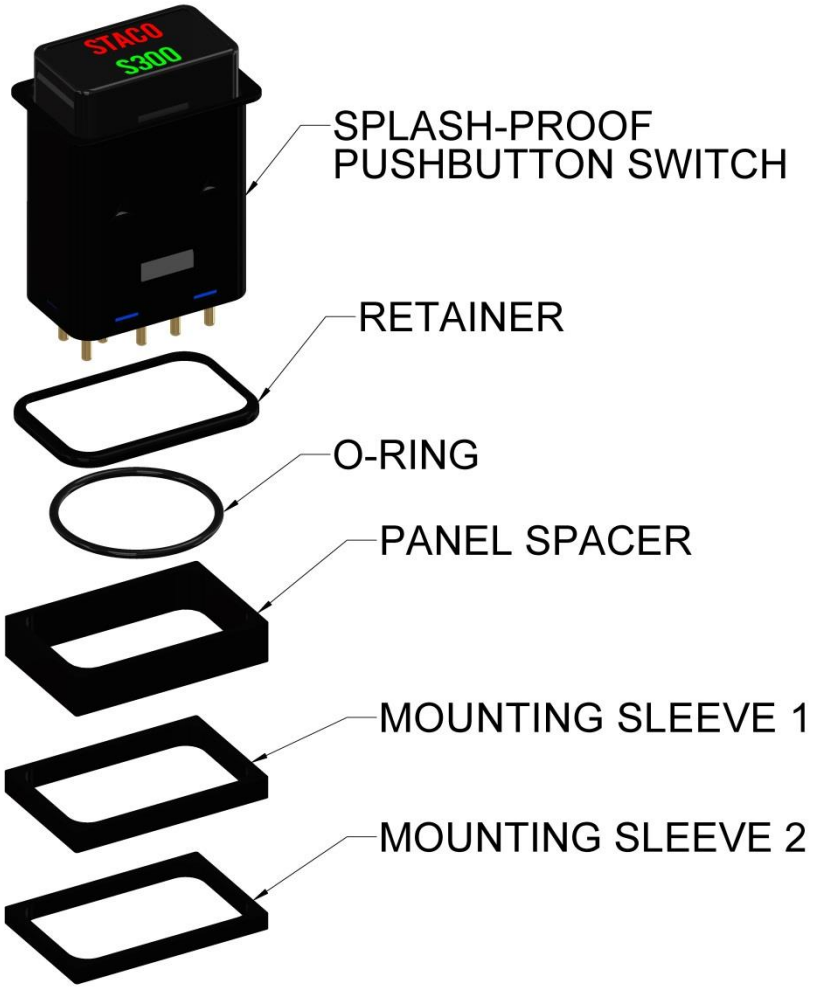

Figure 3: Drip Proof (PCB termination version shown)

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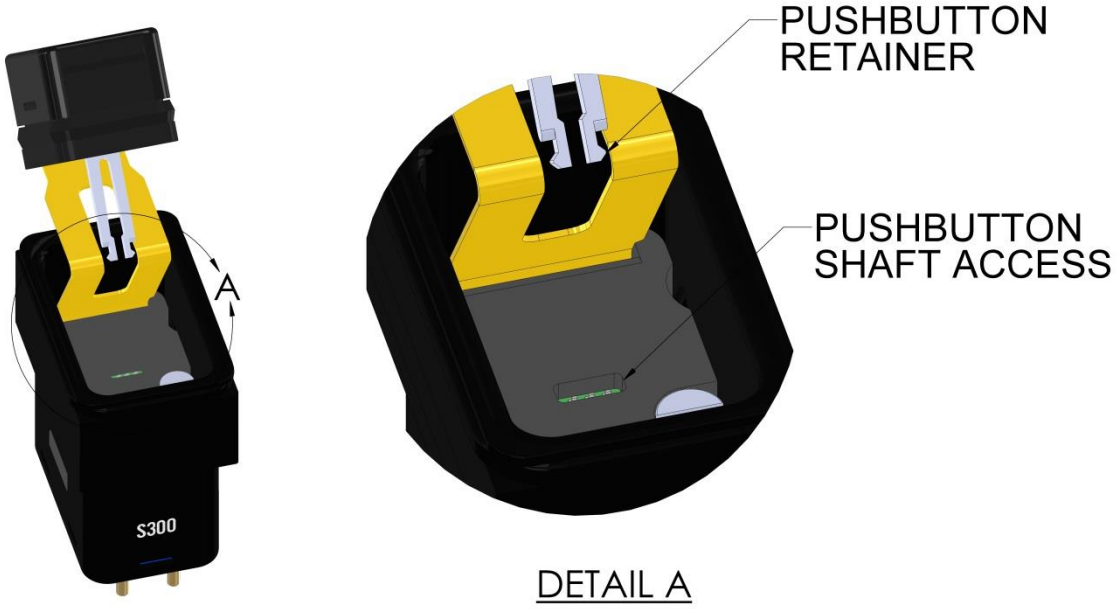


Figure 4: Detail A: Locking mechanism (drip-proof version shown)

Table I: Pushbutton switch assembly BOM

Part Number	Description	Splash-proof	
		Type I	Type III
-	Pushbutton switch	1	1
15097	Panel seal	1	1
-	Panel spacer	1	1
-	Mounting sleeve 1	1	1
-	Mounting sleeve 2	1	1
		QTY	QTY

3.2.2. Customized Configurations

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

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

33XXXX-TAB numbers shall be used when define non-standard pushbutton switch assembly. Such as:

a. Customized artworks; and/or

b. Customized form, fit, and / or function; and/or

c. Customized marking; and/or

d. When the customers/sales require that a non-coded part number to be used

e. Crimp Termination

The XXXX in this model number is a 4-digit, sequentially assigned number. All of these numbers are tabulated and have a three-digit or, under special circumstances, a 3-digit sequential TAB number (Typical example would be 330123-123).

3.3. Matrix Frame Assembly

The pushbutton switch assemblies are available in matrix frames. The matrix frames are available in the following configurations:
ICD-F3H – Front dress bezel matix in solder and PCB terminations.
ICD-R3H – Rear mount flange matrix in solder and PCB terminations.
Details of matrix frames and specifications are found in Interface Control Drawings ICD F3H and ICD-R3H.
Matrix assemblies are designed, tested and qualified in accordance to the requirements of MIL-S-24317.

4.0 GENERAL SPECIFICATIONS

This section provides an overview of the S300 outline dimensions plus mechanical, electrical, display, and optical specifications.

4.1. Outline Dimension

Outline dimensions of splash-proof switches in various configurations are shown in Figure 5: Drip-proof switches - Typical type I solder and PCB termination. See Figure 6: Solder termination and Figure 7: PC termination for termination details. Mounting hardware location and dimension are shown in Table II: Mounting hardware dimension and Figure 8: Hardware (drip-proof).

4.1.1. Pushbutton Switch and Mounting Hardware

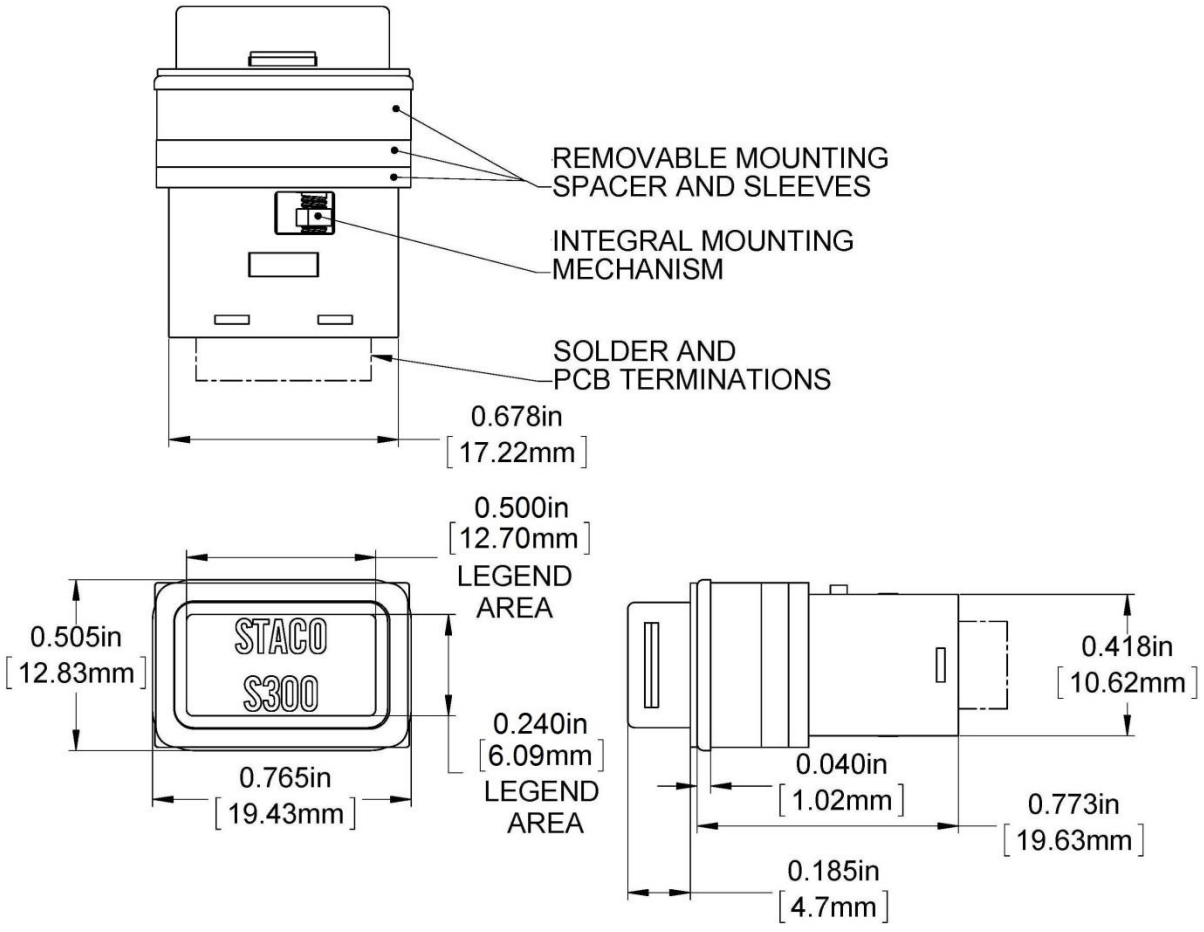


Figure 5: Drip-proof switches - Typical type I solder and PCB termination

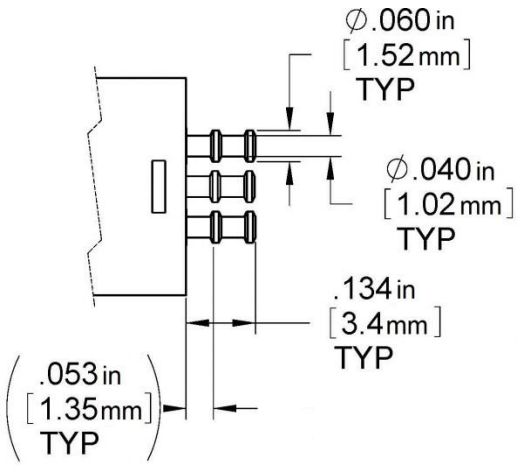


Figure 6: Solder termination

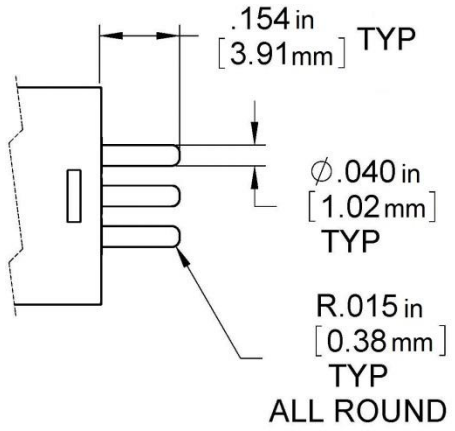


Figure 7: PC termination

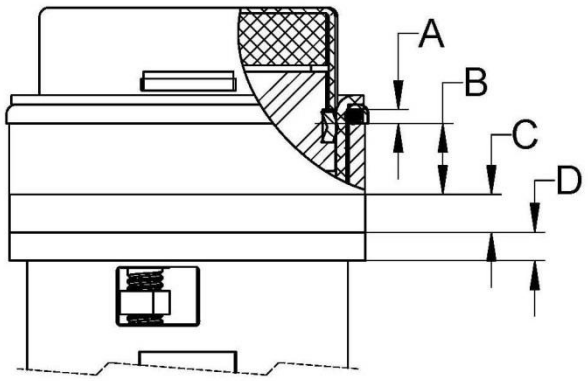


Figure 8: Hardware (drip-proof)

Table II: Mounting hardware dimension

Symbol	Description	Dimension
A	Splash-proof o-ring*	0.030" [.76mm]
B	Panel spacer	0.15" [3.81mm]
C	Mounting sleeve 1	0.080" [2.03mm]
D	Mounting sleeve 2	0.060" [1.52mm]

* Free height or uncompressed, splash-proof panel seal = 0.031"[0.78mm]

4.1.1.1. Mounting Panel

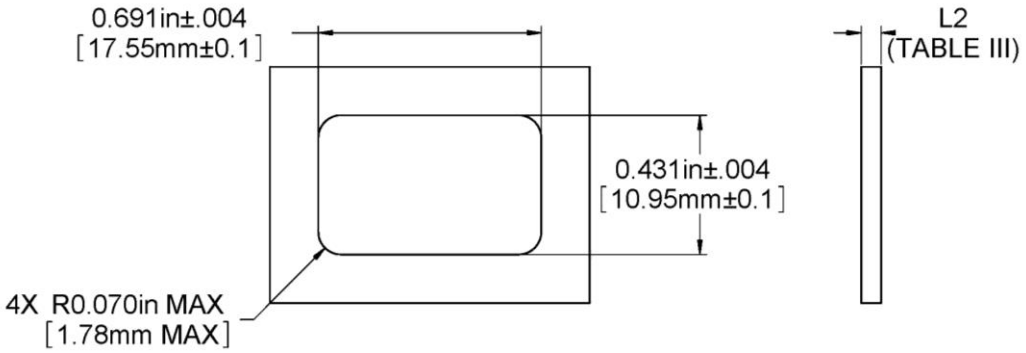


Figure 9: Panel cutout and thickness

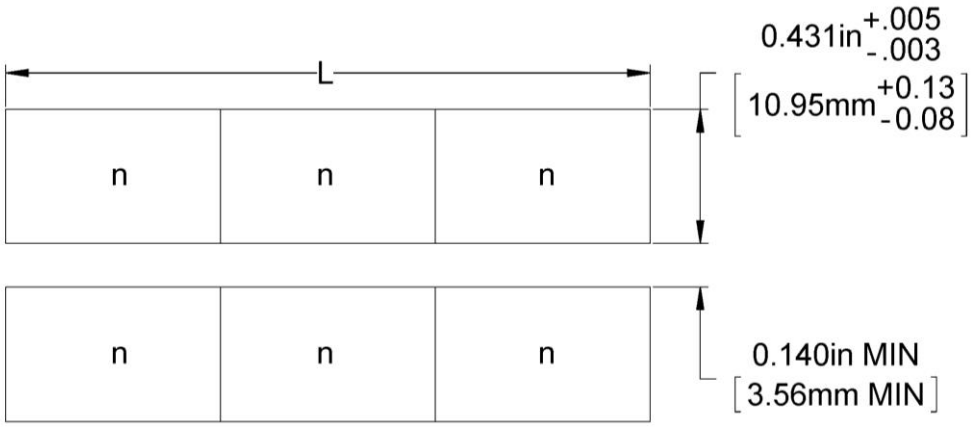


Figure 10: Slot mount for type I & III

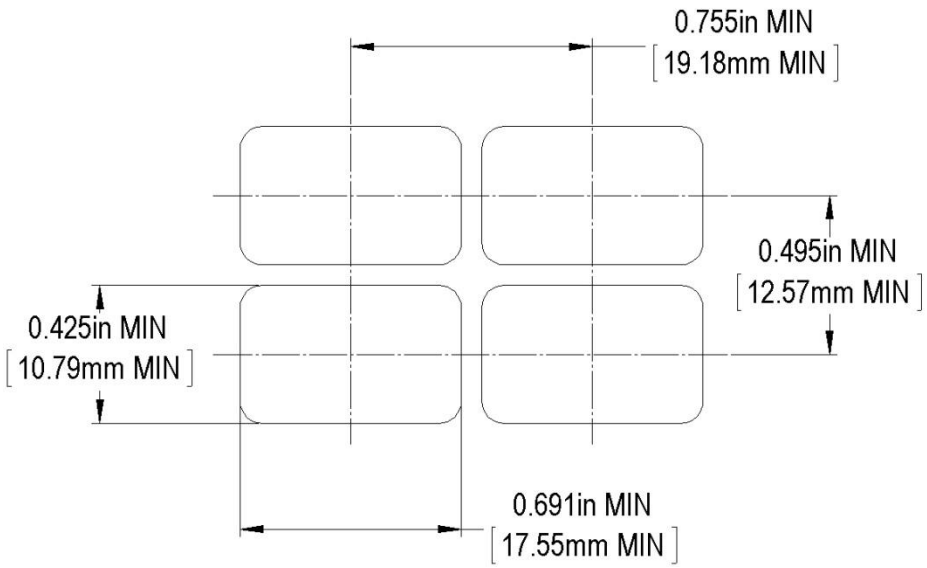


Figure 11: Matrix mount for type I & III

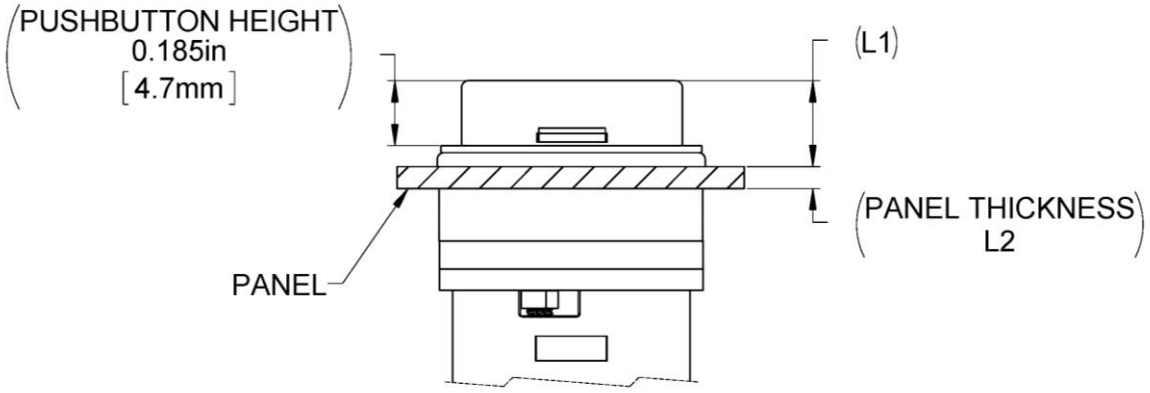


Figure 12: Flushed mount – Splash-proof design

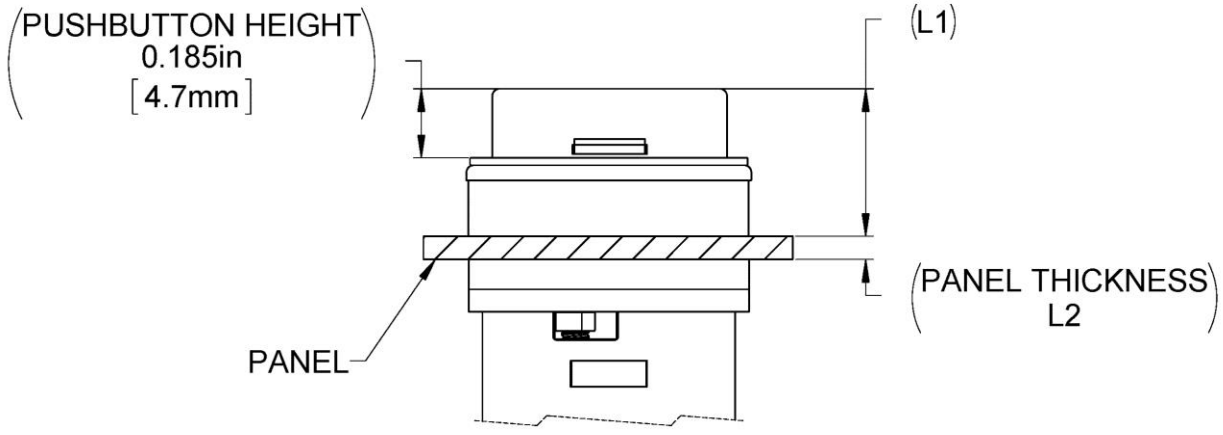


Figure 13: Extended mount – Splash-proof design

Table III: Mounting panel thickness maximum

Description	Flushed mount	Extended mount
Switch type	Splash-proof	Splash-proof
Cap protrusion (L1)	(0.245")	(0.395")
Panel thickness Max. L2	0.330"	0.180"

**See figures 20 & 22 for flushed and extended mounts* details.

4.2. Mechanical Specifications

This section provides an overview of the S300 mechanical characteristics, features, operation, and specifications.

4.2.1. Mechanical Endurance

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

Switches are tested and exceeded MIL-PRF-22885G life cycle requirement as follows:

1,000,000 cycles: 5,000 cycles of operation at -55°C, 10,000 cycles of operation at +85 °C, and 985,000 cycles at room temperature.

4.2.2. Operating Characteristics

Below are switch actions available for S300 product line. The pushbutton switches are tested in accordance with the requirements of MIL-PRF-22885G (Table IV: Action Characteristic).

Table IV: Action Characteristic

MIL-PRF- 22885 Symbol	Action
A	Momentary
B	Alternate
H	Indicator

Indicator - Functions as lighted display only. No switch contacts required.

Momentary - Switches on applying pressure to the pushbutton. The switch contacts return to their original position when the pushbutton is released.

Alternate - Switches on applying pressure to the pushbutton. Switch contacts remain in latch down position when released, and return to their original position when the pushbutton is pressed again.

Below are actuation force, pushbutton travel and alternate action displacement as shown in Table V: Pushbutton Displacement, Figure 14: Pushbutton displacement for splash-proof switches (uncompressed), Figure 15: Pushbutton displacement for splash-proof switches (alternate action) and Figure 16: Pushbutton displacement for splash-proof switches (fully compressed).

Table V: Pushbutton Displacement

Actuation force	1 to 4 pounds (4.4 to 17.7N)	
Pushbutton travel	0.070 ± .005 inch	Pushbutton travel and alternate action displacement is shown in Figure 14: Pushbutton displacement for splash-proof switches (uncompressed), Figure 15: Pushbutton displacement for splash-proof switches (alternate action) and Figure 16: Pushbutton
Alternate displacement	0.040 inch (latched)	

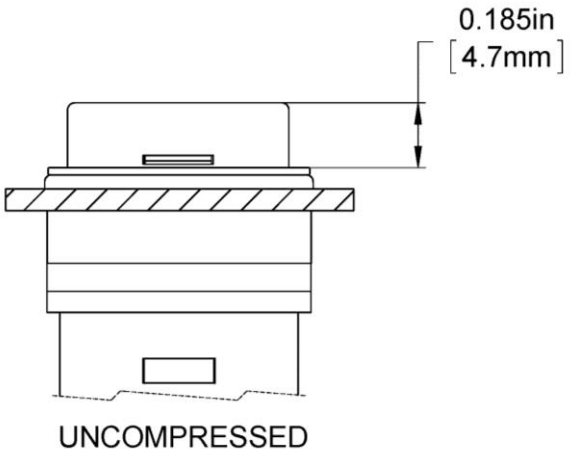


Figure 14: Pushbutton displacement for splash-proof switches (uncompressed)

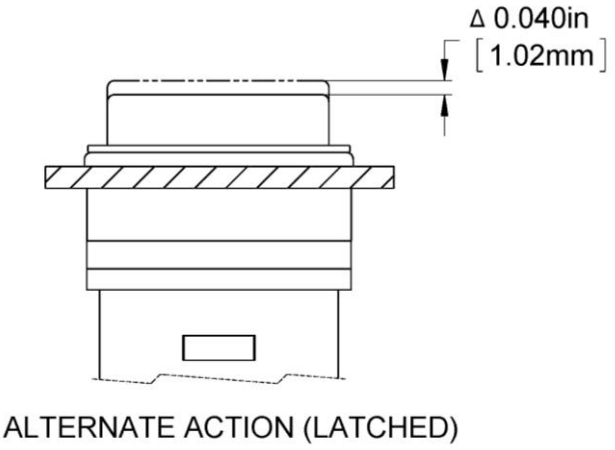


Figure 15: Pushbutton displacement for splash-proof switches (alternate action)

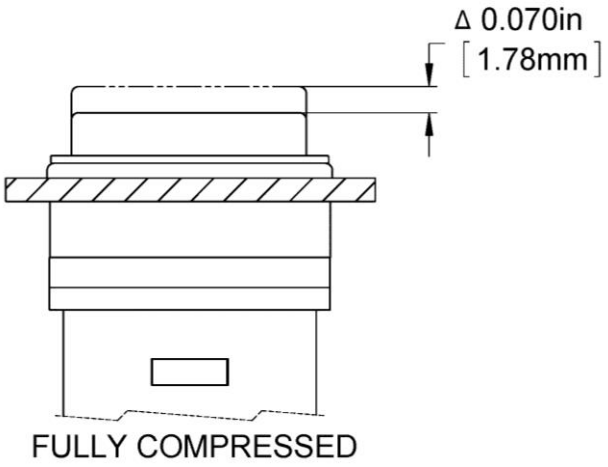


Figure 16: Pushbutton displacement for splash-proof switches (fully compressed)

4.2.3. Termination

Solder terminals. Solder termination should be tin plated. Switch is tested in accordance to the requirements of MIL-PRF-22885G, Para. 4.7.2, MIL-STD-202G, Method 208. Terminal strength tests are conducted as prescribed by MIL-STD-211, test condition A. Refer to Figure 6: Solder termination for details and outline dimensions.

PC termination. PC termination 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. Refer to Figure 7: PC termination for outline dimensions.

4.2.4. Pushbutton Switch Weight

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

Table VI: Pushbutton switch weight

Description	Termination	Ounces (max.)	Grams (max.)
Splash-proof switch assembly	Solder / PC	0.25	7
Splash-proof indicator assembly	Solder / PC		
Mounting hardware	Panel seal, panel	0.035	1

4.2.5. Mounting Provision

The location of the mounting screw within the switch body is shown in Figure 17: Mounting screw location (splash-proof version shown). The recommended torque value for the mounting screw is Refer to Technical Bulletin 222 for pushbutton extraction and installation procedure for splash-proof designs.

The recommended panel cutout for individual and matrix mounting are shown in Figure 9: Panel cutout and thickness, Figure 10: Slot mount for type I & III, and Figure 11: Matrix mount for type I & III. The maximum recommended panel thicknesses accommodated by each configuration is shown in Table III: Mounting panel thickness maximum.

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 mounting (see Figure 10: Slot mount for type I & III).

L (inches) = 0.755" X (n-1) + 0.691".

Where:

L = length of horizontal or vertical mounting slot.

N = number of units in a row or column.

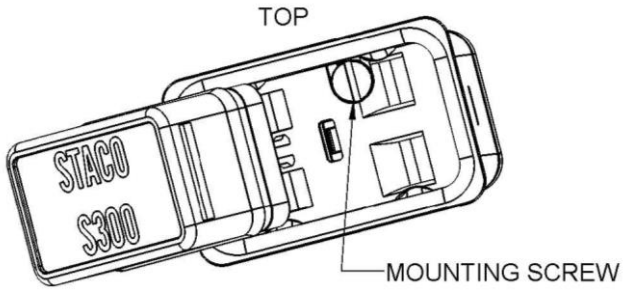


Figure 17: Mounting screw location (splash-proof version shown)

4.3. Electrical Specifications

4.3.1. Schematics

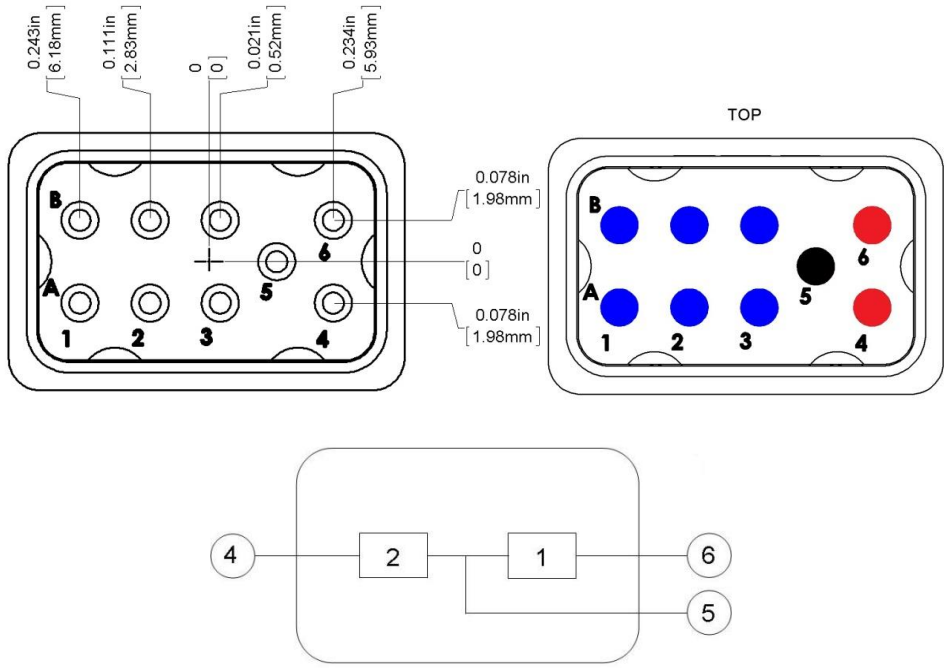
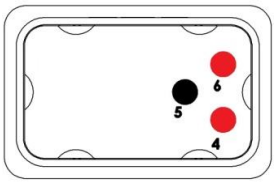
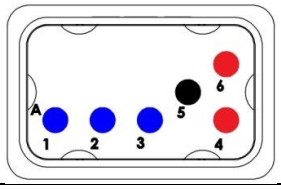
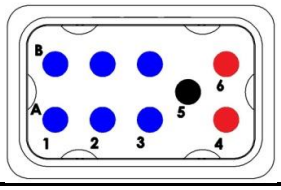
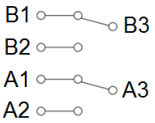


Figure 18: Switch terminal identification (28VDC Common shown)

Notes:

1. Rows A, B, and columns 1, 2, and 3, identify switch contact terminations.
2. Pins 4, and 6 identify backlight circuit terminations.
3. Pin 5 identify ground termination.
4. Pins 4, 5 and 6 are polarity insensitive see Operating Voltage.

Table VII: Switch and termination diagram

Indicator		None	None
Single pole double throw			A1 and A3 (NC) A2 and A3 (NO)
Two pole double throw			B1 and B3 (NC) B2 and B3 (NO) A1 and A3 (NC) A2 and A3 (NO)

Note: Shown in normal position.

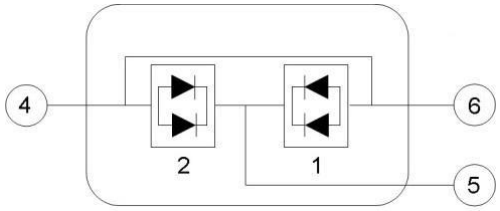
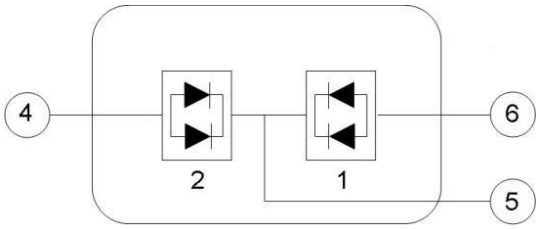
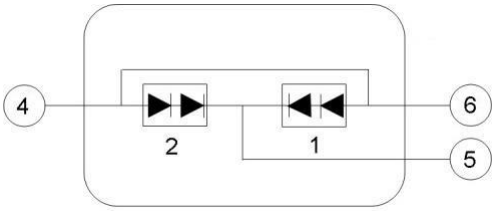
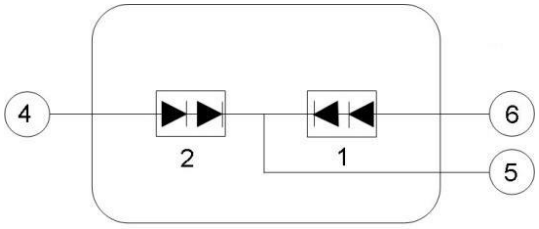
Refer to Figure 18: Switch terminal identification (28VDC Common shown) for terminal designations. Shown in normal positions

4.3.2. Common and Bussing Circuitry

The following schematics are 5 VDC standard common, 28 VDC standard common and bussing circuitry.

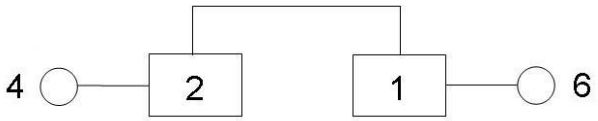
A typical pushbutton switch could require up to three wires to illuminate all four quadrants of the display. To reduce the number of wire input, a selection of common and bussing option is available as shown in Table VIII: Common Circuit diagrams and Table IX: Bussing Circuit diagram.

Table VIII: Common Circuit diagrams

5 VDC Common circuit diagram		
Display Style **(from the front view)**	Single common **(from the rear view)**	Vertical split common **(from the rear view)**
1		
x	28 VDC Common circuit diagram	
Display Style **(from the front view)**	Single common **(from the rear view)**	Vertical split common **(from the rear view)**
1 2		

Note: Red numeral 1, 2 refer to the display style see Table XXI: Display Style and Character Size Option.

Table IX: Bussing Circuit diagram

Bussing circuit diagram – View from rear of switch
1-input / Full screen display
 Single common bussed
2-inputs / 2-way split display
 Vertical bussed

Note: Red numeral 1, 2 refer to the display style see Table XXI: Display Style and Character Size Option.

Use or disclosure of data contained on this sheet is subject to restrictions of the title page of this document.		SIZE A	CAGE CODE 12522	DWG NO SERIES 300 SCD	REV 1.1
SEE SHEET 1	**DO NOT SCALE DRAWING**	SCALE NONE	WT	SHEET SHEET 27 OF 48	

4.3.3. Operating Voltage

The Series 300 pushbutton switches offer two input voltages, 5 VDC and 28 VDC. For 5 VDC applications, the LEDs are connected in parallel and use 24 mA per quadrant when illuminated. For 28 VDC applications, the LEDs are connected in series and use 12 mA per quadrant when illuminated. There shall be two HB LEDs per quadrant. Refer to Table X: Electrical Characteristics for power consumption, faceplate temperature and electrical load range.

Table X: Electrical Characteristics

Lamp Circuit Power Consumption	VDC	Watt
	28	0.728
	5	0.260
Lens face temperature: 10° C max. above		
Switch Contact Electrical load range: 1 µA to 10 A		

High-brightness lighted-emitted diodes.

The Series 300 switch HB LED utilizes a bridge rectifier in each of its two lighting circuits to provide polarity insensitivity. This enables application in current sinking or current sourcing circuits.

4.3.4. Switch Contact Rating

The switch contacts shall be made and break the currents as listed in Table XI: Contact Rating.

Table XI: Contact Rating

		Sea level	70,000 feet
28 VDC	Resistive	10.0 Amperes	5.0 Amperes
	Inductive	5.0 Amperes	2.5 Amperes
120 VAC, 60Hz	Resistive	7.0 Amperes	
	Inductive	3.5 Amperes	
LOW LEVEL	Resistive	10 micro-amperes	
	Inductive		

Note: S300 contacts are designed for universal applications, 10 µA to 10A. However, contacts subjected to a high current (>100 mA) lose their low current capability (<100 mA).

4.3.5. Dimming Control Circuit

Dimming the luminance to the desired level is accomplished by varying the applied voltage. The Series 300 switch has both linear and non-linear dimming circuits with built-in voltage control. 5 VDC switches are available with linear dimming circuits only. 28 VDC switches are available in either linear or non-linear dimming circuits. The output normalized luminance vs. input voltage of each voltage dimming circuit is shown in Figure 19: Typical 5 VDC linear dimming, Figure 20: Typical 28 VDC linear dimming and Figure 21: Typical 28 VDC non-linear dimming.

For 5 VDC linear dimming, visible luminance starts at about 3.6 VDC where LED current is approximately 0.0005 A and continues to 5 VDC where current reaches 0.025 A. See Figure 19: Typical 5 VDC linear dimming.

For 28 VDC linear dimming, visible luminance starts at about 6 VDC where LED current is approximately 0.0002 A and continues to 28 VDC where current reaches 0.0125 A. See Figure 20: Typical 28 VDC linear dimming.

For 28 VDC non-linear dimming, visible luminance starts at about 7 VDC where LED current is approximately 0.0001 A and continues to 28 VDC where current reaches 0.0125 A. See Figure 21: Typical 28 VDC non-linear dimming.

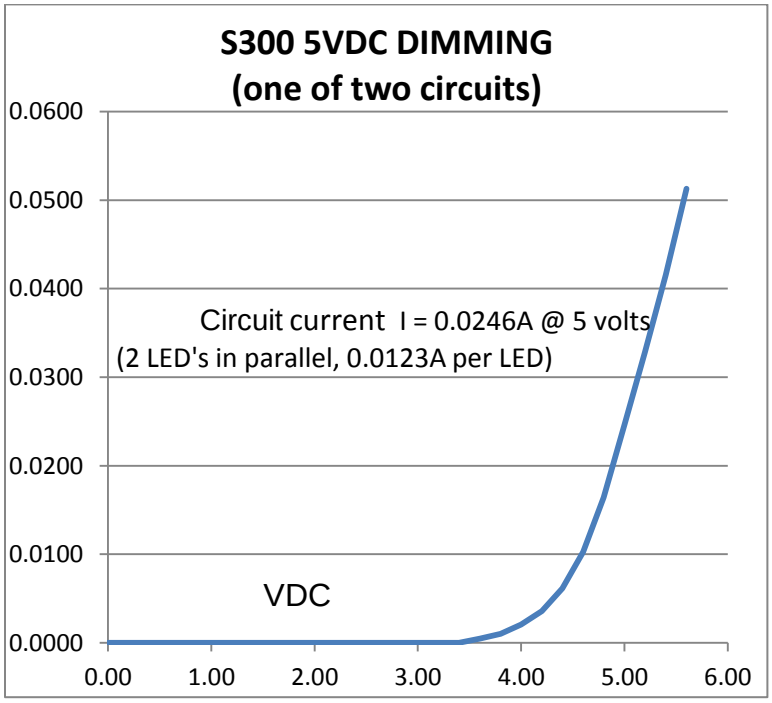


Figure 19: Typical 5 VDC linear dimming

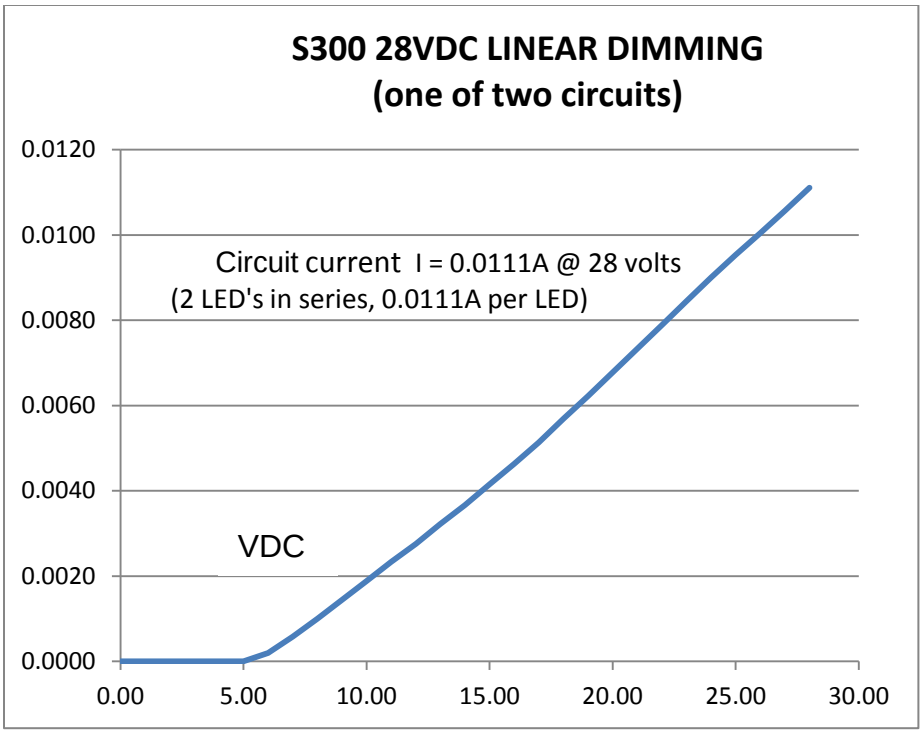


Figure 20: Typical 28 VDC linear dimming

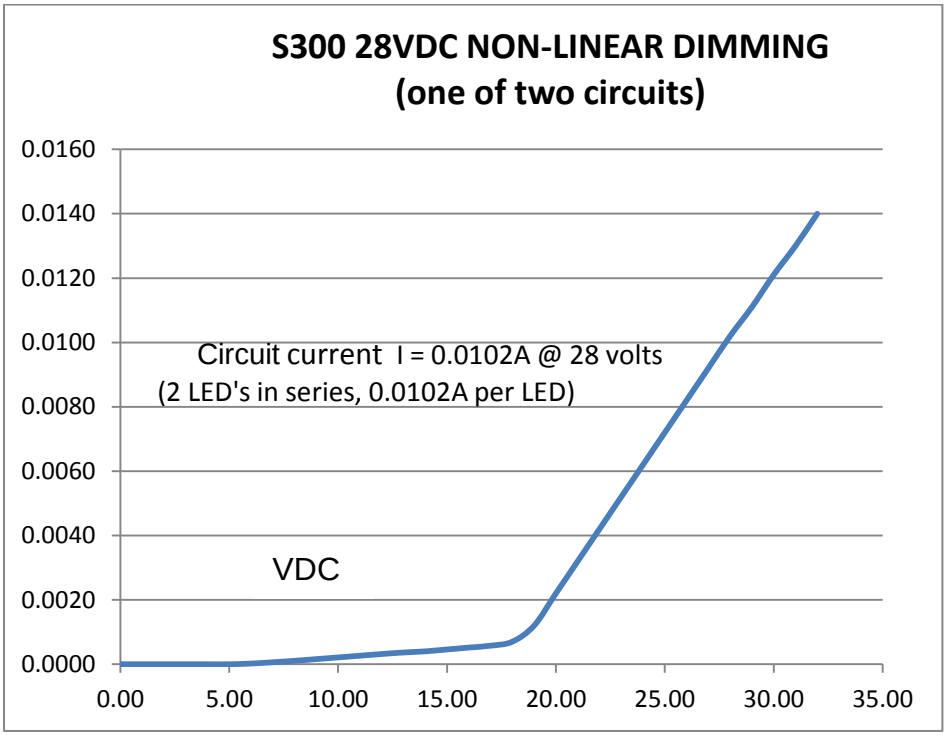


Figure 21: Typical 28 VDC non-linear dimming

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

Example:

Using the luminance data of NVIS yellow from Table XV: NVIS Illuminated Color.

Minimum average luminance = 250 fL.

250 fL x 1.5 (high) = 375 fL.

250 fL x .75 (low) = 188 fL.

4.3.6. Other Electrical Specifications

Contact resistance: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 307of MIL-STD-202G.

Low level circuit: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 311 of MIL-STD-202,.

Electrical endurance: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G at the electrical ratings specified in Table XI: Contact Rating of this document.

Overload cycling: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G.

Contact bounce: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G. Simultaneity is less than 2 milliseconds.

Dielectric strength: The pushbutton switches are tested at both sea level and at a reduced barometric pressure simulating 70,000 feet altitude.

Dielectric withstanding voltage at atmospheric pressure: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 301 of MIL-STD-202G,.

Dielectric withstanding voltage at reduced pressure: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 105C of MIL-STD-202G.

Insulation resistance: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 302 of MIL-STD-202G, condition B.

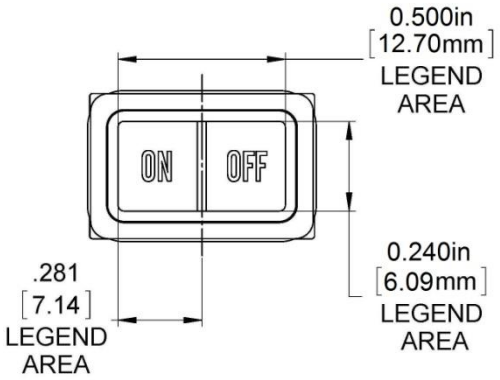
Short circuit: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method I, for 2 cycles.

4.4. Display Specifications

4.4.1. Field of View

The pushbutton switch displays are tested in accordance to the requirements of MIL-PRF-22885G.

Legend area and viewing dimensions are shown in Figure 22: Legend Area and Table XII: Viewing area.



Slash-Proof

Figure 22: Legend Area

Table XII: Viewing area

Viewing area	Splash-Proof dimensions - Inch (mm)
Full screen	0.30" x 0.56" [7.62 mm x 14.22 mm]
Half screen – vertical	0.30" x 0.28" [7.62 mm x 7.11 mm]

4.4.2. Legends

Standard font style & size.

The standard font style is 'alternate gothic number 2' (AG2), available in capital letters and numeric, plus all the character and symbols which are available as shown in Figure 23: Standard font size and style.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789!@#$%^&*()'.,"+/
:;<=>?_`~≠#©¿¡"«»–±¹²³
¼½¾ÀÁÂÃÄÅÈÉÊÌÍÎÏÑÒÓÔÕÖÜÝ

Figure 23: Standard font size and style

Note: Lower case characters not available as standard option in this font. Unless otherwise specified, all symbols will be proportional to the size of the AG2 font.

RECOMMENDED LETTER RATIO

HEIGHT TO WIDTH RATIO: H/W=2
HEIGHT TO STROKE WIDTH: H/b =6

Figure 24: Character height

The character height, as defined in Figure 24: Character height above, shall be the distance (in decimal inches) from the top to the bottom of a capital letter (no descender) 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 XXI: Display Style and Character Size Option. 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.

Non-Roman alphabets – Graphic representative is required from customers for non-roman alphabets such as Hebrew, Russian, Japanese, Korean, Chinese, Arabic, Sanskrit, etc,

Standard and complex shapes – It is recommended that the customers to provide graphic representative or drawings for standard and complex shapes such squares, rectangles, circles, icons, or graphic symbols.

4.5. Optical Performance

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

4.5.1. Luminance Performance

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

QPL tests are conducted with a standard test legend, AG2, and standard lamp box. See xxxxxxxxxxxx

for the minimum average luminance.

Table XIII: LED Luminance performance

	Minimum Luminance (footlamberts)					
22885 Symbol	C	B	H	N	W	S
S300 Code	1	2	3	4	5	6
Red	100	65	150	20	125	200
Green	100	100	150	25	100	250
Aviation Yellow	250	250	300	30	250	450
Lunar White	150	150	200	30	150	450
Blue	100	100	100	20	100	200
Aviation Green	100	100	100	20	100	250
White	150	150	175	25	100	450

Table XIV: Standard Color limits

Standard Color limits													
Red		Green		Aviation Yellow		Lunar White		Blue		Aviation green		White	
x	Y	x	y	x	y	x	y	x	y	x	y	x	y
0.695	0.285	0.3	0.56	0.545	0.425	0.4	0.375	0.25	0.33	0.14	0.47	0.48	0.395
0.705	SL 1/	0.3	SL 1/	0.56	SL 1/	0.4	0.42	0.25	0.42	0.29	0.47	0.48	0.435
0.65	0.33	0.375	0.56	0.59	0.382	0.48	0.375	0.33	0.33	0.03	SL 1/	0.54	0.431
0.66	SL 1/	0.375	SL 1/	0.604	SL 1/	0.48	0.42	0.33	0.42	0.185	SL 1/	0.54	0.391

1/ The term "SL" indicates where intersections occur with the spectrum locus on the CIE1931 chromaticity diagram (Figure 26: CIE 1931 chromaticity diagram).

@ 14 Vdc non-linear dimming the luminance approximately 21 foot-lambert, @ 28 Vdc non-linear dimming the luminance approximately 505 foot-lambert, see Figure 25: Typical Luminance vs Voltage (non-linear dimming).

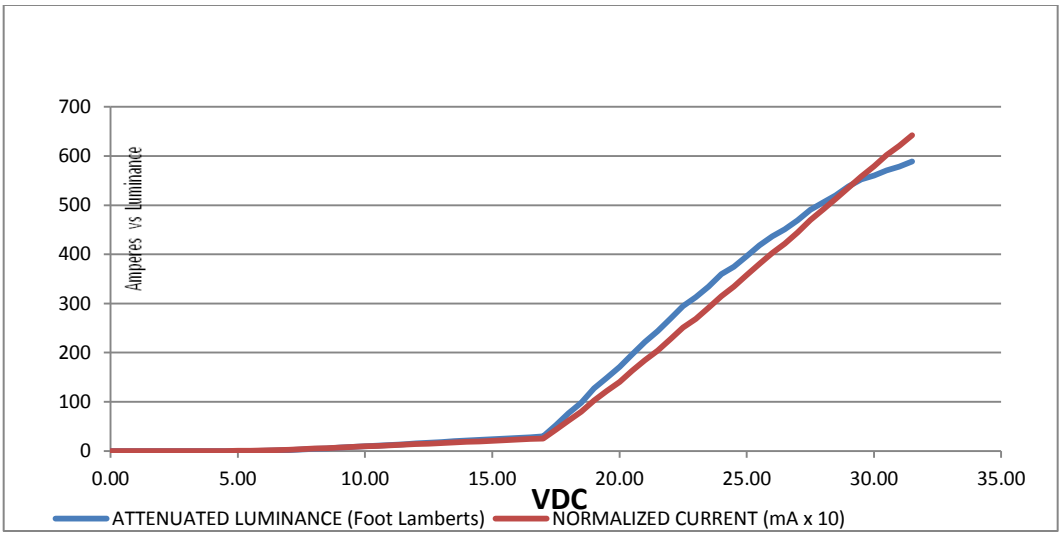
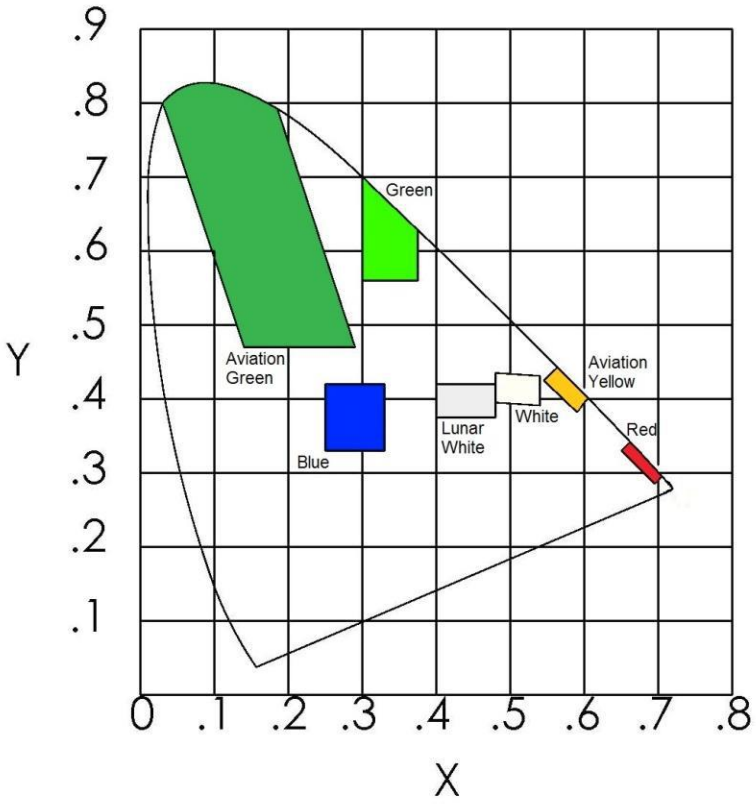


Figure 25: Typical Luminance vs Voltage (non-linear dimming)



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. Refer to Figure 26: CIE 1931 chromaticity diagram and Table XIV: Standard Color limits

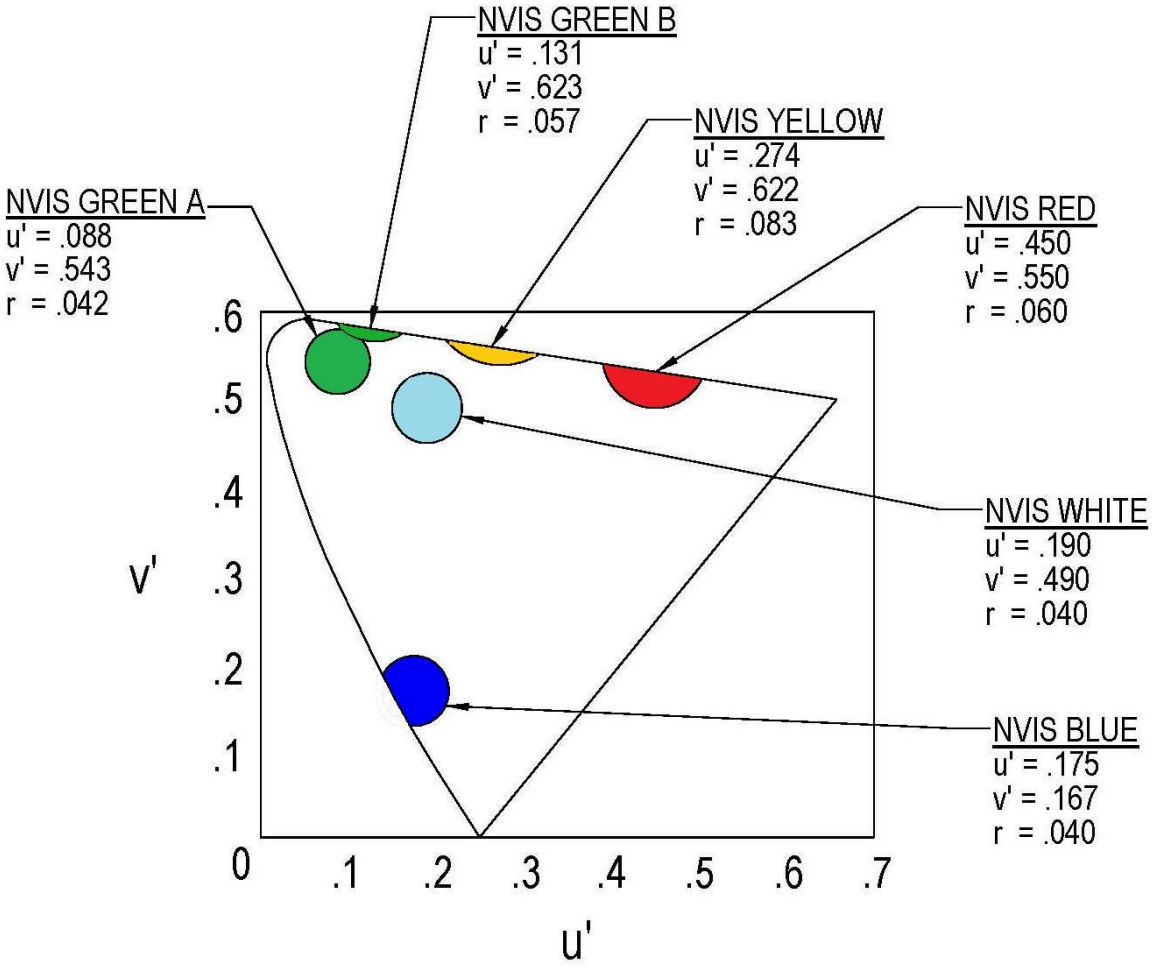
Figure 26: CIE 1931 chromaticity diagram

4.5.2. NVIS Compatibility

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

Available NVIS colors are white, blue, red, green A, green B, yellow A and yellow B.

In general, 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.



The colors are expressed as u' and v' coordinates on the U.C.S 1976 chromaticity diagram. See Figure 27: U.C.S. 1976 chromaticity diagram and Table XIV: Standard Color limits.

Figure 27: U.C.S. 1976 chromaticity diagram

Table XV: NVIS Illuminated Color and Radiance Requirements

NVIS Illuminated color and Radiance Requirements									
Color	Minimum Luminance Estimate (fL)	Chromaticity Coordinates			Contrast - 0°/45° Degrees @10,000 FC		Radiance		
		u'	v'	r	"ON"	"OFF"	Nra ≤	Nrb ≤	Scaled Luminance (fL)
Green A	150	0.088	0.543	0.037	0.60	0.10	1.7 E-10	1.7 E-10	0.10
Green B	150	0.131	0.623	0.057	0.60	0.10	1.7 E-10	1.7 E-10	0.10
Yellow A	150	0.274	0.622	0.083	0.60	0.10	1.7 E-10	-	0.10
Yellow B	150	0.274	0.622	0.083	0.60	0.10	-	1.5 E-7	15.0
Red	80	0.450	0.550	0.060	0.30	0.10	-	1.4 E-7	15.0
White	80	0.190	0.490	0.040	0.30	0.10	-	2.2 E-10	0.10
Blue	1.0	0.175	0.167	0.060	N/A	0.10	-	1.00 E-08	0.50

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 and MIL-L-85762 (when applicable).

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 300 shall be made on a calibrated spectroradiometer. The luminance setting for these measurement shall be 15 ± 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 XV: NVIS Illuminated Color and Radiance Requirements has the summary of the NVIS radiance specification for configurations which are applicable to the Series 300 Product Line.

4.5.3. Sunlight Readability

The Sunlight Readability is tested in accordance to the requirements of MIL-PRF-22885G. 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 ≤ 0.1, see Table XXI: Display Style and Character Size Option.

Sunlight readable displays in the Series 300 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-22885G, the contrast ratios CL and Cul, calculate for each character is as follows:

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 Splash-proof seals.

Table XVI: Type 6 Contrast

Type 6 Contrast		
Color	Average Legend On Contrast MIN	Average Legend Off Contrast MAX
Red	>0.6	0.0±0.1
Green	>0.6	0.0±0.1
Aviation Yellow	>0.6	0.0±0.1
Aviation Green	>0.6	0.0±0.1
Blue	>0.6	0.0±0.1
Lunar white	>0.6	0.0±0.1
white	>0.6	0.0±0.1

4.6. Environmental Specifications

Temperature characteristics

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

Table XVII: Operating temperature range

Condition	Temperature
Operating with lamps un-energized	-65 °C to +85 °C
Operating with lamps energized	-55 °C to +71 °C

Touch temperature: When switches are tested as specified below, the maximum difference between the stabilized lens face temperature and the ambient temperature shall not exceed +10 °C.

Test method: The test method shall be in accordance with EIA448.2 using the recommended panel cutout. The test shall be performed with each of the standard LED voltages at full rated current and at 100 percent duty cycle.

Salt Spray: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 101E of MIL-STD-202G, condition A.

Thermal Shock: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 107G of MIL-STD-202G, , test condition A.

Vibration: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, vibration grade 3, Method 204D of MIL-STD-202G, test condition B.

Acceleration: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, vibration grade 3, Method 212A of MIL-STD-202G, test condition A.

Shock: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method I and II.

Shock, Method I (Specified Pulse): The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Method 213B of MIL-STD-202, test condition B with contact-chatter monitoring performed in accordance to the requirements of Method 310 of MIL-STD-202, test condition A.

Shock, Method II (High Impact): The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885, Method 207B of MIL-STD-202 with contact-chatter monitoring performed in accordance to the requirements of Method 310 of MIL-STD-202, test condition E.

Moisture Resistance: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 106G of MIL-STD-202G.

Splash Proof Seal: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, MIL-STD-108E paragraph 4.9.

Explosion: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 109G of MIL-STD-202G.

Sand & Dust: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G, Method 110 of MIL-STD-202G.

EMI/RFI Shielding: The pushbutton switches are tested in accordance to the requirements of MIL-PRF-22885G.

4.7. 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-22885G. 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-22885G, Para. 3.5.2, which meet flammability requirements of 94V-0 in accordance with UL 94.

Non-Toxic – All components contained in S300 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. PC terminals are plated to facilitate hand, wave or flow soldering methods.

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), hydrochloroflurocarbons (HCFC's), methyl chloroform, carbon tetrachloride and halons.

4.8. Other Requirements

4.8.1. Marking

Permanency and legibility of markings shall conform to requirements of MIL-STD-202G, Method 215 for resistance to solvents.

The following shall be provided as a baseline and as shown in Figure 28: Marking (2 pole & Solder version shown)

a. Stacosystems
b. Cage code (12522)
c. Date code (YYWW; year year week week).
d. Assembly part number (or customer PN).

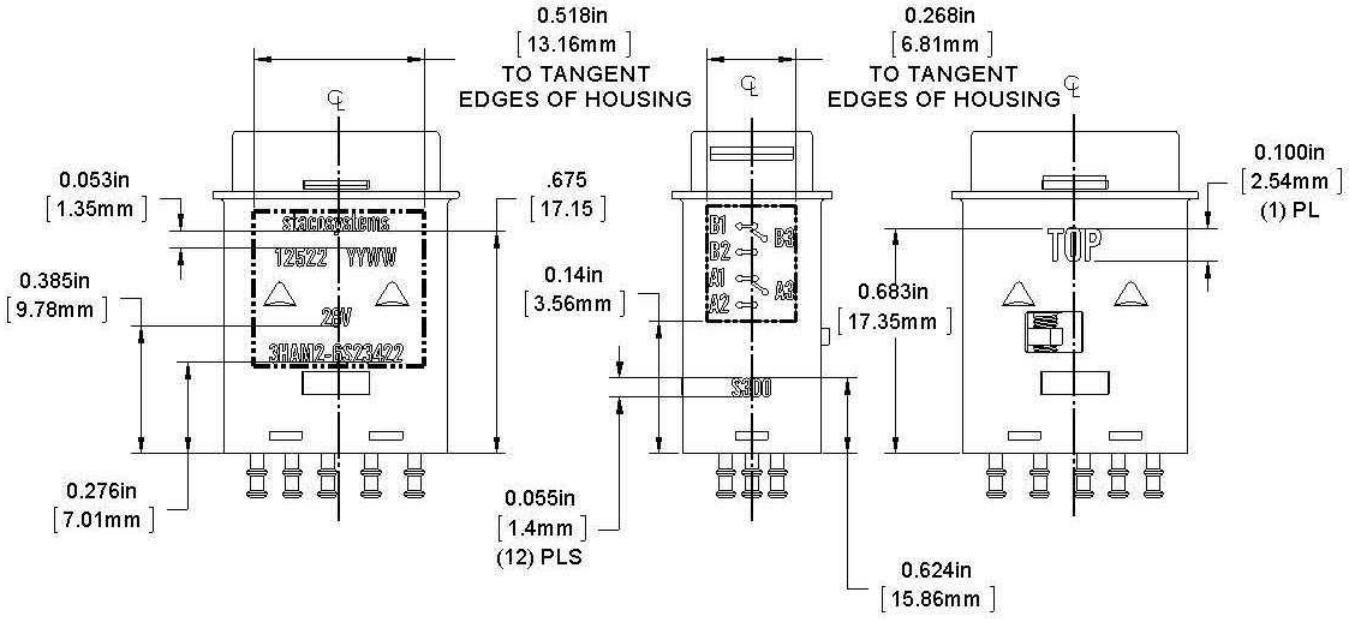


Figure 28: Marking (2 pole & Solder version shown)

5.0 Ordering Information

This section contains the information necessary to order the standard Series 300 pushbutton switch configurations and its features described in this specification.

PART NUMBER MODEL

The Part Number Model (PNM) shall be constructed as illustrated in Figure 29: Part number model. See Table XVIII: Mechanical Option, Table XIX: Electrical Option, Table XX: Enclosure Design, Table XXI: Display Style and Character Size Option and Table XXIII: Illuminating color option.

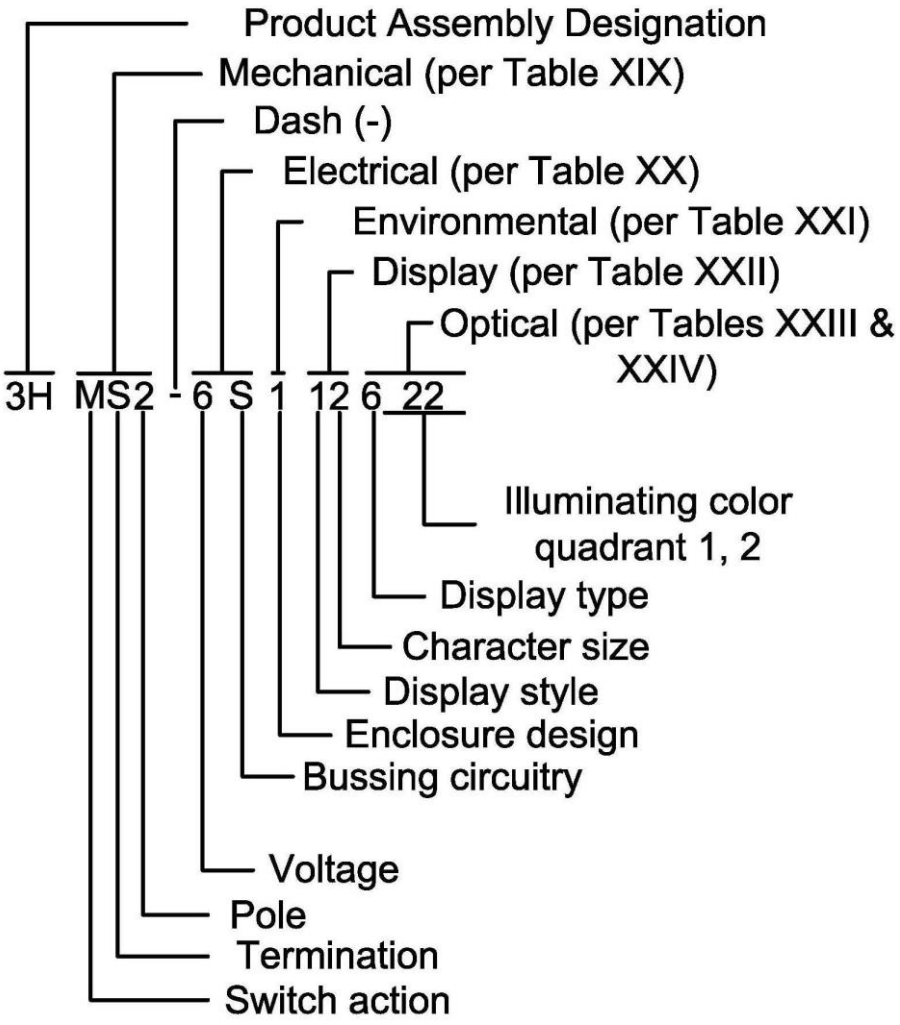


Figure 29: Part number model

Table XVIII: Mechanical Option

Mechanical Option					
PNM Code	Action	PNM Code	Termination	PNM Code	Pole
N	No Action	**S**	Solder	**0**	Indicator
A	Alternate			**1**	1-pole double throw
M	Momentary	**P**	PCB	**2**	2-pole double throw

Table XIX: Electrical Option

Electrical Option			
PNM Code	Voltage	PNM Code	Bussing Circuitry
5	5 VDC Linear Dimming	**S**	Single Common
6	28 VDC Linear Dimming	**V**	Vertical
7	28 VDC Non-Linear Dimming		

Table XX: Enclosure Design

Enclosure Design		
PNM Code	Seal Description/Option	Enclosure Type
1	Drip-proof 1/	I (solder/PCB terminations)
	Splash-proof 1/	

1/ In accordance to MIL-STD-108E.

Table XXI: Display Style and Character Size Option

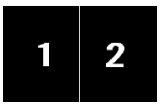
PNM CODE	CHARACTER SIZE IN INCHES (REF)	DISPLAY AREA NO.	LEGEND AREA NO. (H) HORIZ.LINES PER AREA (C) CHARACTERS PER LINE 1/ 1 HxC	LEGEND AREA NO. (H) HORIZ.LINES PER AREA (C) CHARACTERS PER LINE 1/ 2 HxC	DISPLAY STYLE DESCRIPTION
10	NONE		NONE	NONE	**FULL SCREEN DISPLAY**
11	0.072		2x9	X	
12	0.087		2x9	X	
13	0.100		1x6	X	
14	0.125		1x5	X	
15	0.145		1x4	X	
20	NONE		NONE	NONE	**2-WAY VERTICAL SPLIT SCREEN DISPLAY**
21	0.072		1x4	1x4	
22	0.087		1x3	1x3	
23	0.100		1x3	1x3	
24	0.125		1x2	1x2	
25	0.145		1x2	1x2	

Table XXII: Display type option

Display type option			
PNM Code	Description	Non-Illuminated	Illuminated
1	Visible opaque black legends on translucent color background. When illuminated, the background appears in color while the legends remain opaque black.	LED	LED
2	Obscure legends on opaque black background. When illuminated, the background appears in color while the legends remain opaque black.		LED
3	Obscure legends on opaque black background. When illuminated, the legends appear in color while the background remains opaque black.		LED
4	Visible trans-reflective white legends on an opaque black background. When illuminated, the legends appear in color while the background remains opaque black.	LED	LED
5	Visible opaque black legends on trans-reflective white background. When illuminated, the background appears in color while the legends remain opaque black.	LED	LED
6	Obscure legends on opaque black background. When illuminated, the legends are sunlight readable while the background remains opaque black.		LED
7	Obscure legends on opaque black background. When illuminated, the legends are NVIS compatible while the background remains opaque black.		LED
A*	Visible opaque white legends on an opaque black background. When illuminated, the background appears in color while the legends remain opaque white.	LED	LED
E*	Visible trans-reflective white legends on an opaque black background. When illuminated, the legends appear in color while the background remains opaque black	LED	LED

Display type option			
PNM Code	Description	Non-Illuminated	Illuminated
F*	Obscure legends on translucent white background. When illuminated, the background appears in color with white opaque white legends.		LED
G*	Visible opaque white legends on translucent color background. When illuminated, the background appears in color while legends remain opaque white.	LED	LED

**** Available as non-standard catalogue display type***

Table XXIII: Illuminating color option

Illuminating color option		
PNM code	Non NVIS Illumincated Color	NVIS Illuminated Color
0	White	Blue
1	Red	Red
2	Green	Green B
3	Aviation yellow	Yellow B
4	Lunar white	White
5	Not available	Yellow A
6	Blue	Green A
7	Aviation green	

6.0 ACCESSORIES

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.

6.1. Tools

6.1.1. Pushbutton Extraction tool (15193)

It facilitates the removal of display pushbuttons. See Figure 30: Pushbutton extraction tool.

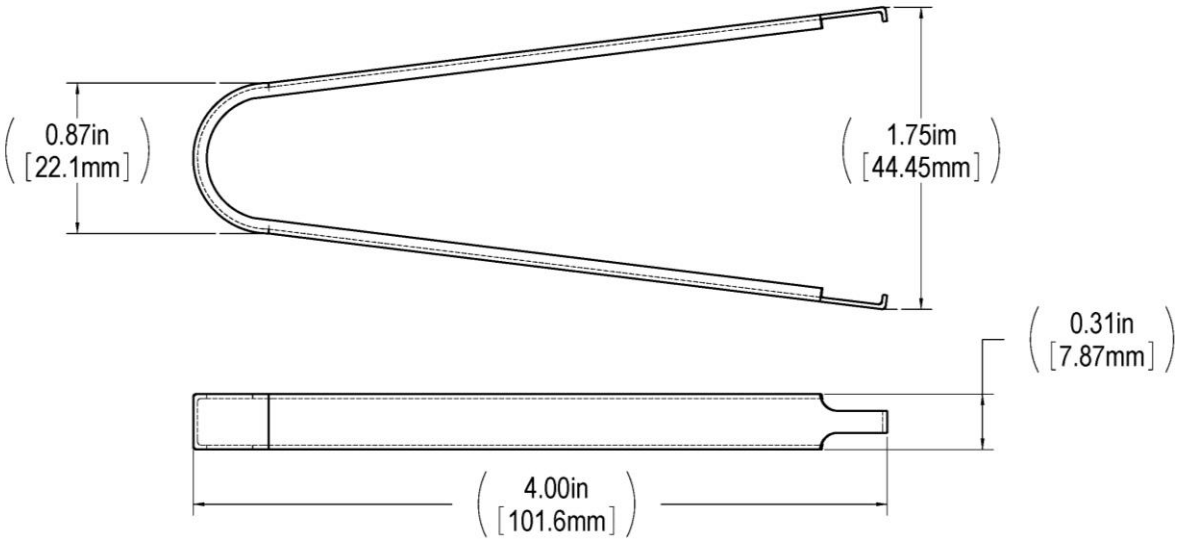


Figure 30: Pushbutton extraction tool

6.1.2. Dress bezel mounting cleat assembly (156107)

The mounting cleat assemblies, as shown in Figure 31: Cleat assembly, 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.

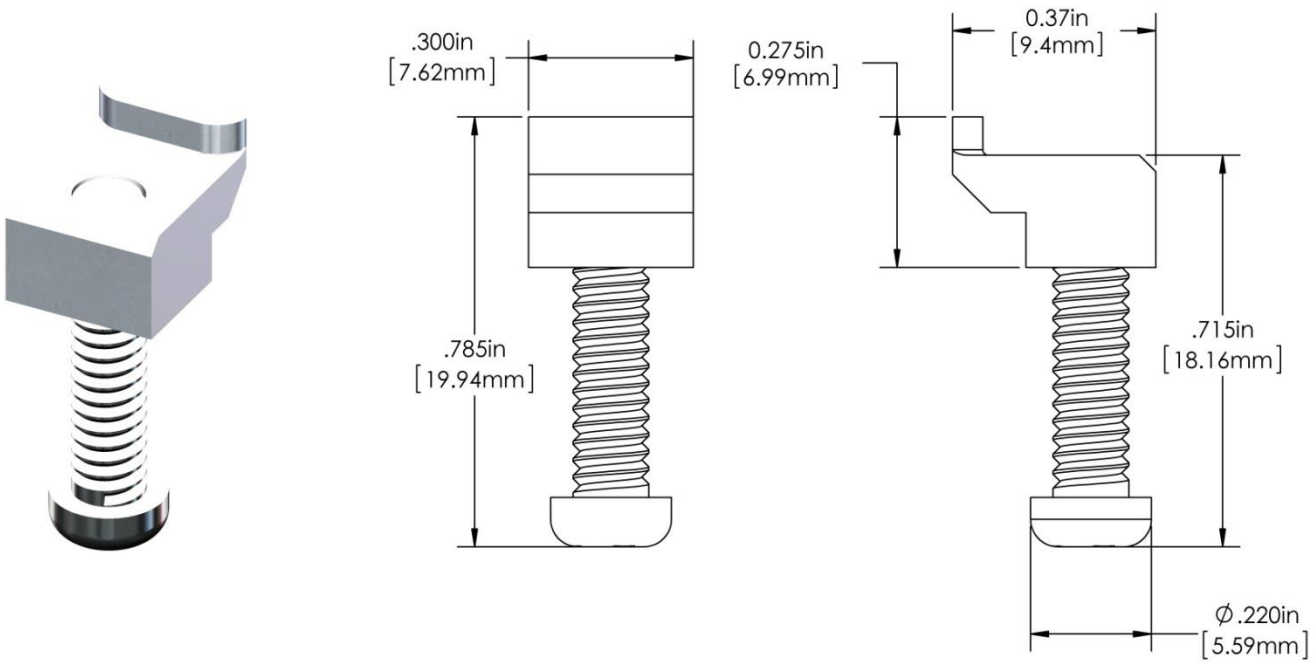


Figure 31: Cleat assembly

6.1.3. Panel Seals (15097)

Additional panel seals may be ordered separately as replacement parts or for use with extended mount applications. See Figure 2: Drip-proof (solder termination version shown).