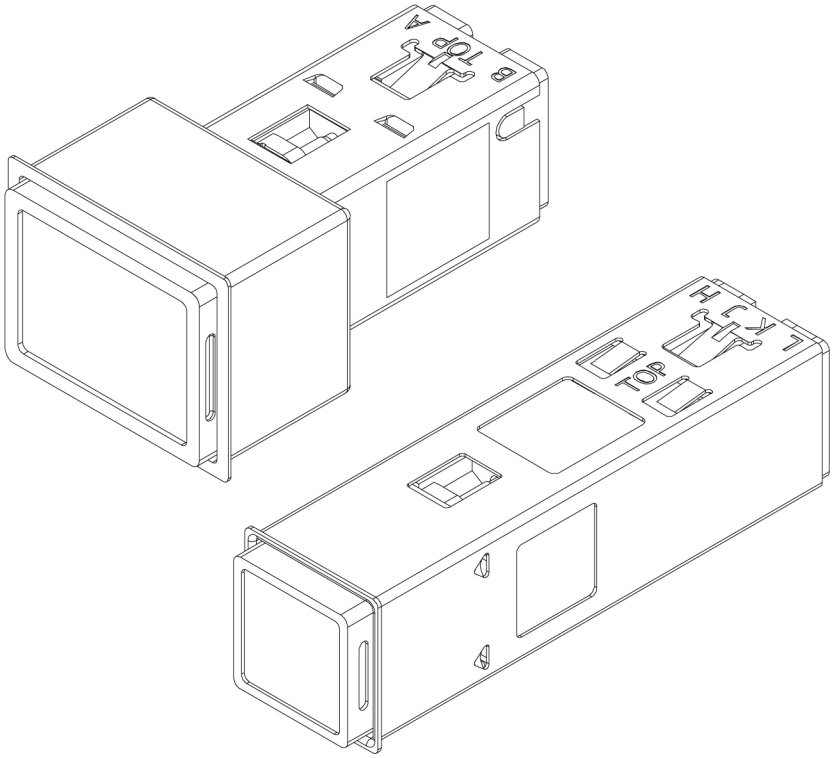
VIVISUN® Advanced Lighted Pushbutton Switches and Indicators

3/4" Standard Square (LED Series)

1" x 1.2" Large Rectangular (LR3 Series)

Includes Installation Guide



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--	02/01/2022	LKJ	Initial Release
A	09/10/2024	MH	Corrected corner tolerance for LR3 panel cutout in Figure 2.2.0-A, removed unnecessary * from Figure 3.3.0-A

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Table of Contents

0.1 Document Overview

This Technical Specification Guide is divided into four parts.

- Section 1.0 describes all of the cap options, including size, lighting types, colors, and dimming control.
- Section 2.0 describes all of the body options available, including size, panel cutout, switch configurations, and termination options.
- Section 3.0 contains information that applies to both caps and bodies, including qualification, reliability, and installation.
- Section 4.0 contains additional information including installation diagrams, circuit diagrams, and details regarding non-standard voltage caps.

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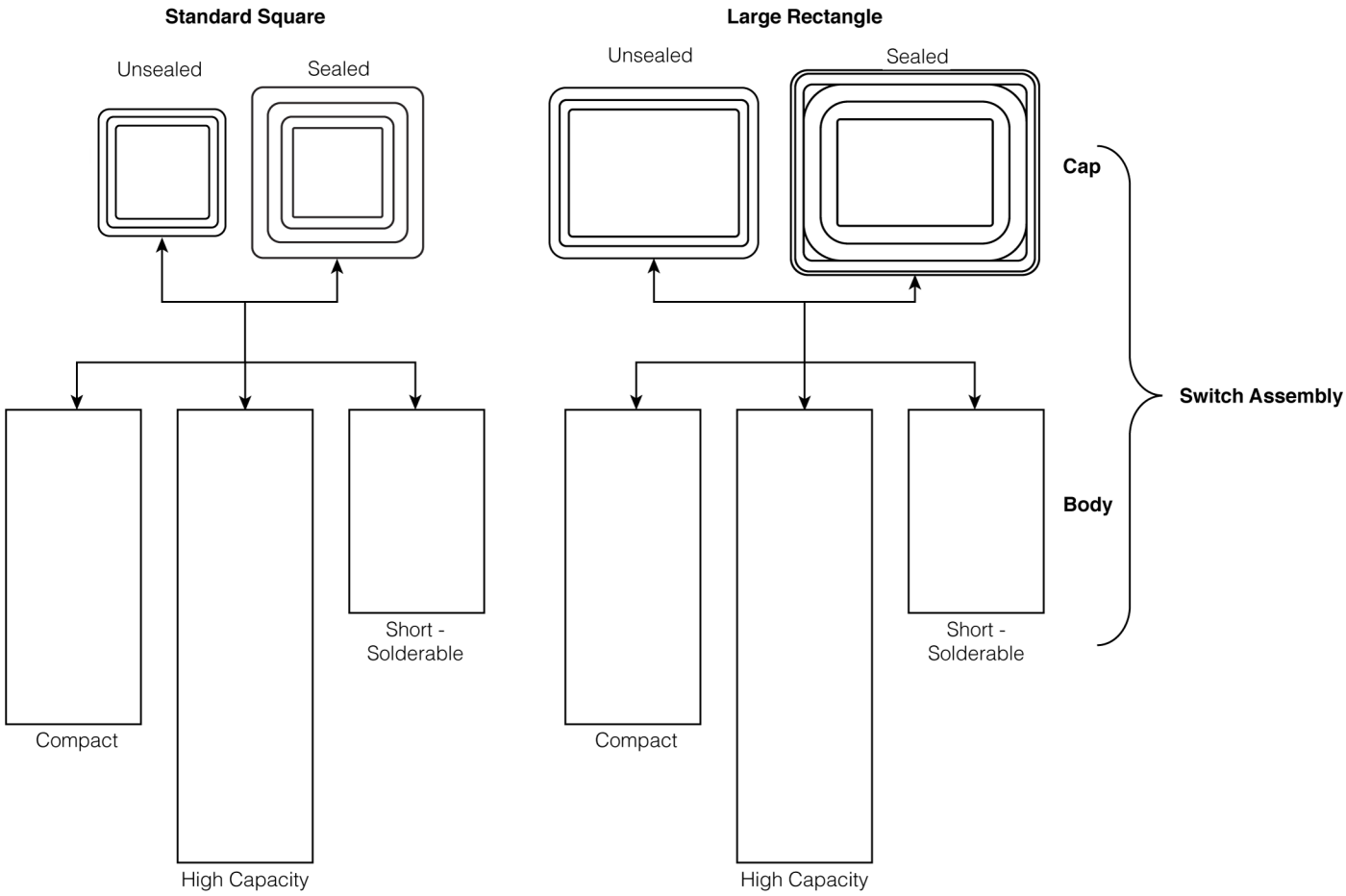
0.2 Product Overview

Applied Avionics, Inc. is the manufacturer of VIVISUN® LED Illuminated Pushbutton Switches. The company specializes in MIL-SPEC quality switches for use in avionics, shipboard and military applications. Except as noted, all parts described in this Technical Specification Guide comply with MIL-PRF 22885/108 and /113, as well as meeting the entire set of DO-160 test requirements.

0.3 Switch Assemblies, Caps and Bodies

There are four cap form factors (two cap sizes combined with two enclosure options each) and six distinct types of bodies (three body form factors for each cap size) which can be combined as shown below to address a variety of design specifications. Compact and High Capacity bodies are designed for a solderless connector plug, while the Short bodies utilize solder terminals.



Parts can be ordered as a switch assembly, which is comprised of a cap, body, spacer, and mounting sleeve. Caps and bodies can also be specified and ordered separately. For Compact and High Capacity bodies, connector plugs are required and can be ordered separately or included as part of the body configuration.

0.4 Part Number Configuration

VIVISUN® switches can be configured in more than 1,000,000 unique configurations, given the numerous cap and body option combinations. Applied Avionics has developed a Part Configurator (https://configurator.appliedavionics.com/) which will guide a user through all of the options included in this Technical Specification Guide. The Part Configurator generates a summary description of all of the options selected for each individual configuration and assigns a part number which can be used for purchasing inquiries. Using the Part Configurator is the best way to ensure part number accuracy.

Part Numbers that are related to Standard Square caps (switch assemblies, caps alone, or bodies alone that accept standard square caps) will start with the “LED-” prefix.

Part Numbers that are related to Large Rectangular caps (switch assemblies, caps alone, or bodies alone that accept large rectangular caps) will start with the “LR3-” prefix.

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1.0 Cap Options

VIVISUN® LED caps come in two sizes, Standard Square (nominally 0.75" square) and Large Rectangular (nominally 1" by 1.2"). Each of these cap sizes can be specified as unsealed or sealed as detailed in Section 1.1.

VIVISUN® caps feature superior visual performance, including full deadface sunlight readable displays and a full range of alternate lighting types. Section 1.2 provides complete information about the cap segmentation options (full face through 4-way split), lighting types and available fonts.

Caps can be specified in a full range of aviation and NVIS compliant colors, as described in Section 1.3. Specific chromaticity and NVIS radiance requirements from MIL-PRF-22885 and MIL-STD-3009 are incorporated in our manufacturing process to ensure that VIVISUN® caps can perform in the most demanding applications.

VIVISUN® caps can be voltage dimmed from daylight brightness to night flying brightness, or can be specified to take advantage of discrete level dimming. Section 1.4 describes the luminance and dimming options available.

The various electrical configuration options are described in Section 1.5, including voltage options, press-to-test options and cap circuit options. There are over 100 unique cap circuit options available.

1.1 Size Options (Unsealed & Sealed)

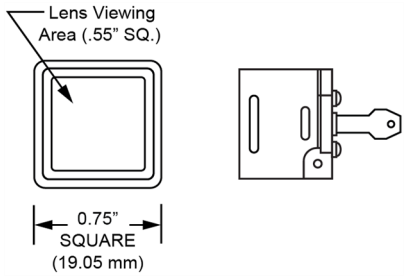
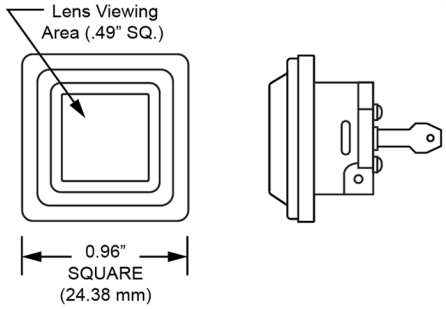
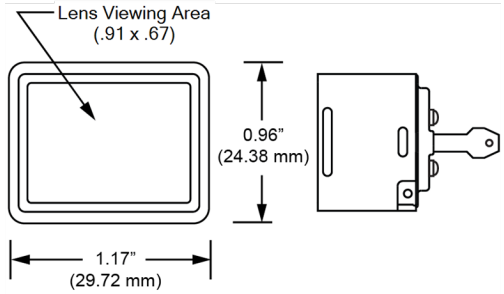
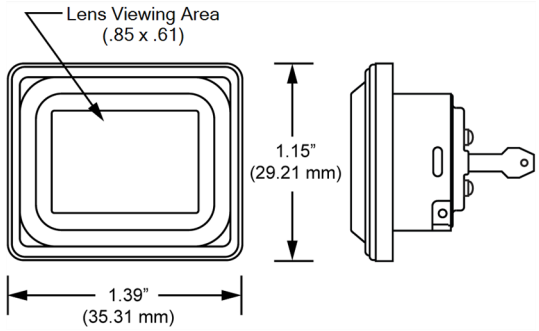
For Standard Square and Large Rectangular caps, the dimensions and viewable area of a cap are based on its specification as unsealed or sealed. Sealed caps prevent the ingress of water, sand, or dust through the mounting cutout in the panel.

For each of the four available cap sizes shown in Figure 1.1.0-A, there are three body sizes.

See Section 2.0 for a complete description of body types, including images and dimensions of caps when used in conjunction with each body type. Bodies that are specified to be used with an unsealed cap are provided with a standard panel spacer. Bodies that are specified to be used with a sealed cap are provided with a specific panel spacer and mounting flange designed to accept the seal that is permanently affixed to the cap.

Caps are mechanically and electrically separate from the body. Caps can be ordered separately, or can be purchased with a switch body as part of a switch assembly.

Figure 1.1.0-A Available Cap Sizes

	Unsealed (Types I, III, and V)	Sealed (Dripproof) (Types II, IV, and VI)
Standard Square		
Large Rectangular		

When installed in a switch body, caps are retained by means of a metallic retainer which is permanently mounted in the switch body housing. Cap material and weight information is provided in Section 3.3. Cap installation and removal information is provided in Section 3.4.

When specified, a sealed cap is supplied with a dripproof seal that mates with the dripproof flange provided with a sealed body. Sealed switches do not allow leakage of water through the seal when subjected to the splashproof, watertight, and dripproof sealing test defined in MIL-PRF-22885F paragraph 4.7.20.1 - .3 and MIL-STD-108. Sealed switches also meet the sand and dust test defined in MIL-PRF-22885F paragraph 4.7.26.

1.2 General Visual Characteristics

VIVISUN® LED pushbutton caps can be specified with a wide variety of visual characteristics. Visual characteristics include display style (number of segments on the cap), lighting types, and font selection. See Section 1.3 for information on lighting colors, and Section 1.4 for information regarding luminance and dimming controls.

Construction

Standard Square and Large Rectangular caps each have four quadrants that can be controlled individually or internally jumpered. A single pushbutton switch can display up to four separate messages, each in a different color and lighting type. Standard Square caps contain 16 LEDs, four per quadrant, and all the electronics necessary for display illumination. Large Rectangular caps contain 24 LEDs, six per quadrant, and all the electronics necessary for display illumination.

Viewing Angle

The displays have a 120° viewing cone (60° each direction to the normal of the display viewing surface) in sunlight and 30° included angle in glare producing angles of direct sunlight conditions.

Uniformity

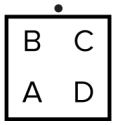
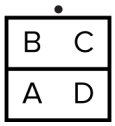
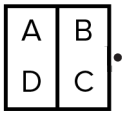
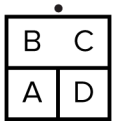
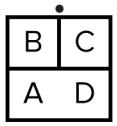
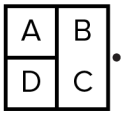
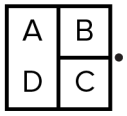
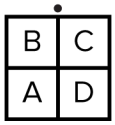
The typical character-to-character uniformity is 2:1 at 28VDC.

1.2.1 Display Styles

Standard Square Caps

A Standard Square pushbutton cap display is available in eight display styles; five standard styles and three additional styles accomplished by mounting the switch in a 90° clockwise rotated position.

Figure 1.2.1-A Standard Square Pushbutton Cap Display Styles

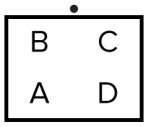
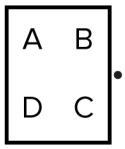
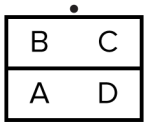
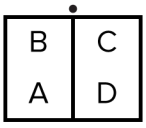
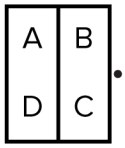
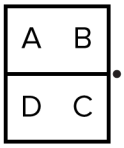
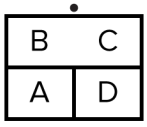
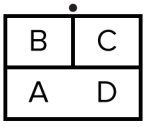
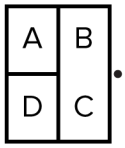
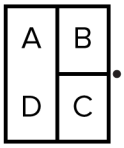
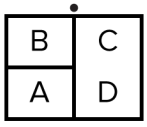
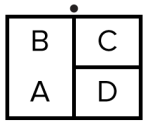
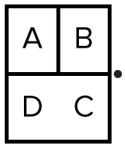
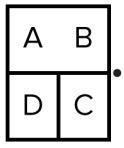
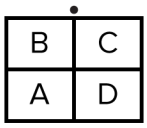
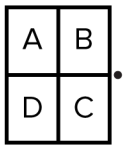
	Standard	Rotated
Full Face	 **H Style**	
2 Way Split	 **B Style**	 **B Style** (Rotated)
Three Way Split	 **E Style**  **C Style**	 **E Style** (Rotated)  **C Style** (Rotated)
Four Way Split	 **D Style**	

- *The letters A, B, C and D represent the four independent lighting segments in each cap as seen from the front of the cap. See Section 1.5 for various electrical interconnection options which can reduce the number of wiring connections to provide the desired illumination.*
- *When specified for mounting in a rotated position, the legends on the caps are rotated in relation to the top of the cap in order to be in the proper orientation after mounting.*
- *The "TOP" of cap is indicated by dot (for reference only).*

Large Rectangular Caps

A Large Rectangular pushbutton cap display is available in sixteen display styles; eight standard styles and eight additional styles accomplished by mounting the switch in a 90° clockwise rotated position.

Figure 1.2.1-B Large Rectangular Pushbutton Display Styles

	Standard		Rotated	
Full Face	 **H Style**		 **H Style** (Rotated)	
2 Way Split	 **B Style**	 **F Style**	 **B Style** (Rotated)	 **F Style** (Rotated)
Three Way Split	 **E Style**	 **C Style**	 **E Style** (Rotated)	 **C Style** (Rotated)
	 **J Style**	 **G Style**	 **J Style** (Rotated)	 **G Style** (Rotated)
Four Way Split	 **D Style**		 **D Style** (Rotated)	

- *The letters A, B, C and D represent the four independent lighting segments in each cap as seen from the front of the cap. See Section 1.5 for various electrical interconnection options which can reduce the number of wiring connections to provide the desired illumination.*
- *When specified for mounting in a rotated position, the legends on the caps are rotated in relation to the top of the cap in order to be in the proper orientation after mounting.*
- *The "TOP" of cap is indicated by dot (for reference only).*

1.2.2 Lighting Types

Standard Square and Large Rectangular caps are available with eight distinct lighting types. Each lighting segment can be configured with a different lighting type. See Section 1.4 for luminance by lighting type.

Figure 1.2.2-A Lighting Types

Display Type	Description	Available Colors See Section 1.3	Non-Energized	Energized
DEADFACE DISPLAYS:				
Type S	Type S displays are sunlight readable per MIL-PRF-22885/108 and have an opaque black background with indiscernible legends until illuminated. See Section 1.3 for specifics on sunlight readability contrast ratios. Contrast ratios are not applicable for a cap with a mixture of Type S and non-Type S lighting segments.	All		
Type H	Type H displays are identical to Type S displays, however sunlight readability contrast ratios do not apply. Type S and Type H cannot be combined on the same cap.	All		
BACKGROUND ILLUMINATING DISPLAYS:				
Type B	Type B displays have a black legend on an obscure black background. When illuminated, the legend remains black and the background appears in color. Sunlight readability contrast requirements do not apply.	All		
Type A	Type A displays have always visible white legends on an obscure black background. When illuminated, the background appears in color.	All		
Type W	The Type W displays have visible black legends on a white translucent background. When illuminated the legend remains black and the background illuminates in color. Display Type W cannot be combined with another Display Type on the same cap.	All except Cyan, NVIS Red, and Alt NVIS Red		
VISIBLE LEGEND DISPLAYS:				
Type D	Type D displays have visible white legends on an opaque black background. When illuminated, the legends light in color.	All except Cyan, NVIS Red, and Alt NVIS Red		
Type N	Type N displays have visible white legends and are always visible in any ambient light except darkened conditions. When energized, the legends light in color at a consistent low luminance level. Type N displays are not designed to be dimmed.	White, Red, NVIS Green A, NVIS green B, and NVIS White.		
OTHER DISPLAYS				
Type X	Type X displays have always visible white opaque lettering which does not illuminate, and the cap does not contain internal electronics.			

1.2.3 Fonts

Standard Square and Large Rectangle caps are available with three Standard Fonts, Custom Symbols or Custom Fonts. The tables below identify which standard fonts are used based on character height and display type as well as custom fonts that are available.

Figure 1.2.3-A Standard Fonts by Character Height and Display Type

Font Height	Type S, H	Type B, A, W, D, N & X
.072	ALTERNATE GOTHIC CONDENSED	
.090		
.109	GLOBE CONDENSED	FUTURA MEDIUM CONDENSED
.125		
.156		
.180*		
.220*		
.250*		

**Large rectangle caps only*

Figure 1.2.3-B Custom Fonts - Available from 0.072" - 0.250"

ALTERNATE GOTHIC

ALTERNATE GOTHIC CONDENSED

GLOBE CONDENSED

FUTURA MEDIUM

FUTURA MEDIUM CONDENSED

DIN1451 MITTLESCHRIFT SQUARE

DIN1451 ENGSCHRIFT SQUARE

DIN1451 MITTLESCHRIFT ROUND

DIN1451 ENGSCHRIFT ROUND

GORTON MEDIUM

GORTON MEDIUM CONDENSED

HELVETICA MEDIUM

HELVETICA MEDIUM CONDENSED

The number of lines per segment and the number of characters per line vary based on font type, font height, and display type.

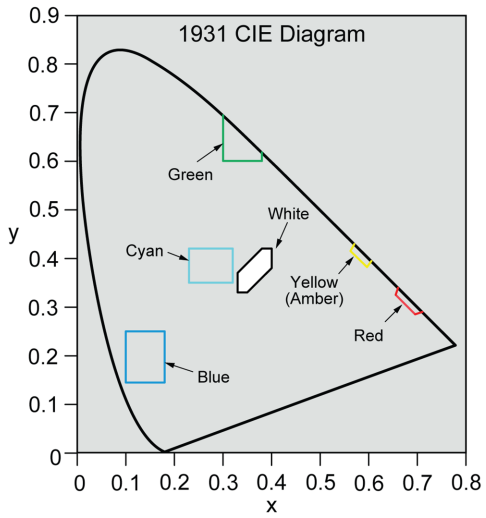
1.3 Colors

Caps are available in a full range of Aviation and NVIS colors. Except where noted, all colors are covered by MIL-PRF-22885/108 and /113 and the NVIS color options are fully compliant with MIL-STD-3009.

1.3.1 Aviation Colors

Aviation colors available include Green, Red, Blue, White, Yellow (Amber), and Cyan as described in Figure 1.3.1-A.

Figure 1.3.1-A Chromaticity Coordinates



1/ Chromaticity is expressed as x and y on the CIE chromaticity diagram. Values shown are corners of the limiting envelope

2/ SL - Spectrum Locus (where intersected by other coordinate).

Color	x 1/	y 1/
Blue	.100 .180 .180 .100	.145 .145 .250 .250
Green	.300 .300 .380 .380	SL 2/ .600 .600 SL 2/
White	.330 .350 .400 .400 .380 .330	.330 .330 .380 .420 .420 .370
Yellow (Amber)	.562 .570 .596 .605	.415 SL 2/ .382 SL 2/
Red	.695 .710 .655 .660	.285 SL 2/ .352 SL 2/
Cyan	.230 .230 .320 .320	.350 .420 .420 .350

Sunlight Readability - Aviation (Display Type S)

Type S displays are sunlight readable and meet the contrast ratio requirements of MIL-PRF-22885 with an opaque black background containing indiscernible legends until illuminated. When energized at rated voltage, the display legends are readable in 10,000 footcandles of direct sunlight including any glare producing angle up to 15° and 30° to the normal of the viewing surface. When the display is not energized the legends are hidden and cannot be read in direct sunlight. The display contrast values meet or exceed the minimum contrast requirements of MIL-PRF-22885.

The minimum contrast values for each color at full rated voltage are shown below.

Figure 1.3.1-B Minimum Contrast Ratios

Color	Contrast @ 15°	Contrast @ 30°
Blue	0.60	0.30
Green	0.60	0.30
White	0.60	0.40
Yellow (Amber)	0.60	0.40
Red	0.60	0.30
Cyan	0.40	0.20

See Appendix D for information about the luminance of other cap voltage options.

1.3.2 NVIS Colors

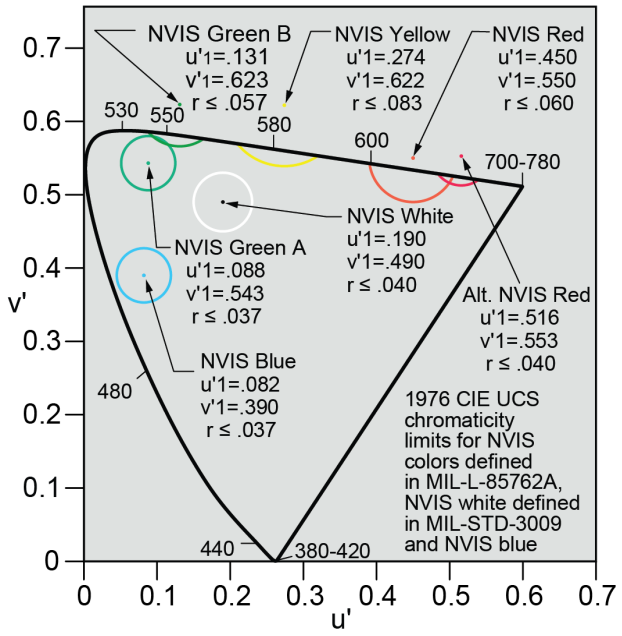
NVIS Compliant

When specified, the VIVISUN® display lighting is compatible with NVIS (Night Vision Imaging System) goggles and complies with the NVIS color and NVIS radiance requirements as defined in MIL-L-85762A and MIL-STD 3009, except as noted.

NVIS Colors and Chromaticity Coordinates

NVIS lighting is available in six MIL-STD-3009 compliant colors listed below (NVIS Green A, NVIS Green B, NVIS Yellow - Class A, NVIS Yellow - Class B, NVIS White, and NVIS Red), plus NVIS Blue and Alternate NVIS Red. Alternate NVIS Red is typically used in civil NVIS applications which do not require MIL-STD-3009 compliance as it exceeds the allowable NVIS Radiance and falls outside the chromaticity coordinates for NVIS Red. Typical 1976 CIE UCS chromaticity coordinates for each color are within the bounded areas shown in Figure 1.3.2-A.

Figure 1.3.2-A NVIS Chromaticity Coordinates



Sunlight Readability - NVIS (Display Type S)

Type S displays are sunlight readable and meet the contrast ratio requirements of MIL-PRF-22885 with an opaque black background containing indiscernible legends until illuminated. When energized at rated voltage, the display legends are readable in 10,000 footcandles of direct sunlight including any glare producing angle up to 15° to the normal of the viewing surface. When the display is not energized the legends are hidden and cannot be read in direct sunlight. The display contrast values meet or exceed the minimum contrast requirements of MIL-PRF-22885F.

The minimum contrast values for each color at full rated voltage are shown below.

Figure 1.3.2-B Minimum Contrast Values	
Color	Contrast @ 15°
NVIS Blue	0.60
NVIS Green A	0.60
NVIS Green B	0.60
NVIS White	0.60
NVIS Yellow Class A	0.60
NVIS Yellow Class B	0.60
NVIS Red	0.40
Alt. NVIS Red	0.40

See Appendix D for information about the luminance of other cap voltage options.

NVIS Radiance

The NVIS compliant lighting meets the following MIL-STD-3009 NVIS radiance requirements when set to the stated luminance levels.

Figure 1.3.2-C Radiance Requirements				
Color	NVIS Radiance		NVIS Type / Class	Luminance for NVIS Radiance Measurement (footlamberts)
	Maximum	Minimum		
NVIS Blue	<= 1.7E-10	none	Type I Class A	0.1
NVIS Green A	<= 1.7E-10	none	Type I Class A	0.1
NVIS Green B	<= 1.7E-10	none	Type I Class A	0.1
NVIS White	<= 1.0E-9	none	Type I Class A	0.1
NVIS Yellow Class A	<= 1.5E-7	>= 0.5E-7	Type I Class A	15.0
NVIS Yellow Class B	<= 1.4E-7	>= 0.47E-7	Type I or II Class B	15.0
NVIS Red	<= 1.4E-7	>= 0.47E-7	Type I or II Class B	15.0
Alt. NVIS Red is excluded from this chart since it does not meet the NVIS Radiance requirements of MIL-STD-3009.				

NVIS Class A is defined as using a 625 nm minus blue filter which does not allow the use of red cockpit lighting. NVIS Class B is defined as using a 665nm minus blue filter which does allow for the use of properly designed NVIS red lighting.

1.4 Luminance and Dimming Control

Caps can be configured with one of two types of dimming control based on the cap size per the chart below. Variable Voltage Dimming varies cap luminance directly with changes in the applied control voltage. Discrete Dimming caps operate at a constant control voltage, but vary luminance to predefined levels based on the state of dimming control pins. Certain dimming controls can be combined with Press-to-Test (PTT) circuitry (see Section 1.5) internal to the caps, allowing for a single test signal to illuminate the entire cap.

Figure 1.4.0-A Dimming Controls for Standard Voltage

Dimming Control	Standard Square*	Large Rectangular
Variable Voltage Dimming	28 VDC (w/ and w/o PTT) 5 VDC (w/o PTT)	28 VDC (w/ and w/o PTT)
Discrete Dimming – Power/Ground (P/G) Control	28 VDC (w/ and w/o PTT)	N/A

**Other voltages available for Variable Voltage Dimming Standard Square caps. See Section 1.5 and Appendix D.*

1.4.1 Variable Voltage Control

Caps with variable voltage control can be dimmed from daylight brightness at full rated voltage to night flying brightness by simply reducing the applied voltage until the desired luminance is achieved. Caps will also respond to changes in duty cycle if pulse width modulation is used. Luminance and voltage levels shown below are for Standard Square caps. Large Rectangular caps would provide typical luminance that is visually equivalent to Standard Square caps at equivalent voltage.

Luminance levels for Type S displays at 28 VDC were selected to: 1) provide superior sunlight readability and contrast ratios; and 2) to provide luminance levels that are visually equivalent to the human eye across all colors. See Luminance Comparison below for the shape of the typical dimming curve over varying voltage for 28 VDC (Figure 1.4.1-A) and 5 VDC (Figure 1.4.1-B). Figure 1.4.1-C and Figure 1.4.1-D contain the typical Type S luminance levels by color over the dimming range for Standard Square caps with typical variable voltage control.

Figure 1.4.1-A 28 VDC Dimming Curve Typical Type S LED Luminance

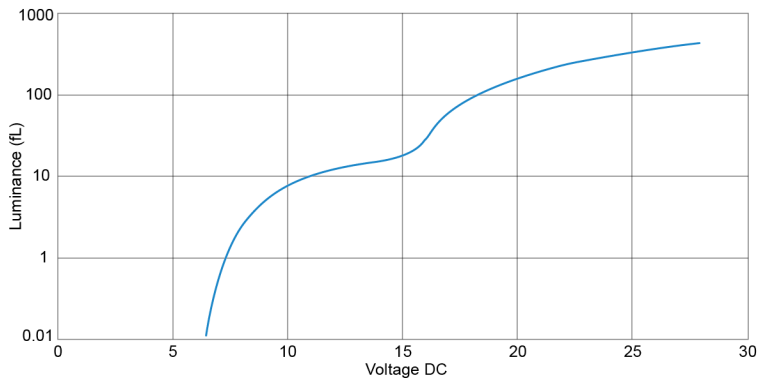


Figure 1.4.1-B 5 VDC Dimming Curve Typical Type S LED Luminance

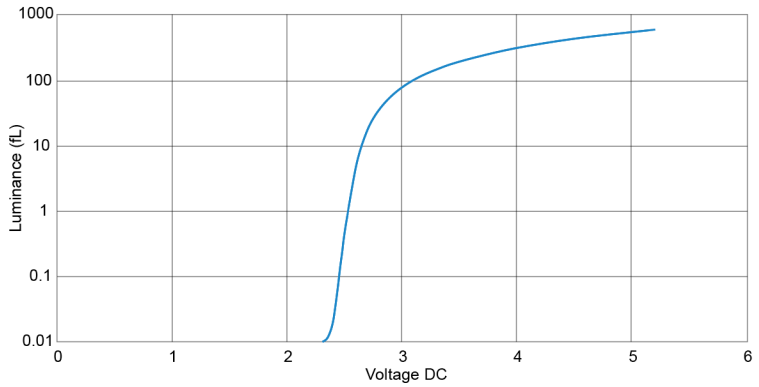


Figure 1.4.1-C Type S 28 VDC Typical Luminance Levels (in fL)

Color	@ 28 VDC		@ 14 VDC	@ 7.2 VDC	@ 6.55 VDC
	Minimum	Typical	Typical Range	Typical Range	Typical Range
Aviation Colors (See Section 1.3.1)					
Blue, Red	240	475	10 - 30	0.5 – 3.0	n/a
Green	300	500	10 - 30	0.5 – 3.0	n/a
White, Yellow	300	550	10 - 30	0.5 – 3.0	n/a
Cyan	150	500	10 - 30	0.5 – 3.0	n/a
NVIS Colors (See Section 1.3.2)					
NVIS Blue, NVIS Red	200	475	10 - 30	n/a	0.05 – 0.3
Alt. NVIS Red	150	400	10 - 30	n/a	n/a
NVIS Green A NVIS Green B	300	500	10 - 30	n/a	0.05 – 0.3
NVIS White	350	550	10 - 30	n/a	0.05 - 0.3
NVIS Yellow Class A NVIS Yellow Class B	300	550	10 - 30	n/a	0.05 – 0.3

Note: Type S NVIS Blue, NVIS Green A, NVIS Green B, NVIS White, NVIS Yellow Class A and NVIS Yellow Class B can be dimmed to 0.1 fL as required by MIL-L-85762 and MIL-STD-411.

Figure 1.4.1-D Type S 5 VDC Cap Dimming			
Color	Luminance (fL) @ 5 VDC		Extinguishment Range (volts) Luminance < .01 fL
	Minimum	Typical	Typical Range
Aviation Colors (See Section 1.3.1)			
Blue, Red	200	475	2.3 – 2.5
Green, Cyan	150	500	2.3 – 2.5
White, Yellow	300	550	2.3 – 2.5
NVIS Colors (See Section 1.3.2)			
NVIS Blue, NVIS Red	200	475	2.3 – 2.5
Alt. NVIS Red	150	400	2.3 – 2.5
NVIS Green A NVIS Green B	150	500	2.3 – 2.5
NVIS White NVIS Yellow Class A NVIS Yellow Class B	300	550	2.3 – 2.5
Note: Type S NVIS Blue, NVIS Green A, NVIS Green B, NVIS White, NVIS Yellow Class A and NVIS Yellow Class B can be dimmed to 0.1 fL as required by MIL-L-85762 and MIL-STD-411.			

Type H displays are similar to Type S displays, except that they are typically illuminated at 200 - 250 fl at 28 VDC full rated voltage. Luminance levels at 14 VDC and 7.2 VDC are similar to Type S. Contrast ratios are not applicable to Type H caps. In certain situations, a cap may have Type S luminance but be specified as Type H due to lower contrast ratios caused by specific legend sizes or symbols.

Type B and Type A displays with background lighting have a lower typical luminance than a similar Type S display, but are designed to be visually equivalent with the visual intensity of a similar Type S display containing illuminated characters.

Type D displays have a typical luminance of 100 fL at full rated voltage for aviation colors (75 fL for NVIS colors) and are voltage dimmed to extinguishment (0.5 fl or less) at approximately 7.2 VDC for a 28 VDC cap and 2.5 - 3.0 VDC for a 5 VDC cap.

Type N displays are not designed to be dimmed, and will provide 0.5 – 3.0 fL (Aviation and NVIS colors) luminance at full rated voltage (28 VDC or 5 VDC).

Type W displays have a typical luminance of 100 fL at full rated voltage for aviation colors (75 fL for NVIS colors) and are voltage dimmed to extinguishment (0.5 fl or less) at approximately 7.2 VDC for a 28 VDC cap and 2.5 - 3.0 VDC for a 5 VDC cap.

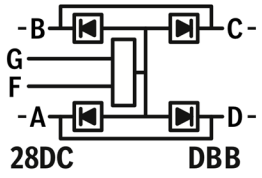
1.4.2 Discrete Dimming

Caps can be configured with up to three predefined modes (Mode 3 is optional) in a single cap by applying various combinations of 28 VDC, Ground, or Open to two dimming control pins (pins F and G), see Figure 1.4.2-A. Discrete Dimming is not available for Large Rectangular Caps. See Figure 1.4.2-B for the luminance levels available for each mode.

Figure 1.4.2-A Discrete Dimming - Power/Ground (P/G) Control

		Dimming Mode Controls		
Polarity	Control Pin	Mode 1	Mode 2	Mode 3
Common Anode	Control Pin F	28 VDC	28 VDC	Open
	Control Pin G	Open	Ground	28 VDC
Common Cathode	Control Pin F	Ground	Ground	Open
	Control Pin G	Open	28 VDC	Ground

Sample common anode cap schematic with Discrete Dimming – Power/Ground Control. See Appendix C for a complete table of the available circuit schematics.



The following nine distinct dimming levels are available covering the entire range of Aviation and NVIS colors. Mode 3 is optional for those applications that only require two distinct levels.

Figure 1.4.2-B Discrete Dimming Levels Available

Dimming Levels Available		Typical Luminance		Dimming Levels by Mode		
Aviation Colors	NVIS Colors	Approx. Equivalent Voltage for LED	Typical Luminance (Full Face, Type S)	Mode 1	Mode 2	Mode 3
Sunlight		28 VDC	350+ fL	✓		
Day		18 - 20 VDC	120 fL	✓	✓	✓
Enclosure		15 - 17 VDC	60 fL		✓	✓
Aviation Night		13 - 15 VDC	15 fL		✓	✓
Low Night		8 - 9 VDC	7 fL		✓	✓
Panel	NVG Compatible	7 – 8 VDC	2 fL		✓	✓
Low Panel (**)	NVG Compatible - 1 fL (**)	7.2 VDC	1 fL		✓	✓
	NVIS Compliant	6.55 - 7 VDC	.1 - 1 fL		✓	✓
Minimum Panel (**)	NVIS Compliant - .1 fL (**)	6.55 VDC	.1 fL		✓	✓

(*) Mode 3 level must be at or below Mode 2 level (**) Tightly controlled equivalent voltage level for given luminance.

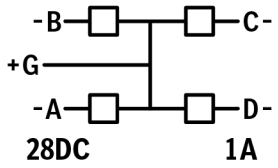
1.5 Electrical Characteristics

VIVISUN® LED pushbutton caps can be specified in a wide range of electrical configurations to meet specific design objectives. Options that can be specified for both Standard Square and Large Rectangular caps include the number of common grounds, polarity, voltage options, adding blocking diodes and/or internal Press-To-Test circuitry, and lighting segment interconnect options.

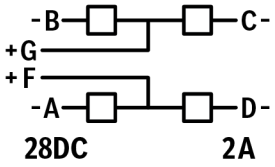
LED Circuit Configurations

Standard Square and Large Rectangular caps each have four quadrants that can be controlled individually. Each quadrant has its own independent electronic circuit including the Driver, Dimming and Protection Circuit (DDPC) needed for their operation. Standard Square caps contain 16 solid state LEDs, four per quadrant, and all the electronics necessary for display illumination. Large Rectangular caps contain 24 solid state LEDs, six per quadrant, and all the electronics necessary for display illumination.

The LED circuit is either a single circuit with one common or it is a horizontal split circuit with two commons.



Example: Single Common



Example: Split Common

Polarity

The LED circuit in Standard Square caps can be either common anode (current sinking) or common cathode (current sourcing). For Standard Square DC voltage caps, polarity is referenced with respect to commons G and F. Standard Square AC voltage caps and Large Rectangular caps are polarity insensitive.

Power Consumption

The typical power consumption of the LED illuminated pushbutton cap at 23° C is 1.18 watts for 28 VDC units. See Figure 1.5.1-A for current draw of caps at various voltages. For Voltage dimmed caps, current draw varies linearly with applied voltage. For Discrete Dimming caps, current draw of each mode will vary, but will not exceed the amounts shown in Figure 1.5.1-A.

1.5.1 Cap Voltage Options

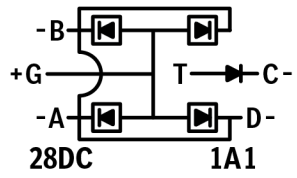
LED caps come in six distinct voltages:

Figure 1.5.1-A Cap Voltage Options (Type S @ Full Rated Voltage)		
	Voltage	Typical Current Draw Per Quadrant
Standard Square Caps		
Standard Voltages	28 VDC	12 mA
	5 VDC	22 mA
Special Voltages (*) (See Appendix D)	28 VAC *	12 mA
	5 VAC *	24 mA
	115 VAC, 400Hz *	11 mA
	115 VAC, 60Hz *	5 mA
Large Rectangular Caps		
Standard Voltage	28 VDC	13 mA
(*) Caps or switch assemblies with these caps are not covered by MIL-PRF-22885. See Appendix D for additional information.		

1.5.2 Press-To-Test Options

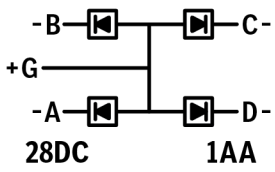
When specified on +28 VDC caps, the Press-To-Test option provides a dedicated test input which allows the entire legend (every segment) to energize when the specified test signal is applied to the dedicated test input. Caps specified with Press-To-Test circuits automatically include blocking diodes. Pin C is the Press-To-Test pin. For Standard Square caps, the test signal will match the polarity of the segment illumination pins (Ground for common anode caps and +28 VDC for common cathode caps). For Large Rectangular caps which are polarity insensitive, the test signal is required to be Ground.

With the dedication of Pin C for Press-To-Test, display styles C and D (see Figure 1.2.1-A) are not available for Standard Square caps and display styles C, D and G (see Figure 1.2.1-B) are not available for Large Rectangular caps.

Sample common anode cap schematic with Variable Voltage Dimming and Press-to-Test. See Appendix C for a complete table of the available circuit schematics.	

1.5.3 Blocking Diodes

When specified, the inclusion of blocking diodes provide diode isolation to each LED input to prevent the occurrence of a sneak path causing load power from entering the illumination power bus. Internally shorted lamp pins are not isolated from each other.

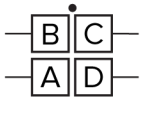
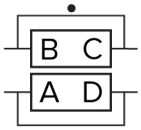
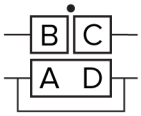
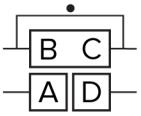
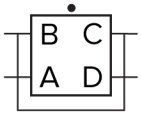
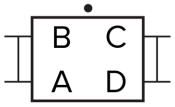
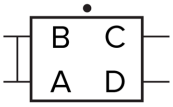
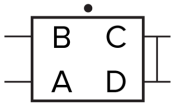
Sample common anode cap schematic with Variable Voltage Dimming and Blocking Diodes. See Appendix C for a complete table of the available circuit schematics.	

1.5.4 Cap Electrical Circuits and Segment Interconnections

Both Standard Square and Large Rectangular caps contain four separate quadrants (A, B, C, D) that can be illuminated independently. To reduce the number of input wires necessary to illuminate the display, the caps are available with the quadrants A, B, C and D internally connected in various circuit options so one input wire can activate one or more quadrants.

There are a total of five distinct segment interconnection options:

Figure 1.5.4-A Segment Interconnect Options

				
Option A	Option B	Option C	Option D	Option E
				
Option F (Large Rectangular Only)	Option G (Large Rectangular Only)	Option J (Large Rectangular Only)		

Quadrants as seen from the front of the switch, with "TOP" of switch indicated by the dot.

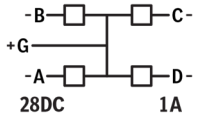
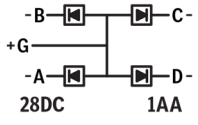
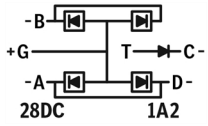
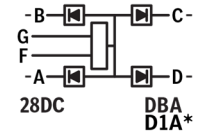
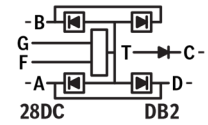
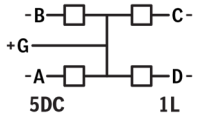
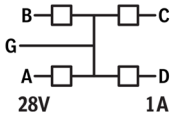
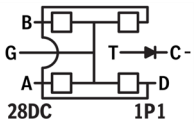
The selection of the segment interconnect option above is independent of the selection of the Cap Display Style in Section 1.2. Typically, the segments on the Display Style may match the interconnection in the cap circuit, but this is not a requirement. For example, a cap with Display Style H (Full Face) from Section 1.2 could be specified with an interconnection Option A above (each quadrant requiring its own illumination pin) for redundancy. Each separate illumination quadrant(s) desired in Display Style, requires a dedicated illumination pin.

Based on the cap voltage, dimming control (voltage dimming vs. discrete dimming), the inclusion of blocking diodes, and the presence (or lack thereof) of a dedicated Press-To-Test circuit, not all interconnect options are available for all configurations. Circuit schematics can also vary by the number of commons (single common or split common) and the polarity (common anode or common cathode) of the cap. See Figure 1.5.4-B and the appropriate table in Appendix C as for the specific segment interconnections options available.

Cap segment interconnection Option A is the only available option for a 28 VAC, 5 VAC, or 115 VAC cap.

No Cap-to Cap Interconnections

Internal cap segment interconnections are solely provided to reduce the number of required external wiring connections required to illuminate the intended display. These redundant connections lack the current carrying capacity to "daisy chain" additional displays or devices, and should not be used in this manner.

Figure 1.5.4-B					
Voltage (*)	Dimming	Blocking Diodes	Press-to-Test	See Appendix C Table:	Example
Standard Square Caps					
28 VDC	Variable Voltage	No	No	C - 1 (20 schematics)	
		Yes	No	C - 2 (20 schematics)	
		Yes	Yes	C - 3 (12 schematics)	
	Discrete (PG)	Yes	No	C - 4 (10 schematics)	
		Yes	Yes	C - 5 (6 schematics)	
5 VDC	Variable Voltage	No	No	C - 6 (20 schematics)	
Large Rectangular Caps					
28 VDC	Variable Voltage	No (*)	No	C - 7 (16 schematics)	
28 VDC	Variable Voltage	No (*)	Yes	C - 8 (10 schematics)	

See Appendix D for circuit schematics for 5 VAC, 28 VAC, 115 VAC, 400 Hz, and 115 VAC, 60 Hz. Caps or switch assemblies with these caps are not covered by MIL-PRF-22885.

(*) Polarity Insensitive circuits

2.0 Body Options

VIVISUN® LED switch/indicator bodies come in three primary sizes; Compact, High Capacity, and Short. All body sizes can be specified with high-reliability MIL-PRF-8805/101 electromechanical switch poles. Compact and High Capacity bodies can also be configured with NEXSYS® components, which are manufactured by Applied Avionics.

2.0.1 Actuation

There are three types of body actions, regardless of body size:

- **Indicator** – cap does not move. Indicators can have NEXSYS components inside that provide electronic switching, even though the cap remains stationary.
- **Alternate Action** – cap is depressed and stays in the latched position until a second cap actuation returns the cap to the normal position. Electromechanical switches remain actuated at all times that the switch is in the latched position.
- **Momentary Action** – cap is depressed and then returns to its original position without latching in the “depressed” position. Electromechanical switches actuate only while cap is depressed. NEXSYS components can be included to electronically “latch” the output, such that a momentary switch can act like an alternate action switch.

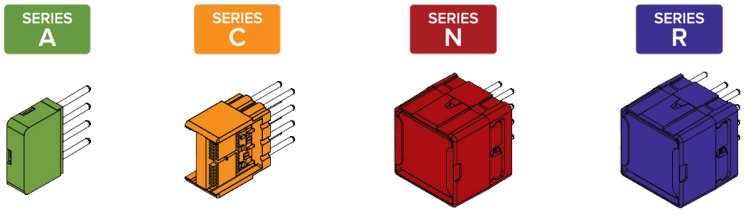
2.1 Sizes and Configurations

For each of the three body sizes, there are four options based on the cap size and the sealing option desired as shown below. Body capacity and termination is determined by the body size. Compact bodies feature solderless connector plug termination with a maximum capacity of two switch poles. High Capacity bodies also feature a solderless connector plug termination with a maximum capacity of four switch poles. Short bodies are the shortest bodies offered and include three different types of solder terminations. Short bodies can accommodate up to two switch poles.

Figure 2.1.0-A Body Options Available

Body Size Options	Maximum Capacity	Termination (See Section 2.4)	Cap Size	Sealing Option
Compact (See Figure 2.1.1-A)	2 Poles	Solderless Connector Plug	Standard Square	Unsealed
				Sealed
			Large Rectangular	Unsealed
				Sealed
High Capacity (See Figure 2.1.2-A)	4 Poles	Solderless Connector Plug	Standard Square	Unsealed
				Sealed
			Large Rectangular	Unsealed
				Sealed
Short (See Figure 2.1.3-A)	2 Poles	Solder Terminals	Standard Square	Unsealed
				Sealed
			Large Rectangular	Unsealed
				Sealed

Regardless of cap size or sealing option, Compact and High Capacity bodies can also accommodate NEXSYS components which can replace one or all of the electro-mechanical switch poles. Short bodies cannot accommodate NEXSYS components. NEXSYS components come in one of four series designations (Series A, Series C, Series N and Series R) which correspond to the physical dimensions and number of pins of each series. The Series designation impacts the number and combinations of specific components that can be included in a single Compact or High Capacity body.



4 Pin 8 Pin 8 Pin 12 pin

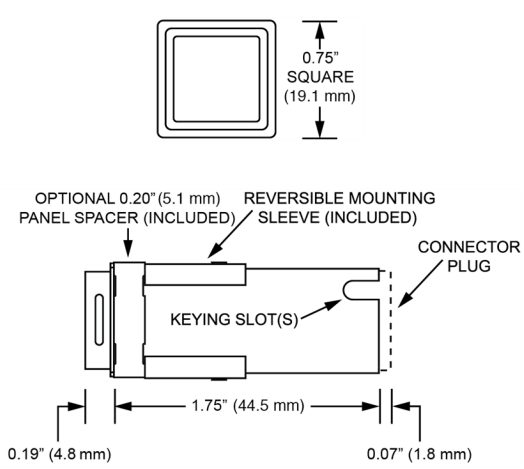
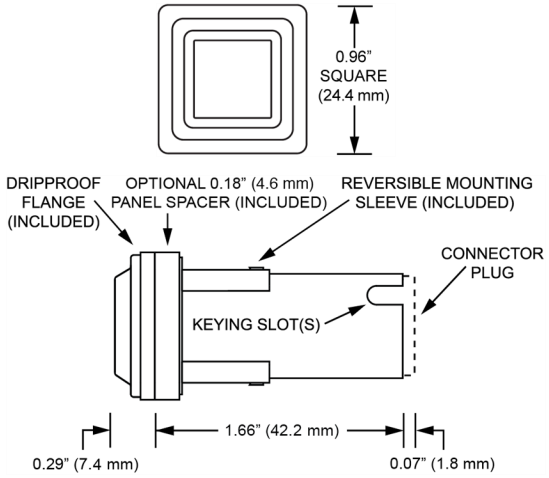
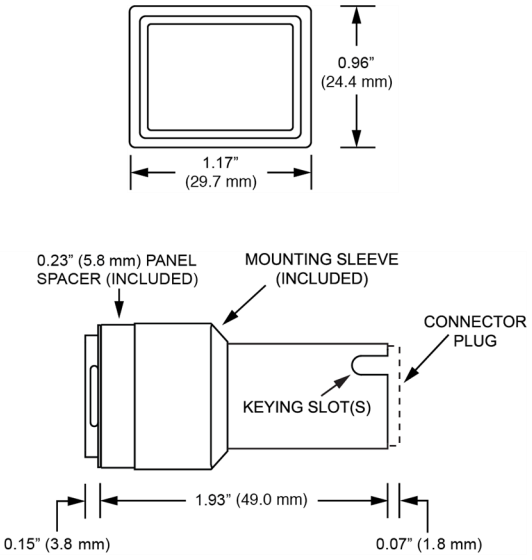
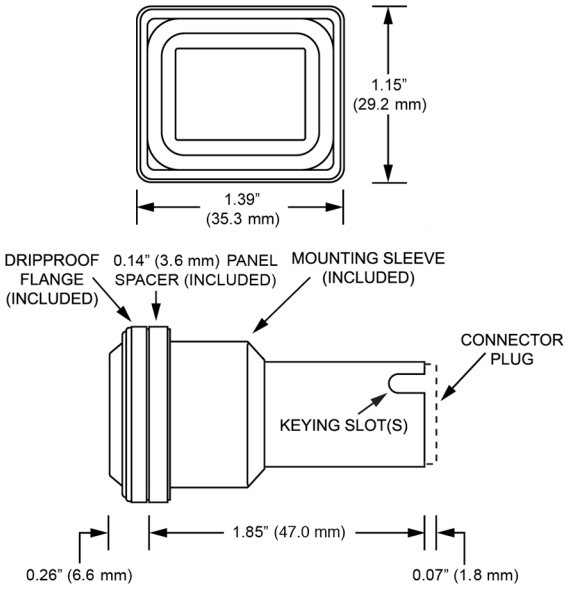
For Compact bodies, the available combinations of electromechanical switches and NEXSYS components are provided in Figure 2.1.1-B. For High Capacity bodies, the available combinations of electromechanical switches and NEXSYS components are provided in Figure 2.1.2-B.

A brief description of the functionality of the different NEXSYS components is provided in Section 2.3.2. For a full description of NEXSYS components, see Technical Specification Guide - NEXSYS Component Technology (TG-NCT-21).

2.1.1 Compact Bodies (2-pole) - Unsealed and Sealed

Compact bodies can be specified for Standard Square or Large Rectangular caps and must be specified to accommodate an unsealed or sealed cap installation.

Figure 2.1.1-A Compact Body - Solderless

	Unsealed (Type III)	Sealed (Type IV)
Standard Square		
Large Rectangular (Landscape Mount)		

When specified, a sealed body is supplied with a dripproof spacer and dripproof flange that accepts the seal of a sealed cap. Sealed switches do not allow leakage of water through the seal when subjected to the splashproof, watertight, and dripproof sealing test defined in MIL-PRF-22885F paragraph 4.7.20.1 - .3 and MIL-STD-108. Sealed switches also meet the sand and dust test defined in MIL-PRF-22885F paragraph 4.7.26.

Configurations (Switches and NEXSYS Components)

VIVISUN® Compact bodies have two available "positions" to accommodate electromechanical switch poles and NEXSYS® components. Positions are identified on the exterior of the switch body and the connector plug as Poles A and B. Electromechanical switches each occupy a single switch pole. In Compact bodies, NEXSYS components can also occupy a single pole position. As shown in Figure 2.1.1-B, there are five specific build configurations that reflect the possible arrangements of switches and NEXSYS components in a Compact Body. The assignment of selected components to specific pole positions is done at the time of final part configuration. An "open" spacer will be placed in any unused pole position.

Figure 2.1.1-B Compact Body - Component Combinations

	No Switch Poles (Indicator)	1 Switch Pole	2 Switch Poles
No NEXSYS Components	OPEN OPEN	SWITCH OPEN	SWITCH SWITCH
Series A only Components	SERIES A OPEN - or - SERIES A SERIES A	SWITCH SERIES A	

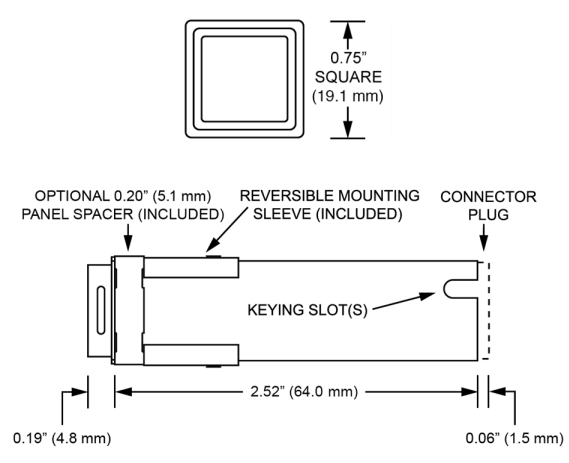
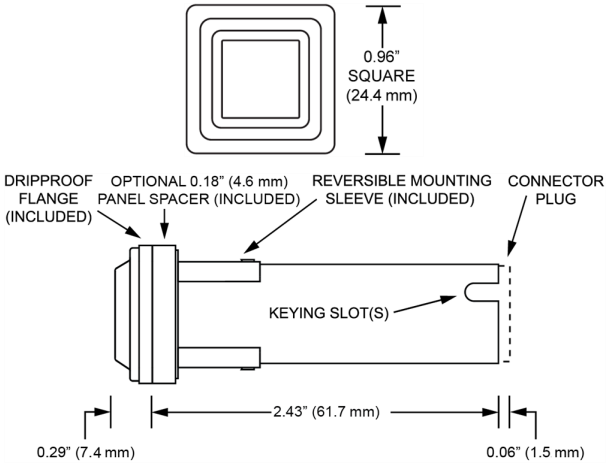
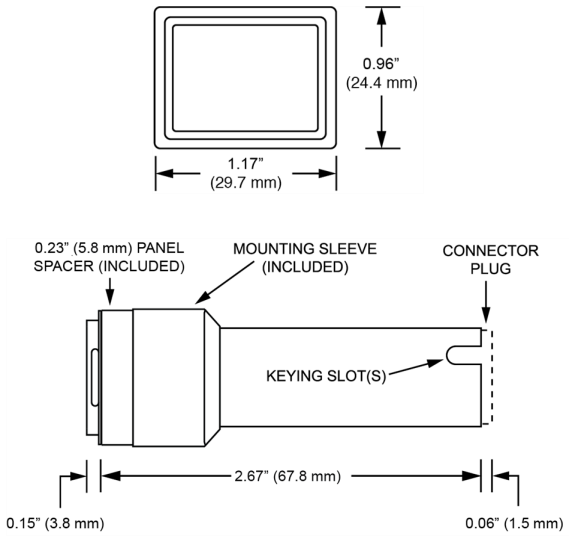
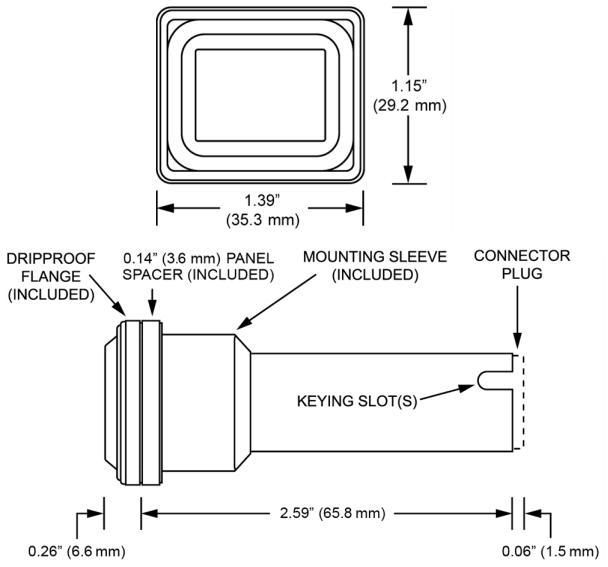
Compact bodies without NEXSYS components (only electro-mechanical switches and/or open spacers) have two keying slots and use connector plug (P/N 18-200) for wiring termination. Compact bodies with one or more NEXSYS components have only one keying slot and use a specially keyed connector plug (P/N 18-442) for wiring termination. See Section 2.4 for complete description of Compact body (14 socket) connector plugs.

See Section 2.4 for installation instructions, and refer to Appendix B for various mounting options, including the proper usage of the optional mounting spacer provided with Standard Square bodies.

2.1.2 High Capacity Bodies (4-pole) - Unsealed and Sealed

High Capacity bodies can be specified for Standard Square or Large Rectangular caps and must be specified to accommodate an unsealed or sealed cap installation.

Figure 2.1.2-A High Capacity Body - Solderless

	Unsealed (Type V)	Sealed (Type VI)
Standard Square		
Large Rectangular (Landscape Mount)		

When specified, a sealed body is supplied with a dripproof spacer and dripproof flange that accepts the seal of a sealed cap. Sealed switches do not allow leakage of water through the seal when subjected to the splashproof, watertight, and dripproof sealing test defined in MIL-PRF-22885F paragraph 4.7.20.1 - .3 and MIL-STD-108. Sealed switches also meet the sand and dust test defined in MIL-PRF-22885F paragraph 4.7.26.

Configurations (Switches and NEXSYS Components)

VIVISUN® High Capacity bodies have four available “positions” to accommodate electromechanical switch poles and NEXSYS® components. Positions are identified on the exterior of the switch body and the connector plug as Poles H, J, K, and L. Electromechanical switches each occupy a single pole. NEXSYS Series A components can each occupy a single pole position. NEXSYS Series C components and Series N components can occupy poles J and K simultaneously and NEXSYS Series R components occupy poles J, K and L simultaneously. As shown in Figure 2.1.2-B, there are 23 possible build configurations that reflect the possible arrangements of switches and NEXSYS components. The assignment of selected components to specific pole positions is done at the time of final part configuration. An “open” spacer will be placed in any unused pole position.

Figure 2.1.2-B High Capacity Body - Component Combinations

	No Switch Poles (Indicator)	1 Switch Pole	2 Switch Poles	3 Switch Poles	4 Switch Poles
No NEXSYS Components					SWITCH SWITCH SWITCH SWITCH
Series A only components	SERIES A SERIES A SERIES A OPEN - or - SERIES A SERIES A SERIES A SERIES A	SWITCH SERIES A SERIES A OPEN - or - SWITCH SERIES A SERIES A SERIES A	SWITCH SERIES A OPEN SWITCH - or - SWITCH SERIES A SERIES A SWITCH	SWITCH SWITCH SERIES A SWITCH	
Series C components	OPEN SERIES C OPEN - or - SERIES A SERIES C OPEN - or - SERIES A SERIES C SERIES A	SWITCH SERIES C OPEN - or - SWITCH SERIES C SERIES A	SWITCH SERIES C SWITCH		
Series N components	OPEN SERIES N OPEN - or - SERIES A SERIES N OPEN - or - SERIES A SERIES N SERIES A	SWITCH SERIES N OPEN - or - SWITCH SERIES N SERIES A	SWITCH SERIES N SWITCH		
Series R components	OPEN SERIES R - or - SERIES A SERIES R	SWITCH SERIES R			

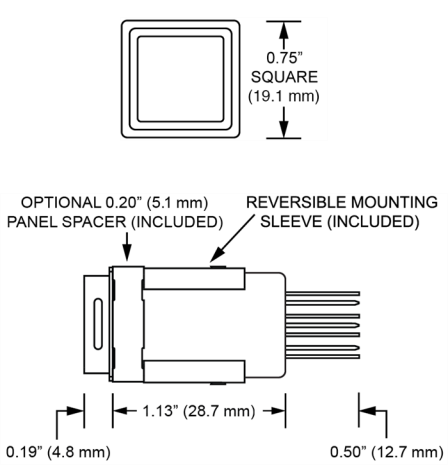
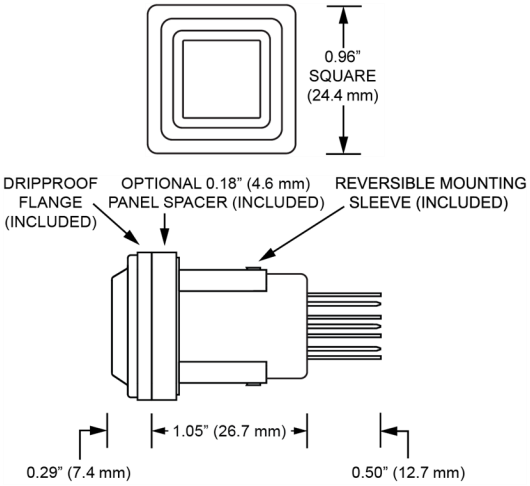
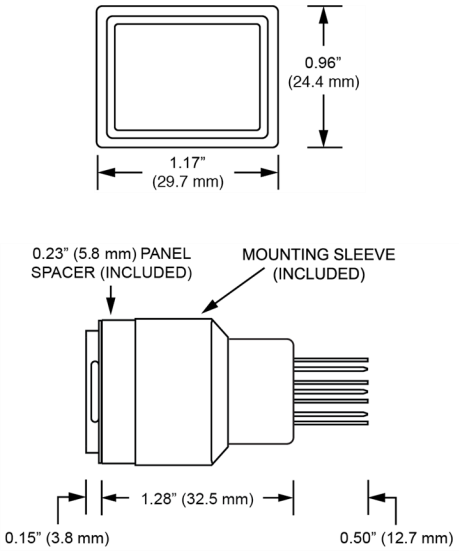
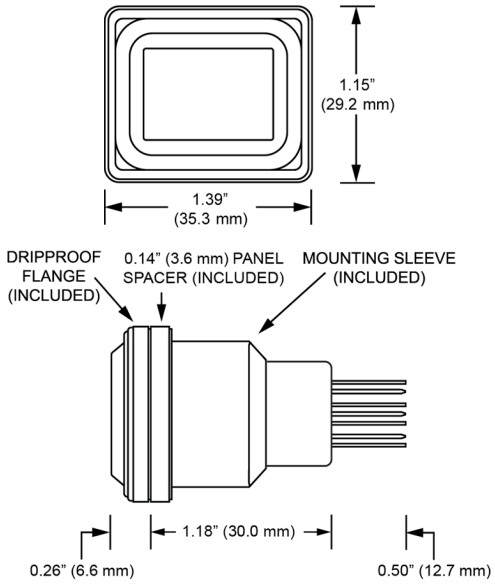
High Capacity bodies without NEXSYS components (only electromechanical switches) have two keying slots and use connector plug (P/N 18-240) for wiring termination. High Capacity bodies with one or more NEXSYS components have only one keying slot and use a specially-keyed connector plug (P/N 18-440) for wiring termination. See Section 2.4 for complete description of High Capacity body (22 socket) connector plugs.

See Section 3.4 for installation instructions and refer to Appendix B for various mounting options, including the proper usage of the optional mounting spacer provided with Standard Square bodies.

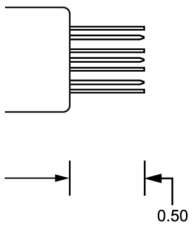
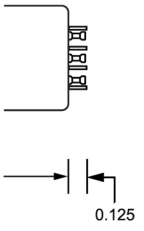
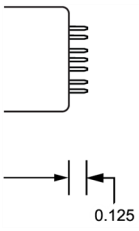
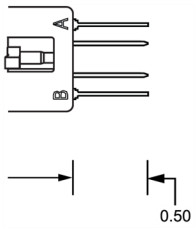
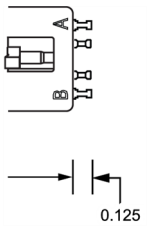
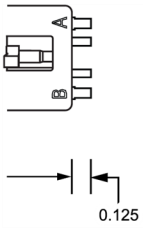
2.1.3 Short Bodies

Short bodies can be specified for Standard Square or Large Rectangular caps and must be specified to accommodate an unsealed or sealed cap installation.

Figure 2.1.3-A Short Bodies - Solderable

	Unsealed (Type I)	Sealed (Type II)
Standard Square	 PCB Pins	 PCB Pins
Large Rectangular (Landscape Mount)	 PCB Pins	 PCB Pins

When specified, a sealed body is supplied with a dripproof spacer and dripproof flange that accepts the seal of a sealed cap. Sealed switches do not allow leakage of water through the seal when subjected to the splashproof, watertight, and dripproof sealing test defined in MIL-PRF-22885F paragraph 4.7.20.1 - .3 and MIL-STD-108. Sealed switches also meet the sand and dust test defined in MIL-PRF-22885F paragraph 4.7.26.

Figure 2.1.3-B 3 Types of Available Solder Terminations			
Solder Terminations (Side Views)	 PCB Pins	 Turret	 Spade
Solder Terminations (Top Views)	 PCB Pins	 Turret	 Spade

Configurations (Switches)

VIVISUN® Short bodies have two available “positions” to accommodate electromechanical switch poles. Positions are identified on the exterior of the switch body and the connector plug as Poles A and B. Electromechanical switches each occupy a single switch pole. NEXSYS® components are not available in Short bodies. As shown in Figure 2.1.3-C, there are three specific build combination configurations that reflects the possible arrangement of up to two switches. An “open” spacer will be placed in any unused pole position.

Figure 2.1.3-C Short Body - Component Combinations			
	No Switch Poles (Indicator)	1 Switch Pole	2 Switch Poles
Combinations			

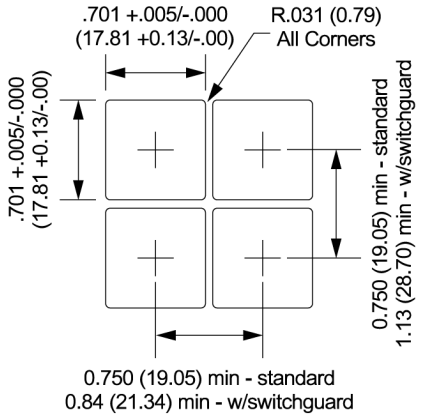
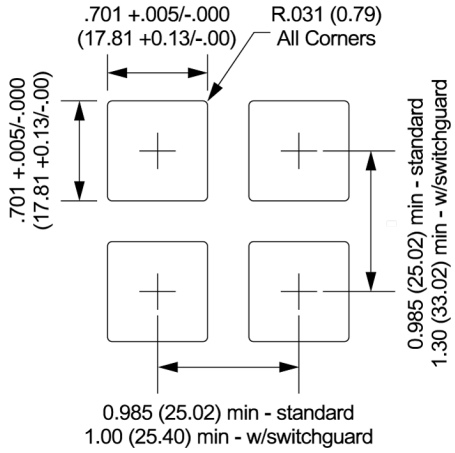
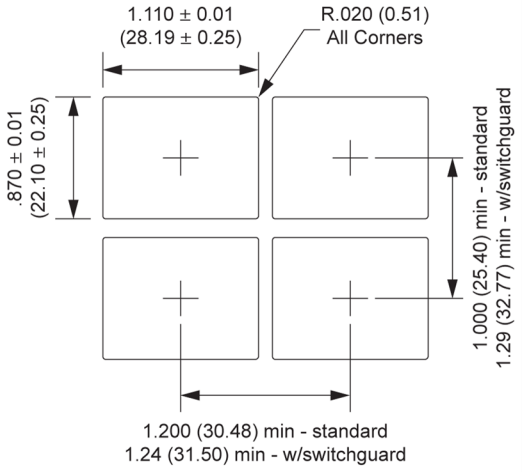
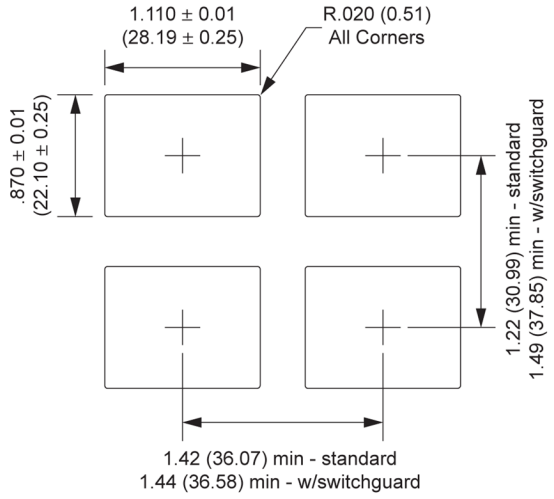
See Section 2.4 for complete description of the solder terminations for Short bodies.

See Section 3.4 for installation instructions, and refer to Appendix B for various mounting options, including the proper usage of the optional mounting spacer provided with Standard Square bodies.

2.2 Panel Cutout

Panel cutouts for Standard Square and Large Rectangular bodies are shown below. The spacing between adjacent switches for standard installations (not using an optional switchguard) and installations utilizing a switchguard are also noted.

Figure 2.2.0-A Panel Cutout

	Unsealed (Types I, III, and V)	Sealed (Types II, IV, VI)
Standard Square		
Large Rectangular (Landscape Mount)		

Dimensions in inches. Metric equivalent follows in ( ) for general information only.

See Section 3.4 for acceptable panel mounting thickness. If you are retro-fitting an existing panel with square cut-outs and the existing cut-out is too large, a Panel Adapter may be used to accommodate a VIVISUN® switch.

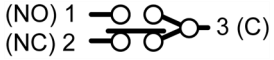
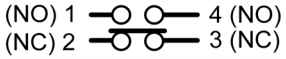
2.3 Switches and NEXSYS Components

As described in Section 2.1, bodies can contain a combination of electromechanical switches and NEXSYS® components based on their size.

2.3.1 Electromechanical Switches

Electromechanical switches are snap action switches qualified to MIL-PRF-8805/101 category I or category II. Switches can be specified as either double throw - single break or double throw - double break (see Figure 2.3.1-A). Switches can be specified with silver contacts (with gold flash) or gold plated contacts. When switches are present in the same body as an 8-pin LOGIC component (See Figure 2.3.2-A), they must be specified with gold plated contacts. All switches contained in a single body must be identical, with respect to the number of breaks and the contact material.

Figure 2.3.1-A Available Electromechanical Switches

Types of Electromechanical Switches		Contacts
Single Break Switch		Silver
		Gold
Double Break Switch		Silver
		Gold

Numbers represent the applicable pin-out designation for switch termination.

Pushbutton Action: Momentary, Alternate

Switch Contact Resistance: Silver with Gold Flash: 0.025 Ohms maximum at 6 VDC, 0.1 ADC.
Silver with Gold Plate: 3.0 Ohms maximum at 30 mVDC, 0.01 ADC.

Intermediate Current: The intermediate current test per MIL-PRF-22885 paragraph 3.35 is applicable to the gold flash silver contacts. 50,000 cycles minimum, 12,500 cycles at -40° C, 12,500 at +71° C and 25,000 cycles at +23° C.

Low Level Life: The low level life test per MIL-PRF-22885 paragraph 3.36 is applicable to the gold plated contacts. 50,000 cycles with contacts loaded at 30 millivolts maximum DC or peak AC at 10 milliamperes maximum. 12,500 cycles at -40° C, 12,500 at +71° C and 25,000 cycles at +23° C.

Contact transition: Mechanical switches are break before make.

Dielectric Withstanding Voltage: 60 Hz at 50,000 ft. 400 volts tms minimum. At sea level: 1000 volts rms minimum, 60 Hz.

Electrical Life: 50,000 cycles at rated loads at 71° C ambient temperature.

Switch Contacts: Available in silver with gold flash or gold plate. See Figure2.3.1-B for switch contact ratings.

Figure 2.3.1-B Switch Contact Ratings			
Silver Contacts with Gold Flash			
	Load	Single Break	Double Break
28VDC @ sea level	Resistive	7.5 amps	4.0 amps
	Inductive	4.0 amps	2.0 amps
	Motor	4.0 amps	-
	Lamp	1.0 amp	-
28VDC @ 50,000 ft	Resistive	4.0 amps	3.0 amps
	Inductive	2.5 amps	1.0 amps
115VAC, 60 Hz, @ sea level	Resistive	7.5 amps	-
	Inductive	4.0 amps	-
Gold Plated Contacts			
28VDC @ sea level	Resistive	1.0 amp	-
	Inductive	0.5 amps	-
28VDC @ 50,000 ft	Resistive	1.0 amp	-
	Inductive	0.5 amps	-

Gold switch contacts are required in configurations that include an 8-pin NEXSYS component.

2.3.2 NEXSYS® Components

NEXSYS® components can be specified alongside electromechanical switches or separately in Compact (See Figure 2.1.1-B) or High Capacity (See Figure 2.1.2-B) bodies. Switch/indicator bodies with NEXSYS components are covered by MIL-PRF-22885/108 and /113. NEXSYS components cannot be used with Short bodies.

Figure 2.3.2-A below lists only the NEXSYS components that can be specified internal to a Compact and/or High Capacity body. A brief description of the functionality of each component follows. See NEXSYS Component Technology Technical Specification Guide (TS-NCT-17) for a complete description of each NEXSYS component.

Figure 2.3.2-A Available NEXSYS® Components

Function	Description	Series	VIVISUN High Capacity Body	VIVISUN Compact Body
Data Conversion				
ARINC 429 Signal Converters	Autonomous ARINC 429 receivers with the protocol logic necessary to capture and convert a specified data-word to discrete output(s), controlled by the decode of a single label and bit, multiple-bits, or multi-bit Binary Decode (BD).	SERIES N SERIES R	✓	
Signal Switching/Control				
Defined Logic	Digital electronic device that performs Boolean logic gate operations *AND*, *OR*, *NOT*, *NAND*, *NOR*, *XOR*, *XNOR*, as well as *BUFFER*.	SERIES C	✓	
Solid State Relay	Normally Open (NO) and Normally Closed (NC) solid-state relays available individually (SSR) or in a combination of four (SSRCH). The bidirectional inputs are polarity insensitive, and the device performs buffered switching with optical isolation between inputs and outputs.	SERIES A SERIES C	✓ ✓	✓
State Control				
Electronic Latch	Electronic latching with multiple trigger modes to activate orthogonal switching (flip-flop) between two known states and a 1Hz blink output.	SERIES C	✓	
Electronic Rotary	Electronic rotary control that performs incremental switching through a loop of up to four latched output states, controlled by input level transitions.	SERIES C	✓	
Timing				
Pulse/Timer	Dual-channel edge detector and pulse generator with independent channels to perform stable retriggerable/resettable one-shot operation for fixed timing applications. Pulse-width output timing options range from 125 ms to 20 sec.	SERIES C	✓	
Time Delay	Time-delay output, controlled by input triggers or power-up. Output timing options range from 125 ms to 4 hrs.	SERIES A	✓	✓
Square Wave Oscillator	Oscillating output controlled by input triggers or power-up. Frequency (cycles/sec) and Period (sec/cycle) options range from 0.25 Hz (4 sec) to 500 Hz (0.002 sec).	SERIES A	✓	✓

Figure 2.3.2-A Available NEXSYS® Components - cont'd				
Function	**Description**	**Series**	**VIVISUN High Capacity Body**	**VIVISUN Compact Body**
Sensing				
Voltage Sensor	Direct Current (DC) voltage sensor performs undervoltage and overvoltage detection to trigger the output. Sensed-voltage (VSD1) setpoint options range from +1 to 48 VDC, and sensed-low voltage (VSD2) setpoint options range from 50 mVDC to 1000 mVDC (+1 VDC).	SERIES A	✓	✓
Current Sensor	Direct Current (DC), low-side current sensor that performs undercurrent and overcurrent detection to trigger the output. Sensed-current setpoint options range from 10 mA to 1000 mA (1.0 A).	SERIES A	✓	✓
Passive				
Diode Pack	Package of two diodes specified as either commercial (1N6484) or military (JANTX1N5621) grade.	SERIES A	✓	✓
Terminal Block	4-splice configuration for increased wiring efficiency.	SERIES A	✓	✓

2.4 Termination

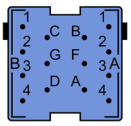
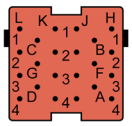
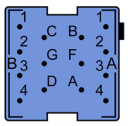
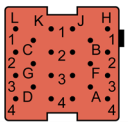
VIVISUN® bodies are available with a solderless termination (Compact and High Capacity bodies) or with solder terminations (Short bodies).

2.4.1 Solderless (Compact and High Capacity Bodies)

Compact and High Capacity bodies have a solderless connector plug than can be separated from the body for ease of installation and wiring. A specially keyed version of the connector plug is required if a Compact or High Capacity body contain any NEXSYS® components. The specification of a body as: a) Standard Square vs. Large Rectangular or; b) unsealed vs. sealed has no impact on the solderless connector plug required.

Plugs can be ordered and delivered with the bodies or can be ordered separately.

Figure 2.4.1-A Solderless Connector Plugs (as seen from rear of switch)

Body Description	Compact Body (14 Sockets)	High Capacity Body (22 Sockets)
Bodies WITHOUT NEXSYS components	 P/N 18-200	 P/N 18-240
Bodies WITH NEXSYS Components (Specially Keyed) (Note: Missing key tab allows insertion in bodies containing NEXSYS components)	 P/N 18-442	 P/N 18-440
	Pinout Description	
	A, B,C, D, F, G: Cap Circuit Pins A 1-4, B 1-4: Switch pole or NEXSYS component pins	A, B,C, D, F, G: Cap Circuit Pins H 1-4, J 1-4, K 1-4, L 1-4: Switch pole or NEXSYS component pins

Solderless Termination

All connector plugs accept MIL-C-39029/22-192 sockets crimped onto 20, 22, or 24 gauge wire. Crimp sockets (P/N 18-219) are not provided with connector plugs.

Loading Wires

Wires with the MIL-C-39029/22-192 sockets crimped on are inserted into and extracted from the connector plug by use of a M81969/14-02 tool (P/N 18-216).

Mating the Solderless Connector Plug

No tool is necessary to plug the connector into the housing, but an extraction tool, P/N 18-234 is required to unplug the connector plug from the switch body.

Sealing Plug

Sealing Plugs, P/N 18-215, are provided with each connector plug. Sealing plugs should be inserted in each unused pinout location.

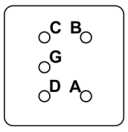
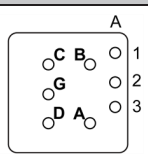
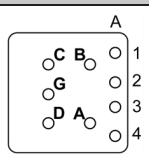
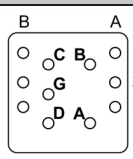
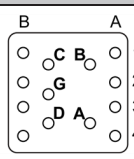
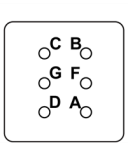
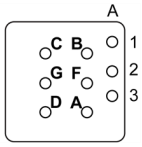
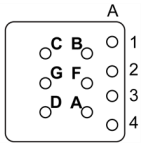
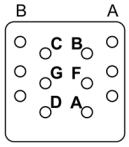
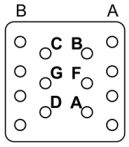
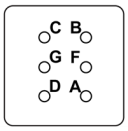
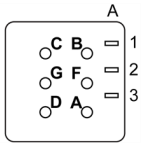
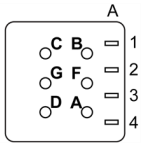
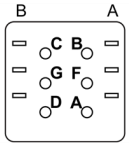
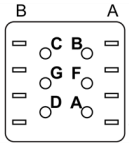
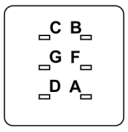
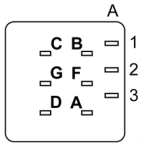
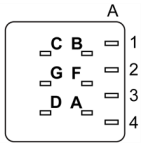
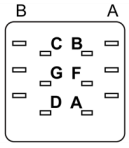
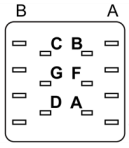
Weight of Connector Plugs

6 grams (0.21 oz).

2.4.2 Solderable (Short Bodies)

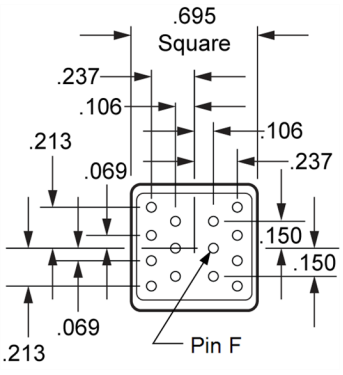
Short bodies have three types of solderable terminations per Figure 2.1.3-B. Figure 2.4.2-A below shows the terminals provided for the illuminated cap circuits (terminals A, B, C, D, F, and G) and the two available switch poles (A1-A4 and B1-B4) based on the type of solder termination. Terminals are marked on the switch body. There are 20 unique solderable pinouts based on the type of switches specified and the number of commons in the illuminated cap being used in the body.

Figure 2.4.2-A Solder Terminations (As seen from rear of switch)

	Indicator	Single Pole Switch		Double Pole Switch	
		Single Break	Double Break	Single Break	Double Break
PCB Pins (See Figure 2.4.2-B)					
Single Common					
Split Common					
Turret and Spade Terminations					
Single Common and Split Common (*)					
Single Common and Split Common (*)					
(*) Pin F will be provided but non-functional for single common Spade or Turret terminations					

For PCB applications, the specific pin spacing is as shown in Figure 2.4.2-B.

Figure 2.4.2-B PCB Pin Spacing (as seen from rear of switch)



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3.0 General Characteristics

VIVISUN LED Illuminated Pushbutton Switches are designed and tested to meet the highest environmental and electrical qualifications in the industry. Section 3.1 contains a complete listing of qualification, specifications, and reference levels for VIVISUN LED Switches. In addition, specific qualification references are provided for optional features, including NVIS lighting, high shock options, and additional EMI shielding options (Sections 3.1.3 - 3.1.4 respectively).

Reliability data is found in Section 3.2 and information regarding the weight and material selections is found in Section 3.3.

VIVISUN switches and indicators can accommodate a variety of mounting situations. Selection of the appropriate installation and the mounting procedure is found in Section 3.4, and installation diagrams can be found in Section 4.2

3.1 Qualifications

3.1.1 Environmental Qualifications

Figure 3.1.1-A

Test Description	Specification	Section	Category	Reference Levels
Altitude	RTCA/DO-160	4	A2, F2	-15,000, +55,000 Feet
	MIL-STD-202	105C	B	
	MIL-STD-810	500	Procedure II	
Temperature	RTCA/DO-160	4	F2	-55°C and +85°C Non-operational -55°C and +71°C Operational
	MIL-STD-810	501/502	Procedure III	
Temperature Variation	RTCA/DO-160	5	S2	5 Cycles -55°C / +85°C
	MIL-STD-202	107	A	
	MIL-STD-810	503	1	
High Temperature Survival (Non-Operating)	MIL-STD-202	108A	A	+85°C, 96 Hours (Switch) +125°C, 96 Hours (NEXSYS Modules)
Humidity	RTCA/DO-160	6	B	240 Hours, +38°C / 65°C, > 90% RH 240 Hours, -10°C / 65°C, > 90% RH
	MIL-STD-202	106	N/A	
Operational Shock and Crash Safety	RTCA/DO-160	7	B	20 G Sawtooth
	MIL-STD-202	213	B	20G Acceleration, 75 G Half-Sine
	MIL-STD-810	516	N/A	N/A
Acceleration	RTCA/DO-160	7	B	20 G, 3 Axis
	MIL-STD-202	212	A	
	MIL-STD-810	513	Procedure III	
Vibration	RTCA/DO-160	8	R, U	10 to 2000 Hz, Sine on Random
	MIL-STD-202	204	B	10 to 2000 Hz 15 G
Explosive Atmosphere	RTCA/DO-160	9	E	N/A
	MIL-STD-202	109C	B	
Waterproofness	RTCA/DO-160	10	R	450 Litres / Hour 15 Gallons / Minute
	MIL-PRF-22885	4.7.20	Splash-proof	-10°C /+ 40°C 85% RH
Sand and Dust	RTCA/DO-160	12	D	Silica Media
	MIL-STD-202	110	N/A	
Fungus Resistance	RTCA/DO-160	13	F	Compliance by Material Selection
	MIL-PRF-22885	3.5.2	N/A	
Salt Fog	RTCA/DO-160	14	T	96 Hour Tests
	MIL-STD-202	101	A	
Magnetic Effect	RTCA/DO-160	15	Z	1° Deflection, at < 0.3m

3.1.2 Electrical Qualifications

Figure 3.1.2-A

Test Description	Specification	Section	Category	Reference Levels
Power Input Aircraft Power (DC) (see Appendix D for AC cap performance)	RTCA/DO-160	16.6; except as noted below	A and B	200ms / 50ms dropout (CS, CT, DL, ER, PT, SR429/4, TD, VS)**
		16.6.1.3 (Momentary Power Interrupt)	A and B	
			B	50ms dropout (EL, SR429/1, TD)**
			N/A	No digital circuitry. (SSR, TB, DP)**
		16.6.1.5, 16.6.2.2	B	Tests not applicable to Category A
	MIL-HDBK-704-8	LDC (102, 301, 401, 501, 602)	N/A	N/A
Spike / Transient	RTCA/DO-160	17	A	Power 600V, 10µsec, 50 ohms
Audio Frequency Conducted Susceptibility	RTCA/DO-160	18	Z	Power Input, 4V P to P, 1 to 150 KHz
	MIL-STD-461	CS101	Curve 2	
Induced Signal Susceptibility	RTCA/DO-160	19	CW	10,000V/m, 120A/m, 350 and 800 Hz
RF Conducted Susceptibility*	RTCA/DO-160	20	Y	300mA, 10KHz to 400Hz
	MIL-STD-461	CS114	Curve 5	109dBµA, 10KHz to 200MHz
RF Radiated Susceptibility*	RTCA/DO-160	20	Y	200V/m 2MHz to 18GHz
	MIL-STD-461	RS103	200V/m	
Conducted RF Emissions	RTCA/DO-160	21	P	150KHz to 152MHz
	MIL-STD-461	CE102	N/A	10KHz to 10MHz
Radiated RF Emissions	RTCA/DO-160	21	P	100MHz to 6GHz
	MIL-STD-461	RE102	N/A	10KHz to 6GHz
Lightning Induced Transient*	RTCA/DO-160	22	XXK3L3	Waveform 3, 600V, 1MHz, 10MHz, Single, Multiple, Burst Waveform 4, 300V, 69µsec Waveform 5A, 300V, 120µsec
	MIL-STD-461	CS117	L1	
Military Transient*	MIL-STD-461	CS115	N/A	5A 30nS 30/Sec for 1 minute
	MIL-STD-461	CS116	N/A	Damped Sinusoidal, 10KHz to 100MHz
Dielectric Withstanding	MIL-STD-202	301		1000 VAC
Electrostatic Discharge	RTCA/DO-160	25	N/A	15,000V, 150pF, 330 ohms
	MIL-STD-461	CS118	Level 4	

** Stated EMC performance based on tests performed on an individually monitored component using unshielded cables as defined by the applicable EMC test document. The EMC performance of an installed system using NEXSYS components can be dependent on the actual installation environment and interconnection method.*

*** Key to Abbreviations Above: CS=Current Sensor, CT=Square Wave Oscillator, DL=Defined Logic, DP=Diode Pack, EL=Electronic Latch, ER=Electronic Rotary, PT=Pulse/Timer, SR429/1=ARINC 429 Signal Converter (/1M), SR429/4=ARINC 429 Signal Converter (/4M and /4D), SSR=Solid State Relay, TB=Terminal Block, TD=Time Delay, VS=Voltage Sensor*

3.1.3 High Impact Options

When specified, the sealed indicators and momentary action sealed switches meet the high impact shock test defined in MIL-PRF-22885F, paragraph 4.7.16.2 Method II. The High Impact option is not available for Large Rectangular bodies.

A separate heavy-weight shock option (MIL-DTL-901) is also available for certain applications.

3.1.4 EMI/RFI Shielding Option

When specified, the shielding efficiency of the pushbutton switch and cap mounted in a metallic panel is no less than 60dB from 100MHz to 1000MHz. Shielding efficiency is not applicable to a pushbutton switch and cap mounted in a non-metallic panel or using a Panel Mounting Adapter to fill a hole larger than 0.75 inch.

3.2 Reliability

Mean Time to Failure

The VIVISUN® Lighted Pushbutton Switch Mean Time to Failure for the 28 VDC or 5 VDC lighted pushbutton cap is in excess of 125,000 hours as calculated per MIL-HDBK-217F, Notice 2 for an AIF (Airborne Inhabited Fighter) environment at 60° C, and in excess of 250,000 hours for AIC (Aircraft Inhibited Cargo) at 40° C.

No Maintenance

The high reliability design enables the VIVISUN® Lighted Pushbutton Switch to operate virtually maintenance free for the life of the avionics platform.

Mechanical Life

100,000 cycles. Tested for 10,000 cycles at -40° C, 20,000 at +71° C and 70,000 cycles at +25° C.

Pushbutton Action

Momentary, Alternate or Indicator.

Operating Characteristics:

Actuation travel: 0.150” +/- 0.030”
Actuation force: 2 to 5 pounds.

A low tactile force (non MIL-PRF) option is also available (1.5 to 3 pounds).

Strength of Actuator

25 pounds static load.

Minimum Current for Luminance

The 28 VDC LED displays require approximately 1 milliamp of current per quadrant for Standard Square (3 mA for Large Rectangular) before producing a perceptible level of luminance so that the LEDs will not light inadvertently due to microamp currents. In emergency situations, 28 VDC Type S displays will produce a luminance in excess 50fL at 18 VDC.

3.3 Weight and Materials

Figure 3.3.0-A Weight			
Cap Only			
Cap Size	**Body Size**	**Weight – Grams (oz)**	
		Unsealed	Sealed
Standard Square	Cap Only	4 gm (0.14 oz)	7 gm (0.25 oz)
Large Rectangular	Cap Only	9 gm (0.32 oz)	11 gm (0.39 oz)
Switch Assembly (Cap + Body)			
Cap Size	**Body Size**	**Weight – Grams (oz)**	
		Unsealed	Sealed
Standard Square (*)	Compact (*)	26 gm (0.92 oz)	28 gm (0.99 oz)
	High Capacity (*)	38 gm (1.34 oz)	41 gm (1.45 oz)
	Short Body (*)	19 gm (0.67 oz)	21 gm (0.75 oz)
Large Rectangular (*)	Compact (*)	40 gm (1.41 oz)	51 gm (1.80 oz)
	High Capacity (*)	51 gm (1.80 oz)	62 gm (2.19 oz)
	Short Body (*)	37 gm (1.31 oz)	46 gm (1.62 oz)
Connector Plugs	Compact (18-200 & 18-442)	6 gm (0.21 oz)	
	High Capacity (18-240 & 18-442)	6 gm (0.21 oz)	
(*) Includes cap, mounting sleeve and spacer. Excludes connector plug.			

Figure 3.3.0-B Materials			
Cap			
Component	Description	Size	Material
Bezel	Standard Square	All Sizes	Aluminum, Black anodized
	Large Rectangular	All Sizes	PPS
Face of Cap	All Types	All Sizes	Acrylic
Dripproof Seal (if specified)	All Types	All Sizes	Silicon Rubber
Body			
Component	Description	Size	Material
Housing	All Types	Compact & High Capacity	Stainless Steel
		Short	Aluminum, Black anodized
Mounting Spacer	Standard Square	All Sizes	Engineered Plastic
	Large Rectangular (Non EMI)	All Sizes	PEEK
	Large Rectangular (EMI)	All Sizes	Nickel Plated Brass
Mounting Sleeve	Standard Square	All Sizes	Stainless Steel
	Large Rectangular	All Sizes	PEEK

3.4 Installation

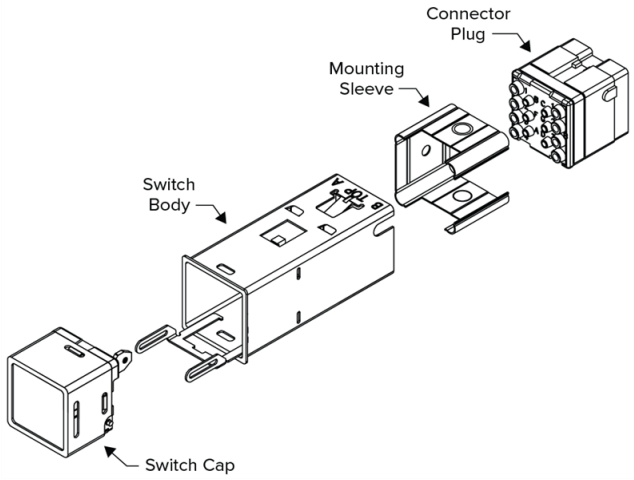
Proper installation is crucial to getting the full performance from your VIVISUN® switch or indicator. Proper installation falls into three major steps: 1) installing the body; 2) wiring/installing the connector plug; and 3) installing the illuminated cap.

If you are installing or replacing only the cap, it is not necessary to uninstall an existing switch body. Special tools are available (cap extraction tool, connector plug extraction tool, and crimped wire insertion/extraction tool) that should be used for correct switch installation.

Locate the proper installation guide

Appendix B has installation guides covering the following installations. Extended mount installations typically use the provided spacer to accommodate edge-lit panels.

Installation Guides			
Panel (*)	Enclosure	Appendix B	
Standard Square			
		Standard Mount	Extended Mount
Thin Panel	Unsealed	B-1	B-2
	Sealed	B-3	B-4
Thick Panel	Unsealed	B-5	N/A
	Sealed	B-6	N/A
Thin with Panel Adapter	Unsealed	B-7	N/A
	Sealed	B-8	N/A
Large Rectangular			
Thin Panel	Unsealed	B-9	B-10
	Sealed	B-11	B-12
Thick Panel	Unsealed	B-13	N/A
	Sealed	B-14	N/A
(*) Thin panels are .032 - .187" thick. Thick panels are from .187 - .300" thick.			



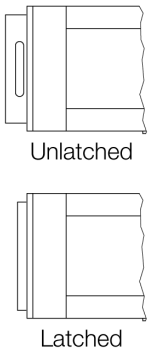
3.4.1 Mounting the switch or indicator body

1. Remove the cap from the body if cap is present.

Caps can be removed from the body by locating the slots on either side of the cap and pulling the cap out (extraction force = 2 to 5 pounds) using a (P/N 17-150) cap extraction tool. **Caps that are mounted in alternate action housings must be in the unlatched position before removal to avoid damaging the latching mechanism**.

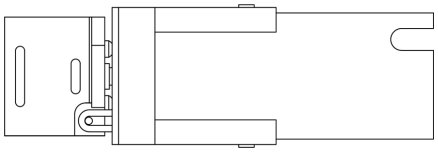
Figure 3.4.1-A

P/N 17-150

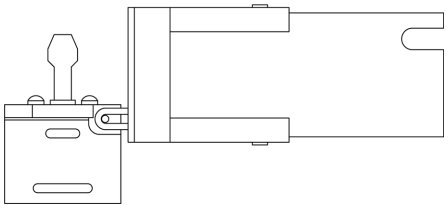


Using the extraction slots, pull the pushbutton cap fully out of the switch body and allow the cap to rotate 90° where it is held by the retainers. Remove the cap entirely by gently spreading the retainers and releasing the cap pins.

Figure 3.4.1-B



Pushbutton Cap Extracted



Pushbutton Cap Retained

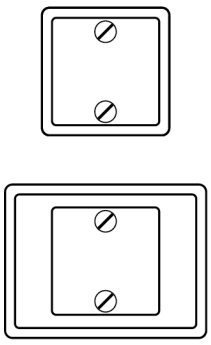
2. Install body into panel

Remove the mounting sleeve and insert the switch body into the mounting plate cutout, (see Figure 2.2.0-A for cutout dimensions). Then, from behind the mounting plate, slide the mounting sleeve onto the switch body.

Switch bodies are mounted to the panel by capturing the panel between the flange on the switch body and the mounting sleeve. The switch body has internal mounting lugs that capture the mounting sleeve and draw the mounting sleeve tight to the back of the panel. All mounting screws are integral to the switch. Tighten the two screws inside the switch body until the integral mounting hardware pulls the mounting sleeve up tight against the mounting plate using typically 18 inch-ounces of torque.

Ensure that each lug has "engaged" the mounting sleeve and has not slipped underneath the mounting sleeve.

Figure 3.4.1-C



3. Install Connector Plug

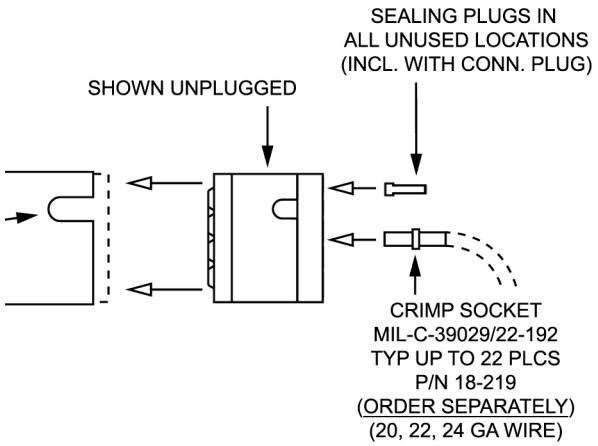
The connector plug is separable from the switch body and can be prewired to facilitate easier installation. It is also important to wire the plug before inserting into the body to ensure proper seating of sockets. The solderless connector plug accepts MIL-C-39029/22-192 sockets crimped onto 20, 22, or 24 gauge wire without soldering. These sockets are not included with plugs and **must be ordered seperately** (P/N 18-219). Crimped wires are inserted into and extracted from the connector plug by use of a M81969/14-02 tool (P/N 18-216).

No tool is necessary to insert the connector plug into the back of the switch body. The connector plug should be inserted until both of the locking tabs “click” into position. Test that the connector plug is properly inserted and retained in the body by tugging on the wire bundle.

Removal of the connector plug from the back of the switch body requires a connector plug extraction tool (P/N 18-234) to avoid damaging the locking tabs. Manually spreading the locking tabs without using the specified tool will prevent proper retention of connector plug when it is reinserted, causing intermittent wiring contact. Connector plugs should not be removed by manually spreading the locking tabs.

For switch bodies with solderable terminations, the solderable wire connections can be made either before or after the switch body is installed.

Figure 3.4.1-D Connector Plug Installation



P/N 18-234
Connector Plug
Extraction Tool

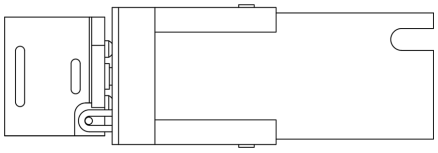
P/N 18-216
Crimp Socket
Wire Removal Tool

3.4.2 Replacing/Reinstalling Cap

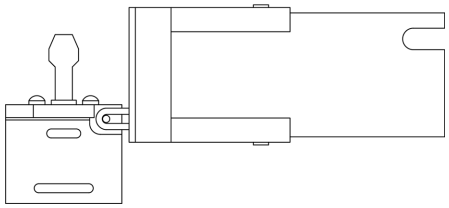
Cap Removal

Caps can be removed from the body by locating the slots on either side of the cap and pulling cap out (extraction force = 2 to 5 pounds) using a (P/N 17-150) cap extraction tool. **Caps that are mounted in alternate action housings must be in the unlatched position before removal to avoid damaging the latching mechanism.** Caps can be changed, if needed, by gently spreading the retainers, releasing the cap pins, and replacing with another cap.

Figure 3.4.2-A



Pushbutton Cap Extracted



Pushbutton Cap Retained

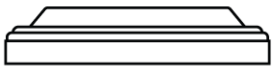
Cap Insertion (Unsealed and Sealed Caps)

The cap bezel contains two retention pins which should be hooked onto the ends of the metallic sliding retainer. Both pins should be captured by the retainer. Rotate, insert probe pin into slot in body, and push gently. Cap is keyed via a pin on the probe to prevent incorrect insertion.

Sealed Caps

After the switch body assembly is properly mounted, the cap can be inserted (See Cap Insertion above). Seal the cap onto the seal mounting flange, by pressing a lower corner of the seal into the lower flange corner using firm finger pressure. Next, press each of the remaining corners of the seal into their respective flange corners. Follow by pressing each of the four sides into the seal mounting flange, ensuring all sides of the seal are fully seated.

Figure 3.4.2-B



Fully Sealed

Improper Seal

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4.0 Appendices

Section 4 contains supplemental information that should be read in conjunction with this entire technical guide.

4.1 Appendix A - NVIS

VIVISUN caps can be configured with NVIS compliant lighting as described in Section 1.3.2 and Section 4.1 provides additional information about NVIS response curves.

4.2 Appendix B - Installation Diagrams

Proper installation of a VIVISUN switch varies by panel thickness, sealing options, and presence of an edgelit panel. Section 4.2 provides exploded installation views for each installation situation.

4.3 Appendix C - Circuit Diagram

As described in Section 1.5.4, VIVISUN caps have various types of segment interconnects based on voltage, polarity, number of currents, dimming methods, and the presence of blocking diodes/press-to-test. Section 4.3 provides a complete listing of the electrical cap circuits offered.

4.4 Appendix D - Other Cap Voltages

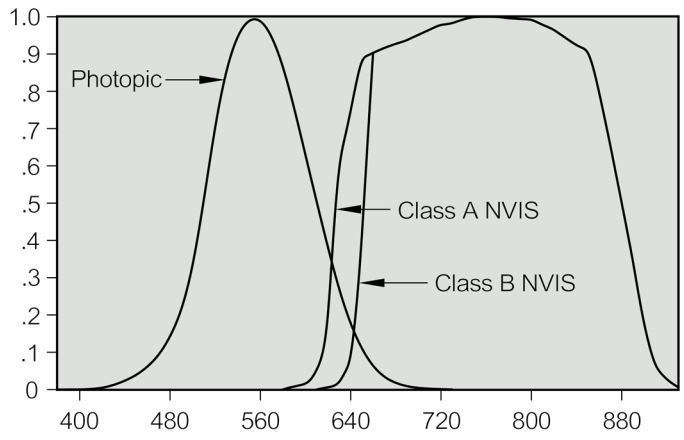
The most common voltages of VIVISUN caps are 28VDC and 5VDC, however VIVISUN offers additional cap voltages as decribed in Section 4.4.

4.1 Appendix A: NVIS Exhibit

NVIS Response Curves

There are two NVIS response curves. The Class A curve uses a 625 nm minus blue filter which does not allow any red cockpit lighting. The Class B curve uses a 665 nm minus blue filter which allows the use of properly designed NVIS red lighting. Figure 4.1.0-A shows the Class A and Class B relative response curves as compared to the photopic relative response curve.

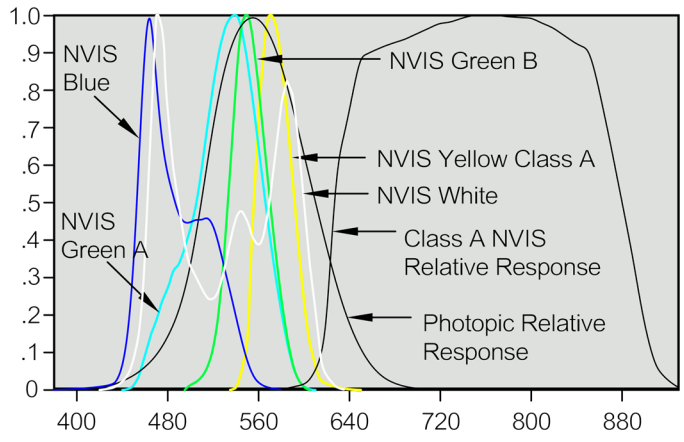
Figure 4.1.0-A Photopic, Class A NVIS and Class B NVIS Relative Response



Spectral Radiance, Type I Class A Colors

Figure 4.1.0-B shows the normalized spectral radiance curves for the Type I Class A colors of NVIS Blue, NVIS Green A, NVIS Green B, NVIS White and NVIS Yellow Class A. Also shown are the relative photopic response and the relative spectral response of the Class A NVIS. These are the only colors that are allowed in a Class A cockpit.

Figure 4.1.0-B Normalized Spectral Radiance for Type I Class A NVIS Colors

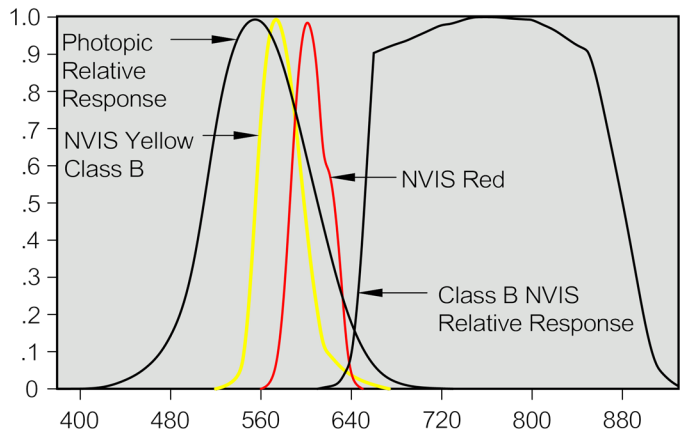


Spectral Radiance, Type I Class B Colors

Figure 4.1.0-C shows the normalized spectral radiance curves for the Type I Class B colors of NVIS Yellow Class B and NVIS Red, the relative photopic response and the spectral response of the Class B NVIS. The NVIS Red is allowed in a

Class B cockpit in addition to NVIS Blue, NVIS Green A, NVIS Green B, NVIS White and NVIS Yellow Class B.

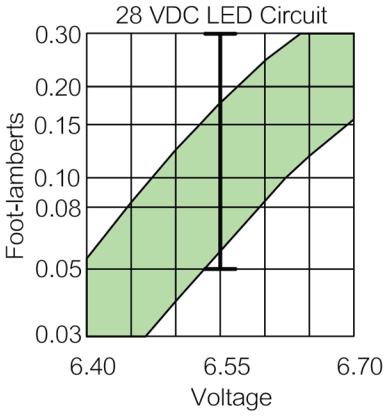
Figure 4.1.0-C Normalized Spectral Radiance for Type I Class B NVIS Colors



NVIS Dimming Compatible Dimming

The Type S NVIS Blue, NVIS Green A, NVIS Green B, NVIS White and NVIS Yellow colors can be dimmed to 0.1 footlamberts as required by MIL-L 85762A and MIL-STD 411F for NVIS compatible military aircrew stations. The average display luminance is 0.05 to 0.3 footlamberts at 6.55 VDC for the 28 VDC LED circuits as measured at 23° C.

Figure 4.1.0-D Typical NVIS Compatible Dimming Range at 23°C (Type S)



Minimum Luminance Current

The 28 VDC LED displays require approximately 1 milliamp of current per quadrant before producing a perceptible level of luminance so the LEDs will not light inadvertently due to microamp currents.

Emergency Power Operation

The Type S displays are easily readable in emergency power conditions of 18 VDC producing in excess of 50 footlamberts at 18 VDC.

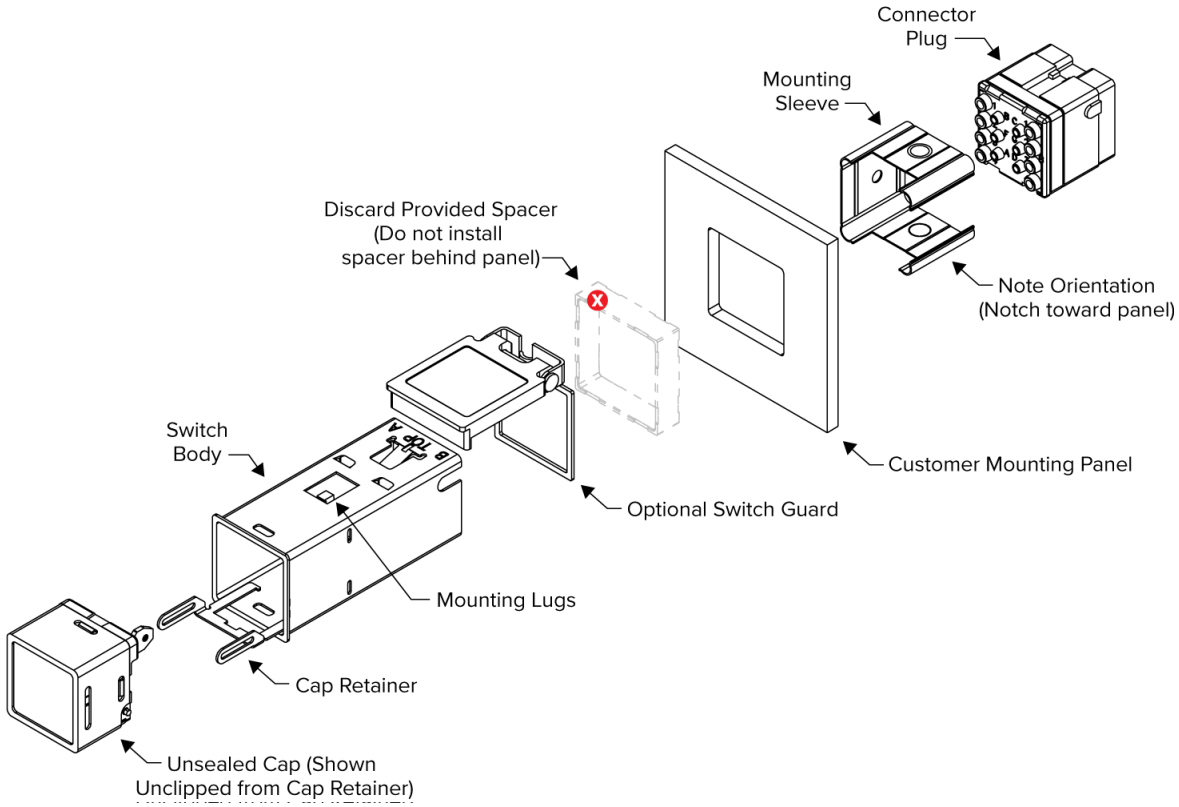
4.2 Appendix B: Installation Diagrams

Extended mount installations typically use the provided spacer to accommodate edge-lit panels.

Installation Guides			
Panel (*)	Enclosure	Appendix B	
Standard Square			
		Standard Mount	Extended Mount
Thin Panel	Unsealed	B-1	B-2
	Sealed	B-3	B-4
Thick Panel	Unsealed	B-5	N/A
	Sealed	B-6	N/A
Thin with Panel Adapter	Unsealed	B-7	N/A
	Sealed	B-8	N/A
Large Rectangular			
Thin Panel	Unsealed	B-9	B-10
	Sealed	B-11	B-12
Thick Panel	Unsealed	B-13	N/A
	Sealed	B-14	N/A
(*) Thin panels are .032 - .187" thick. Thick panels are from .187 - .300" thick.			

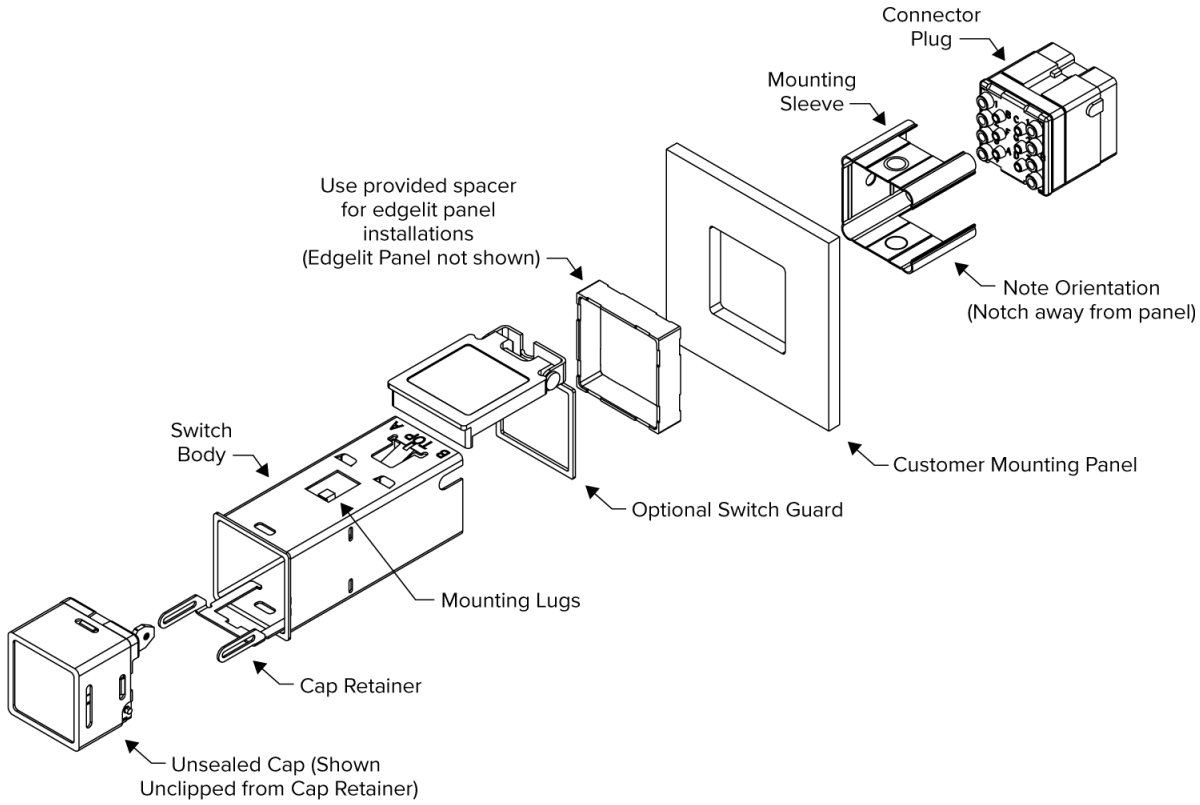
B-1

Standard Square	Thin Panel	Unsealed	Standard Mount



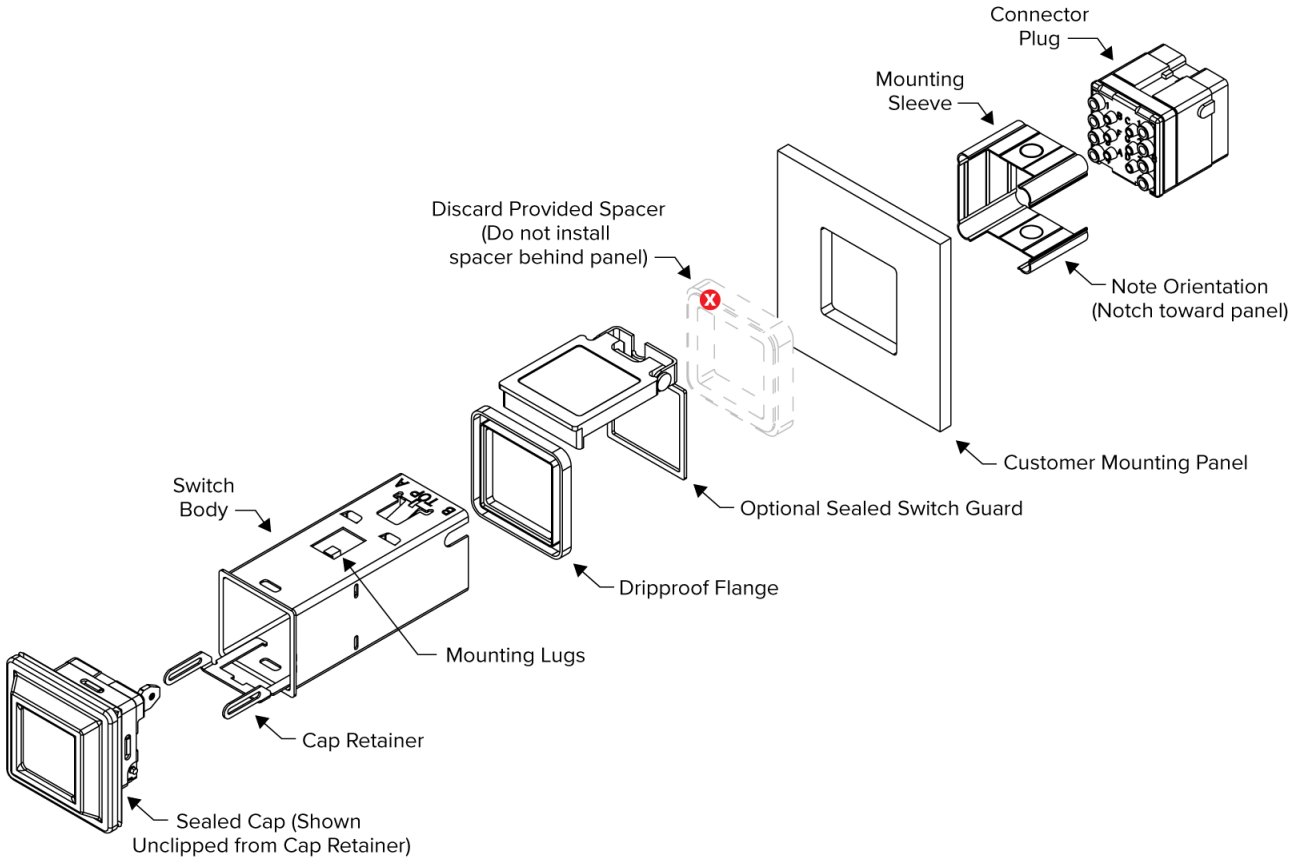
B-2

Standard Square	Thin Panel	Unsealed	Extended Mount



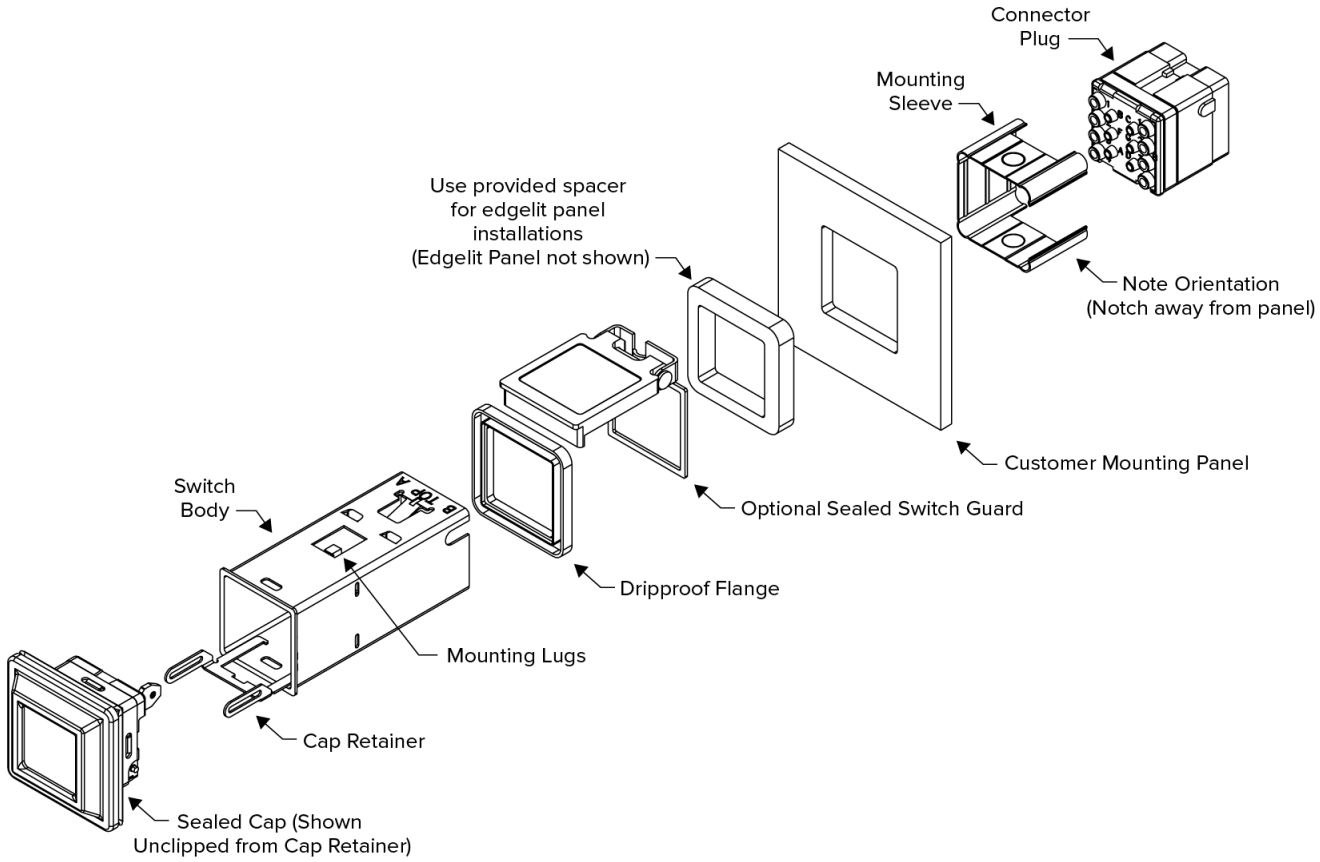
B-3

Standard Square	Thin Panel	Sealed	Standard Mount



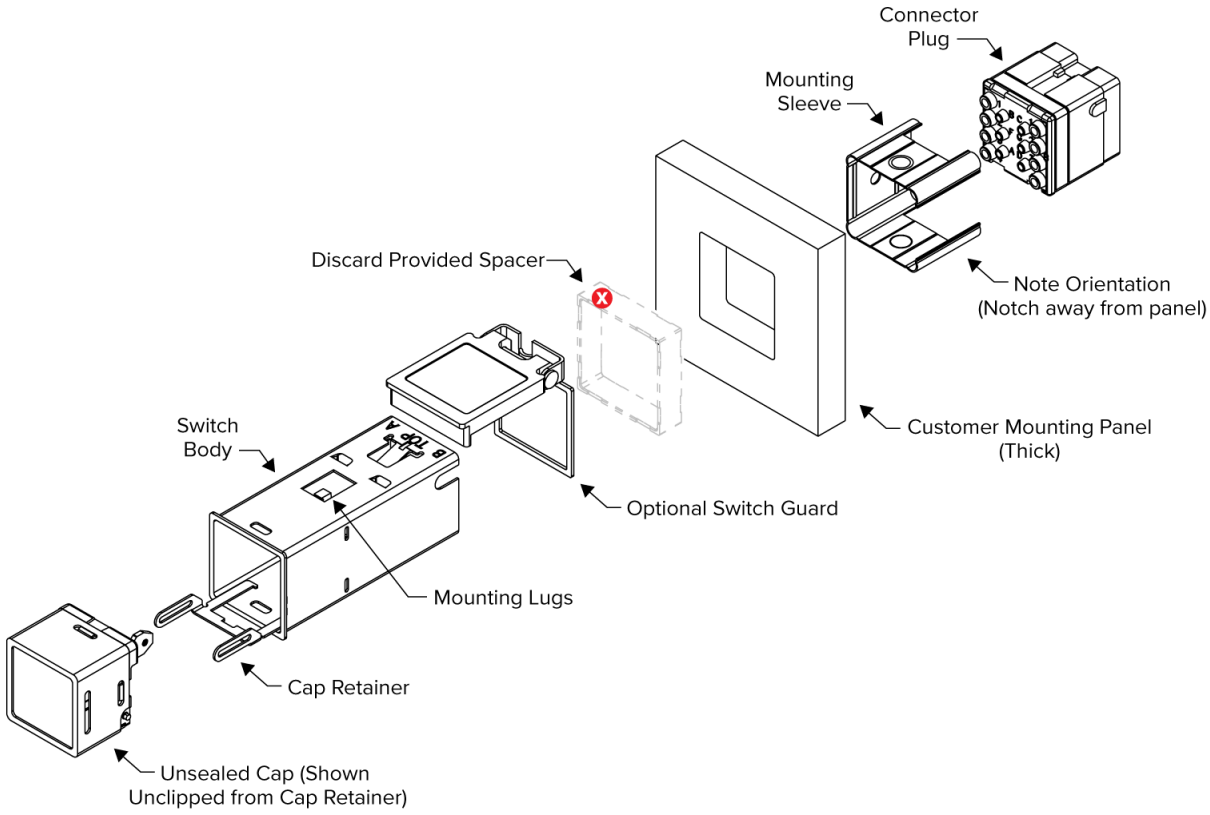
B-4

Standard Square	Thin Panel	Sealed	Extended Mount



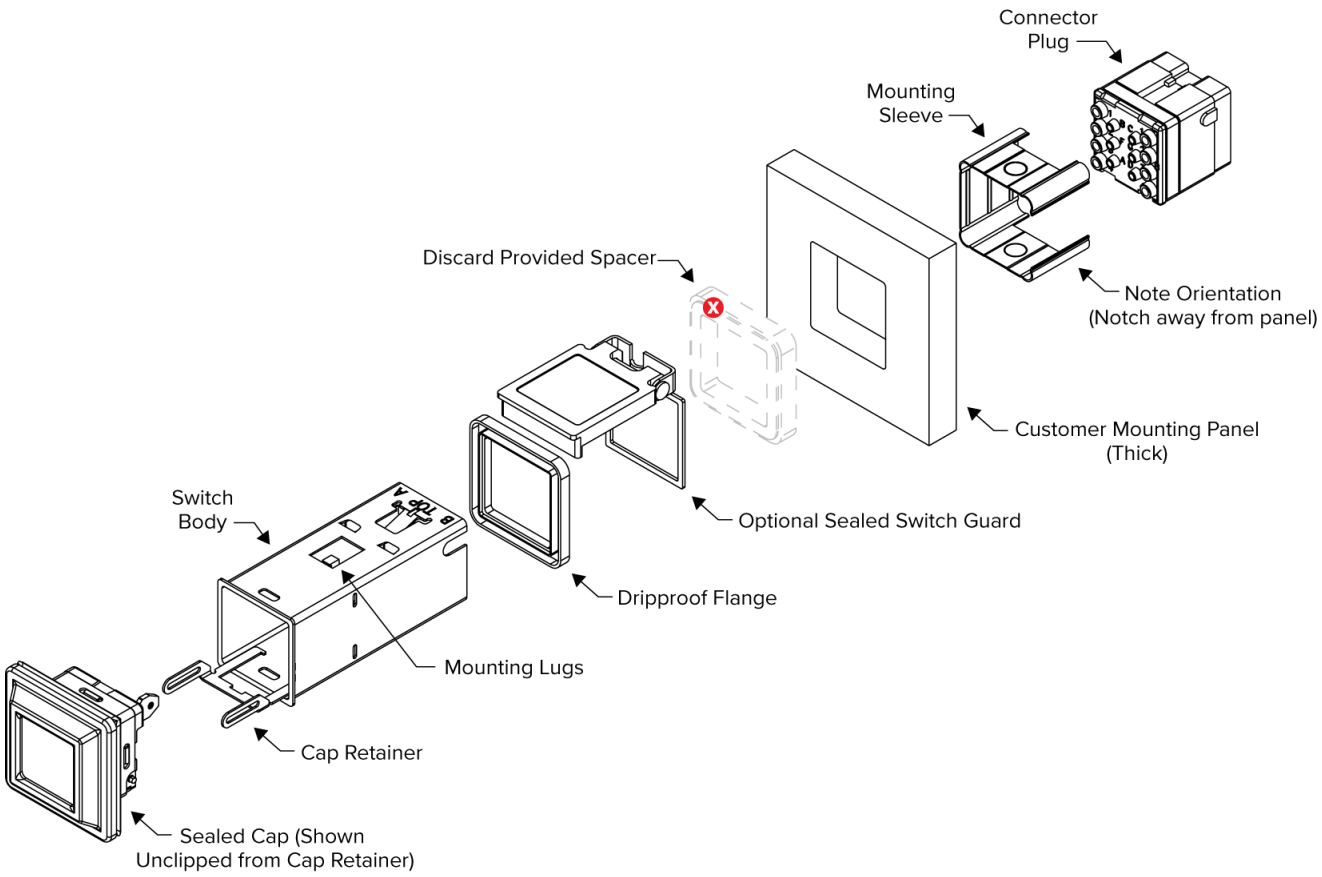
B-5

Standard Square	Thick Panel	Unsealed	Standard Mount



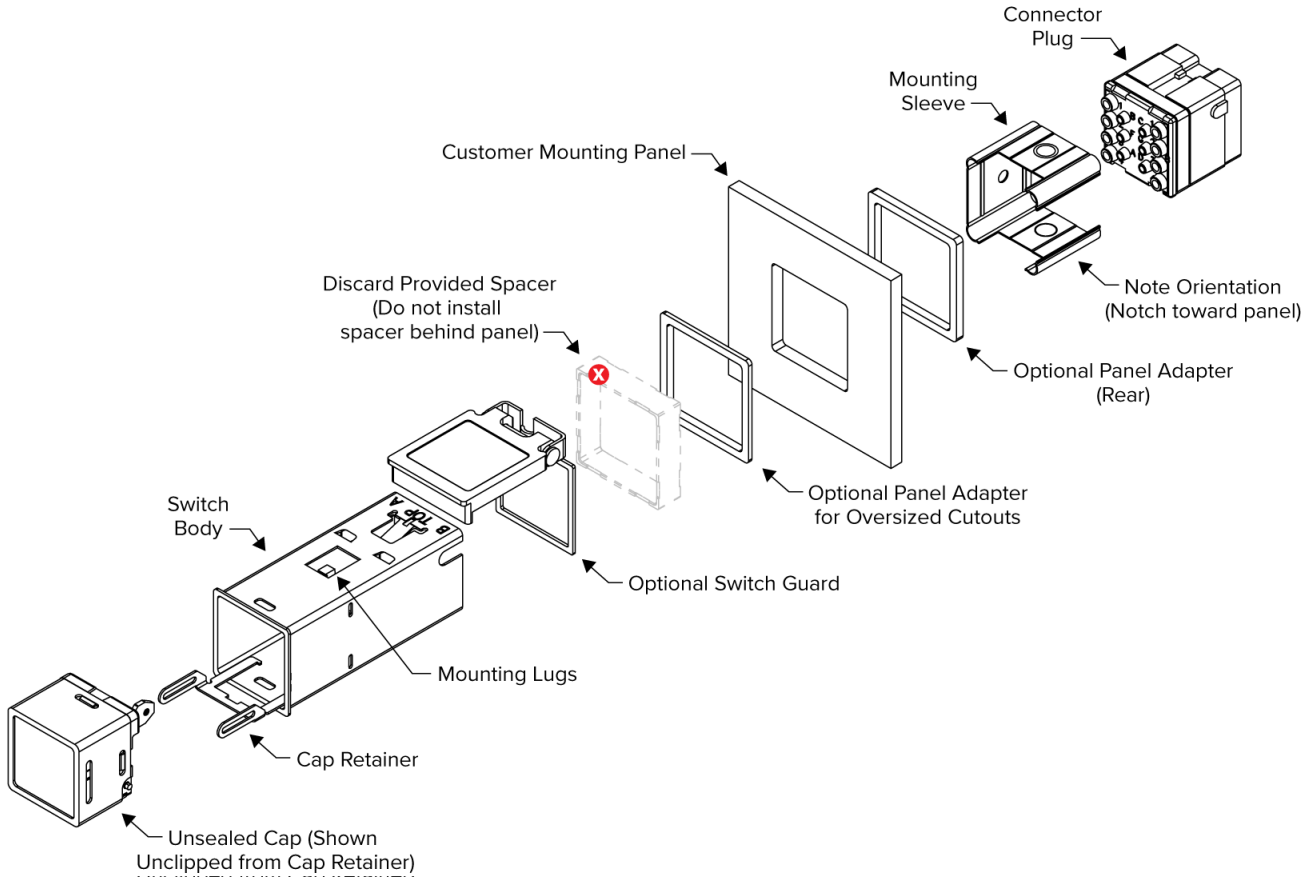
B-6

Standard Square	Thick Panel	Sealed	Standard Mount



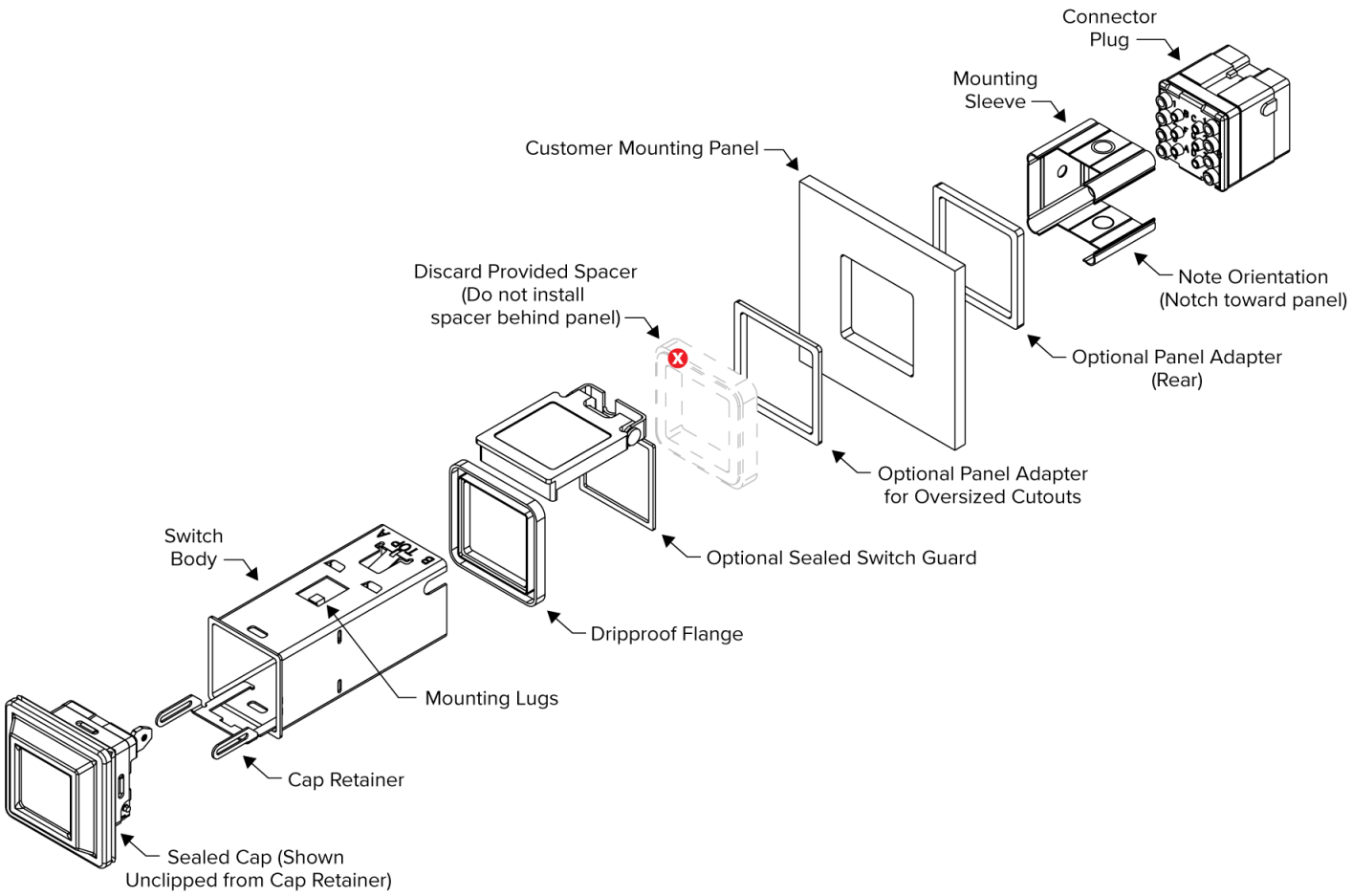
B-7

Standard Square	Thin Panel	Unsealed	Standard Mount	Adapter



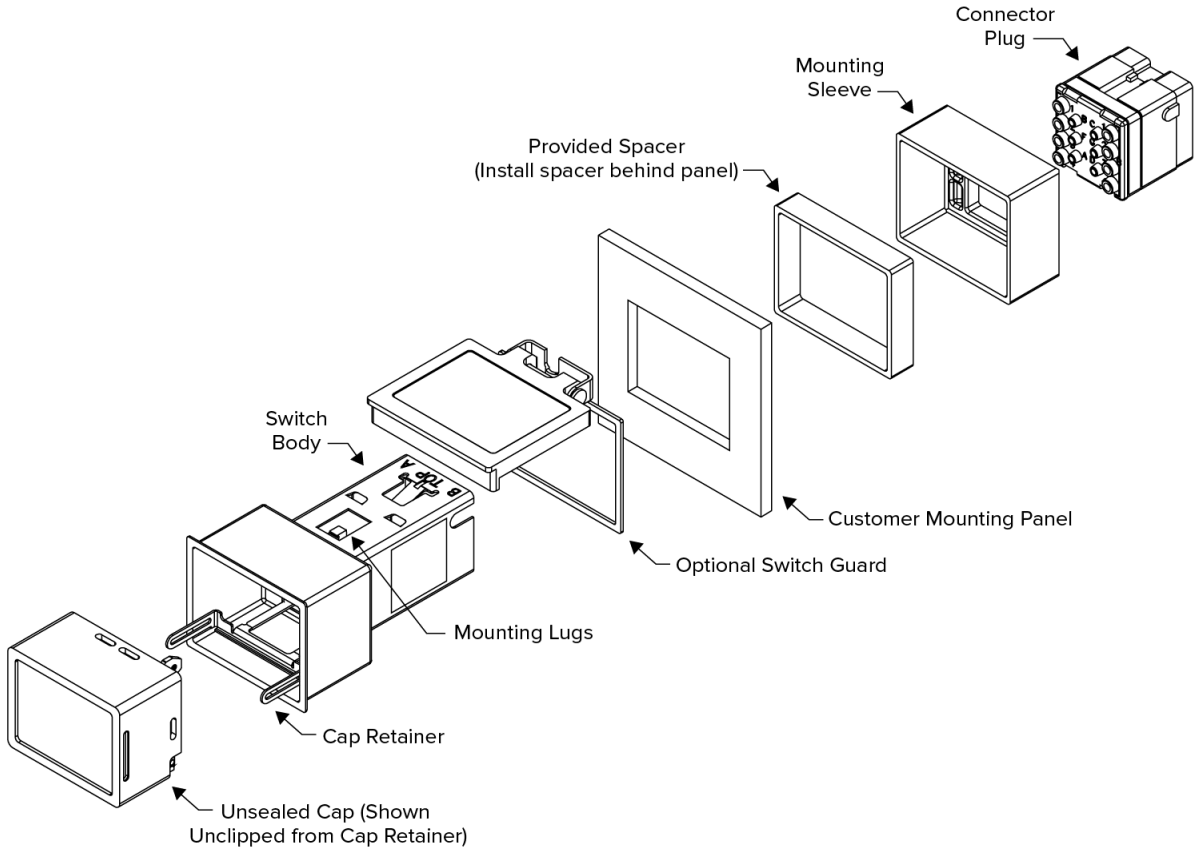
B-8

Standard Square	Thin Panel	Sealed	Standard Mount	Adapter



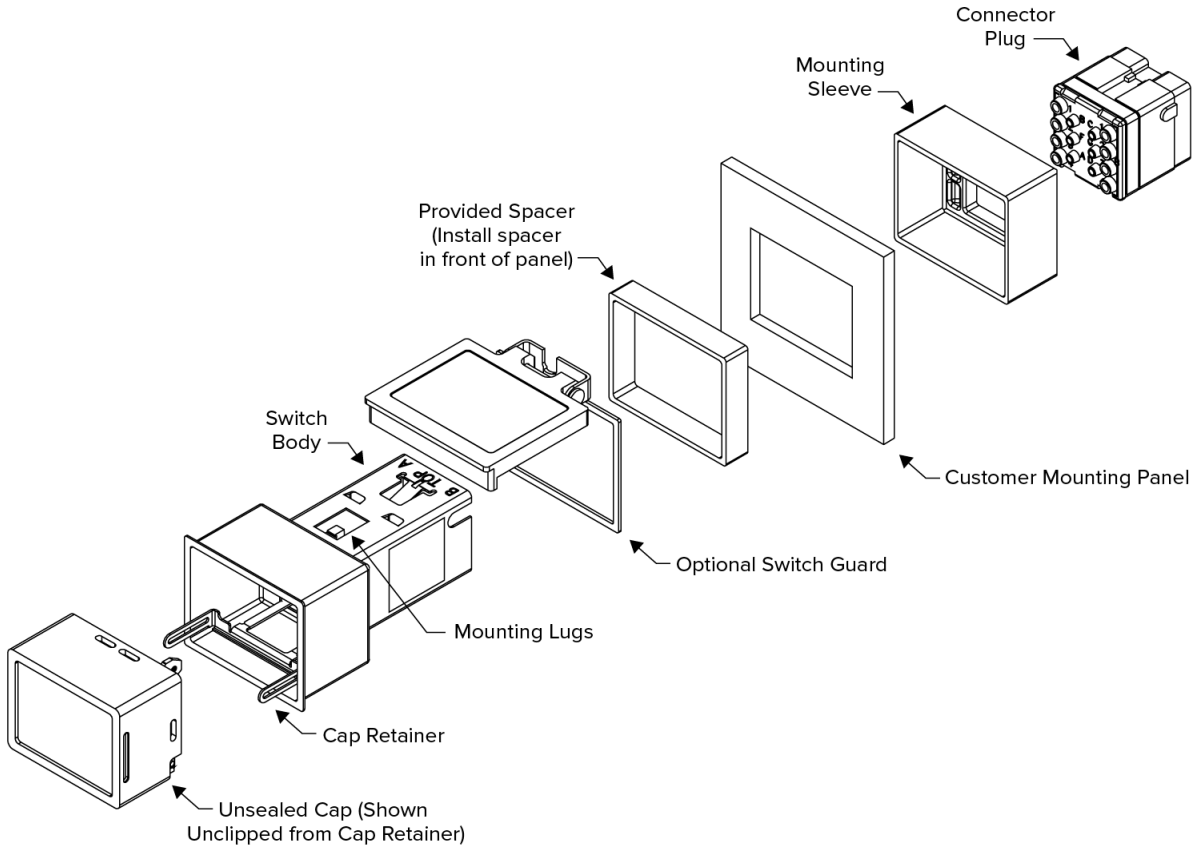
B-9

Large Rectangular	Thin Panel	Unsealed	Standard Mount



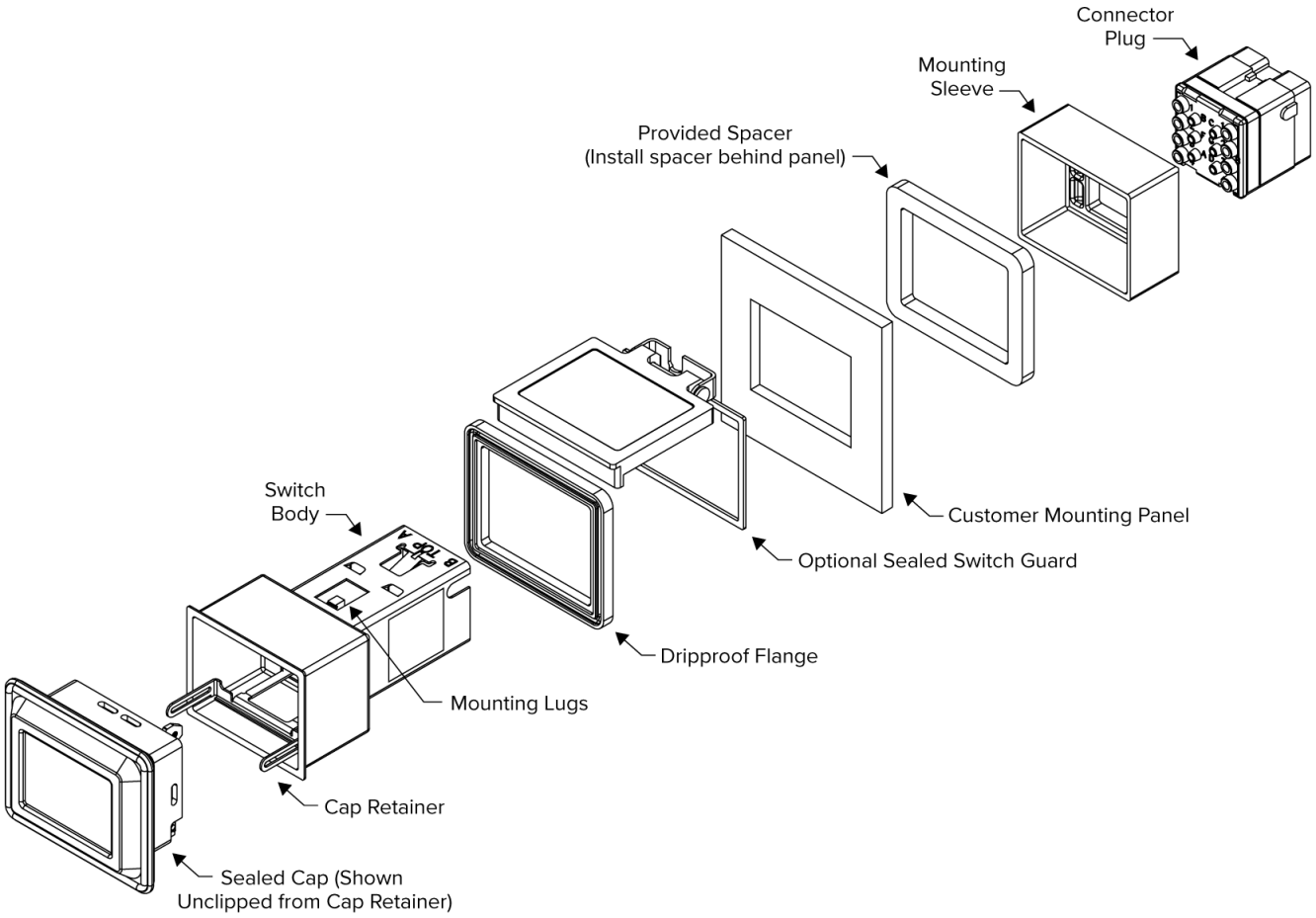
B-10

Large Rectangular	Thin Panel	Unsealed	Extended Mount



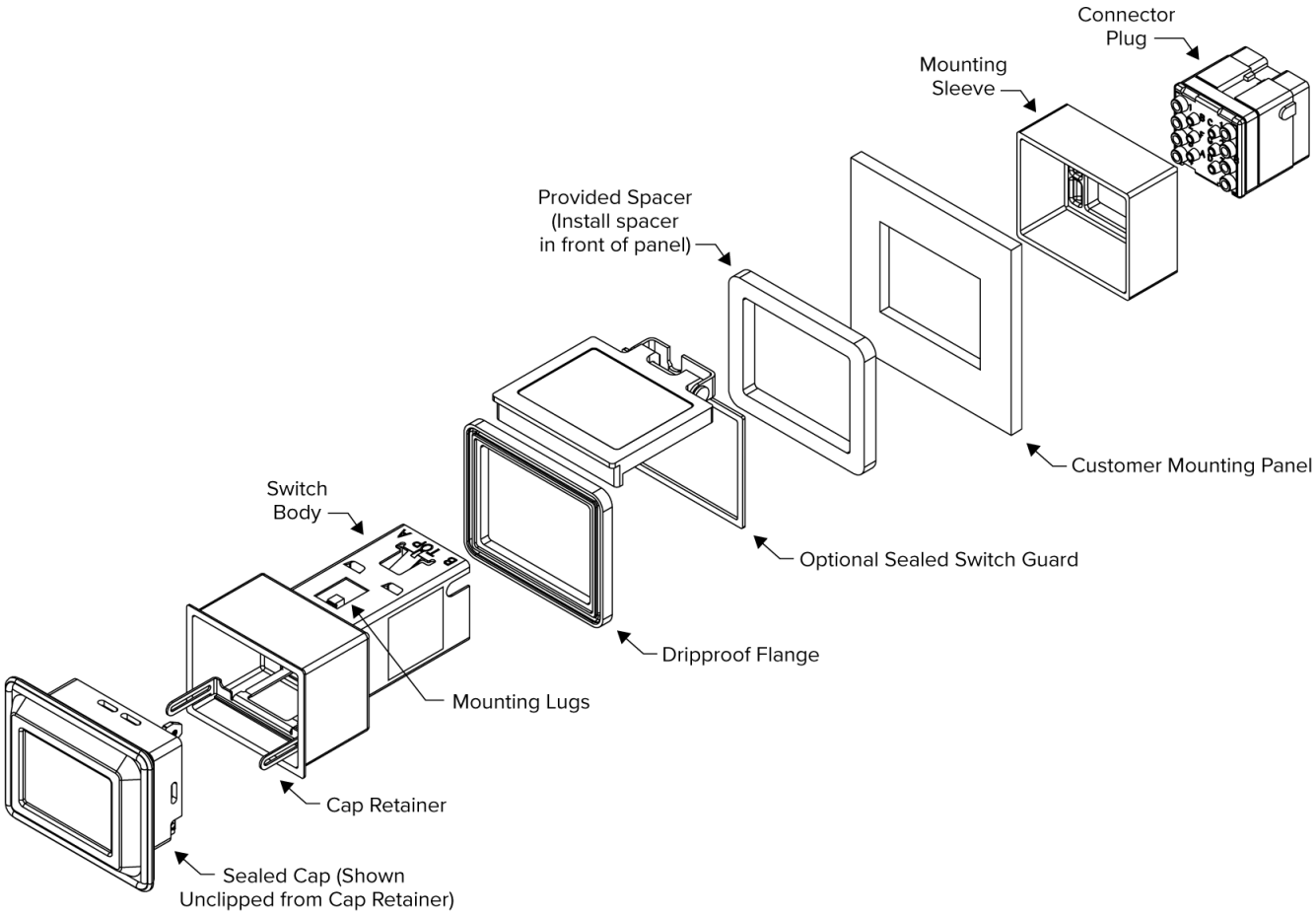
B-11

Large Rectangular	Thin Panel	Sealed	Standard Mount



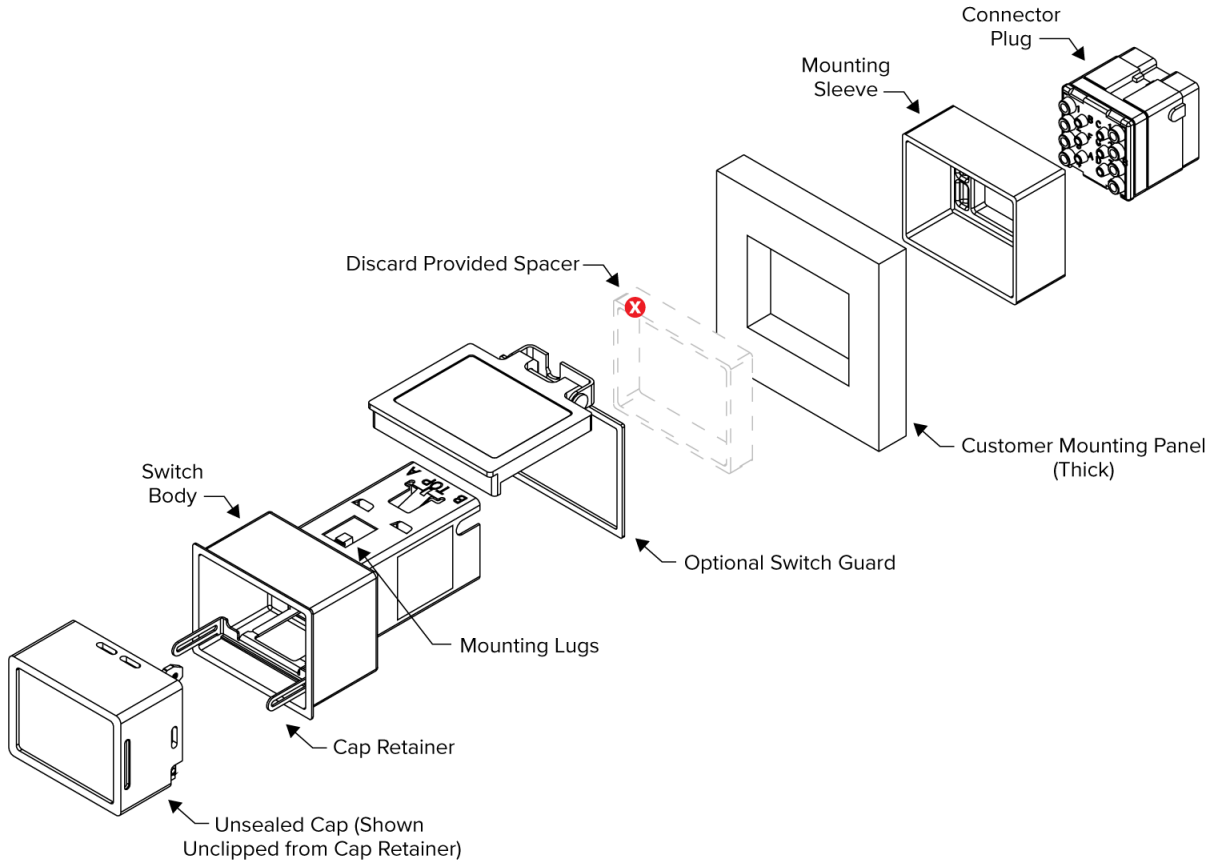
B-12

Large Rectangular	Thin Panel	Sealed	Extended Mount



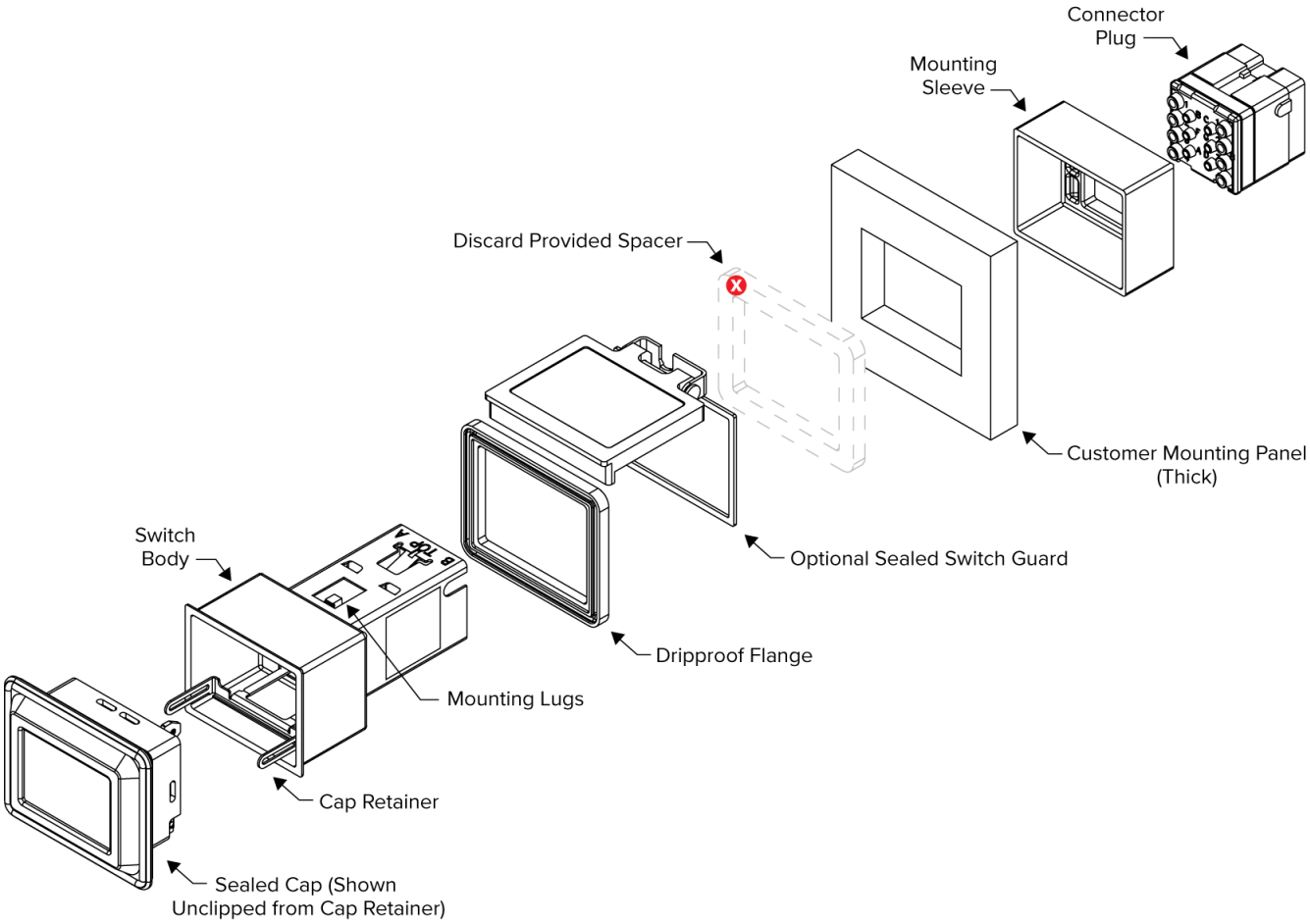
B-13

Large Rectangular	Thick Panel	Unsealed	Standard Mount



B-14

Large Rectangular	Thick Panel	Sealed	Standard Mount



4.3 Appendix C: Circuit Diagrams

Table C-1	Standard Square 28 Volt Dimming: Voltage	Blocking Diodes: No Press-To-Test: No

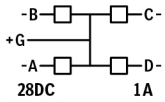
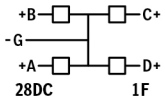
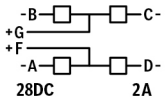
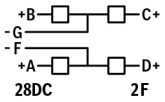
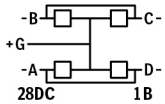
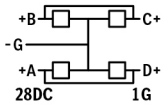
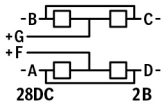
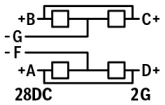
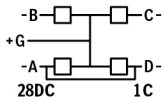
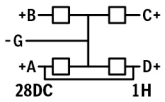
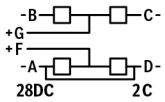
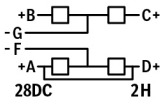
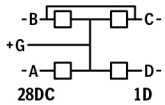
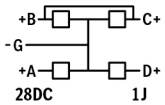
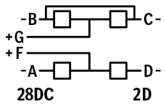
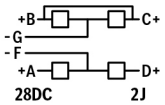
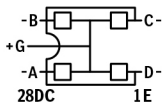
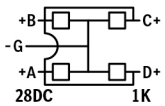
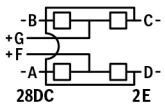
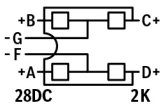
	Single Common		Split Common	
	Common Anode	Common Cathode	Common Anode	Common Cathode
Option A				
Option B				
Option C				
Option D				
Option E				

Table C-2	Standard Square 28 Volt Dimming: Voltage	Blocking Diodes: Yes Press-To-Test: No

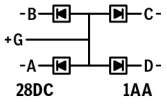
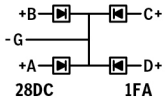
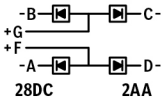
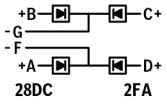
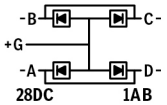
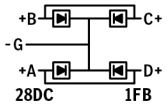
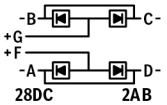
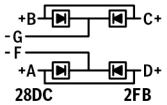
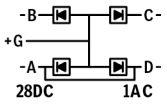
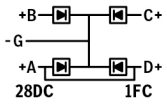
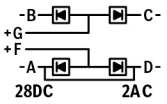
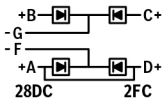
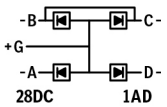
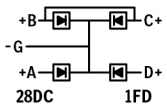
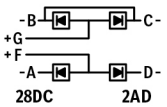
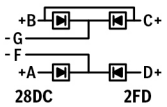
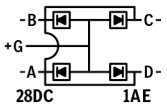
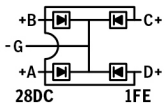
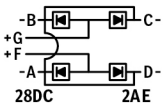
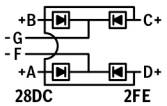
	Single Common		Split Common	
	Common Anode	Common Cathode	Common Anode	Common Cathode
Option A				
Option B				
Option C				
Option D				
Option E				

Table C-3	Standard Square 28 Volt Dimming: Voltage	Blocking Diodes: Yes Press-To-Test: Yes

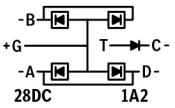
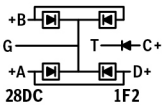
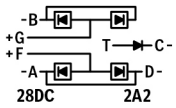
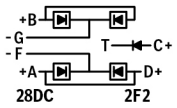
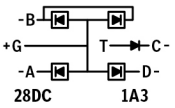
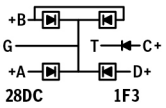
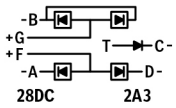
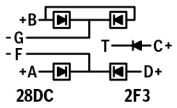
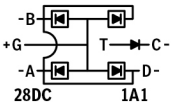
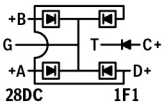
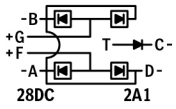
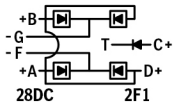
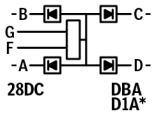
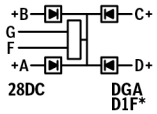
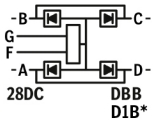
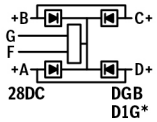
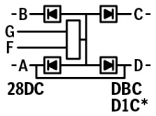
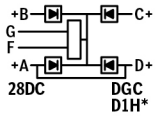
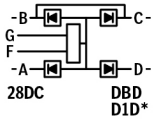
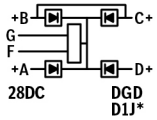
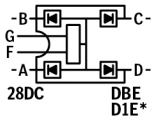
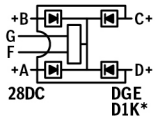
	Single Common		Split Common	
	Common Anode	Common Cathode	Common Anode	Common Cathode
Option B				
Option D				
Option E				

Table C-4	Standard Square 28 Volt Dimming: Discrete (PG)	Blocking Diodes: Yes Press-To-Test: No

	PG Discrete Dimming - Single Common - without Press-To-Test	
	Common Anode	Common Cathode
Option A		
Option B		
Option C		
Option D		
Option E		

*Alternate Identification for Schematic Shown

Table C-5	Standard Square 28 Volt Dimming: Discrete (PG)	Blocking Diodes: Yes Press-To-Test: Yes

PG Discrete Dimming - Single Common - with Press-To-Test

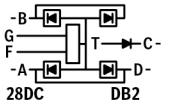
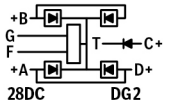
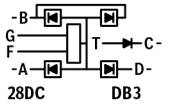
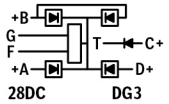
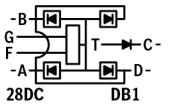
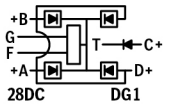
	Common Anode	Common Cathode
Option B		
Option D		
Option E		

Table C-6	Standard Square 5 Volt Dimming: Discrete: No	Blocking Diodes: No Press-To-Test: No

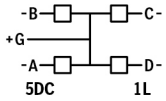
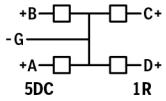
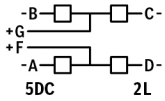
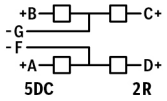
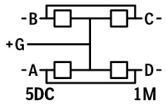
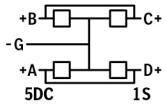
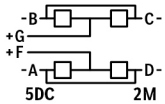
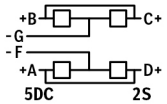
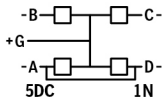
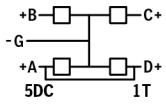
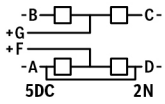
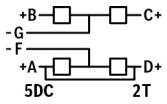
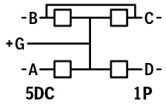
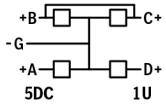
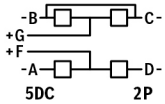
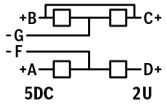
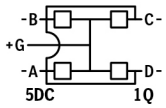
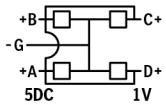
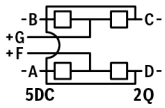
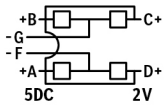
	Single Common		Split Common	
	Common Anode	Common Cathode	Common Anode	Common Cathode
Option A				
Option B				
Option C				
Option D				
Option E				

Table C-7	Large Rectangle 28 Volt Dimming: Voltage	Blocking Diodes: No Press-To-Test: No

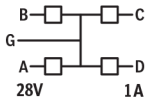
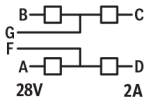
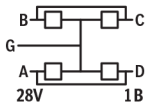
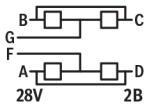
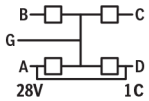
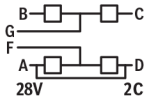
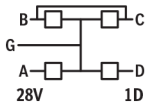
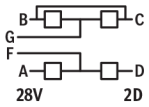
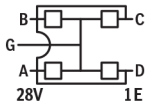
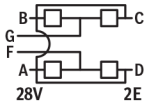
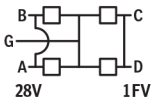
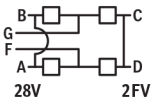
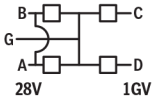
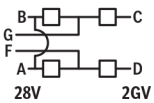
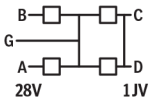
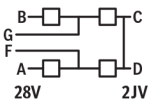
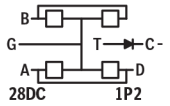
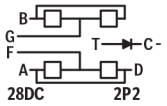
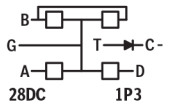
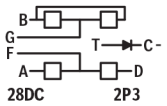
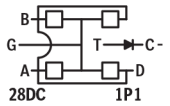
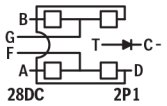
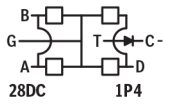
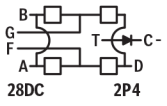
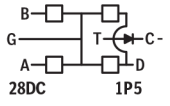
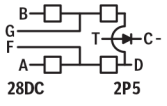
	Polarity Insensitive	
	Single Common	Split Common
Option A		
Option B		
Option C		
Option D		
Option E		
Option F		
Option G		
Option J		

Table C-8	Large Rectangle 28 Volt Dimming: Voltage	Blocking Diodes: No Press-To-Test: Yes

	Polarity Insensitive	
	Single Common	Split Common
Option B		
Option D		
Option E		
Option F		
Option J		

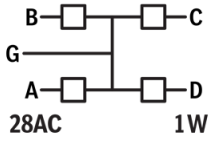
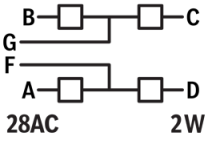
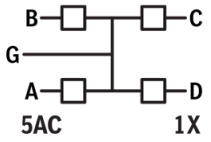
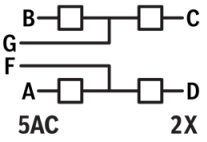
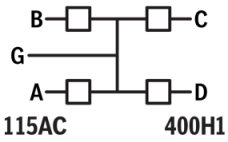
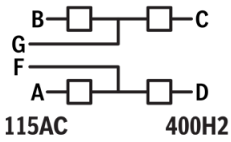
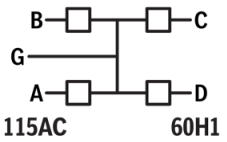
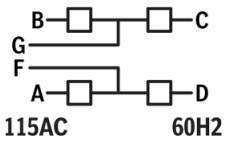
4.4 Appendix D: Other Cap Voltages

The following cap voltages are available in a Standard Square cap but are not covered by MIL-PRF-22885. These caps are not available in Large Rectangular caps.

Standard Square caps with these voltages are available in all Display Styles (see Figure 1.2.1-A), Lighting Types (see Section 1.2.2), Fonts (see Section 1.2.3) and Colors (see Section 1.3). Only Option A from Figure 1.5.4-A (Segment Interconnect Options) is available with these voltages.

Luminance is controlled by variable voltage control. Discrete Dimming, Press-to-Test, and Blocking Diodes options are not available with cap voltages listed in Appendix D.

Figure 4.4.0-A Other Cap Voltage Characteristics

Voltage	Cap Schematic		Luminance Levels
	Single Common	Split Common	
28 VAC			similar to Figure 1.4.1-C
5 VAC			similar to Figure 1.4.1-D
115 VAC, 400 Hz			similar to Minimum/Typical shown in Figure 1.4.1-C at 28VDC
115 VAC, 60 Hz			similar to Minimum/Typical shown in Figure 1.4.1-C at 28VDC

Caps with the voltages above meet all of the environmental qualifications shown in Section 3.1.1 with the following exceptions.

Figure 4.4.0-B Environmental Qualifications

Test Description	Specification	Section	Category	Reference Levels
Power Input Aircraft Power (AC)	RTCA/DO-160 (400 Hz Parts)	16.5.1	A(CF)	115 VAC 400 Hz
		16.5.2	A(CF)	115 VAC 400 Hz
	MIL-HDBK-704-B (60 Hz Parts)	LDC 101, 102, 104-110, 201, 301, 302, 304, 401, 601, 603		5 VAC, 28 VAC, 115 VAC 60 Hz