

Pilot and Signaling Devices

Heavy-Duty 22.5 mm Watertight/Oiltight Push Buttons

C-2000

Section 9

Technical Data

600 VAC Max., 300 VDC Max.

10 Amps Continuous AC, 2.5 Amps Continuous DC

General Specifications

Conformity to standards	UL508 (USA) NEMA ICS-2 (USA) VDE 0660 (Germany) BSI (Great Britain) CEI EN60947.5. 1 (Italy) CENELEC EN 5000 7 (Europe)	CSA C22.2 No. 14-M91 (Canada) IEC 947.5. 1 (International) UTE (France) NFC 63140 (France) JIS (Japan)	
Approvals	UL listed —File Number E66677 CSA Certified —File Number 16661-63 Manufacturing facility is registered to ISO 9000	CE	
Finger protection at terminals	IP2X according to IEC 529 Terminal identification per CENELEC EN 50013		
Enclosure ratings	Suitable for use in NEMA Types 1, 3, 3R, 3S, 4, 4X, 12, and 13 enclosures. (Multi-function push buttons are suitable for NEMA Type 1 enclosures only unless used with protective rubber cap accessory.) IP66 per IEC 529, when mounted in enclosures with equal or superior seal.		
Ambient temperature	<u>Operating</u> -13° to + 158°F -25° to + 70°C	<u>Storage</u> -40° to + 158°F -40° to + 70°C	
Climate suitability/humidity	<u>Climate Type</u> Temperature Wet Hot Wet Variable Wet	<u>Temperature</u> 74°F (23°C) 74°F (23°C) 104°F (40°C) 74° to 104°F (23° to 40°C)	<u>Relative Humidity</u> 50% 83% 92% 83% to 92%
Resistance to vibration	Per IEC 68-2-6 . 16g with a frequency from 40-500 Hz and maximum peak-to-peak amplitude of 0.75mm.		
Resistance to shock	According to MIL 202B, method 202A . Test was performed for 1/2 sinusoid for 11ms, 38g max for all operators with transformers and 100g for all other operators.		
Operating force	Standard push button operator: 2.5 lbs. (11N) Each contact block: 1.3 lbs. (6N) Selector switch operator: 2.4 in.-lb. (0.27 N-m)		

Wire Terminals

Wire capacity and terminal torque requirements (for all power supplies and contact blocks)	Suitable for #22-#12 AWG stranded or solid copper wires, single or parallel conductors of same size. Terminal torque: 7-12 in./lb. Parallel conductor size combinations (stranded or solid wire):	
	Parallel Conductor Size Combinations (Stranded or Solid Wire)	
	Terminal Torque	
	#12 with #14 #14 with #16 #16 with #18 #16 with #20 #16 with #22 #18 with #22 #18 with #20 #20 with #22	12 in.-lb. 12 in.-lb. 12 in.-lb. 12 in.-lb. 12 in.-lb. 10-12 in.-lb. 10-12 in.-lb. 7-12 in.-lb.
Quick connect terminals	Suitable for one female tab connector measuring 0.25 x 0.03 inches (6.35 x 0.8 mm) or two female tab connectors measuring 0.11 x 0.03 inches (2.8 x 0.8 mm).	

Contact Data

Electrical reliability data	Electrical life and reliability in low level current: 80 million operations at 12V, 5mA, resistive load. (32 contacts tested successfully for 2.5 million operations.)								
Dust resistance	In extremely dusty environments, electrical life at low level current is 250,000 operations at 12 V, 5mA, resistive load. In a clean environment, electrical life at low level current is 10 million operations at 12 V, 5mA, resistive load.								
Thermal current	I _{th} = 10A per IEC 947-5-1								
Insulation voltage	U _i = 660 Volts ac/dc (opposite polarity) except 2NO and 2NC blocks 300 Vac/dc								
Protection from electrical shock	Class I per IEC 536 for metal operators Class II (double insulation) per IEC 536 for plastic operators								
Insulation category	Group "C" per VDE 0110								
Dielectric strength	2500 Volts								
Short circuit protection	10A type gG fuse, per IEC 269.1 & 269.3								
Pilot duty ratings	A600 (maximum make volt-amperes = 7200; maximum break volt-amperes = 720; PF = .25)								
	Volts (V)	12	24	48	60	120	240	480	600
	Continuous (A)	10	10	10	10	10	10	10	10
	Making (A)	60	60	60	60	60	30	15	12
	Breaking (A)	10	10	10	10	6	3	1.5	1.2
	Q300 (maximum make or break volt-amperes = 69)								
	Volts (V)	12	24	48	60	125	250	300	
	Continuous (A)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Making (A)	2.5	2.5	1.4	1.1	0.55	0.27	0.23	
	Breaking (A)	2.5	2.5	1.4	1.1	0.55	0.27	0.23	



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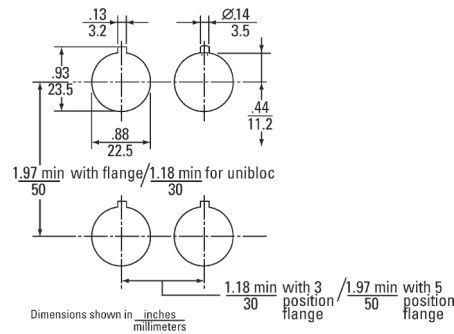
Contact Data

IEC utilization categories	AC15 Control of AC Electromagnetic Loads									
	Rated operational voltage and current									
	Ue (V)	12	24	48	60	110	220	380	500	600
	Ie (A)	10	10	10	10	6	3	2	1.5	1.2
	DC13 Control of DC Electromagnets									
	Rated operational voltage and current									
	Ue (V)	12	24	48	60	110	220	300		
	Ie (A)	2.5	2.5	1.4	1.0	0.55	0.27	0.2		
Contact characteristics	NC: slow make, double break (positive opening) NO: slow make, double break Self-cleaning (wiping action) contact Double-bridge contacts with four points of contact									
Contact resistance	≤25mOhm per IEC 255.7 category 3 @ 24V, 1 amp									
Contact fidelity	Minimum current: 5mA Minimum voltage: 12 Vac/dc, maximum resistance—2 ohms									
Logic reed contact data	NC: Single break NO: Single break 120 Vac maximum, 0.15A maximum, 8VA maximum 30 Vdc maximum, .15A maximum, 4.5W maximum									

Mounting

Acceptable panel thickness	.040-.236 inches (1-6mm)
Operator locking ring torque	26 in./lb. (3 N-m)
Force required to forcibly remove contact blocks and flange	Contact block or power supply from flange: 27 lbs. (118 N) 3- or 5-block flange from metal operator: 88 lbs. (392 N) 3- or 5-block flange from plastic operator: 66 lbs. (294 N)

Mounting Dimensions



Mechanical Life Ratings for Operators

Operators	Number of Operations
Standard push buttons	3,000,000
Illuminated push buttons	1,000,000—3,000,000 ¹
Momentary mushroom-head push buttons	3,000,000
Maintained mushroom-head push buttons	500,000
Push-to-latch, turn-to-release mushroom-head push buttons	300,000
3-position mushroom-head push buttons	300,000
Nonilluminated selector switches	1,000,000
Illuminated selector switches	500,000
Joysticks	500,000
Toggle switches	500,000
Wobble sticks	1,000,000
Key-operated push buttons	500,000
Selector push buttons	1,000,000

¹Number of operations dependent on the operating duration of the lamp. If the lamp is left on for long periods of time, its heat can reduce mechanical life. All illuminated push buttons meet at least 1,000,000 operations.



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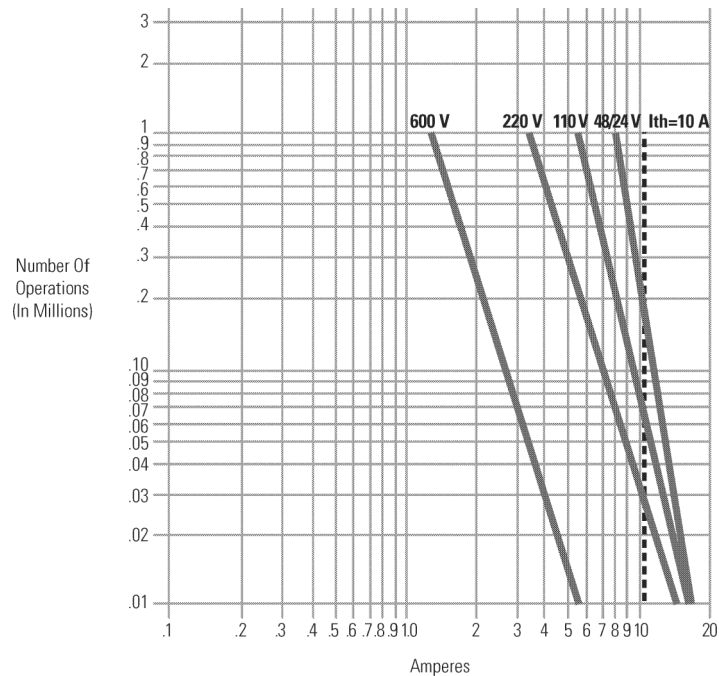
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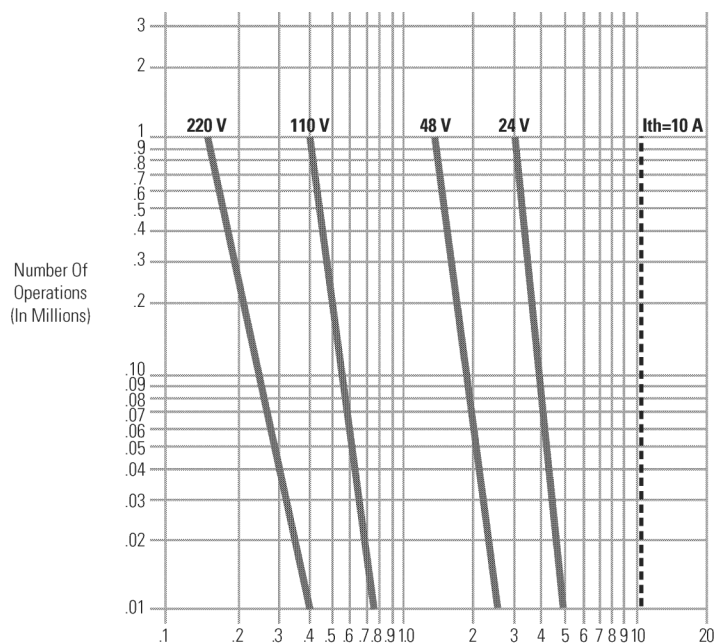
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Electrical Life Ratings for Contacts



Electrical Life—50/60 Hz alternating current (inductive)
per utilization category AC15



Electrical Life—direct current (inductive)
per utilization category DC13



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Materials

Component	Material
Cap/levers/knobs (nonilluminated)	Polyamide/acetal
Cap/levers/knobs (illuminated)	Polycarbonate
Metal housing	Copper-nickel-chrome plated zinc/aluminum alloy
Plastic housing	Polyamide/acetal
Plunger	Polyester
Springs	Stainless steel
Body-to-panel gasket	Polyester elastomer
Cap-to-body gasket	Vinyl nitrile rubber
Lubricant	Lithium grease
Cams for nonilluminated selector switches	Polyamide/acetal
Cams for illuminated selector switches	Polyester
Cam followers	Polyamide/acetal
Contact block and power supply housings	Polyamide/acetal
Contacts	Pure silver
Conductors	Brass alloy
Flanges	Polyamide/acetal
Flange latches	Polyamide/acetal
Printed circuit board adapter	Polyamide/acetal
Joystick protective housing	Vinyl nitrile rubber
Joystick plunger, lever & cam	Acetal resin
Joystick actuator	Polyamide/acetal
Push-to-latch, turn-to-release actuator & plunger	Polyamide/acetal
Wobble stick	Polycarbonate
Toggle switch lever	Polyamide/acetal
Protective caps (clear)	Silicon rubber
Protective caps (colored)	Vinyl nitrile rubber
Push button protective guards	Polycarbonate
Mushroom-head guards	Polyamide/acetal
Padlockable cover	Polycarbonate and zinc-plated zinc/aluminum alloy
Metal locking rings	Zinc-plated zinc/aluminum alloy
Keys	Plated brass
Nameplate holders	Polyamide/acetal
Nameplate inserts	Laminated polyester
Hole plug	Polyamide/acetal

Power Supply Selection

Type	Principle of Operation	Benefit
Full voltage	Supplies input voltage directly to bulb.	Smallest and least expensive. Can be used with LEDs.
Transformer	Utilizes a transformer to step the input voltage down to 6 volts.	Transformer has the effect of damping the inrush current and voltage spikes from the switching device seen when the light is turned on, actually protecting the bulb from these factors that shorten life. Generates less heat than the resistor power supplies. Reduces unsafe supply voltages (up to 600 V) down to a safe level for lamp servicing. Can be used with LEDs. Able to withstand a short circuit of the lamp or lamp socket without damage.
Normal resistor	Utilizes a resistor in series with the incandescent lamp to drop the lamp voltage to 50% of the input voltage.	Least expensive way to reduce unsafe supply voltages (up to 240 V) down to a safe level for lamp servicing.
Diode resistor	Utilizes a resistor and a diode in series with the lamp to rectify and drop a 240 Vac input voltage to operate a 130 V incandescent lamp.	Provides the same function as the normal resistor, but takes up only one position in the flange rather than two. Generates less heat than the normal resistor power supplies.
Long-life resistor	Utilizes a resistor in series with the 130 V incandescent lamp to provide a lamp voltage 80% that of the input voltage.	Extends life of a 130 V incandescent bulb by 1300% (from 2000 to 28,000 hours).
Flashing (full-voltage or transformer)	Utilizes a flashing circuit which can be enabled or disabled by externally switching (shorting) two connections.	Allows the lamp to be switched between OFF, ON, and FLASHING modes.
Panel test (full-voltage or standard resistor)	Utilizes a diode to isolate the lamp test circuit from the supply circuit.	Allows use of indicating lights and "panel test" feature rather than individual push-to-test illuminated push buttons. Eliminates the need for the NO/NC contacts used on conventional push-to-test pilot lights.



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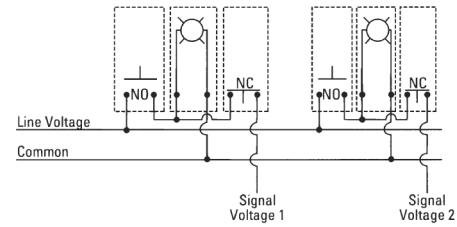
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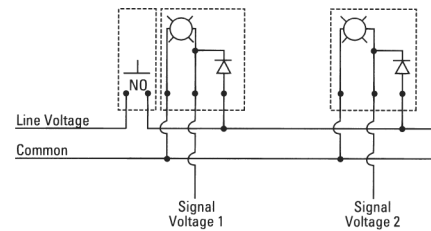
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Maximum Panel Test Power Supplies Per Contact Block

Supply Voltage	AC	DC
6	15	15
12	30	30
24	60	60
48	120	66
60	150	66
130	300	72



Push-to-Test Indicating Lights



Panel Test Power Supplies

Maximum Number of Contacts¹

Operator Type	Power Supply Type	Standard 3-Block Flange	Optional 5-Block Flange
Push button Mushroom-head push button Wobble stick	—	4	8
Nonilluminated selector switch Key selector switch	—	4	8
Illuminated push button Illuminated mushroom-head push button	Full-voltage, diode & resistor, long-life resistor	4	8
Illuminated push button Illuminated mushroom-head push button	Standard resistor, panel test, standard transformer	2	6
Illuminated push button Illuminated mushroom-head push button	All flashing/continuous	0	4
Illuminated selector switch	Full voltage, diode & resistor, long-life resistor	4	4
Illuminated selector switch	Standard resistor, panel test, standard transformer	2	4
Illuminated selector switch	All flashing/continuous	0	4
Push-pull mushroom-head push button	—	2	—
Push twist-to-reset mushroom-head (standard) Push key-to-reset mushroom-head (standard)	—	2	—
Push twist-to-reset mushroom-head—direct snap action Push key-to-reset mushroom-head—direct snap action	—	4 ²	—
Illuminated push-pull mushroom-head push button	Full voltage, diode & resistor, long-life resistor	2	—
Illuminated push-pull mushroom-head push button	Standard resistor, panel test, standard transformer	2	—
Illuminated push-pull mushroom-head push button	All flashing/continuous	0	—
Joystick Key-operated push button Selector push button	—	4	8
Toggle switch	—	4	4
Multi-function push button (for each button)	—	2 + 2	4 + 4
Illuminated multi-function push button (for each button)	Full-voltage, diode & resistor, long-life resistor	2 + 2	4 + 4
Illuminated multi-function push button (for each button)	Standard resistor, panel test, standard transformer	0 + 2	2 + 4
Illuminated multi-function push button (for each button)	All flashing/continuous	0 + 0	2 + 2
All operator types when used in plastic enclosures	—	2	—

¹ In some cases, the maximum number of contacts shown is less than the available number of flange positions. This is because, in these instances, contact block force would affect operation of the device or reduce operator life below values cited elsewhere. For specific application assistance, contact your nearest GE Representative.

² Early versions with white rear plunger suitable for a maximum of two single contacts.



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Lamp Selection

Incandescent, neon, and light-emitting diode (LED) lamps are available for use in indicating lights, illuminated push buttons and illuminated selector switches. Although incandescent lamps have traditionally been the most frequently used, it is wise to review the characteristics of the different types of lamps and select the one that is most appropriate for the application. Although the incandescent lamp offers the lowest initial cost, the LED is usually the most economical over the long term, due to its long life, resistance to shock and vibration, and lower power consumption.

Benefits of LEDs include:

—**Resistance to shock and vibration**—Since LEDs are solid-state, they are completely impervious to the problems associated with shock and vibration that can significantly reduce the life of incandescent lamps by mechanically breaking the filament. The high inrush currents at startup associated with incandescent lamps also act to significantly reduce the life of lamps used in frequent on-off applications.

—**Longer life**—The LEDs used with C-2000 push buttons have a service life of 100,000 hours (11 years) compared to 20,000 hours (28 months) for the neon lamps, and 2,000 hours (3 months) for the standard incandescent lamps.

—**Reduced power consumption**—The LEDs used for the C-2000 push buttons consume between 10% and 52% less power than the equivalent BA9S incandescent lamp. The table below shows the power consumption of each type:

Volts AC/DC	Incandescent	Watts	LED	Watts	Neon	Watts
6	BA9S606	0.6	080BA9S6L*	0.59	—	—
6	BA9S615	1.5	—	—	—	—
12	BA9S12	2.0	080BA9S12L*	0.78	—	—
24	BA9S24	2.0	080BA9S24L*	0.84	—	—
48	BA9S48	2.0	080BA9S48L*	1.12	—	—
60	BA9S6012	1.2	—	—	—	—
110	—	—	—	—	BA9SN110	0.077
120	—	—	080BA9S120L*	1.4	—	—
130	BA9S130	2.0	—	—	—	—
220	—	—	—	—	BA9SN220	0.330

—**Lower operating temperature**—Because of the lower power consumption and greater efficiency of LEDs, they operate much cooler than incandescent lamps. Thus, in applications where heat in the enclosure could be a problem, LED lamps are a better choice.

Incandescent bulbs are recommended for light-duty applications and panels not subject to shock and vibration. Neon lamps offer a middle ground, at a cost and performance between the LED and the incandescent, but can have problems associated with flicker induced by noise and frequency. LED lamps offer the best overall performance for the long term.

Lamp Comparison

Bulb Type	Approx. Lifespan (hours)	Shock & Vibration Immunity	Operating Temperature	Power Consumption	Brightness
LED	100,000	High	Medium	Medium	Medium
Incandescent	2,000	Low	High	High	High
Neon	20,000	Medium	Low	Low	Low



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Guideform Specifications

IEC 22 mm push buttons shall be type GE C-2000 series. They shall be listed by Underwriters Laboratories (UL), certified by Canadian Standards Association (CSA) and conform to International Electrotechnical Commission (IEC) and Japanese Industrial Standard (JIS) standards. All push buttons, selector switches and pilot lights shall conform to the applicable requirements of NEMA standard ICS-2 for AC and DC control circuits. Enclosures shall be listed by UL and certified by CSA.

Standard features shall include:

- Fully automated manufacturing with 100% on-line inspection.
- Manufactured in ISO 9001 certified facility.
- 4 different operator styles: round metal body with polished chrome finish, round metal body with satin chrome finish, black round engineered plastic body, and black square engineered plastic body.
- Contact blocks and power supplies completely interchangeable among all 4 styles of operators.
- Locking rings that tighten from the rear with a special wrench or flat-blade screwdriver.
- Contact block flanges that mount on operators with 4-point positive locking.
- Universal mounting design that permits push buttons to be mounted with or without locating notch punched in panel. Orientation tab on operator notch that is removable with screwdriver.
- Modular assembly incorporating snap-on contact blocks and power supplies, removable with flat-blade screw driver.
- Devices mount on 30 mm x 50 mm (1.18 x 1.97 in.) center.
- Devices mount on panel thickness of 1 to 6 mm (.039 to .236 in.).
- Captive front-of-panel gasket for superior sealing.
- Lamps removable from the front of the panel.
- Metal operators constructed of die cast body.
- Polished and satin chrome operators feature triple chrome plating.
- Permanent marking of contact blocks by laser etching.
- Double bridge wiping action contact block design for applications from 12-600 volts ac and 12-300 volts dc.
- PLC interfacing with standard contact blocks.
- Contact blocks rated for 10 million electrical operations at 12 volts, 5 milliamps.
- Contact block cases shall be ultrasonically welded to provide superior protection in dust conditions. Contact blocks rated for 250,000 operations at 12 volts, 5 milliamps in severely dusty conditions.
- Power supplies shall be available in full-voltage, resistor, and transformer forms.
- Resistor power supplies shall be available in standard, diode, and long-life forms.
- Screw, quick-connect, and base-mount contact blocks.
- Printed circuit board connector for use with quick-connect contact blocks.
- Global nomenclature.
- Multi-lingual nameplates.
- Global availability.

