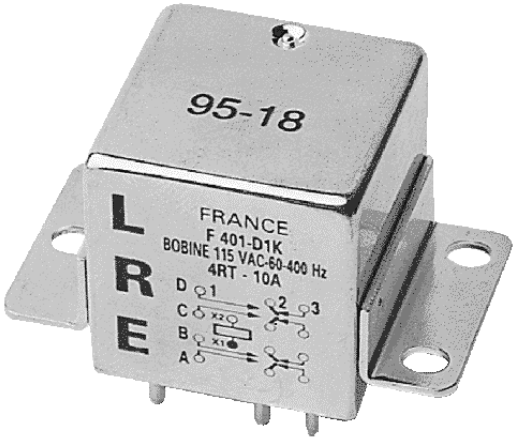
ENGINEERING DATA SHEET

M401

RELAY - NONLATCH
4 PDT, 10 AMP



APPLICATION NOTES:
001
002
007
023

APPLICABLE SOCKETS:
S401
SC40*

Non latching hermetically sealed relay

Contact arrangement	**4 PDT**
Coil supply	**Alternating current**
Meets the requirements of	**MIL-R-6106** **CECC16101-019**

PRINCIPLE TECHNICAL CHARACTERISTICS

Contacts rated at	**10 Amps / 28 Vdc or 115 Vac - 400 Hz**
Weight	**80 grams max**
Dimensions max. of case in mm	**26 x 25.7 x 26**

Balanced-force design

Hermetically sealed, corrosion protected metal can

Intrinsically safe relay

CONTACT ELECTRICAL CHARACTERISTICS

Minimum operating cycles	Contact rating per pole and load type	Load Current in Amps		
		@28 Vdc	@115 Vac, 400 Hz	@115/200 Vac, 400 Hz, 3Ø
100,000 cycles	resistive load	10	10	10
20,000 cycles	inductive load (L/R=5ms)	8	8	8
100,000 cycles	motor load	4	4	4
100,000 cycles	lamp load	2	2	2
50 cycles	resistive overload	40	60	
400,000 cycles	at 25% rated resistive load			

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Fax: (33) 3 87 97 96 86

ASIA
Units 602-603 6/F Lakeside 1
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Pak Shek Kok, Tai Po, N.T.
Hong Kong
Tel: (852) 2 191 3830
Fax: (852) 2 389 5803

Data sheets are for initial product selection and comparison. Contact Esterline Power Systems prior to choosing a component.

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COIL CHARACTERISTICS (Vdc) M401

	Vac / 400 Hz		Vac / 60-400 Hz	
CODE	**E**	**F**	**J**	**K**
Nominal operating voltage	28	115	28	115
Maximum operating voltage	30	124	30	124
Maximum pickup voltage at +125° C	22	90	22	90
Maximum drop-out voltage at -65° C	1.5	5	1.5	5
Maximum coil current in Amps at +25° C	0.225	0.04	0.12	0.028
Temperature range	-65° C to +125 ° C		-45° C to +85 ° C	

GENERAL CHARACTERISTICS

Dielectric strength at sea level	
- Contacts to ground and between contacts	1250 Vrms / 50 Hz
- Coil to ground	1000 Vrms / 50 Hz
Dielectric strength at altitude 25,000 m (all points)	350 Vrms / 50 Hz
Initial insulation resistance at 500 Vdc	100 M Ω min.
Sinusoidal vibration	30G / 75 to 3000 Hz
Shock	200G / 6 ms
Maximum contact opening time under vibration and shock	10 µs
Operate time at nominal voltage	15 ms max
Release time	50 ms max
Bounce time	1 ms max
Contact voltage drop at nominal current	
- initial value	150 mV max
- after life	175 mV max

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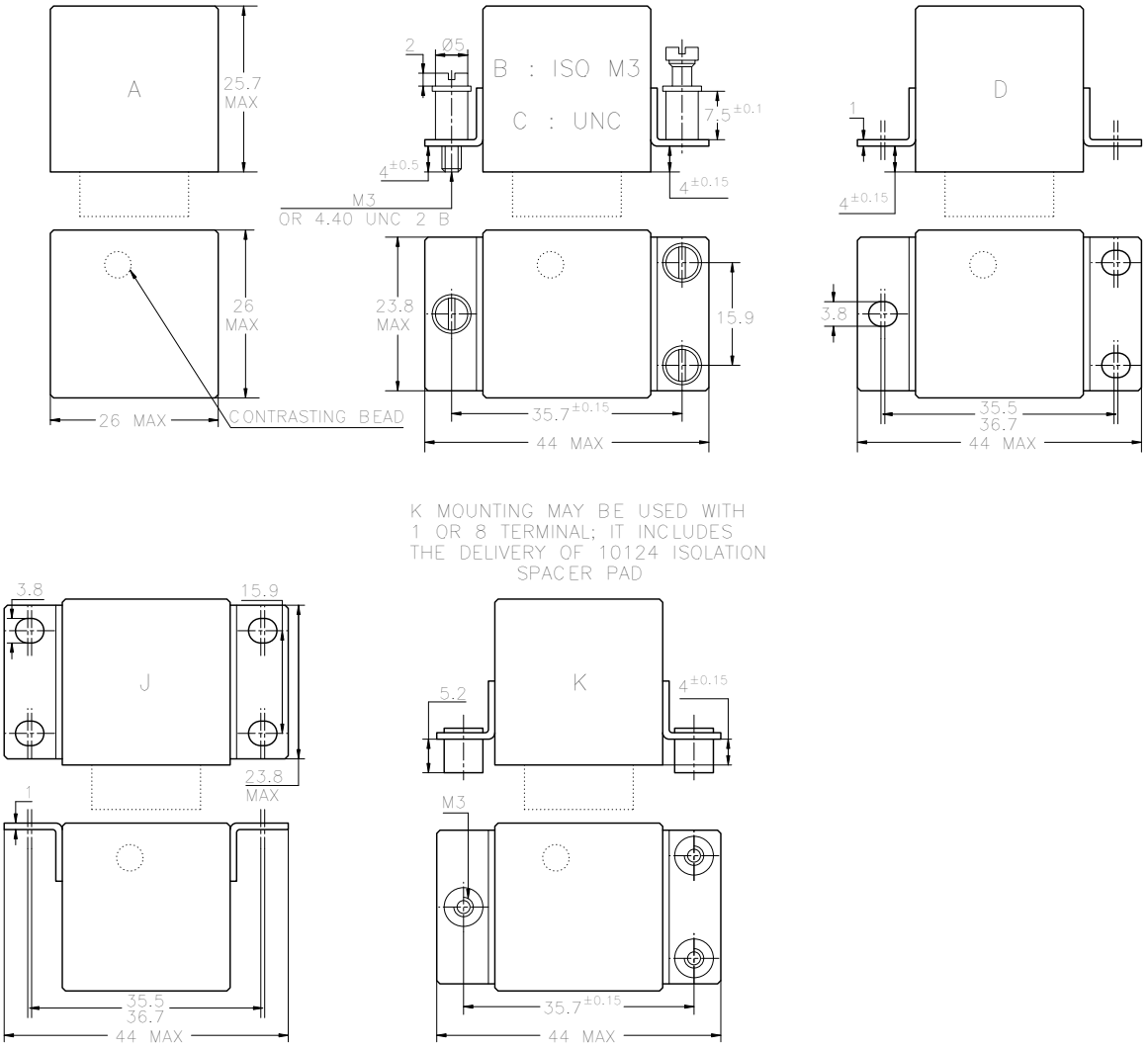
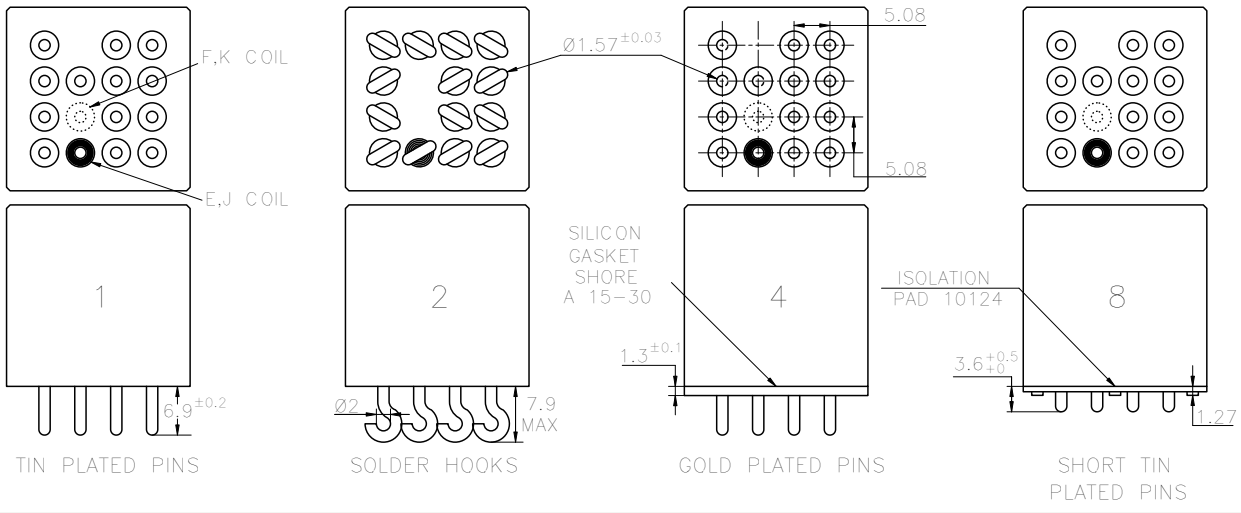


Dimensions in mm

Tolerances, unless otherwise specified, ±0.25mm

TERMINAL TYPES



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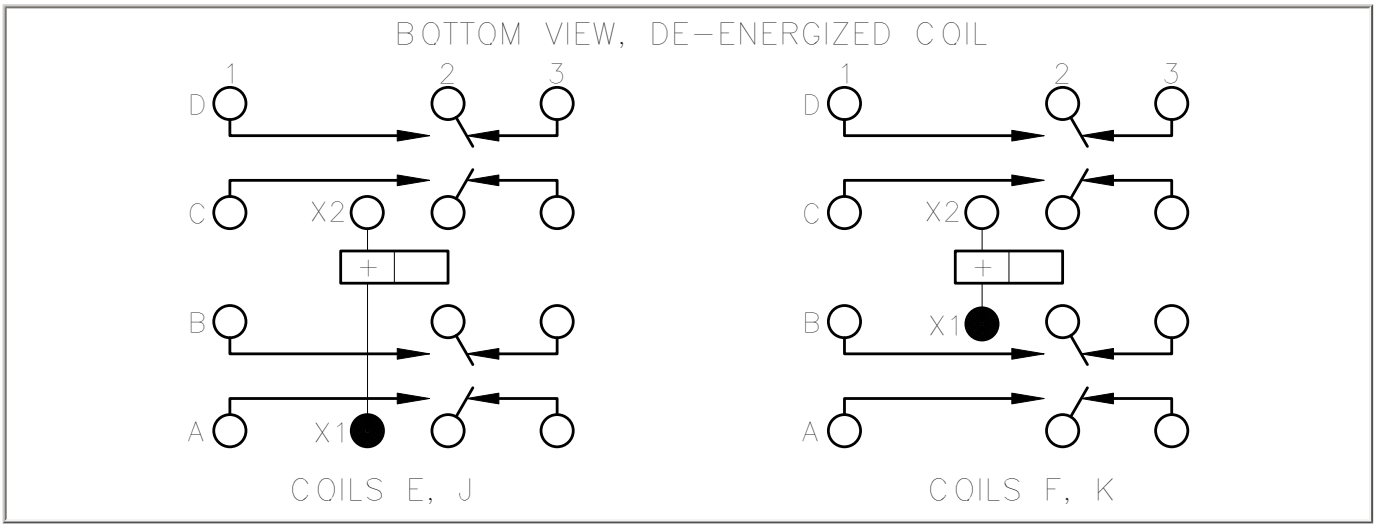

NUMBERING SYSTEM

```
                                                    M401   B   4   E   C   ER
Basic series designation_____________________________|     |   |   |   |   |
1-Mounting Style (A,B,C,D,J,K)_____________________________|   |   |   |   |
2-Terminal Types (1,2,4,8)_________________________________|   |   |   |
3-Coil Voltage (E,F,J,K)___________________________________________|   |   |
4-See Note 4 Below_________________________________________________________|   |
5-See Note 5 Below_________________________________________________________________|
```

NOTES

1. Relays with mounting styles B,C,D and terminal type 4 are compatible with socket families S401, SF401...
2. Isolation spacer pads for PCB mounting available on request.
3. For other mounting styles or terminal types, please contact the factory.

[4]. **Options**

- **C:** Circuit breaker compatibility 15 A / 1 hour; 50 A / 5 sec; 100 A / 1.2 sec 250 A / 0.2 sec; 350 A /0.1 sec
- **H:** High current version, 15 Amps resistive contact rating
- **D:** low level: 1 mAmp / 30 mV

[5]. **Quality level:**

- **006:** Qualified to CECC16303-802
- **ER:** Please contact factory.

TYPICAL CHARACTERISTICS

- Coil resistance/temperature change: See application note no. 001
- Life expectancy for loads other than 28Vdc: See application note no. 002

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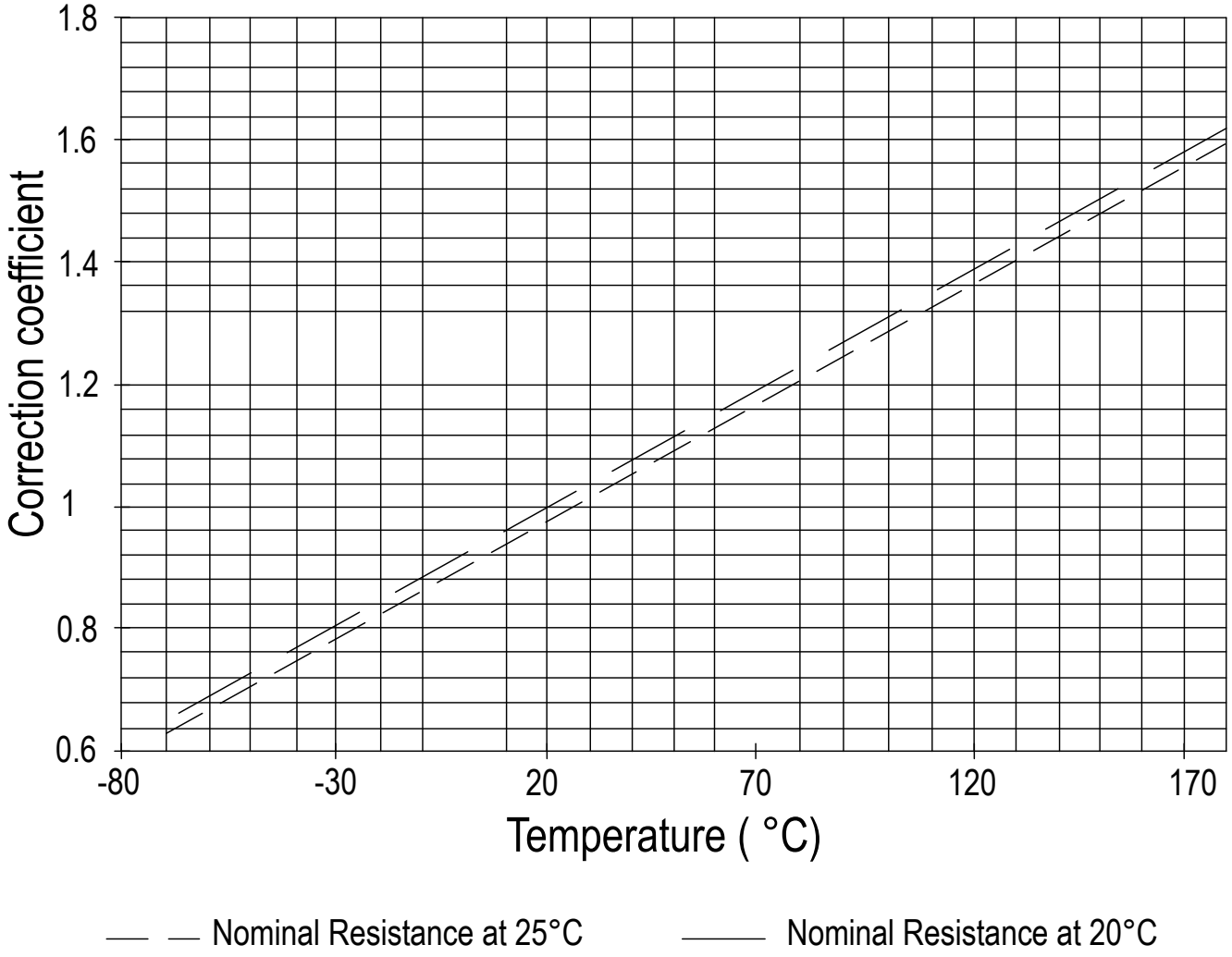
CORRECTION DUE TO COIL COPPER WIRE RESISTANCE CHANGE IN TEMPERATURE



Example: Coil resistance at 25°C: 935 ohms. What is it at 125°C?
Correction coefficient on diagram is: 1.39 at 125°C. R becomes: 935x1.39=1299 Ohms

Correction also applies to operating voltages

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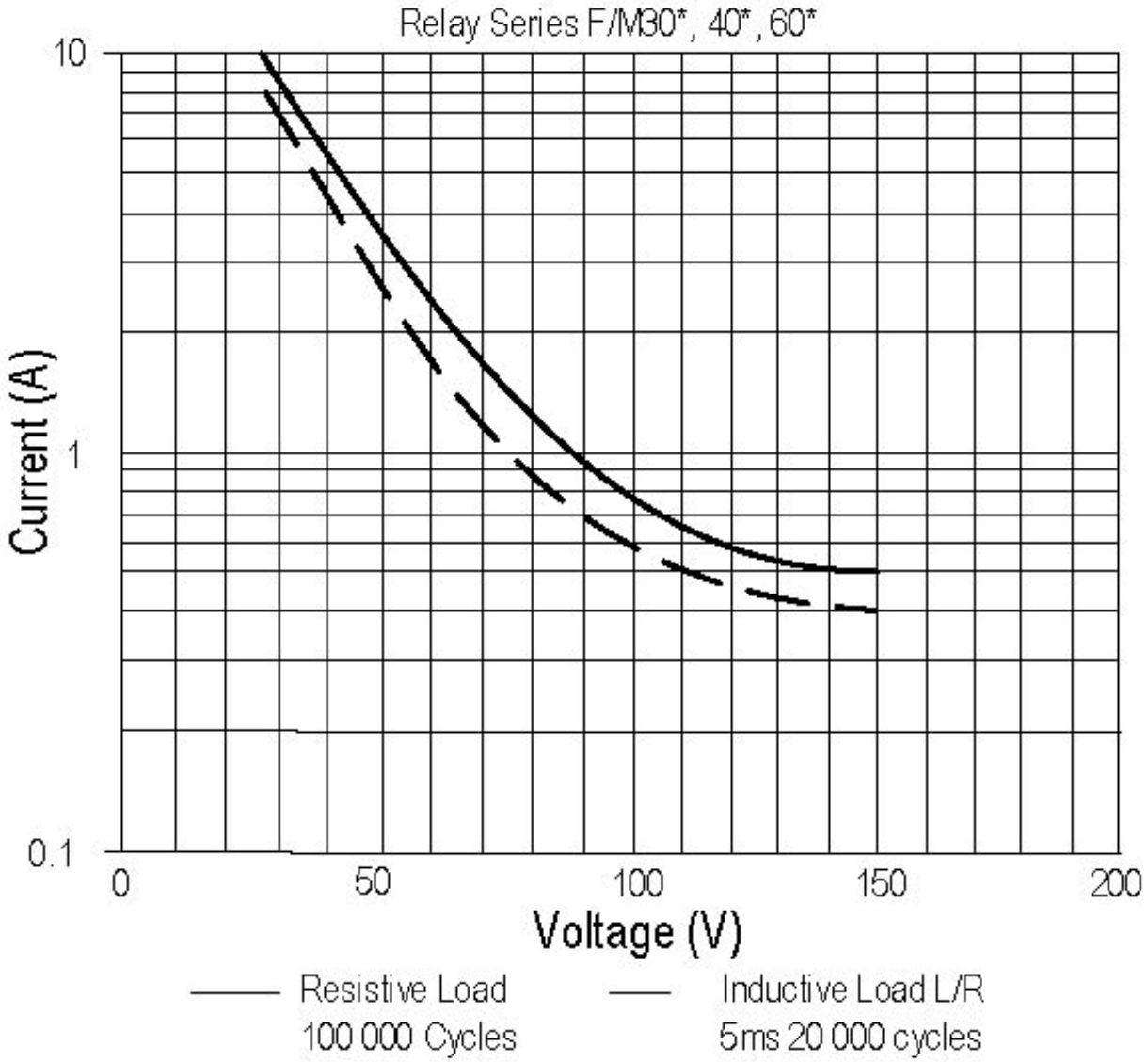
LIFE CAPABILITY VERSUS VOLTAGE



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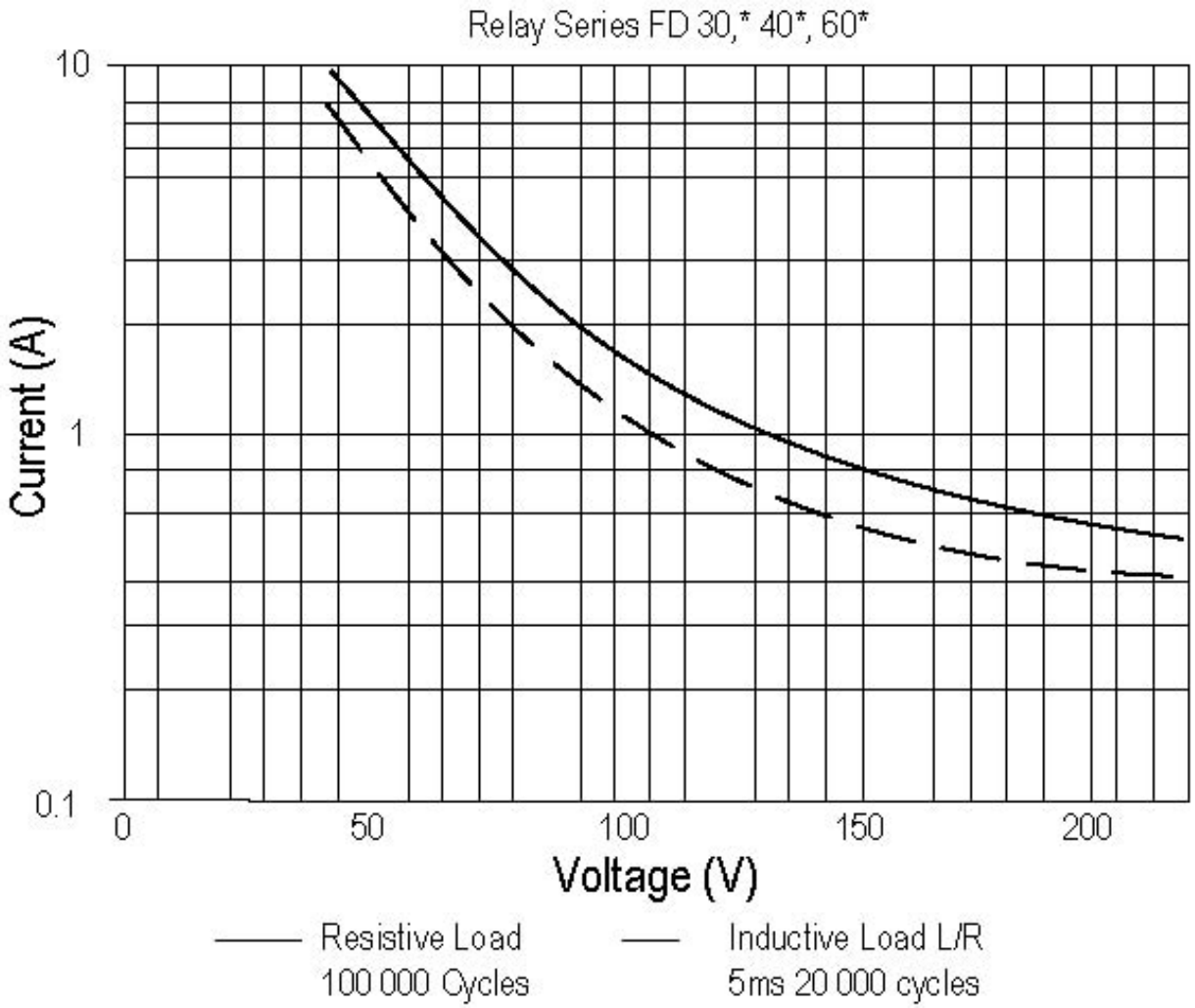
LIFE CAPABILITY VERSUS VOLTAGE



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SUPPRESSOR DEVICES FOR RELAY COILS

The inductive nature of relay coils allows them to create magnetic forces which are converted to mechanical movements to operate contact systems. When voltage is applied to a coil, the resulting current generates a magnetic flux, creating mechanical work. Upon deenergizing the coil, the collapasing magnetic field induces a reverse voltage (also known as back EMF) which tends to maintain current flow in the coil. The induced voltage level mainly depends on the duration of the deenergization. The faster the switch-off, the higher the induced voltage.

All coil suppression networks are based on a reduction of speed of current decay. This reduction may also slow down the opening of contacts, adversly effecting contact life and reliability. Therefore, it is very important to have a clear understanding of these phenomena when designing a coil suppression circuitry.

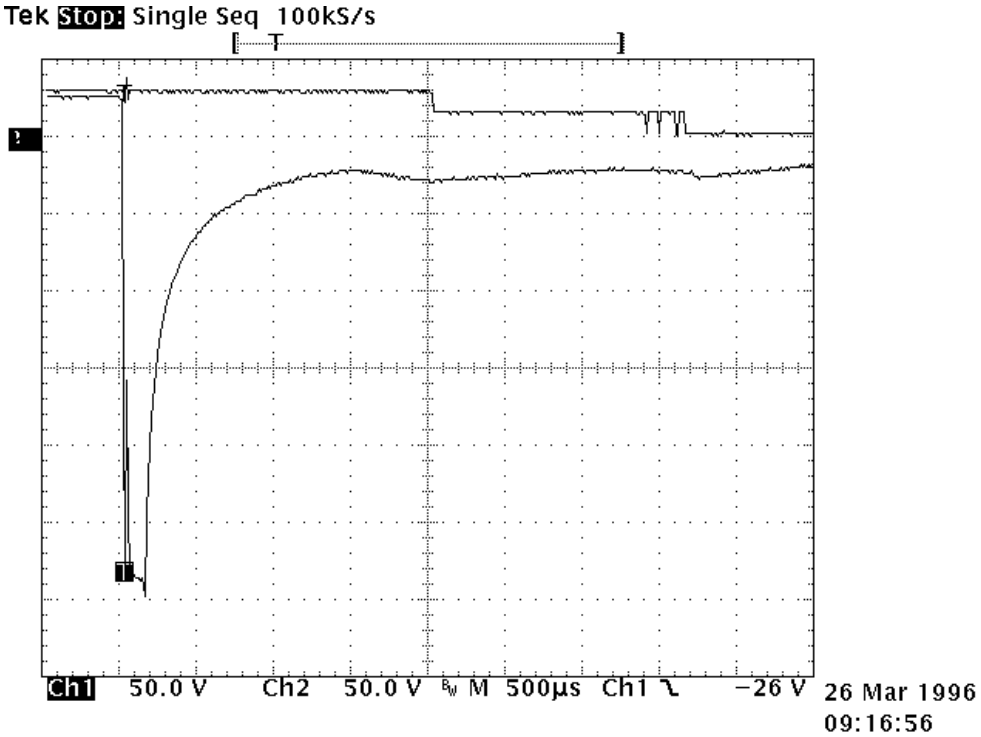
Typical coil characteristics

On the graph below, the upper record shows the contacts state. (High level NO contacts closed, low level NC contacts closed, intermediate state contact transfer). The lower record shows the voltage across the coil when the current is switched off by another relay contact.

The surge voltage is limited to -300V by the arc generated across contact poles. Discharge duration is about 200 mircoseconds after which the current change does not generate sufficient voltage. The voltage decreases to the point where the contacts start to move, at this time, the voltage increases due to the energy contained in the NO contact springs. The voltage decreases again during transfer, and increases once more when the magnetic circuit is closed on permanent magnet.

Operating times are as follows:
Time to start the movement 1.5ms
Total motion time 2.3ms
Transfer time 1.4ms

Contact State



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Types of suppressors:

Passive devices.

The resistor capacitor circuit

It eliminates the power dissipation problem, as well as fast voltage rises. With a proper match between coil and resistor, approximate capacitance value can be calculated from:

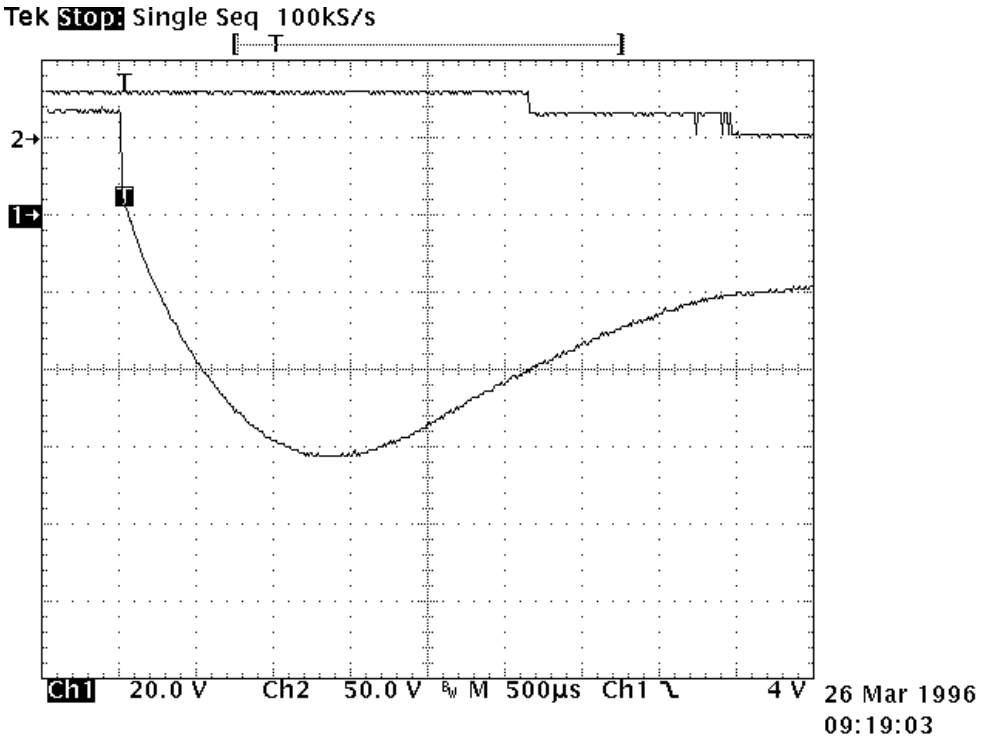
C = 0.02xT/R, where

T = operating time in milliseconds
R = coil resistance in kiloOhms
C = capacitance in microFarads

The series resistor must be between 0.5 and 1 times the coil resistance. Special consideration must be taken for the capacitor inrush current in the case of a low resistance coil.

The record shown opposite is performed on the same relay as above. The operation time becomes:
- time to start the movement 2.3ms
- transfer time 1.2ms

The major difficulty comes from the capacitor volume. In our example of a relay with a 290 Ω coil and time delay of 8 ms, a capacitance value of C=0.5 uF is found. This non polarized capacitor, with a voltage of 63V minimum, has a volume of about 1cm^3. For 150V, this volume becomes 1.5 cm^3.



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The bifilar coil

The principle is to wind on the magnetic circuit of the main coil a second coil shorted on itself. By a proper adaptation of the internal resistance of this second coil it is possible to find an acceptable equilibrium between surge voltage and reduction of the opening speed. To be efficient at fast voltage changes, the coupling of two coils must be perfect. This implies embedded windings. The volume occupied by the second coil reduces the efficiency of the main coil and results in higher coil power consumption. This method cannot be applied efficiently to products not specifically designed for this purpose.

The resistor (parallel with the coil)
For efficient action, the resistor must be of the same order of magnitude as the coil resistance. A resistor 1.5 times the coil resistance will limit the surge to 1.5 times the supply voltage. Release time and opening speed are moderately affected. The major problem is the extra power dissipated.

Semi-conductor devices

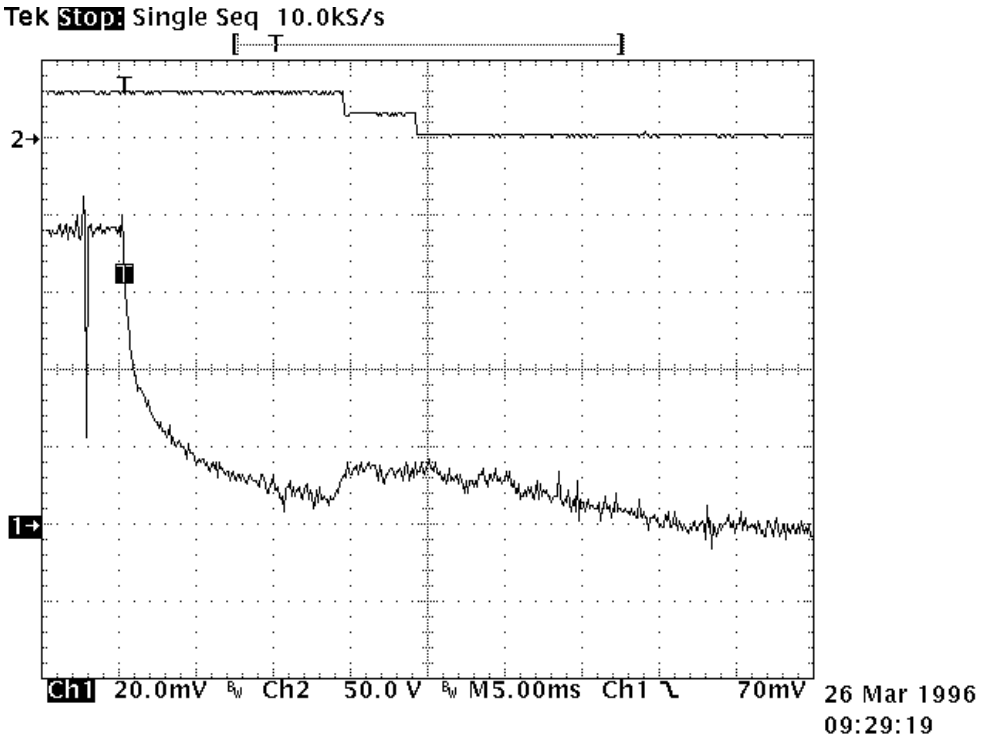
The diode

It is the most simple method to totally suppress the surge voltage. It has the major disadvantage of the higher reduction of contact opening speed. This is due to the total recycling, through the diode, of the energy contained in the coil itself. The following measurement is performed once again on the same relay. Operation times are given by the upper curve:

- time to start the movement 14ms
- transfer time 5ms

These times are multiplied by a coefficient from 4 to 8.
The lower curve shows the coil current. The increase prior to NO contact opening indicates that the contact spring dissipates its energy. At the opening time the current becomes constant as a result of practically zero opening speed.

Due to this kind of behavior, this type of suppression must be avoided for power relays. For small relays which have to switch low currents of less than 0.2 A, degradation of life is not that significant and the method may be acceptable.



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The diode + resistor network

It eliminates the inconvenience of the resistor alone, explained above, and it limits the action of a single diode. It is now preferred to used the diode + zener network.

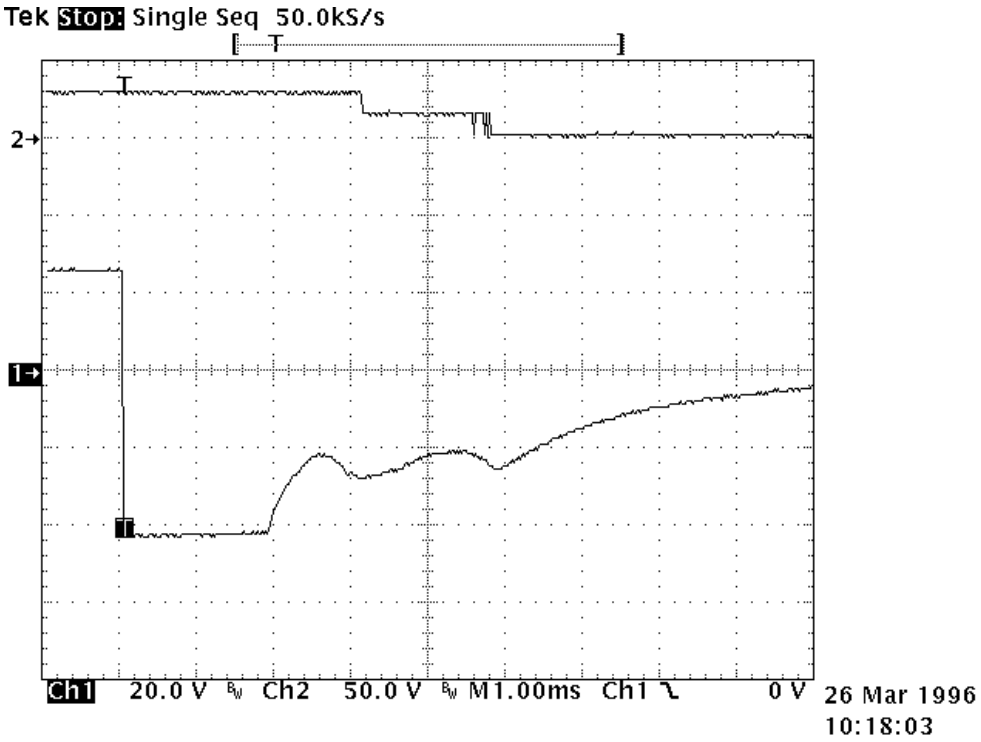
The diode + zener network

Like the resistor, the zener allows a faster decurrent decay. In addition it introduces a threshold level for current conduction which avoids the recycling of energy released during contact movement.

The lower curve on the opposite record demonstrates those characteristics. Voltage limitation occurs at 42V. The two voltages spikes generated by internal movement are at lower levels than zener conduction. As a result, no current is recycled in the coil.

The opening time phases are as follows:
- time to start the movement 2.6ms
- total motion time 2.4ms
- transfer time 1.4ms

The release time is slightly increased. The contacts' opening speed remains unchanged.



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MOUNTING DISTANCE BETWEEN RELAYS
Applicable to M2XX / M3XX / M4XX / M5XX

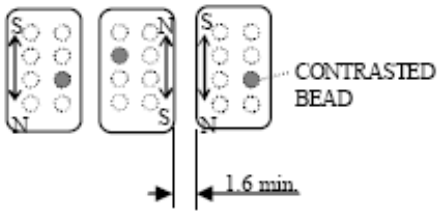
Definition and applicability

This application note defines the minimum distance between relays to maintain the whole performances of the relays as given in our data sheets.

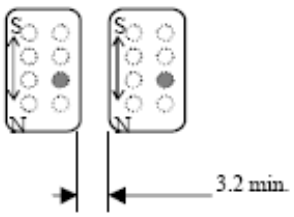
Phenomenon analysis

Each relay generates a magnetic field either when relay is de-energised because of the permanent magnet or in the energised position because of permanent magnet and coil. The magnetic field generated by one relay could affect the performance of another relay when the below minimum distance between relay is not respected. If the relays are mounted adjacent to each other, it is advisable to alternate direction of magnetic path on every other unit and to keep a 1.6 mm space between relays, figure “A”. Or when mounted in the same direction, separate each relay from the other by 3.2 mm, figure “B”. If two or more rows of relays are installed, allow clearance of 3.2 mm between rows, figures “C” and “D”. Provide 4.8 mm space between relays if used in opposition, figure “E”. Distance in millimetre.

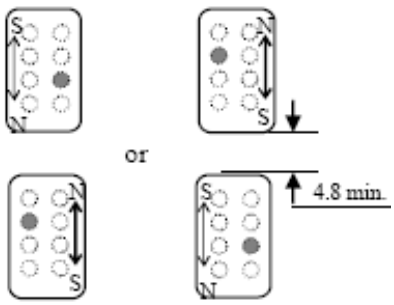
« A »



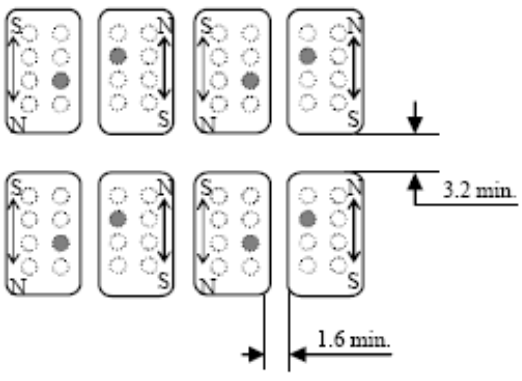
« B »



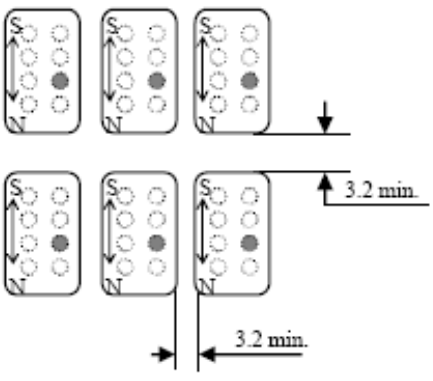
« E »



« C »



« D »



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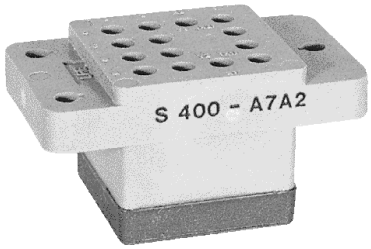
ENGINEERING DATA SHEET

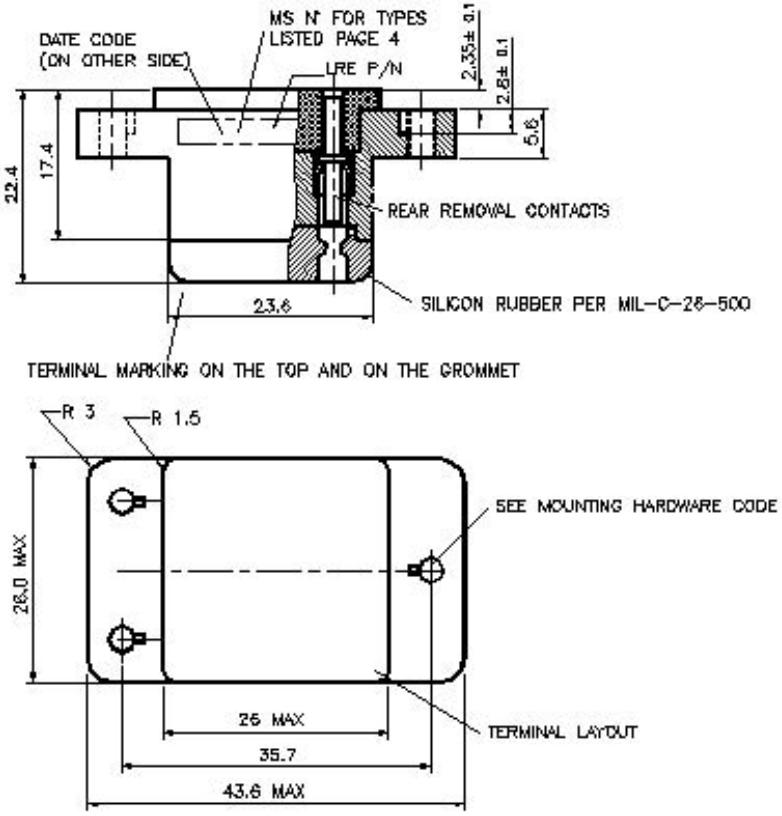
S400, S401, S402

SOCKET FOR RELAYS
10 AMP



BASIC SOCKET SERIES DESIGNATION FOR:

Series M400 (DC Coil), M401 (AC Coil),
M402 (DC Coil), FLS402, T402, T412, T441, VS400, CS400



GENERAL CHARACTERISTICS

Crimp tool contact	M 22520/1-01 with turret M 22520/1-02 or MS 3191-1.
Insertion and extraction tool	NAS 1664-16.
Weight	35g max.
Temperature range	-70° C to +125° C.

This connection is designed to the standards and requirements of MIL-S-12883
Contacts and hardware to be delivered disassembled in a plastic bag.
Tolerances, unless otherwise specified, ±0.25mm.

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Fax: (852) 2 389 5803

Data sheets are for initial product selection and comparison. Contact Leach International prior to choosing a component.

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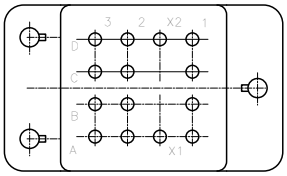
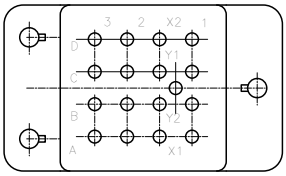
CODE S400



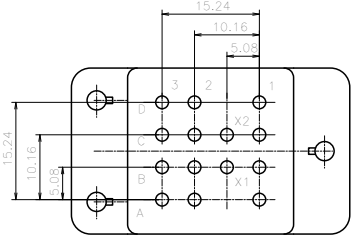
POSITION, TOLERANCE SEE CODE B
FOR M400 RELAY

CODE D S402



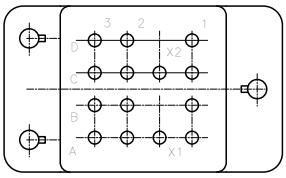
POSITION, TOLERANCE SEE CODE B
FOR M402 RELAY

CODE B S401



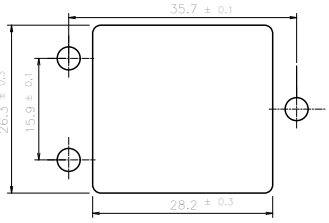
FOR M401 RELAY, FOR K COIL

CODE C S401



FOR M401 RELAY, FOR J COIL

MOUNTING HOLE LAYOUT

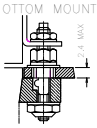


FOR HOLE CLEARANCE,
SEE HARDWARE CODE

MOUNTING HARDWARE

CODE 1 : 05-284-12

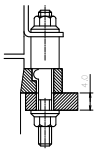
LOOSE UNC HARDWARE
BOTTOM MOUNT



MOUNTING TORQUE
NUT 4/40:0,45 ±0,1 Nm
NUT 10-32:1,2 MAX
:3,6 mm

CODE 2 : 05-284-00

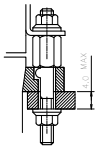
LOOSE METRIC HARDWARE
TOP MOUNT



MOUNTING TORQUE:0,45 ±0,1 Nm
:3,6 mm

CODE 3 : 05-284-07

LOOSE METRIC HARDWARE
TOP MOUNT

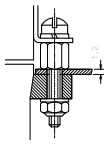


MOUNTING TORQUE:0,45 ±0,1 Nm
:3,6 mm

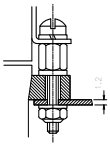
CODE 6 : 05-284-13

UNC HARDWARE

BOTTOM MOUNT



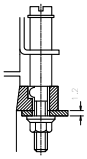
TOP MOUNT



MOUNTING TORQUE:0,45 ±0,1 Nm
MOUNTING HOLE:3,6 mm MOUNTING HOLE:3,6 mm

CODE 7 : 05-284-15

METRIC HARDWARE
TOP MOUNT

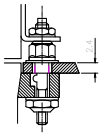


MOUNTING TORQUE:0,45 ±0,1 Nm
FOR RELAYS WITH CODE B TERMINALS
MOUNTING HOLE:3,6 mm

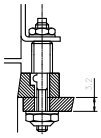
CODE 8 : 05-284-20

LOOSE UNC STUDS MIL-S-12883/41 - EDIT C

BOTTOM MOUNT



TOP MOUNT

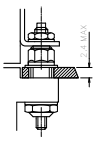


MOUNTIONG TORQUE: NUT 4/40:0,45 ±0,1 Nm - NUT 10-32: 1,2 MAX
MOUNTING HOLE: 5,3 mm MOUNTING HOLE: 3,6 mm

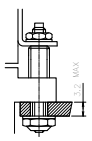
CODE 9 : 05-284-21

FIXED UNC STUDS PER MIL-S-12883/41 - EDIT C

BOTTOM MOUNT



TOP MOUNT



MOUNTING TORQUE: NUT 4/40:0,45 ±0,1 Nm - NUT 10-32: 1,2 MAX
MOUNTING HOLE: 5,3 mm MOUNTING HOLE: 3,6 mm

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Code A	Code B
Recommended for contact code 2 contact code 8 **Diameter: 1.2 .....2.4mm**	Recommended for contact code 3 contact code 9 **Diameter: 0.8 .....1.6mm**

CONTACT SIZE AND STYLE

	Code 2 05 911 00 Crimpend to accomodate AWG16-18-20 Contact mating end #16	Code 3 05 911 10 Crimpend to accomodate AWG20-22-24 Contact mating end #16
Code 0 Without contacts	Code 8 30 315 00 Crimpend to accomodate AWG16-18-20 MIL-C-39029/92-533 Bin Code colour bands or Bin Code numbering on crimpside Contact mating end #16	Code 9 30 315 10 Crimpend to accomodate AWG20-22-24 MIL-C-39029/92-534 Bin Code colour bands or Bin Code numbering on crimpside Contact mating end #16

SOCKET NUMBERING SYSTEM

```
                                        S400  A   1   A    2
1-Basic socket designation_____________|   |   |   |    |
2-Terminal Layout______________________|   |   |   |    |
3-Mounting Hardware____________________|   |   |    |
4-Grommet to seal on wire insulation___|   |    |
5-Contact size and style_______________|
```


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	MS - Number	LEACH P/N	Contacts to accomodate wire #		Applicable for relays
MIL-S-12883/40	-01	S400-A6A2	16-18-20	Loose terminals Above/below panel mounting	M400-D4A /-L/-N/-B/-C
	-05	S400-A6B3	20-22-24		
	-02	S401-B6A2	16-18-20		M 401-D4F/-K
	-03	N/A	N/A		N/A
	-04	S401-C6A2	16-18-20		M 401-D4E/-J
	MS - Number	**LEACH P/N**	**Contacts to accomodate wire #**		**Applicable for relays**
MIL-S-12883/40B	-13	S400-A1A2	16-18-20	Loose terminals below panel mounting	M400-D4A /-L/-N/-B/-C
	-17	S400-A1B3	20-22-24		
	-14	S401-B1A2	16-18-20		M 401-D4F/-K
	-16	S401-C1A2	16-18-20		M 401-D4E/-J
	MS - Number	**LEACH P/N**	**Contacts to accomodate wire #**		**Applicable for relays**
MIL-S-12883/40C	-13S	S400-A8A8	16-18-20	Loose terminals Above/below panel mounting	M400-D4A /-L/-N/-B/-C
	-17S	S400-A8B9	20-22-24		
	-14S	S401-B8A8	16-18-20		M401-D4F/-K
	to be determined	S401-C8A8	16-18-20		M401-D4E/-J
	-18S	S402-D8A8	16-18-20		M402-D4A/ -L/-N/-B/-C
MIL-S-12883/40C	-19S	S400-A9A8	16-18-20	Fixed terminals Above/below panel mounting	M400-D4A /-L/-N/-B/-C
	-23S	S400-A9B9	20-22-24		
	-20S	S401-B9A8	16-18-20		M 401-D4F/-K
	to be determined	S401-C9A8	16-18-20		M 401-D4E/-J
	-24S	S402-D9A8	16-18-20		M 402-D4A/ -L/-N/-B/-C

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ENGINEERING DATA SHEET

SC30*, SC40*

SOCKET FOR 2 OR 4 POLE
10 AMP

2 POLE

4 POLE

SNAP AND LOCK SOCKET SERIES DESIGNATION FOR:

SERIES M300, M301, M302, M400, M401, M402, T402, T412

DESIGNED TO THE STANDARDS AND REQUIREMENTS OF:

2-pole, 10A relays	**MIL-PRF-12883/41**
Mates with	**M83536, M83726 and MS27709**
4-pole, 10A relays	**MIL-PRF-12883/40**
Mates with	**M83536**

FEATURES

Low profile
Bottom panel mount
Snaps into panel
Other models available

MATERIALS

Socket body	**Polyetherimide per MIL-P-46184**
Grommet	**Silicone rubber per ZZ-R-765**
Hardware	**Stainless Steel**
Contacts	**Copper alloy, hard gold plated per MIL-G-45204**
Contact retainers	**Beryllium copper**

GENERAL CHARACTERISTICS

Insulation resistance	1000 M Ω min.
Dielectric withstanding voltage	1500 VRMS sea level; 500 VRMS at 25,000 m
Weight	15.3g max.
Temperature range	-65°C to +125°C
Vibration	MIL-STD-202, Method 204, Test Condition G
Shock	MIL-STD-202, Method 213, Test Condition C

This socket is designed to snap and lock into a panel to reduce hardware requirement and mounting time. Contacts and hardware are provided disassembled in a plastic bag. Standard tolerances are ±.025mm unless otherwise noted.

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Room 501, 5/F, The Centre Mark
287 - 299 Queen's Road Central
Hong Kong
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Fax: (852) 2 389 5803

Data sheets are for initial product selection and comparison. Contact Leach International prior to choosing a component.

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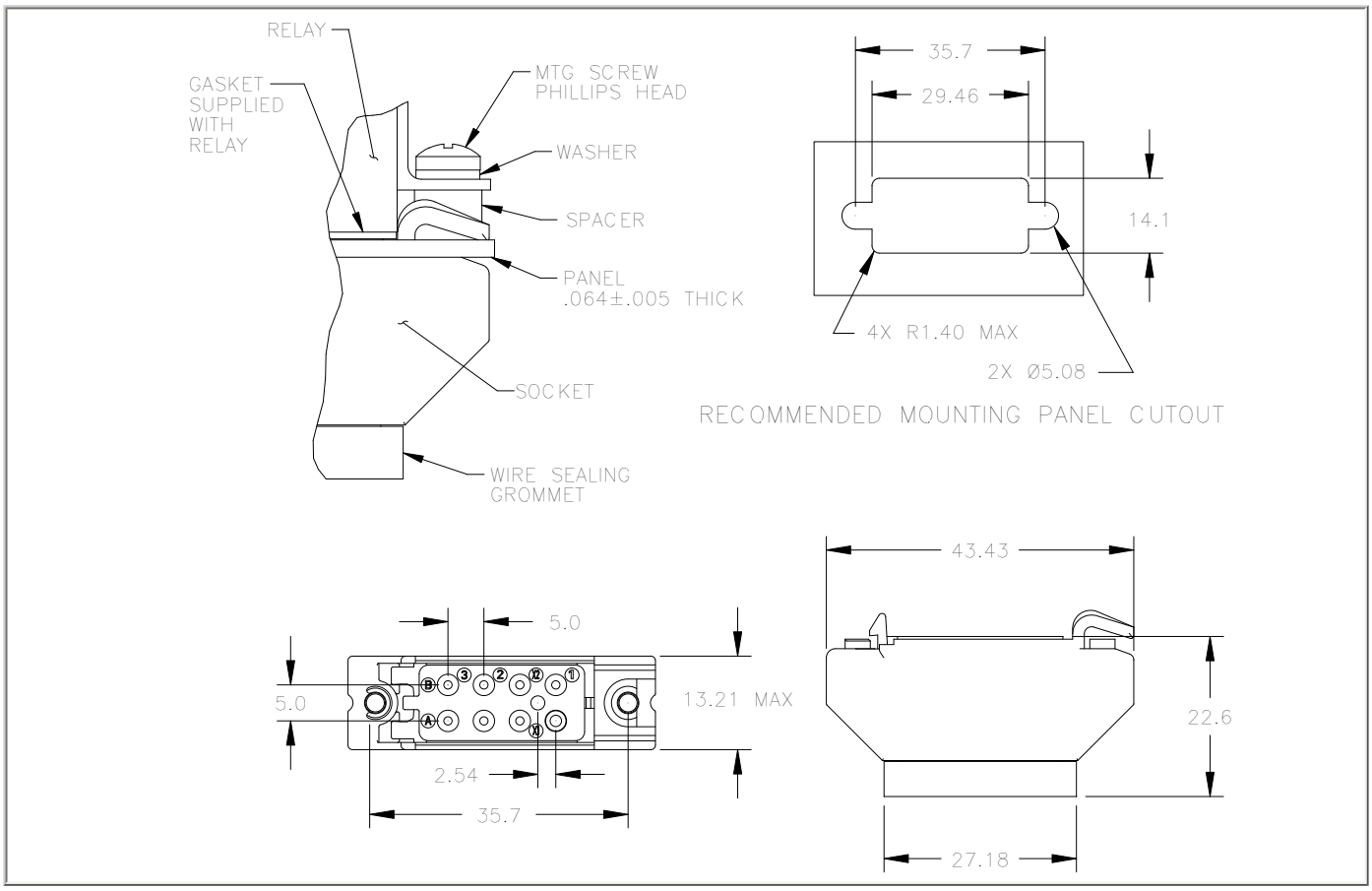
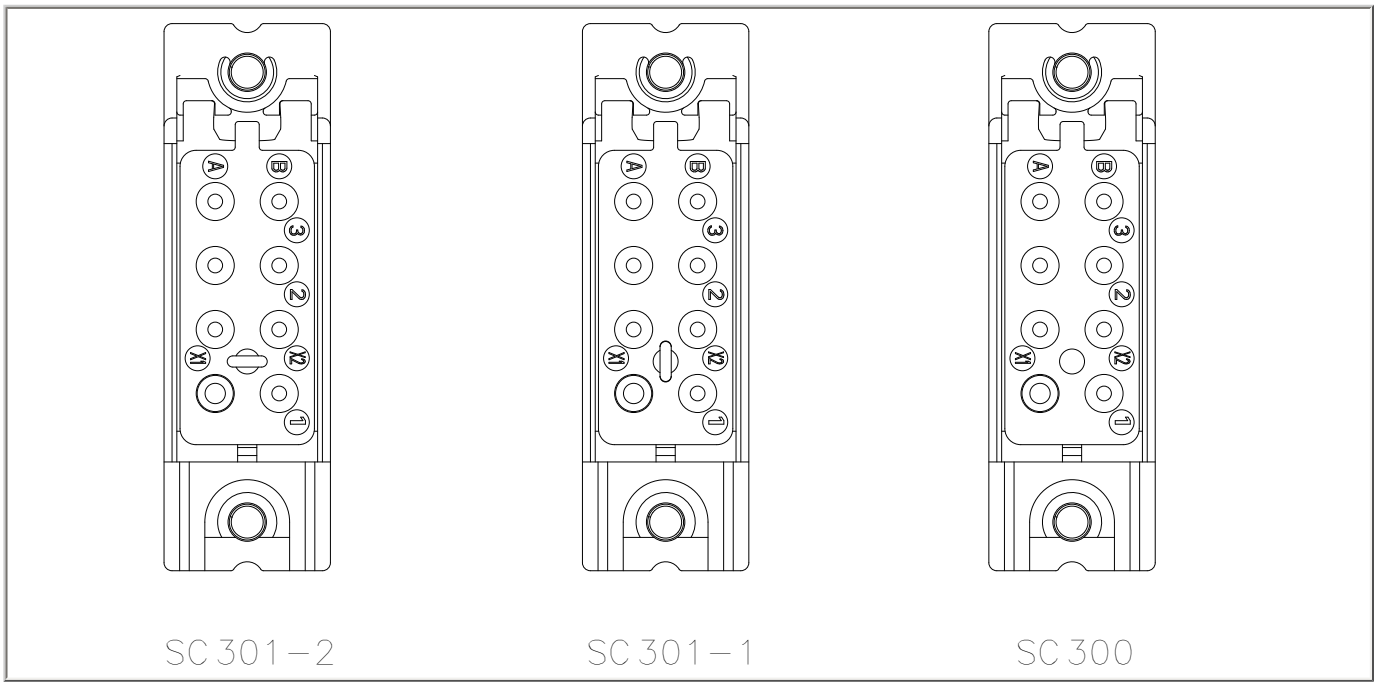
SOCKET DIMENSIONS

SC30* (2 POLE)



TERMINAL LAYOUT



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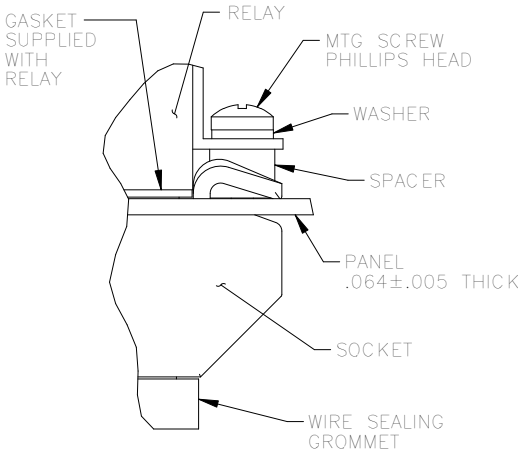
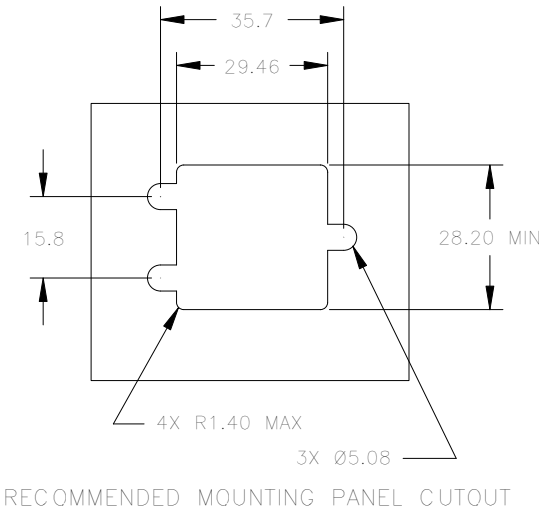
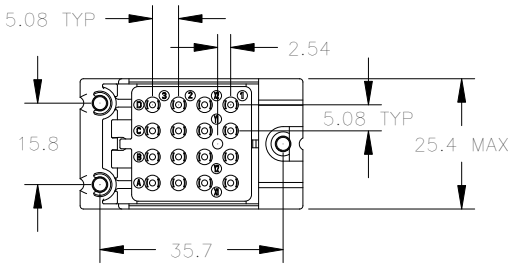
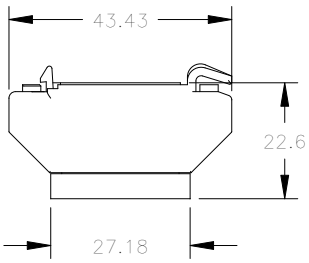


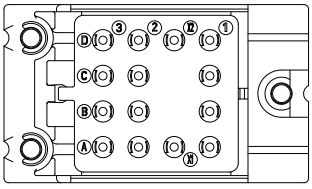


RECOMMENDED MOUNTING PANEL CUTOUT

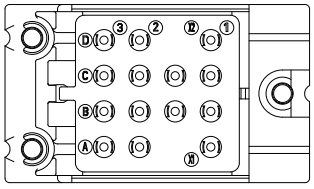




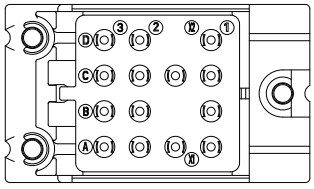
TERMINAL LAYOUT



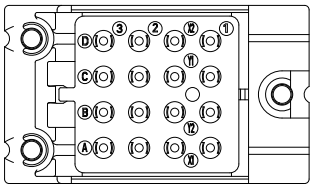
SC400



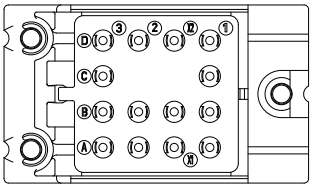
SC401–1



SC401–2



SC402



SCTDX–1

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```
                                                SC  300  01
1-Basic socket snap lock designation_____________|   |   ||
2-Mating relay (M300, M301, M302, M400, M401_____|   |   ||
2-Hardware (0=less hardware, 1=with hardware)_____________||
3-Contacts (0=less contacts, 1=with contacts)_____________|
```


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