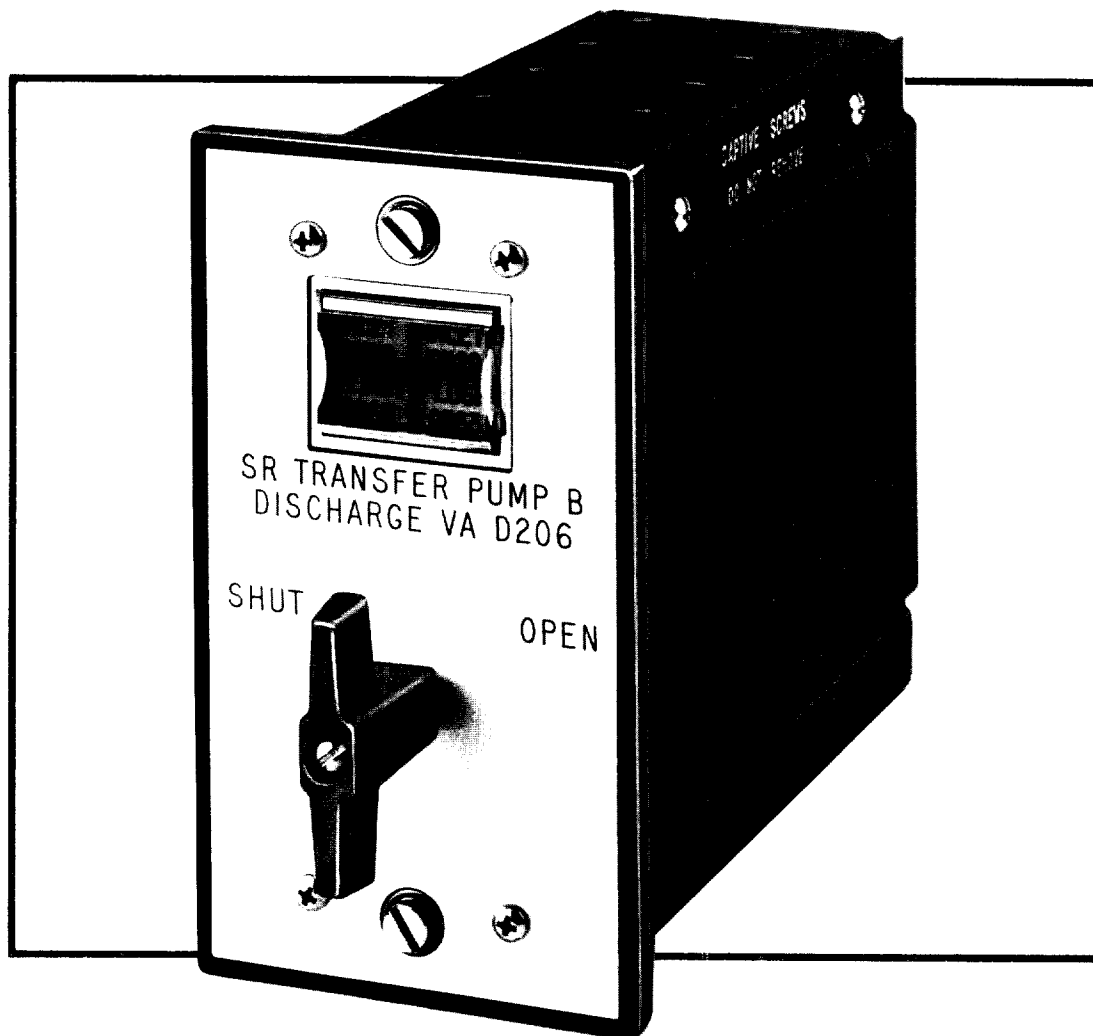


Technical Publication

**MOD-1**

Effective June 15, 1991

# A NEW MODULAR PLUG-IN FRONT OF PANEL MOUNT INSTRUMENT & CONTROL SWITCH FOR POWER INDUSTRY APPLICATIONS



**ELECTROSWITCH**

UNIT OF ELECTRO SWITCH CORP.

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A New Modular  
Plug-In  
Front of Panel Mount  
Instrument and Control Switch  
for Power Industry Applications

ELECTROSWITCH  
Weymouth, Massachusetts

ABSTRACT

A miniature modularized instrument and control switch has been developed for Class 1E Applications in nuclear power generating stations. They are also useful for general power industry and industrial applications.

Modular units have the following advantages over traditional instrument and control switches:

1. Plug-in, quick disconnect capability.
2. Front of panel servicing without the necessity of using service loops.
3. Integral indicating and annunciator lights with or without integral dropping resistors.
4. Total integrated markings for better control and simpler panel fabrication (position engravings, title engravings, lamp engravings, and item identification tagging).

This bulletin describes the module with its many variations and accessories. It also contains a system for simplified specifying and ordering.

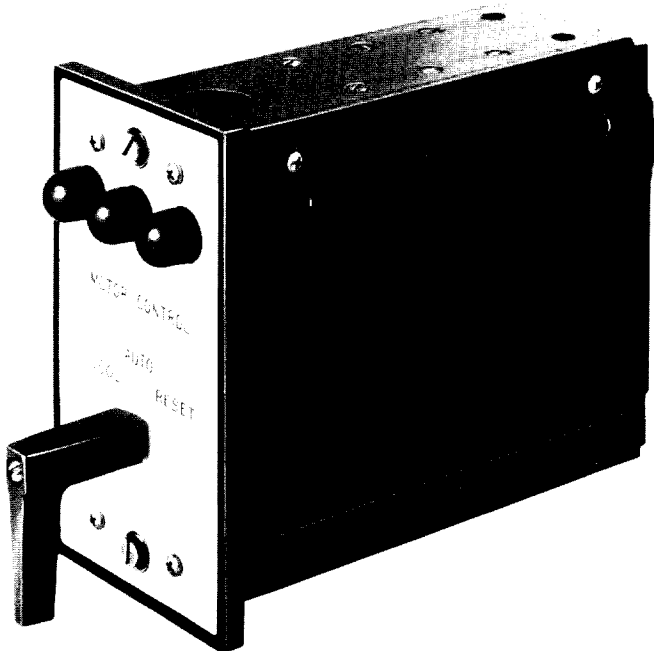


Fig. 1. Modularized series 20  
Instrument and Control Switch

Initial Release - June 1, 1980

Revised - June 15, 1991

INTRODUCTION

Control panels in supervisory control centers and power generating plants have been steadily increasing in size and complexity over the years. Electro Switch introduced the miniature series 20 Instrument and Control Switch in 1975 to help reduce this size since the 6-inch mounting centers of the traditional switches were a main cause of the increasing size.

The series 20 with a less than 2-inch square deck could be mounted easily on 3-inch centers — a fifty percent reduction. Generally, this was a satisfactory improvement. The indicating lights often associated with the switches then became the sizing problem. A product evolution took place and a family of series 20 switches was developed, combining switches and lights in different ways. These switches are described in Technical Bulletin MIN-1.

Applying the smaller switches in compact switchboards revealed many problems — predominantly in servicing. Wiring became difficult and it was difficult to get access to switch terminals. Techniques were developed with experience but the desirable access of the old panels was lost.

The modularized control switch had been around for many years. Since it used the conventionally sized switch, size savings were not realized. Combining the field proven and serviceable module concept with the small size of the series 20 switch resulted in the most desirable of all the combinations. The 2.62 inch width makes mounting on 3-inch centers possible and the 4.75 inch height (including lights and all engraving) makes it possible to mount more of them in a vertical row. The modular "look" also allows tight arrangements without wondering where one switch ends and the next begins. Wire can be neatly managed with the plug and socket arrangement. A minimal service loop is needed. All the features outlined in the ABSTRACT are met.

THE SWITCH

The series 20 switch was developed to provide all the desired power industry features in a more compact package.

These features include:

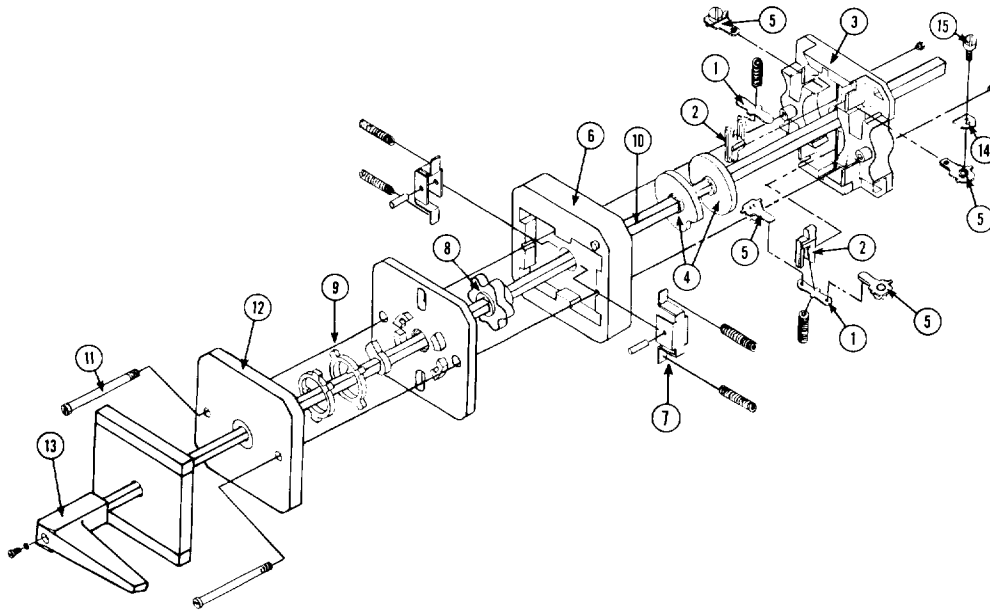


Fig. 2. Exploded view of the miniature instrument and control switch

- 20A-600VAC or 2-1/2A-125VDC rated contacts. This rating is the same as present units, and although generally not needed, provides heavy-duty contacts and precludes tracing circuits to determine the acceptability of lesser ratings.
- Choice of interchangeable shaped handles. round-knurled for instrument switches pistol-grip for control switches oval for general use selector switches oval-removable for synchroscope (not interchangeable)
- Mechanical red/green target on control switches.
- Slip-contacts for alarm and indicator circuits on control switches.
- Pull-to-lock for a safety lock-out on control switches.
- Shorting contacts for transfer service on current transformer circuits.
- Full qualification to IEEE Std-323-1984 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations) including aging by electro-mechanical endurance tests and the NRC preferred seismic test method of biaxial repeatable broadband multi-frequency response spectrum shape in accordance with IEEE Std-344-1987 (IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations).

The quality control system of Electro Switch is in conformance with NRC regulation 10CFR50 Appendix B which outlines the Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.

The quality assurance system is also in accordance with ANSI/ASME NQA-1-1986 entitled Quality Assurance Requirements for Nuclear Power Plants.

The switch is a modular design with switching decks<sup>(3)</sup> stacked with a detent mechanism deck<sup>(6)</sup>, a mounting plate<sup>(12)</sup>, and a handle<sup>(13)</sup>. A steel shaft<sup>(10)</sup> couples the handle to the operating parts. Two steel securing rods<sup>(11)</sup> are used to bolt the whole mechanism rigidly together. The basic parts and assemblies are shown on Fig. 2.

#### The Detent Assembly

The detent assembly<sup>(6)</sup> consists of a spring-loaded detent block<sup>(7)</sup> with a roller coming into contact with a notched detent wheel<sup>(8)</sup>. By the choice of this detent wheel, the detent handle provides the standard 45° detenting as well as optional 30°, 60°, or 90° detenting. The stop arms<sup>(9)</sup> are located under the mounting plate. These limit the angular rotation to the desired number and location of positions.

#### The Contact Assembly

The contact assembly<sup>(3)</sup> consists of the rigid thermosetting plastic housing, two sets of stationary contacts<sup>(5)</sup>, and two spring-loaded movable contacts<sup>(1)</sup> held in cam-followers<sup>(2)</sup>. Floating on the shaft and held within the contacting chamber are the two independent cams<sup>(4)</sup>. The cams are notched to provide the contact "close" angles desired. The contacts are spring-loaded closed and mechanically opened by the cam action to avoid sticking. The terminal screw<sup>(15)</sup> and pressure clamp<sup>(14)</sup> are designed to accommodate up to #12AWG wire — stranded wire with lugs or solid wire, either with or without lugs.

### The Handles

A choice of handles is available as for other instrument and control switches. These handles are interchangeable. The common usage for the different shapes are:

- Round-knurled — meter transfer
- Oval — general transfer and selector
- Pistol-grip — breaker and motor control

There is also an oval removable handle design available. These may be keyed and are generally used in synchroscope selector applications. The keying insures a sequence-of-events control of several switches. These handles are illustrated on Fig. 3.

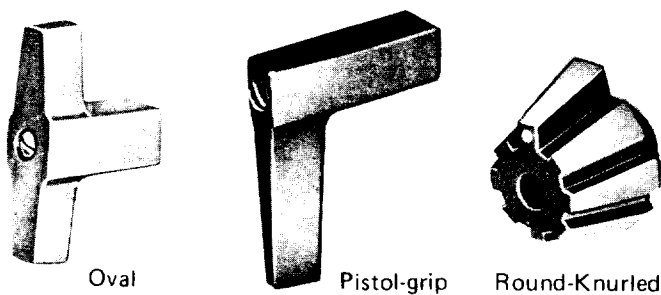


Fig. 3. Handles

### The Pull-to-Lock Mechanism

Control switches generally have positions both 45° left and right of the normal vertical position. The handle spring-returns to the normal position. The pull-to-lock mechanism enables an operator to turn the handle beyond the left (normally TRIP) position to the 90° left location, pull-out the handle and thereby lock the switch into this position. This precludes the possibility of someone inadvertently closing a circuit-breaker when it is desired that it stay in the tripped position.

### The Slip-Contacts

Because control switches return to the normal vertical position after performing their function, the control contacts in these positions open. It is often desirable to have alarm or indicator contacts stay on and show what the last active position was. The slip-contacts do this. A maximum of four slip-contacts can be provided and will be grouped at the rear of the switch. The contacts are closed when the switch is turned to its commanded position. The slip mechanism enables the handle to return to normal without disturbing the slip-contact decks, and the slip-contacts will only open when the switch is turned to the other control position.

### Other Mechanical Features

The switch design is very flexible and easily lends itself to having options available. The following are some examples:

- A spring-return mechanism is substituted for the standard detent mechanism — this provides a momentary contact in either the left or right position (or both) with spring-return upon release of the handle to the normal vertical position.
- A key-operator can be provided as a further option.
- A gear-train can combine two or more switches for operation by one handle where the number of contacts is greater than the capacity of one switch or there is a panel depth restriction.

### Contact Operation

The contacting consists simply of shunting two isolated contacts to make a circuit as illustrated in Fig. 4.

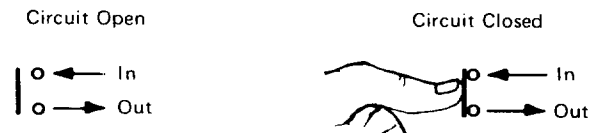


Fig. 4. Basic contact scheme

Using this simple principle, two independent sets of contacts are placed in each deck. The moving portion is spring-loaded to close the contact. A notch on the cam that is affixed to the operating shaft allows the moving contact to spring closed, bridging the stationary contacts. This action is illustrated in Fig. 5.

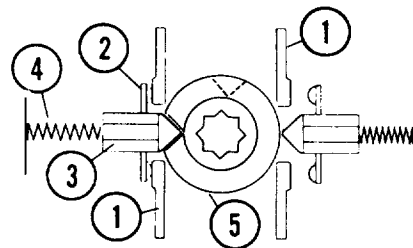


Fig. 5. Contact operation

As illustrated, the movable contact<sup>(2)</sup> is spring-loaded<sup>(4)</sup> and held by the cam follower<sup>(3)</sup>. It makes a circuit with the two stationary contacts<sup>(1)</sup> when the cam follower enters the notch in the cam<sup>(5)</sup>.

Identically, the same thing is happening with the contact set on the right. This circuit is held open by the cam and will close when the notch on a second independent cam is rotated around and comes in proximity to its cam follower (the second cam notch is illustrated by the dotted lines — the cam is underneath the other one).

Contacting Charts

The contacts for applications purposes are illustrated in the traditional manner as shown on Fig. 6. An "X" in a box indicates a closed circuit. An "X—X" in two (or more) adjacent position boxes indicates a closure in all positions and between positions. An "X—X" in a box indicates MBB make-before-break or shorting action.

The chart shows eight positions but a switch may have from two to twelve positions with the standard 45° indexing and optional 30° and 90° indexing as shown on Fig. 7.

Circuit-breaker control switches and some motor-control switches have a spring-return action to the normal vertical position after either of the two active positions. The mechanical target indicates the last active position — green if the left position; red if the right position. This arrangement is shown on Fig. 8.

DECK	CONTACTS HANDLE END	POSITIONS							
		1	2	3	4	5	6	7	8
1	10— — —02								
	30— — —04								
2	50— — —06								
	70— — —08								
3	90— — —10								
	110— — —12								
4	130— — —14								
	150— — —16								
5	170— — —18								
	190— — —20								
6	210— — —22								
	230— — —24								
7	250— — —26								
	270— — —28								
8	290— — —30								
	310— — —32								

Fig. 6. Standard contact chart for switches from 1 to 12 decks

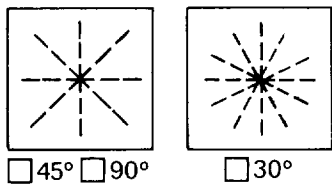


Fig. 7. Handle positions for standard nameplate



Fig. 8. Handle positions using target nameplate

Since some circuits use slip-contacts that stay on after either active position (for alarms, lights, etc.), a different contact chart is appropriate, as illustrated on Fig. 9.

X C O U N D	CONTACTS HANDLE END	POSITIONS			
		1	2	2	4
1	10— — —02				
	30— — —04				
2	50— — —06				
	70— — —08				
3	90— — —10				
	110— — —12				
4	130— — —14				
	150— — —16				
5	170— — —18				
	190— — —20				
6	210— — —22				
	230— — —24				
7	250— — —26				
	270— — —28				
8	290— — —30				
	310— — —32				

Fig. 9. Contact chart for control switches from 1 to 8 decks used with a target nameplate

Figure 8 and 9 also indicate the pull-to-lock position<sup>(1)</sup> that is available with the control switches.

The contact chart illustrated on Fig. 6 indicates the maximum stacking of up to twelve decks for standard detent switches. Switches with spring-return action (momentary) are limited to eight decks as illustrated on Fig. 9. The charts also show the terminal marking scheme. Figures 6 through 9 are repeated on the DESIGN GUIDE that becomes part of the specifying drawing. The DESIGN GUIDE is printed on pages 19 and 20.

Contact charts, wiring diagrams, and es-cutcheon plate engravings for the most common instrument and control applications are detailed on pages 9 to 19 of Technical Publication MIN-1. Additionally, the design flexibility enables the user to specify literally millions of contacting arrangements using the standard design and stocked parts to exactly satisfy his switching needs.

Contact Ratings

The series 20 Instrument and Control Switch has been tested to many different circuit conditions. The interrupting ratings are based on 10,000 operations of life, using suddenly applied and removed rated voltage, with no extensive burning of contacts. Inductive ratings are based on tests using standard inductance L/R=0.04 for DC and cosθ=0.4 for AC. The Interrupting Rating column headed "double contacts" means two contacts in series. Short-time, and continuous ratings are based on temperature rise in contact members and supporting parts not exceeding 50°C above ambient.

TABLE I  
Contact Ratings for  
Series 20 Instrument & Control Switch

CONTACT CIRCUIT VOLTS	INTERRUPTING RATING (AMPS)				SHORT TIME RATING (AMPS)*	CONTINUOUS RATING (AMPS)
	RESISTIVE		INDUCTIVE			
	SINGLE CONTACT	DOUBLE CONTACT	SINGLE CONTACT	DOUBLE CONTACT		
12VDC					40	24
24VDC					40	24
48VDC					40	24
125VDC	3		2.5 1/2	7 1/2	40	24
250VDC	-				40	24
600VDC	-				40	24
120VAC	20				40	24
240VAC	20				40	24
480VAC	20				40	24
600VAC	20				40	24

\*Short time current is for one minute

1/2 .43 hy  
1A-125VDC, L/R = .04 (5 hy)

Ratings shown with a dash are not recommended. Ratings that are blank are in the process of being evaluated and may be available upon request.

Circuit-breaker control switches must "make" the circuit, but independent means (such as breaker auxiliary contacts) "break" the circuit. In these and similar applications, a "make" rating is useful (the switch "breaks" on no-load). Make ratings are: 120A-125VDC.

#### Allowable Variation from Rated Voltage

Series 20 Instrument and Control Switches are not sensitive to normal variations in voltage. The interrupting capacity is important as indicated in Table I. Variations of plus and minus 20% in rated voltage need not be considered as long as the interrupting current is not exceeded.

#### VERIFICATION TESTING

The series 20 Instrument and Control Switch has undergone extensive laboratory testing to verify its ruggedness and reliability under a variety of power industry applications. The most important tests include aging since experience with similar electro-mechanical devices shows that failure will most likely occur after electro-mechanical endurance tests. These aging tests accelerate mechanical wear and electrical contact erosion and pitting due to arcing.

The aging tests are conducted in conformance with the following specifications and standards:

- IEEE-STD-323-1984-IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

- IEEE-STD-344-1987-IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

- ANSI/IEEE C37.90-1989 Relays and Relay Systems Associated with Electric Power Apparatus

- ANSI/IEEE C37.98-1987 Standard for Seismic Testing of Relays

The relay standards are used since no suitable switch specification is available. The requirements and applications of the switches are similar and compatible with relays.

The testing is performed in accordance with ESC-STD-1000-General Specifications for Rotary Switches and Auxiliary Relays for Utility Applications including Class 1E Equipment Requirements for Nuclear Power Generating Stations. The tests include ratings evaluation tests, aging tests to simulate forty years operating life, and seismic tests.

#### Aging Tests

Aging tests are run in accordance with IEEE-STD-323-1984 and ESC-STD-1000 and consist of the following (run in sequence):

1. Visual and mechanical examination
2. Circuit configuration and operation
3. Dielectric withstanding voltage - 2200VRMS, 60Hz for one minute
4. Insulation resistance - 100 megohms minimum at 500VDC
5. Contact resistance - 10 milliohms maximum at rated current
6. Radiation aging - 10 megarads (10<sup>7</sup>), Co<sup>60</sup> gamma
7. Humidity aging - 96 hours at 95% RH
8. Temperature rise (contacts) - 50°C maximum
9. Temperature aging - 120 hours at 80°C
10. Endurance - 10,000 cycles under electrical load
11. Seismic vibration - ZPA=5g
12. After test measurements (in order) - items 3, 4, 5, 8, 2, 1

Details on the background of these tests plus the methods and procedures are outlined in ESC-STD-1000.

#### Seismic Tests

The series 20 Instrument and Control Switch is subjected to fragility testing in a seismic environment after aging to an accelerated life estimated to be forty years. This sequence is outlined under Aging Tests. The seismic tests are in accordance with IEEE-STD-344-1987 and ANSI/IEEE C37.98-1987. The tests are performed in accordance with ESC-STD-1000. Broadband repeatable multi-frequency input motions are used. The Fragility Response Spectrum (FRS) envelopes the Standard Response Spectrum (SRS) shown in Fig. 10 using a biaxial input motion.

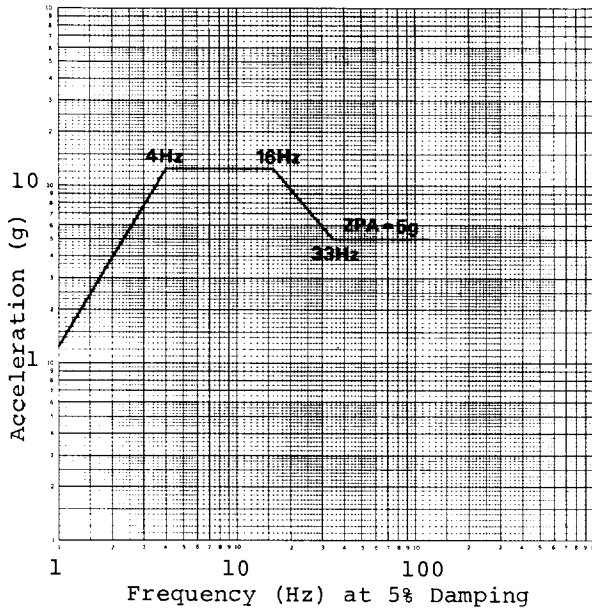


Fig. 10. Multi-frequency Broadband Standard Response Spectrum (SRS)

THE MODULE

The module, as illustrated on Fig. 11 combines the series 20 Instrument and Control Switch with a plug-in connector and a set of indicating lamps. These are assembled into an enclosure to provide a self-contained unit.

The front plate provides room for all engraving needed. Advantages provided include:

- Front of panel servicing
- Plug-in quick connect capability
- Integral indicators
- Integrated markings and engravings

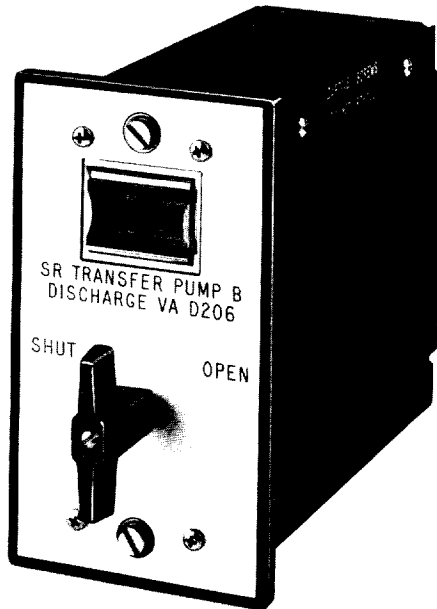


Fig. 11. Front-of-panel-mount, plug-in, lighted switch

The Connector

The connector used is the Burndy Bantamate Trim Trio round connector shown on Fig. 12.

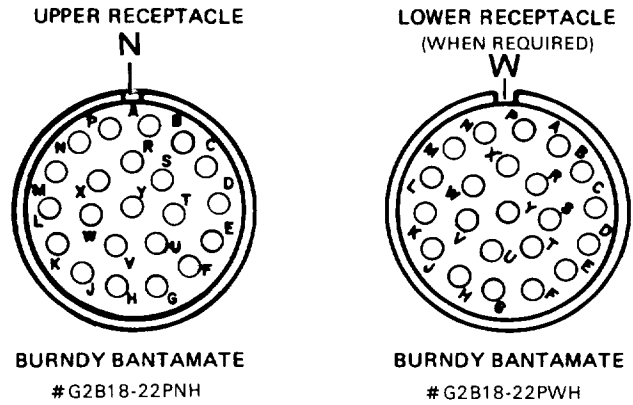


Fig. 12. Connector receptacle

Generally, only one connector is needed and the "N" polarization is used. When two connectors are needed, the lower receptacle is provided with the "W" polarization as illustrated. The number shown is the Burndy catalog number. The code is described on the MASTER DRAWINGS on pages 14, 16, and 18.

The receptacles contain the pins. Two styles are offered — either machined contacts with 13 ampere carrying capacity or the formed contacts with 10 ampere capacity. Both types are adequate for this application. The formed contacts are more economical. The contacts are further described on the MASTER DRAWINGS on pages 13-18.

The plugs and sockets are generally supplied with the modules to insure compatibility and for quality assurance purposes. The plugs are illustrated on the MASTER DRAWINGS. This includes information on a wire strain relief clamp that is supplied with the plug.

The Lamp Assembly

Lamp assemblies are available in three styles to help satisfy specific applications requirements, as follows:

<u>STYLE</u>	<u>MANUFACTURER</u>
Round surface, round dome	Dialco
Round surface, flat dome	Korry
Square, flush surface	Master Specialties

The different types are illustrated on Fig. 13.

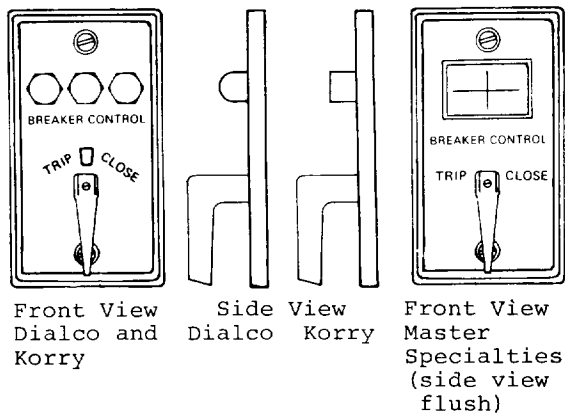


Fig. 13. Choice of lamp configuration

Some of the features of the Dialco lamp that may be desirable include:

1. Traditional dome shape is similar in shape to those used on previous panels.
2. Excellent viewing from a distance and from the side.
3. Push-to-test features for ease of lamp testing.
4. Lens color is same as lighted color so they can be distinguished when the lamp is out.
5. Bright even illumination when lighted.
6. Accommodation for two or three lights in one row with one or two rows.
7. Availability of all normally used lamp colors — amber, blue, green, red, white.

The Korry lamp has generally the same features as the Dialco lamp with the following differences:

1. The illumination is not as even as the Dialco because of the flattened surface.
2. Integral dropping resistors are available.
3. Limited engraving space is provided on the flattened surface.

The Master Specialties Company (MSC) lamp is a totally different design with the following features:

1. Modern, square, flush mount.
2. 4-segment "quad" lamp arrangement providing any combination of 1, 2, 3, or 4 lamp colors per assembly.
3. Lamp color does not show when lamp is "off" avoiding any confusion.
4. Bright even illumination of each segment when lighted.
5. Provision for clear engraving of each of four segments (up to two rows of five characters each).

All lampholders use the T-1-3/4 midget flanged base, 28VDC lamp (GE #387) that is available from local sources. The lamps are easily replaced from the front of the panel with no tools.

#### ORDERING DATA

The series 20 modules have virtually infinite numbers of combinations available. In a given systems application no two modules are likely to be identical. No attempt is made to limit the flexibility of this module either.

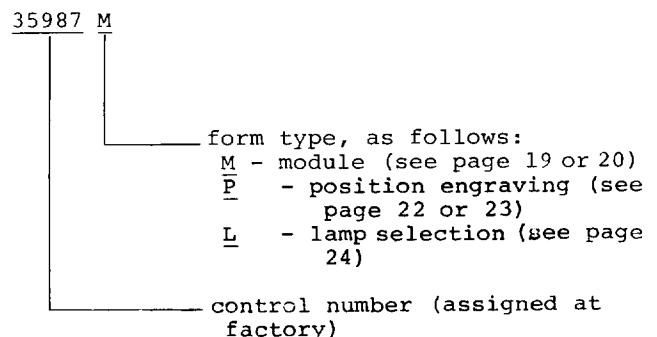
Certain standardization seems to be possible in a given system of modules such as switch arrangements, position engravings, and lamp types. Other variables are unlikely to repeat such as customer module identification, tag numbers (or other production identification), and title engravings. To aid the efficient handling of all these variables, four forms have been developed. The details on these forms are fed into a computer and a report is generated that contains all the detail in a readable and usable form. This MODULE LIST is illustrated on Fig. 14 and is used for the following:

- Uppermost engineering drawing under revision control.
- Acknowledgement of the customer order.
- Bill-of-material for final assembly.
- Final inspection check list.
- Shipping document.

This MODULE LIST also does many things such as generating orders for lamps, engravings, etc. Once the data is entered and checked it becomes error-free when organized in many different ways to help the management of the order from start to finish. It is also a convenient document for storage, thereby maintaining the record for the time required by the customer.

#### Specifying the Basic Standard Modules

The forms needed to specify series 20 Modules are included in this bulletin on the pages noted. These may be copied or supplies of the forms are available upon request. The completed forms will be assigned a five digit control number at the factory. The numbering is as follows:



YOUR COMPANY NAME SX-200668-750 AMEND 2		DATE 5/23/80		ELECTRO SWITCH CORP. WEYMOUTH, MASSACHUSETTS		PAGE 1 MODULE LIST 12345 REV 2 DATE 5/30/80						
ITEM #	QTY	DWG, P/N, REV, ETC	CUSTOMER IDENTIFICATION	TAG NUMBER	MODULE #	REV	TYPE	HDL LAMP	NAMEPLATE IDENTIFICATION	LLR POS	TITLE	ENGRAVING
1-001	1	MK-10	854.2	39650M-1	0	MIS	C		W	IA	STEAM DUMP INTLK CONTROL-A 43-SDA	
1-002	1	MK-10	855.2	39650M-1	0	MIS	C		W	IA	STEAM DUMP INTLK CONTROL-B 43-SDB	
2-001	1	MK-11	472.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-80 1B-NNS	
2-002	2	7	473.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-80 1A-NNS	
2-003	1	MK-11	474.2	36950M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1B-NNS	
2-004	1	MK-11	475.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1A-NNS	
2-005	1	MK-11	2955.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1B-NNS	
2-006	1	MK-11	2956.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1A-NNS	
2-007	1	MK-11	2969.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1B-NNS	
2-008	1	MK-11	2970.2	39650M-2	0	MISIL	D	IA	W	IB	CONTROL ROD DRIVE MECHANISM COOL FAN E-81 1A-NNS	
3-001	1	MK-12	250.2	39650M-3	0	MISIL	B	IA	W	IC	CNTL ROOM PURGE EXH FAN ES-1 1A-NNS	
3-002	1	MK-12	251.2	39650M-3	0	MISIL	B	IA	W	IC	CNTL ROOM PURGE EXH FAN ES-1 1A-NNS	
3-003	1	MK-12	246.2	39650M-3	0	MISIL	B	IA	W	IC	CNTL ROOM PURGE EXH FAN ES-1 1A-NNS	
4-001	1	MK-13	166.2	39650M-4	0	MISIL	B	IA	W	IC	LETON LINE SUP ISU VA CS-L501SN	
											LETON TO DMNZR OR VCT DIVERT VA CS-M510SN	
											PRESSURIZER REF TK TO RPM SUP ISU VA AC-526	

Fig. 14. Typical MODULE LIST

The forms and their uses are:

1. The MODULE INDEX worksheet on page 21 is the uppermost specifying sheet and will key the printing of the final MODULE LIST (see Fig. 14). It contains the following:

ITEM up to 4 digits - not needed if the tag number contains a unique number.

QTY quantity per item (usually one).

CUST IDENT customer identification - may be a drawing number, module type or whatever the customer uses for control - may be omitted if the customer uses the Electro Switch identification for control purposes - up to 15 characters (alpha or numeric or combinations) plus up to 2 digits (alpha/numeric) for revisions.

TAG NO. tag number or location number - up to 15 digits (alpha/numeric).

MOD CODE module identification - taken from the DESIGN GUIDE (pages 19-20) assigned at factory.

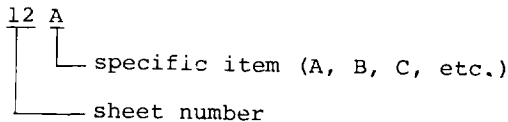
HDLE CODE handle code  
B-oval, C-round-knurled, D-pistol-grip, S-others or specials.

LAMP CODE 3 digits (alpha/numeric) taken from MSC SERIES 10H LAMP specification sheet (page 24) or lens colors for Dialco or Korry lamps (A,B,G, R,W).

POS CODE position engraving code taken from the MODULE POSITIONS ENGRAVING specification sheets (pages 22-23).

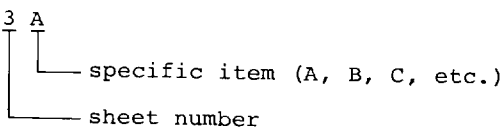
TITLE ENGRAVINGS do not seem to repeat so this sheet is used to specify the required engravings.

2. The MODULE POSITIONS ENGRAVING specification sheets on pages 22 and 23 enable the organization of repeating position engravings and aids standardization efforts. These sheets will be numbered with P and the order number, e.g. 35987P, followed by a dash and a code. The CODE is as follows:



The position engravings (limited to 5 characters) are entered in the boxes provided.

3. The MSC SERIES 10H LAMP specification sheet (on page 24) is used when MSC lamps are required. When Dialco or Korry lamps are required, the data is entered on the DESIGN GUIDE (page 19). The drawing contains the instructions. The drawing will be numbered L and the order number, e.g. 35987L, followed by a dash and a code. The code is as follows:



4. The DESIGN GUIDES (page 19 for Dialco or Korry lights or page 20 for MSC lights) provide the technical detail of the switch and connections, including:

- Contacting arrangement including connector pin designations and internal jumpers.
- Lamp wiring including connector pin designations. For Dialco and Korry, complete data is provided, e.g. lamps and locations (the lens colors are shown on the MODULE INDEX worksheet). For MSC only, the lamp type is shown to indicate the wiring that is chosen from Fig. 16 on page 10, including the pin locations).
- The module type is chosen from Fig. 15 below.
- Dropping resistors are shown when required.
- ACTIONS, OTHER FEATURES, HANDLE POSITIONS, NAMEPLATE color and style, etc.

#### The Basic Standard Modules

The modules break down into a finite number of basic combinations of lights, switch, and engraving arrangements. The standard styles are illustrated on Fig. 15. The shapes and lines mean the following:

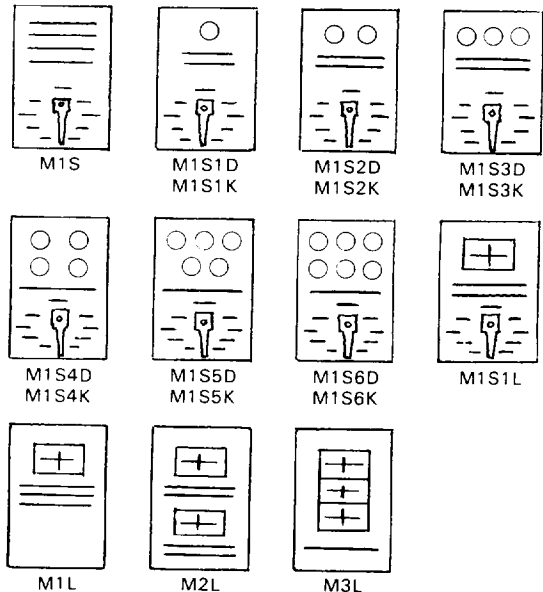
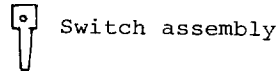
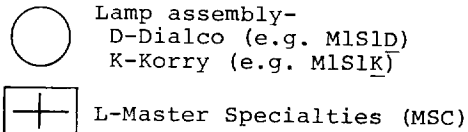


Fig. 15. Basic Standard Module Types

Specifying Master Specialties (MSC) Lamps

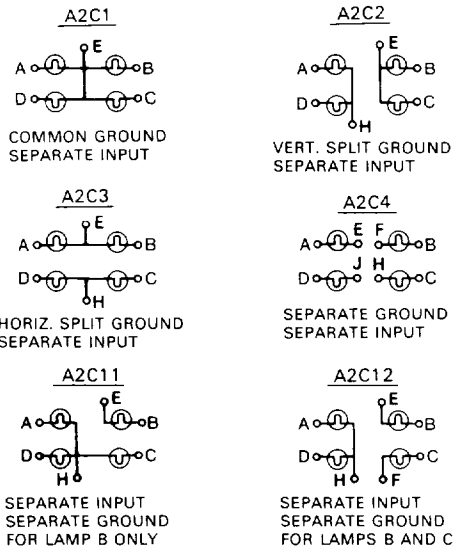
The MSC series 10H lamp assembly is used. This series has been qualified for class 1E applications. They, like the modules, are available in infinite numbers of variations. Preferred standards have been chosen to simplify the specification process. The contacting chart (DESIGN GUIDE) generally only shows the lamp type, e.g. 10HA2C1J3L. This describes the basic lamp plus its wiring which is unique for a given module. The rest of the MSC number has to do with lamp colors, screen arrangements, and engravings. These are best handled on the MSC SERIES 10H LAMP specification sheet, page 24.

The MSC catalog number is outlined below on Fig. 16.

10H A2C1 J3L (----) N15 R1V

10H  
└─ Series

10H A2C1  
└─ lamp circuits as follows  
(show wiring and connector  
pin letters on DESIGN GUIDE):



10HA2C1 J3L  
└─ describes the lamp used—  
28VDC, T-1-3/4, midget  
flange base, incandescent

10HA2C1J3L (----)  
└─ lamp colors—dashes  
indicate upper left,  
upper right, lower left,  
lower right in that order  
and are available in the  
following colors:  
A amber R red  
B blue W white  
G green Y yellow

Fig. 16. MSC Catalog Number Code  
(also continued on next column)

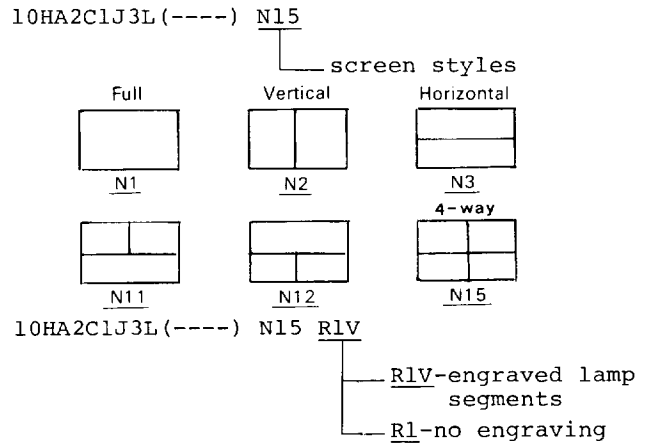


Fig. 16. (Continued)

The actual engraving is shown on the MSC SERIES 10H LAMP specification sheet. The limits of engraving are:

N1R1V—up to 4 rows of 12 characters each

N2R1V—up to 4 rows per segment and up to 5 characters per row

N3R1V—up to 2 rows per segment and up to 12 characters per row

N11R1V)  
N12R1V) combination of N1R1V and N2R1V

N15R1V—up to 2 rows per segment and up to 5 characters per row

Specifying Non-standard Modules

The design of power plant control panels utilize a great variety of different switches and indicator lamp combinations. Most applications can be satisfied using the standard modules previously described. The non-standards may be provided by modifying the standard module. A few examples are:

1. Two lights in one module — one is for class 1E and one is not. This is satisfied by using the standard module with a barrier inside separating the two lamps and two separate connectors.
2. Two switches in one module — one is for class 1E and one is not. This is satisfied by a so-called dual-train module — two modules isolated but held together with a common shaft. Panel appearance is the same as a single standard module.

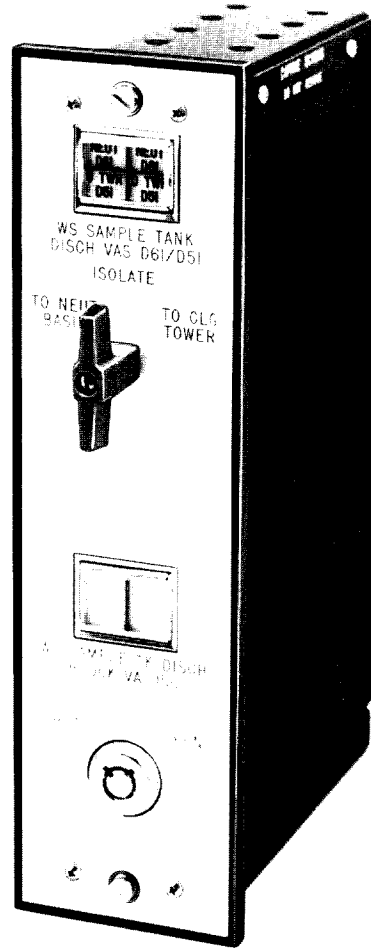
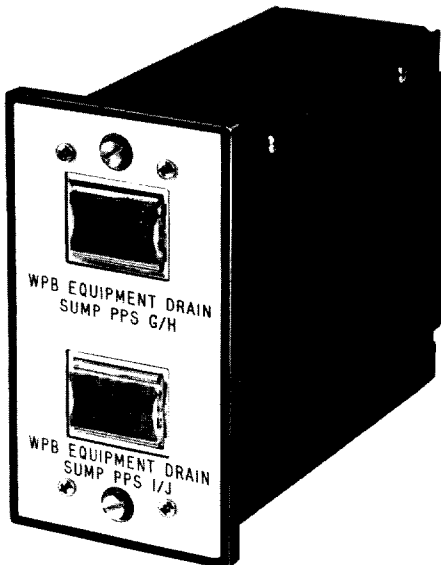
It is also often desirable to assemble other components in the standard or larger module for uniform appearance. A larger module with 4-1/4 x 6-3/4 inch at the panel supplements the standard 2-5/8 x 4-3/4 inch standard module for these applications. Some examples of these applications include:

1. Four MSC lamp units are needed.

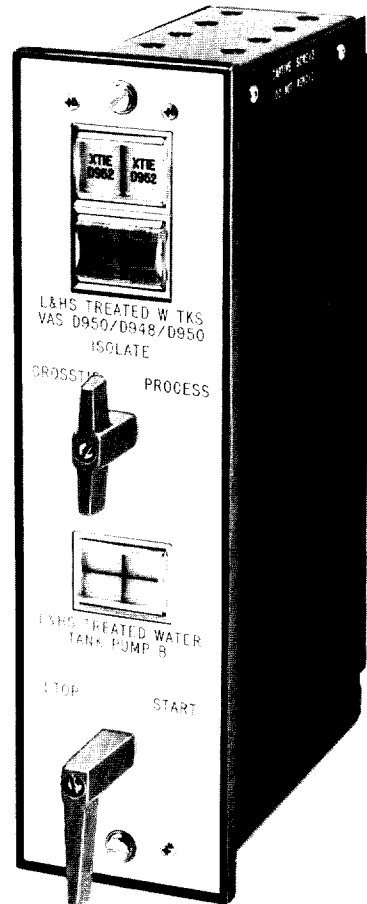
2. A twelve position rod control switch is too large for the standard module.
3. A rod-motion "joy-stick" switch is too large for the standard module.
4. Totalizing and predetermining counters fit nicely in the larger module.

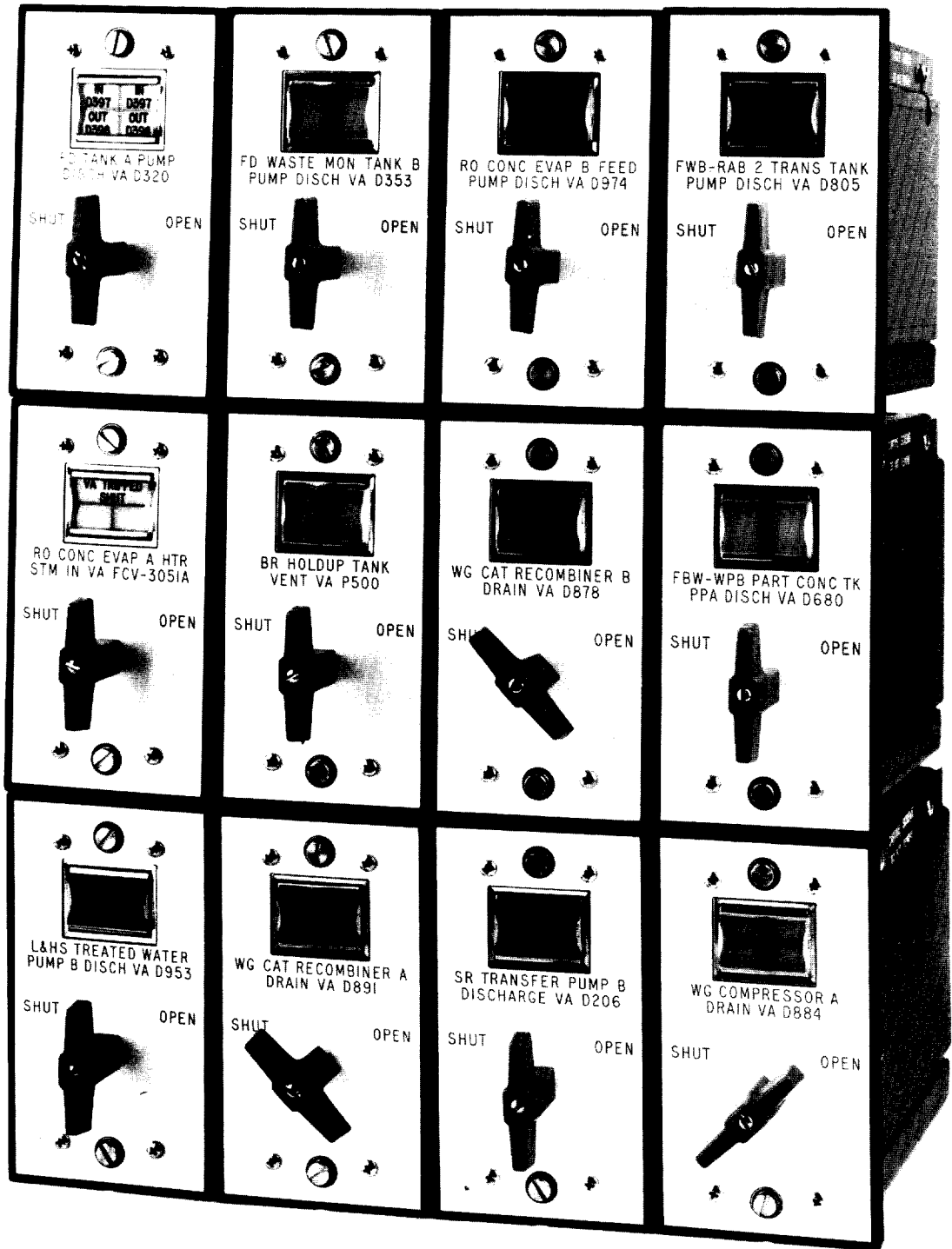
A "so-called" double module is also available for applications where it is desirable that several lights and several switches are combined in one module so as to have one set of connectors handle these several components. Typical of these specials are illustrated in the following figures.

These and other non-standard modules are available by describing what is needed. Ordering material will then be provided.



5/1



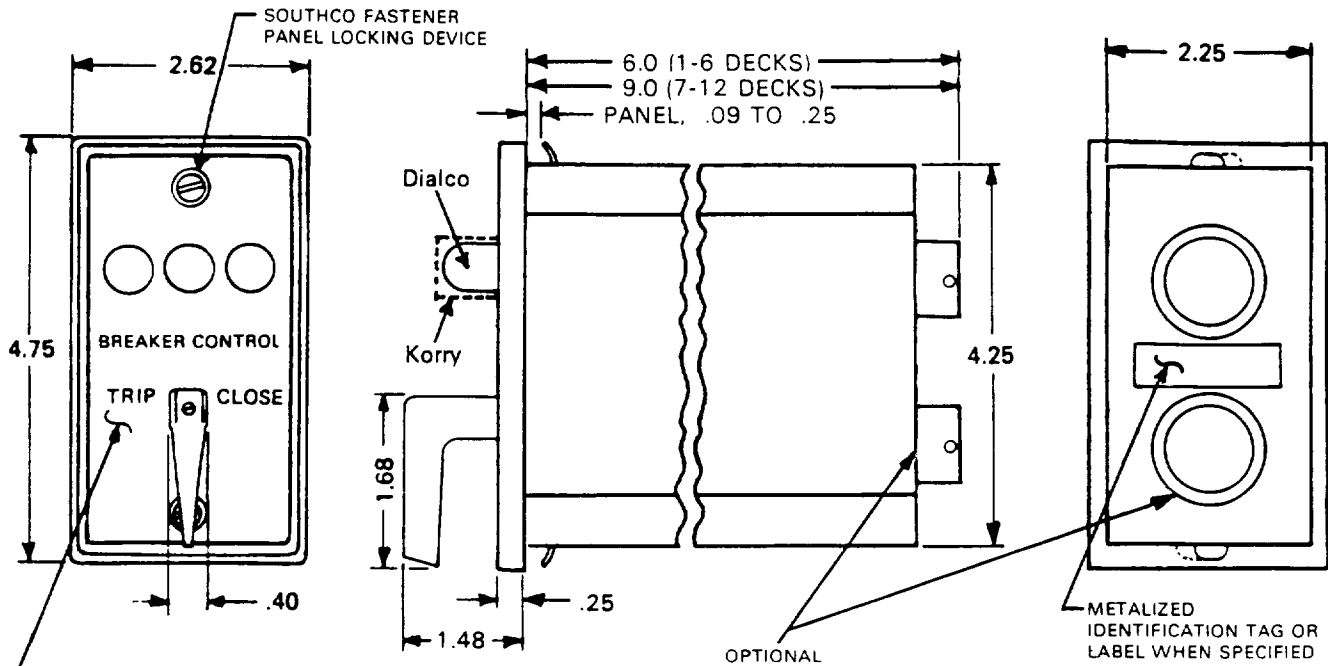




**ELECTROSWITCH**  
 UNIT OF ELECTRO SWITCH CORP  
 WEYMOUTH, MASSACHUSETTS 02188  
 TELEPHONE: (617) 335-5200 FAX: (617) 335-4253

# MASTER DRAWING

**SERIES 20M**  
**PLUG-IN MODULE**  
**INSTRUMENT & CONTROL SWITCH**



Typical engraving shown, 1/8 characters.  
 Titles - 3 lines maximum (1 line maximum with handles other than pistol-grip shown), 21 characters maximum per line - Positions - 5 characters maximum. Nameplate color and engraving colors as specified.  
 Variations from above may be specified.

### LAMP DATA

Indicators are Dialco or Korry as specified with number of lamps, lens colors and wiring as specified.

Replacement lamps are T-1 3/4 mid-geet flanged base, 28 VDC, GE#387 or equal.

### OTHER HANDLES

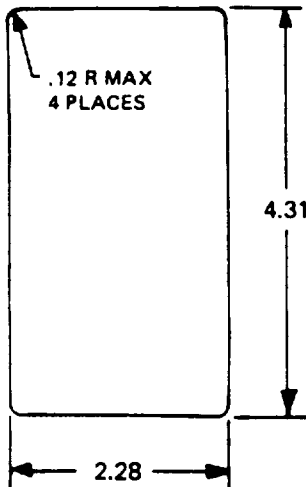
Round-knurled and Oval handles are available and interchangeable - see MASTER 20K

### SWITCH RATINGS

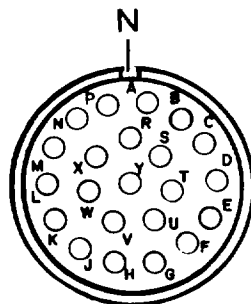
20A-600VAC  
 3A-125VDC

OTHER TECHNICAL DATA IN TECHNICAL BULLETIN MIN-1 TESTED TO ESC-STD-1000

### PANEL CUTOUT



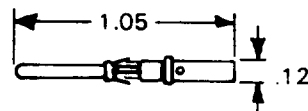
### CONNECTOR RECEPTACLE



BURNDY BANTAMATE  
 #G2B18-22PNH

Connector plug data on sheet 2

### TERMINAL



#16 Formed contacts (.062 diameter), copper alloy, gold-plated, SM16M-1S6, rated 10 amperes - use same installation tools as sockets.

#16 AWG stranded wire per MIL-W-16878, Teflon Type E or as specified.

MADE BY: JM 3/2/81  
 APPR. BY: mmm 3/2/81

DWG. NO: 264STD-6

SHEET 1 OF 2

REV B

ECN #12782 6-28-82 JR MMR  
 ECN #12413 8-18-81 WJH MMR  
 REVISIONS: (A) (B)



**ELECTROSWITCH**  
 UNIT OF ELECTRO SWITCH CORP  
 WEYMOUTH, MASSACHUSETTS 02188  
 TELEPHONE: (617) 335-5200 FAX: (617) 335-4253

# MASTER DRAWING

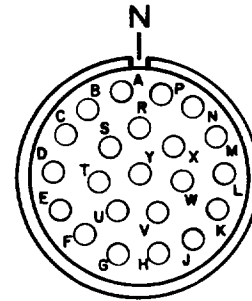
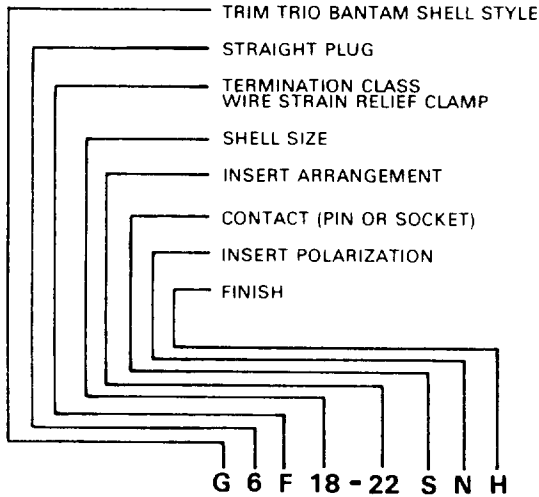
**SERIES 20  
 PLUG-IN MODULE  
 INSTRUMENT & CONTROL SWITCH**

## TRIM TRIO ROUND CONNECTORS

SHELL SIZE 18

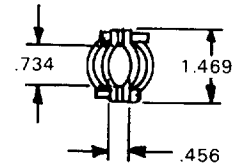
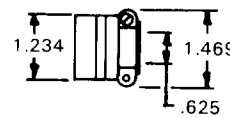
INSERT ARRANGEMENT, 22 PIN

G6F18-22SNH



TERMINATION CLASS F  
 WIRE STRAIN RELIEF CLAMP

H - CADMIUM PLATE WITH OLIVE CHROMATE CONVERSION COATING AS SPECIFIED IN MIL-C-26482

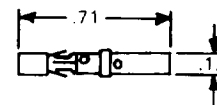


Plug shown and sockets (same quantity as pins) supplied when specified

### INSTALLATION DATA

- Wire: 20-16AWG per MIL-W-16878
- Cable strip length: .250
- Installation tools
  - Die set N16RT-24 for M8ND/Y8ND
  - UTM-2 Crimp Mechanism CM11
  - Extraction tool RX16-D11

TERMINAL SOCKET  
 SC16M-1S6

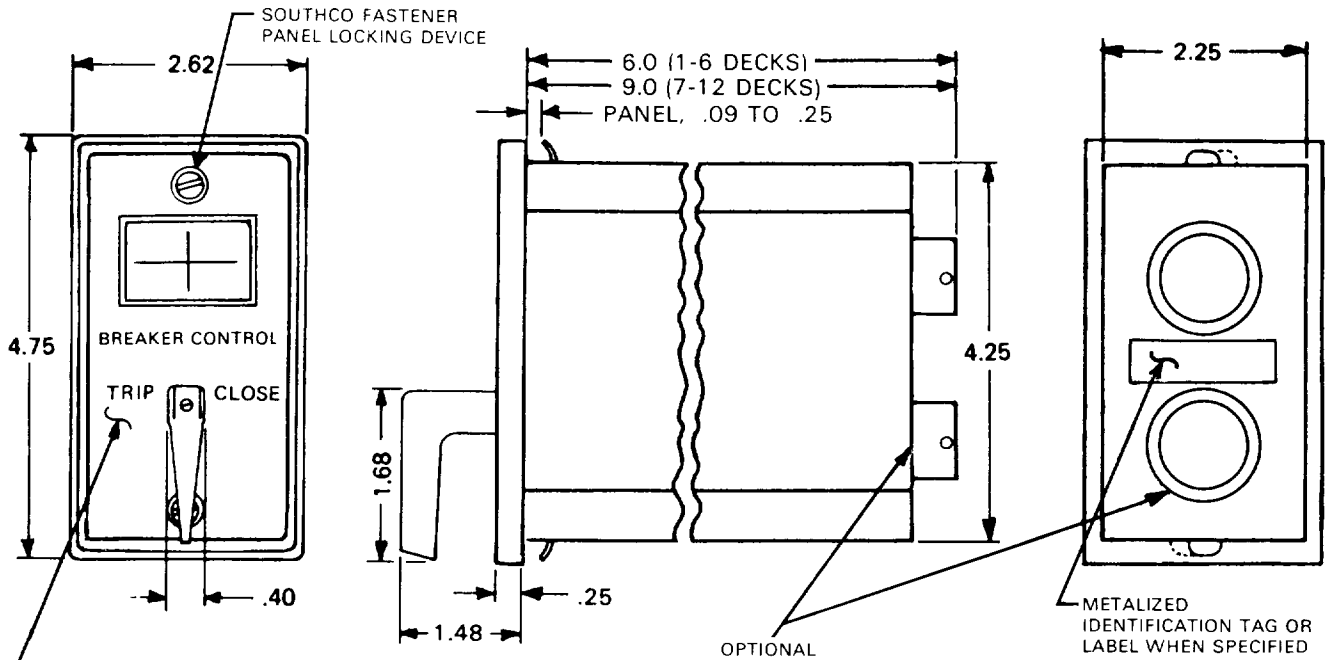


DIMENSIONS ARE IN INCHES

WIRE TYPES OTHER THAN THOSE NOTED MAY ALSO BE ACCOMMODATED BY CONTACTS ABOVE. CONSULT BURNDY, GIVING WIRE PARTICULARS CONTACTS INSTALLED BY THE UTM-2 AUTOMATIC INSTALLATION MACHINES (FURNISHED 3000 TO A REEL).

PINS AND SOCKETS ARE MADE OF HIGH CONDUCTIVITY COPPER ALLOY.

DWG. NO: **264STD-6**  
 SHEET 2 OF 2



Typical engraving shown, 1/8 characters.  
 Titles - 3 lines maximum (1 line maximum with handles other than pistol-grip shown), 21 characters maximum per line - Positions - 5 characters maximum. Nameplate color and engraving colors as specified.  
 Variations from above may be specified.

**LAMP DATA**

Indicators are Master Specialties type 10H with number of lamps, lens colors, number of segments, wiring, and engravings as specified.  
 Replacement lamps are T-1 3/4 mid-gage flanged base, 28 VDC, GE#387 or equal.

**OTHER HANDLES**

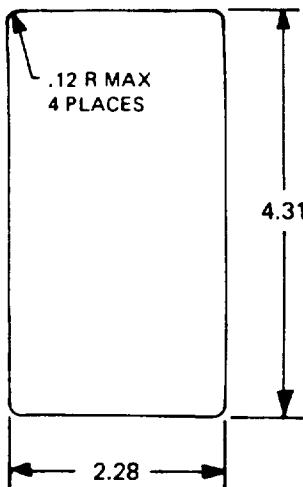
Round-knurled and Oval handles are available and interchangeable - see MASTER 20K

**SWITCH RATINGS**

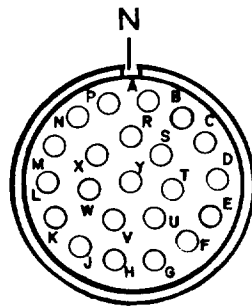
20A-600VAC  
 3A-125VDC

OTHER TECHNICAL DATA IN  
 TECHNICAL BULLETIN MIN-1  
 TESTED TO ESC-STD-1000

**PANEL CUTOUT**



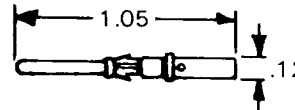
**CONNECTOR RECEPTACLE**



BURNDY BANTAMATE  
 #G2B18-22PNH

Connector plug data on sheet 2

**TERMINAL**



- #16 Formed contacts (.062 diameter), copper alloy, gold-plated, SM16M-1S6, rated 10 amperes - use same installation tools as sockets.
- #16 AWG stranded wire per MIL-W-16878, Teflon Type E or as specified.

ECN #11255  
 3-25-80 IRU KHL  
 REVISIONS: (A)

MADE BY: IRU	12/12/79
APPR. BY: KHL	12/12/79

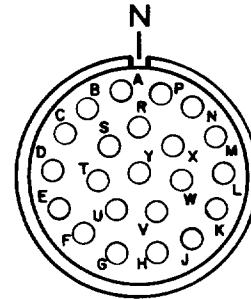
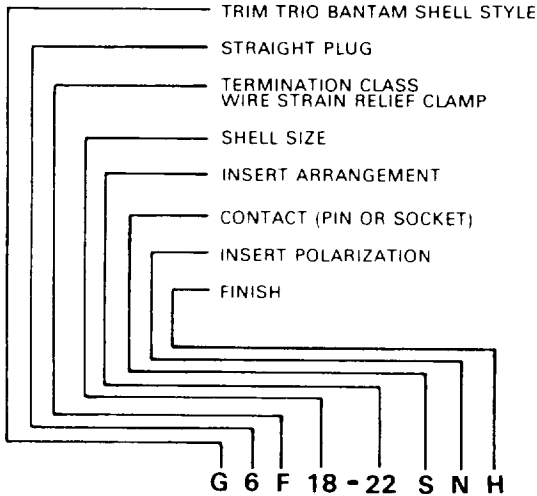
DWG. NO: 264STD-5	REV A
SHEET 1 OF 2	

**TRIM TRIO  
 ROUND  
 CONNECTORS**

**SHELL SIZE 18**

**INSERT ARRANGEMENT, 22 PIN**

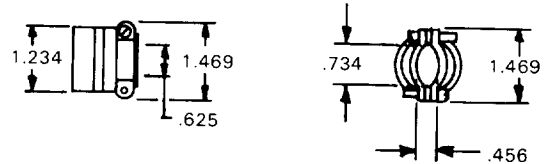
**G6F18-22SNH**



**TERMINATION CLASS F  
 WIRE STRAIN RELIEF CLAMP**

H - CADMIUM PLATE WITH OLIVE CHROMATE CONVERSION COATING AS SPECIFIED IN MIL-C-26482

Plug shown and sockets (same quantity as pins) supplied when specified



**INSTALLATION DATA**

Wire: 20-16AWG per MIL-W-16878

Cable strip length: .250

Installation tools

Die set N16RT-24 for M8ND/Y8ND

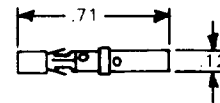
UTM-2 Crimp

Mechanism CM11

Extraction tool RX16-D11

**TERMINAL SOCKET**

**SC16M-1S6**



DIMENSIONS ARE IN INCHES

WIRE TYPES OTHER THAN THOSE NOTED MAY ALSO BE ACCOMMODATED BY CONTACTS ABOVE. CONSULT BURNDY, GIVING WIRE PARTICULARS CONTACTS INSTALLED BY THE UTM-2 AUTOMATIC INSTALLATION MACHINES (FURNISHED 3000 TO A REEL).

PINS AND SOCKETS ARE MADE OF HIGH CONDUCTIVITY COPPER ALLOY.

DWG. NO: **264STD-5**

SHEET **2** OF **2**



**SWITCH**  
 Panel Thickness .09-.25  
 Depth behind panel 6.0

**ACTIONS**

Maintained

Spring-return to Vertical (0°)

\_\_\_\_\_

**OTHER FEATURES**

Slip-contacts

Pull-to-lock

\_\_\_\_\_

**HANDLE POSITIONS**

30°

45°

**HANDLES**

Knurled  Oval

Pistol-grip  None

**NAMEPLATE**

WHITE  
 Black Letters

\_\_\_\_\_

MSC SERIES 10H INDICATOR UNITS (MSC type designations)

10HA2C1J3L  10HA2C2J3L  10HA2C3J3L

10HA2C4J3L  10HA2C11J3L  10HA2C12J3L

Complete MSC Cat. No. that includes segment combination, lamp colors and engravings is listed separately.

**DROPPING RESISTORS**  
 (2800Ω FOR 125VDC)

SUPPLIED

NOT SUPPLIED

**LAMP WIRING**

**LAMP ENGRAVING**

\_\_\_\_\_

**TITLE ENGRAVING**

\_\_\_\_\_

**OTHER**

handle listed separately

**POSITION ENGRAVING**

--	--	--	--	--	--	--	--	--	--

**SHOW JUMPERS TO BE SUPPLIED**

4	3	1	2
●	●	●	●
8	7	5	6
●	●	●	●
12	11	9	10
●	●	●	●
16	15	13	14
●	●	●	●
20	19	17	18
●	●	●	●
24	23	21	22
●	●	●	●

DECK	CONTACTS HANDLE END	POSITIONS							
		1	2	3	4	5	6	7	8
1	1-O-H-O2								
	3-O-H-O4								
2	5-O-H-O6								
	7-O-H-O8								
3	9-O-H-O10								
	11-O-H-O12								
4	13-O-H-O14								
	15-O-H-O16								
5	17-O-H-O18								
	19-O-H-O20								
6	21-O-H-O22								
	23-O-H-O24								

Numbers are switch terminal designations  
 Letters are connector terminal designations

**DOCUMENT CONTROL**  
 Quality Assurance ANSI/ASME NQA-1-1979  
 Qualification ESC-STD-1000

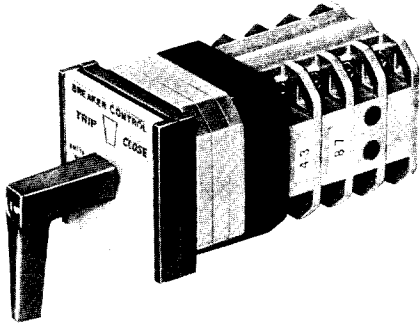
**DRAWING MASTERS**

Module - 264STD-   
 Switch - 20K

REVISIONS

MADE BY:	DATE:	DWG No.
APPR. BY:	DATE:	SHEET OF

Technical Publication MIN-1



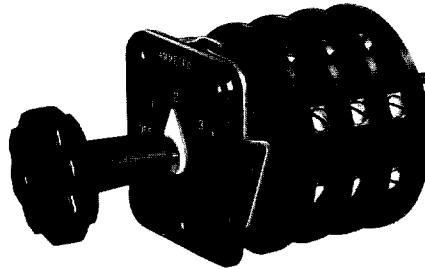
SERIES 20

MINIATURE INSTRUMENT & CONTROL SWITCH

20A-600VAC

1 to 12 decks 2 to 24 contacts

Technical Publication 24-1



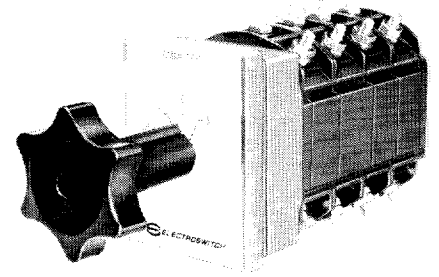
SERIES 24

STANDARD INSTRUMENT & CONTROL SWITCH

20A-120VAC 6A-600VAC

1 to 10 decks 2 to 20 contacts

Technical Publication W-1



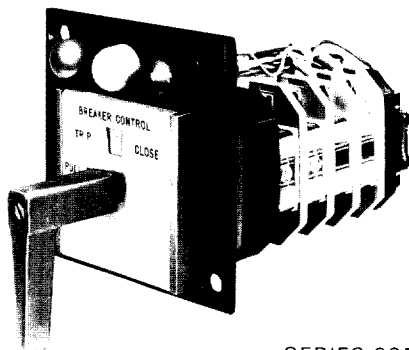
SERIES W2

INSTRUMENT & CONTROL SWITCH

20A-600VAC

1 TO 8 stages 2 to 48 contacts

Technical Publication MIN-1



SERIES 20P

LIGHTED INSTRUMENT & CONTROL SWITCH

20A-600VAC

1 to 12 decks 2 to 24 contacts

**POWER INDUSTRY PRODUCTS**

are qualified by laboratory testing to the following standards:

ANSI/IEEE 323-1984 (Environment)

ANSI/IEEE Std 344-1987 (Seismic)

ANSI/IEEE C37.90-1989 (General)

ANSI/IEEE C37.98-1987 (Seismic)

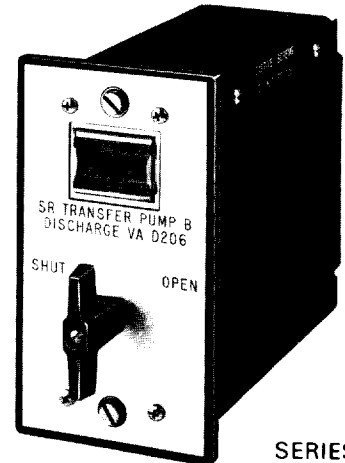
We also conform to:

NRC 10CFR21

NRC 10CFR50, Append. B

ANSI/ASME NQA-1-1986

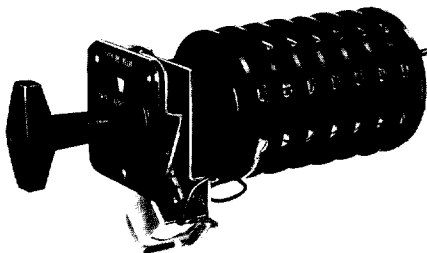
Technical Publication MOD-1



SERIES 20

PLUG-IN MODULE INSTRUMENT & CONTROL SWITCH

Technical Publication LOR-1

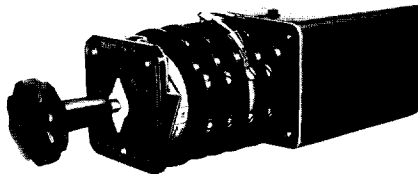


SERIES 24 LOR & LOR/ER

HIGH SPEED TRIP MANUAL & ELECTRIC TRIP RESET LOCK-OUT RELAYS

up to 40 contacts  
8 msec transfer time

Technical Publication SSR-1

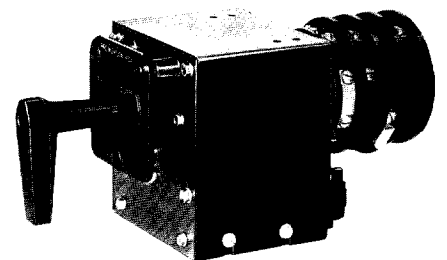


SERIES 24 SSR

ELECTRICALLY OPERATED SELECTOR SWITCH RELAY

Multi-contact auxiliary relay  
2 to 8 positions

Technical Publication CSR-1



SERIES 24 CSR

CONTROL SWITCH RELAY

Replaces manual instrument & control switches  
2 to 20 contacts  
20A-120VAC



**ELECTROSWITCH**  
UNIT OF ELECTRO SWITCH CORP.

180 King Avenue, Weymouth, Massachusetts 02188

Telephone: 617/335/5200 • FAX: 617/335/4253