APPLICATION NOTES:
001
007

APPLICABLE SOCKET:
SO-1064-10444/10445

Contact arrangement	**2 PDT**
Designed to the performance standards of	**MIL-PRF-83536 CECC16303-803**

PRINCIPLE TECHNICAL CHARACTERISTICS

Contacts rated at	**Low level, 28 Vdc and 115/200 Vac, 400Hz 3Ø, case grounded**
Weight	**15 grams max**
Dimensions max. of case in mm	**20.6 x 19.3 x 10.4**

Special models available upon request
Hermetically sealed, corrosion resistant metal can.

CONTACT ELECTRICAL CHARACTERISTICS

Contact rating per pole and load type [1]	Load current in Amps		
	@28 Vdc	**@115 Vac, 400 Hz 1Ø**	**@115/200 Vac, 400 Hz 3Ø**
Resistive	5	5	5
Inductive [2]	3	5	5
Motor	2	3	3
Lamp	1	1	-
Overload	20	30	30
Rupture	25	40	40
Low level [3]	-	-	-
Time current characteristics [4]	-	-	-

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

	Vac 400 Hz	Vac 50 thru 400 Hz	
CODE	F	J	K
Nominal operating voltage	115	28	115
Maximum operating voltage	122	30	122
Maximum pickup voltage			
- Cold coil at +85° C	90	23	95
- During high temp test at +85° C	95.4	24.6	100
- During continuous current test at +85° C	103.5	25.9	105
Maximum drop-out voltage	30	10	30
Coil current maximum milliAmperes at +25° C	40	100	24

GENERAL CHARACTERISTICS
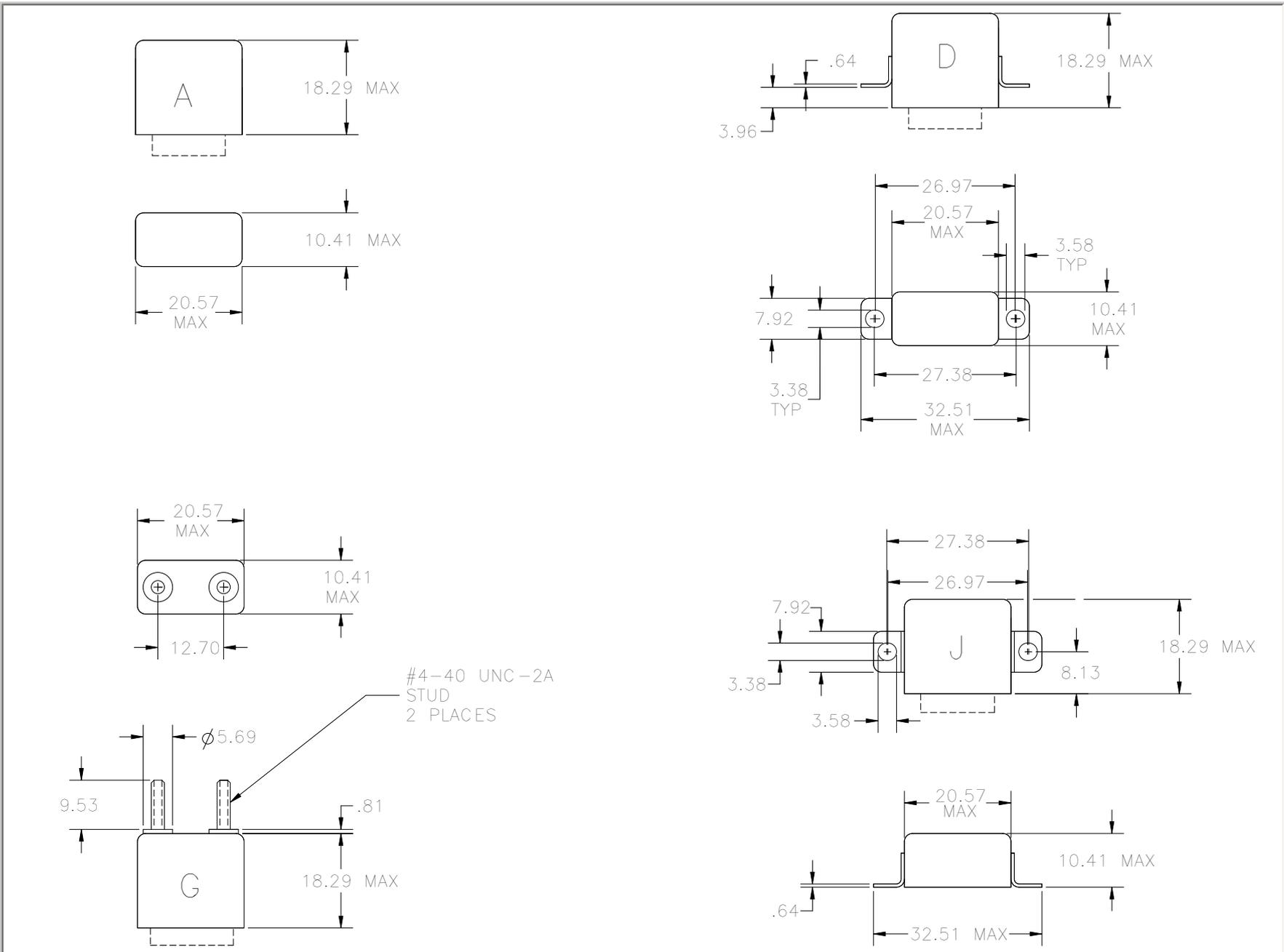
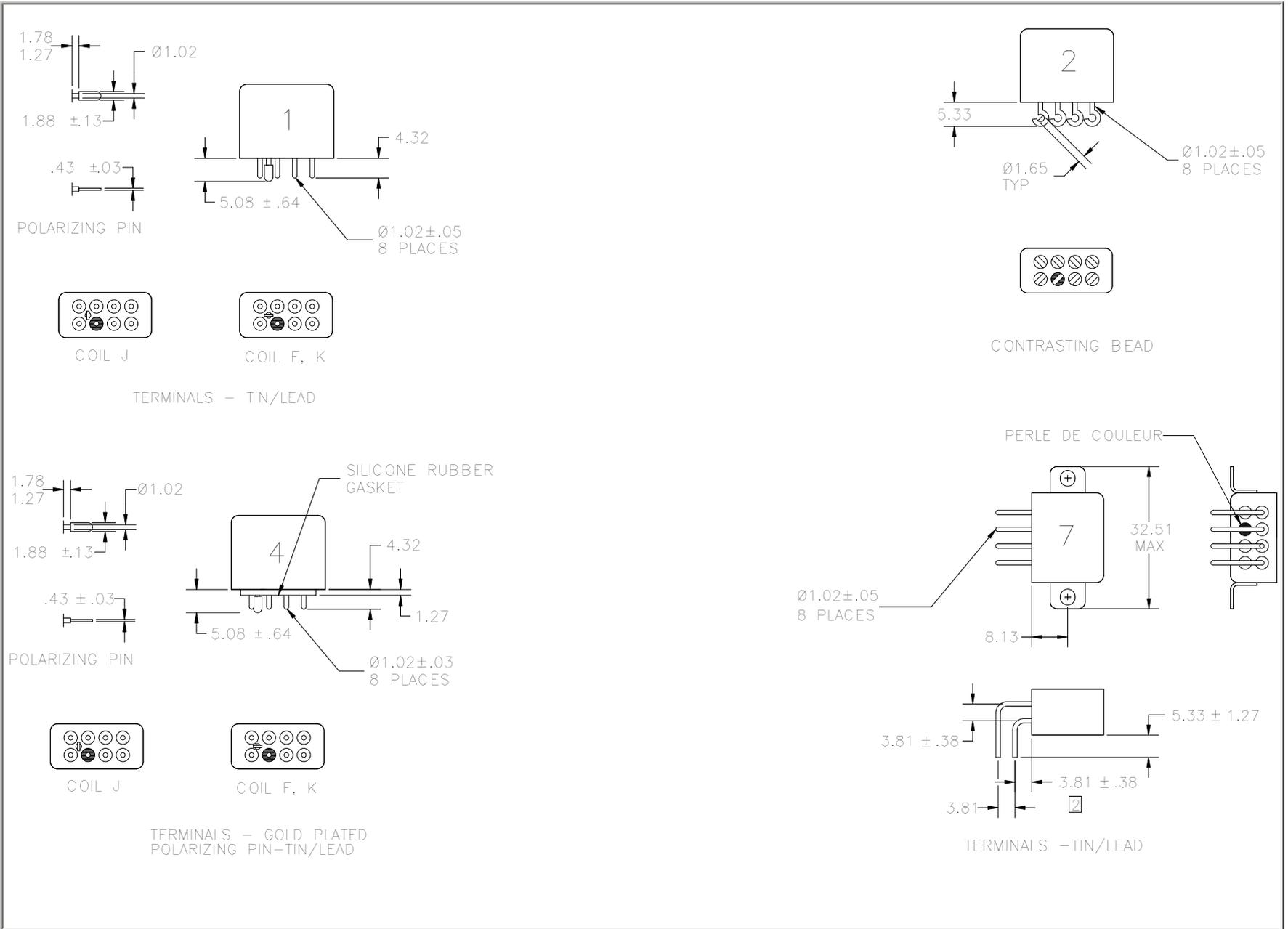|	
Temperature range	-70°C to +85°C
Minimum operating cycles (life) at rated load	50,000 [2]
Minimum operating cycles (life) at 25% rated load	200,000
Dielectric strength at sea level	
- All circuits to ground and circuit to circuit	1000 Vrms
- Coil to ground	1000 Vrms
Dielectric strength at altitude 25,000 m	500 Vrms [5]
Insulation resistance	
- Initial (500 Vdc)	100 M Ω min
- After environmental tests (500 Vdc)	50 M Ω min
Sinusoidal vibration (A, D and J mounting)	0.12DA / 10 to 70 Hz 30G / 70 to 3000 Hz
Sinusoidal vibration (E mounting in track)	0.06DA / 10 to 57 Hz 10G /57 to 500 Hz 20G / 500 to 3000 Hz
Sinusoidal vibration (G mounting)	0.12DA / 10 to 57 Hz 20G /57 to 3000 Hz
Random vibration	
- Applicable specification	MIL-STD-202
- Method	214
- Test condition - A, D and J mounting	1G (0.4G^2/Hz, 50 to 2000 Hz)
- Test condition - E and G mounting (E in track)	1E (0.2G^2/Hz, 50 to 2000 Hz)
- Duration	15 minutes each plane
Shock (A, D and J mounting)	200G / 6 ms
Shock (E mounting in track)	50G / 11 ms
Shock (G mounting)	100G / 6 ms
Maximum contact opening time under vibration and shock	10 µs
Operate time at nominal voltage@25°C	12 ms max
Release time at nominal voltage@25°C	20 ms max
Contact make bounce at nominal voltage@25°C	1 ms max
Contact release break bounce at nominal voltage@25°C	0.1 ms max
Weight maximum	15.42 grams

[1] Standard Intermediate current test applicable.

[2] DC Inductive load 5,000 cycles, AC Inductive load 10,000 cycles.

[3] Low level endurance test: contact load of 10 to 50 millivolt, 10 to 50 microamp, 100 Ohm max. contact resistance.

[4] Refer to MIL-R-83536 for details.

[5] 500 VRMS with silicone rubber gasket compressed, 250 VRMS all other conditions.
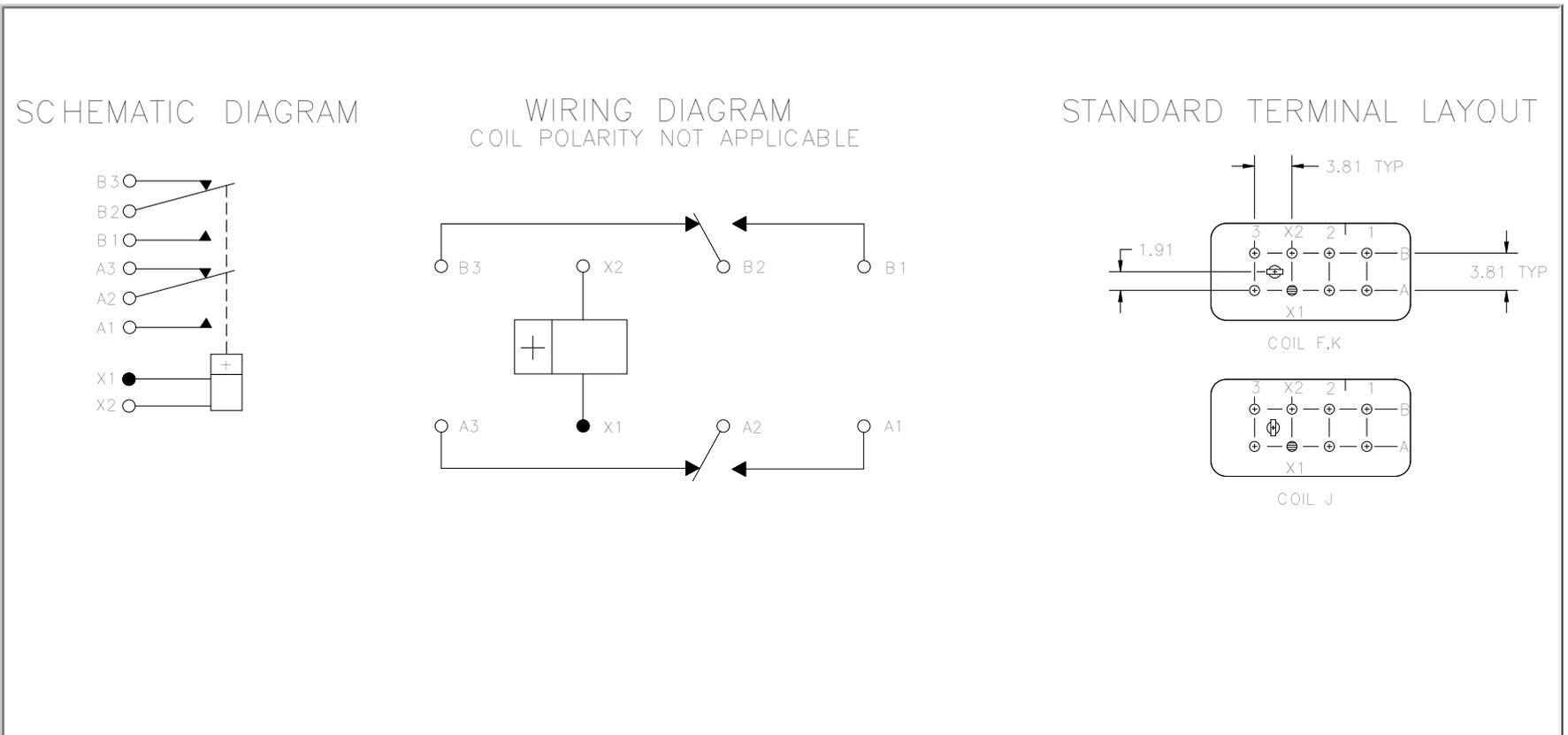
NUMBERING SYSTEM

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                                                      XA   A   1   F
    Basic series designation_____|   |   |  |
    1-Mounting Style (A,D,G or J)_____|   |  |
    2-Terminal Types (1,2,4 or 7)_____|  |
    3-Coil Voltage, see coil characteristics (F,J,K)_____|
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MOUNTING STYLES

1.78
1.27
Ø1.02

1.88 ±.13

1

4.32

5.08 ±.64

.43 ±.03

POLARIZING PIN

Ø1.02±.05
8 PLACES

COIL J

COIL F, K

TERMINALS — TIN/LEAD

2

5.33

Ø1.65
TYP

Ø1.02±.05
8 PLACES

CONTRASTING BEAD

1.78
1.27
Ø1.02

1.88 ±.13

SILICONE RUBBER
GASKET

4

4.32

1.27

5.08 ±.64

.43 ±.03

POLARIZING PIN

Ø1.02±.03
8 PLACES

COIL J

COIL F, K

TERMINALS — GOLD PLATED
POLARIZING PIN—TIN/LEAD

PERLE DE COULEUR

7

32.51
MAX

Ø1.02±.05
8 PLACES

8.13

3.81 ±.38

5.33 ± 1.27

3.81 ±.38

3.81

TERMINALS —TIN/LEAD

1. This end of the pin will lie within a circular tolerance zone; the diameter of which will be 2.54 (8 places).

SCHEMATIC DIAGRAM

B3
B2
B1
A3
A2
A1
X1
X2

WIRING DIAGRAM
COIL POLARITY NOT APPLICABLE

B3   X2   B2   B1

+

A3   X1   A2   A1

STANDARD TERMINAL LAYOUT

3.81 TYP

1.91

3   X2   2   1
                    B
                    A
X1

3.81 TYP

COIL F,K

3   X2   2   1
                    B
                    A
X1

COIL J

TOL: .XX ±.76; .XXX ±.25

CORRECTION DUE TO COIL COPPER WIRE RESISTANCE CHANGE IN TEMPERATURE
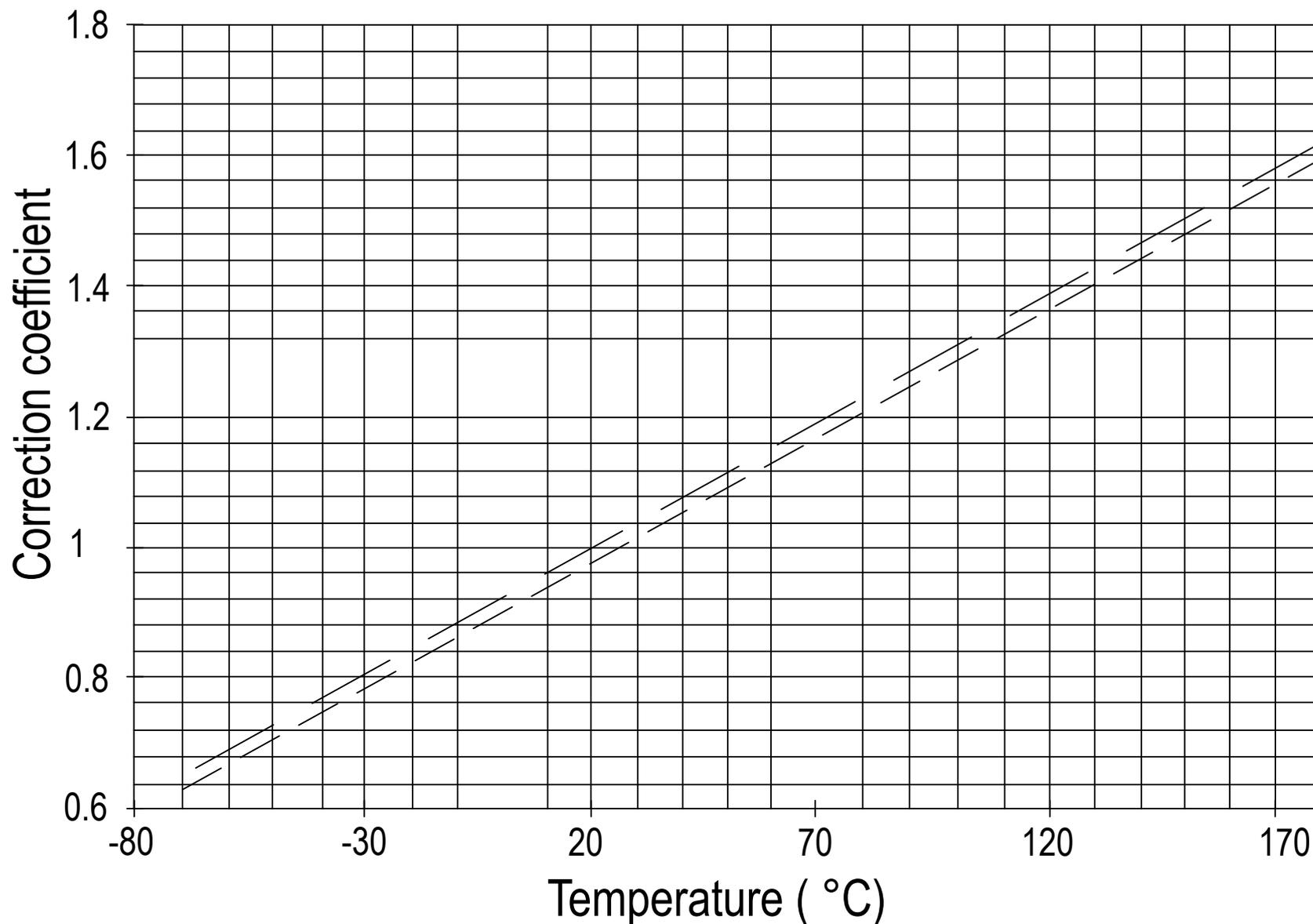
— — Nominal Resistance at 25°C   ——— Nominal Resistance at 20°C

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

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
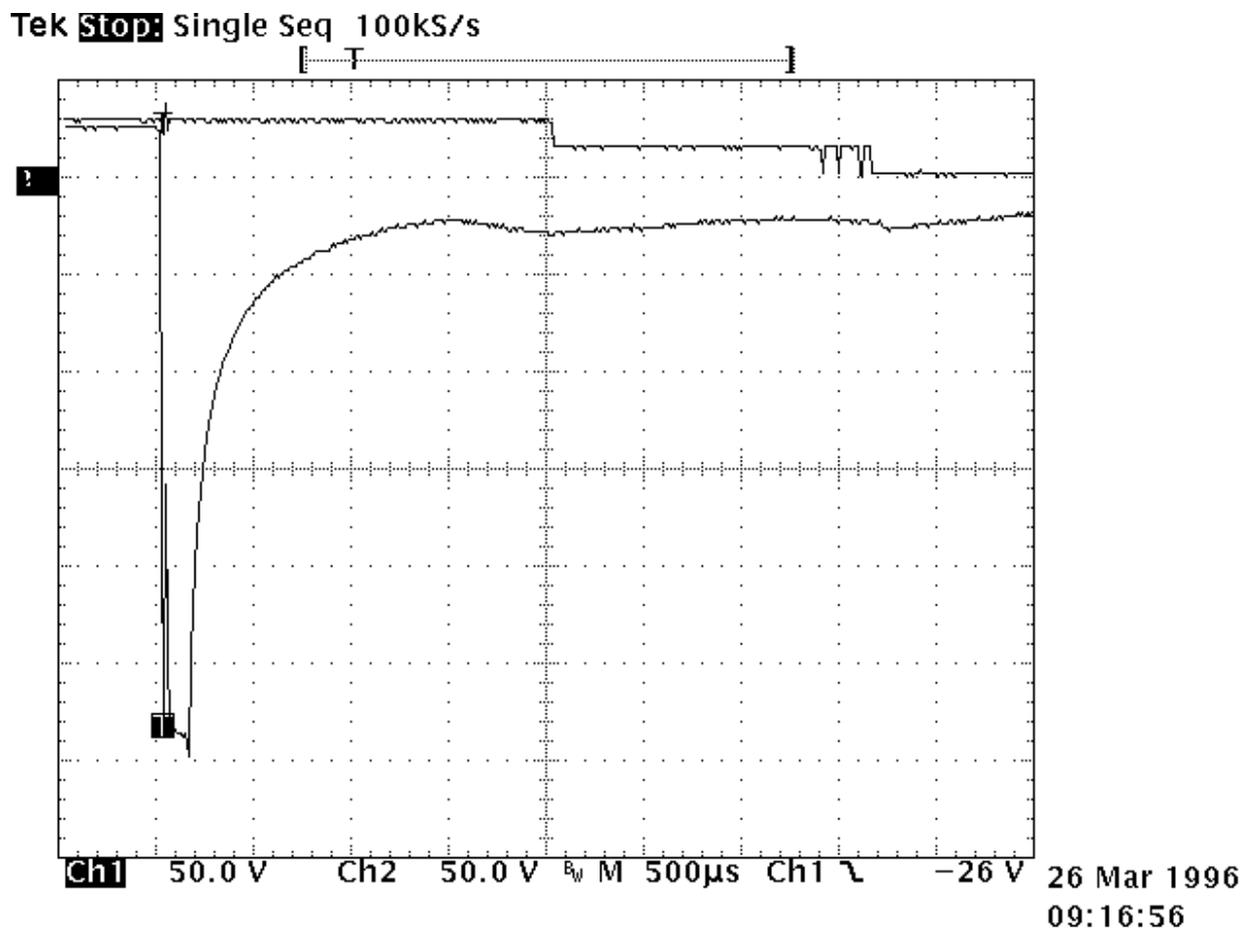
Types of suppressors:

Passive devices.

<u>The resistor capacitor circuit</u>

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.
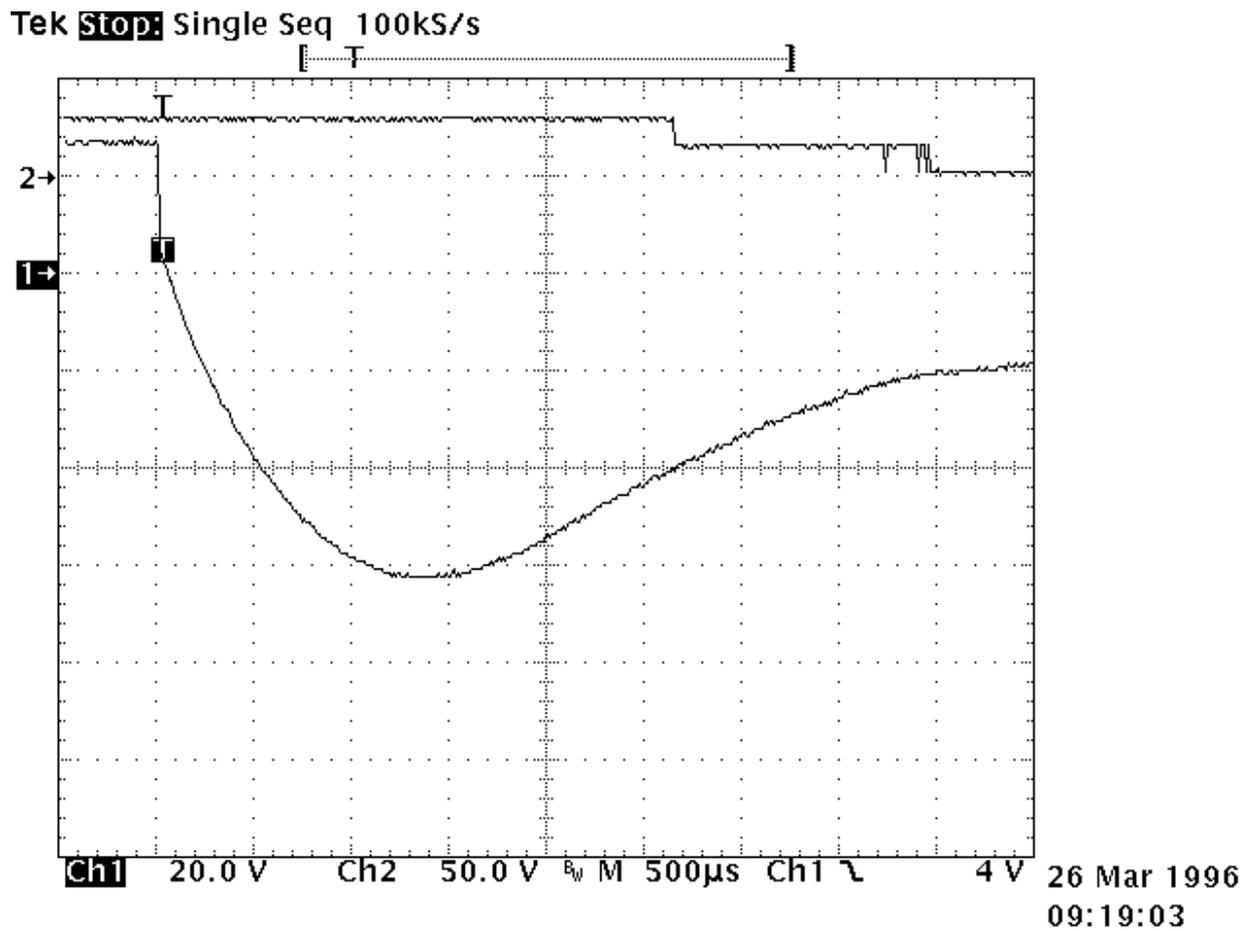
The bifilar coil

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.

Tek Stop: Single Seq 10.0kS/s

Ch1 20.0mV   Ch2 50.0 V   M5.00ms Ch1   70mV   26 Mar 1996
09:29:19
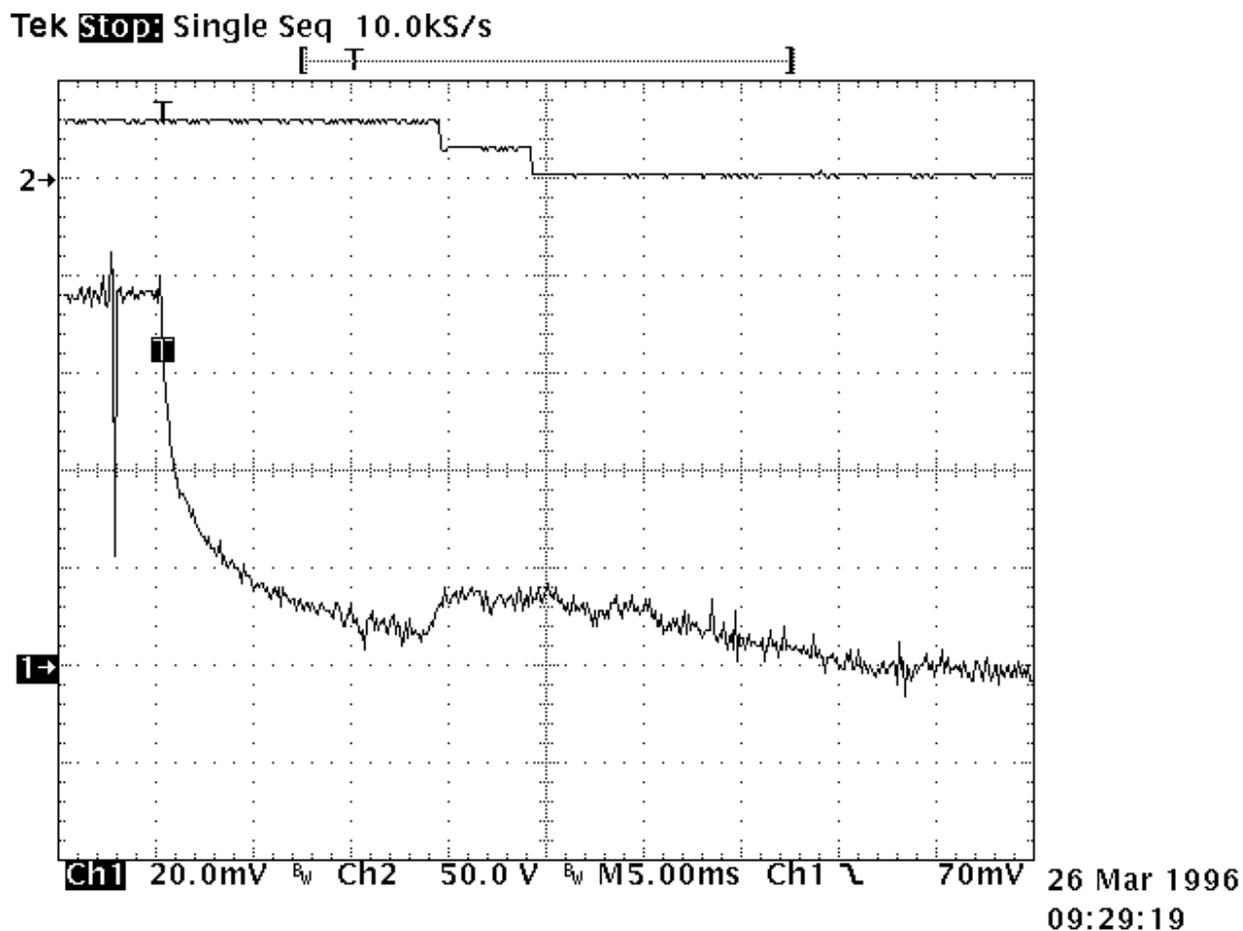
The diode + resistor network

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.
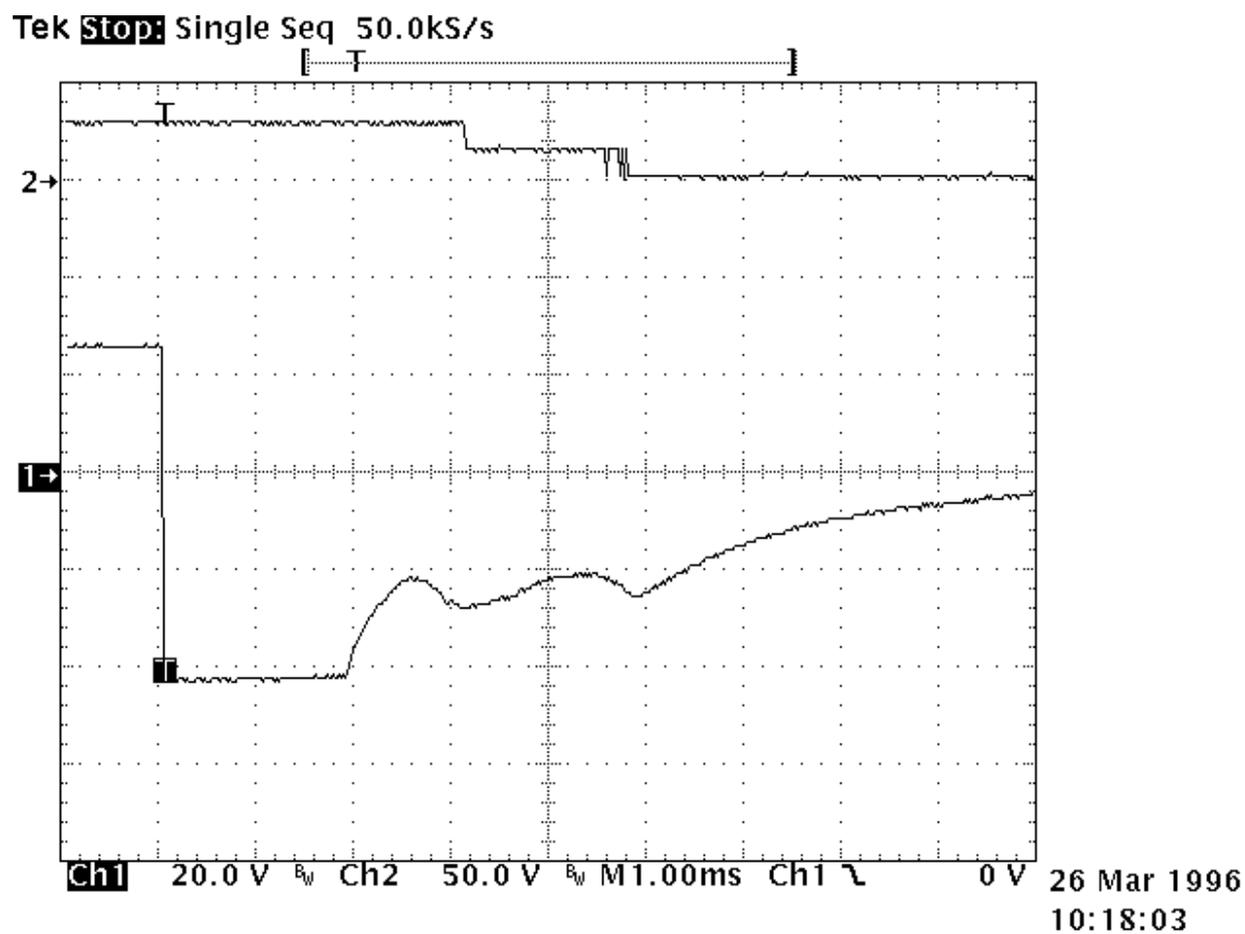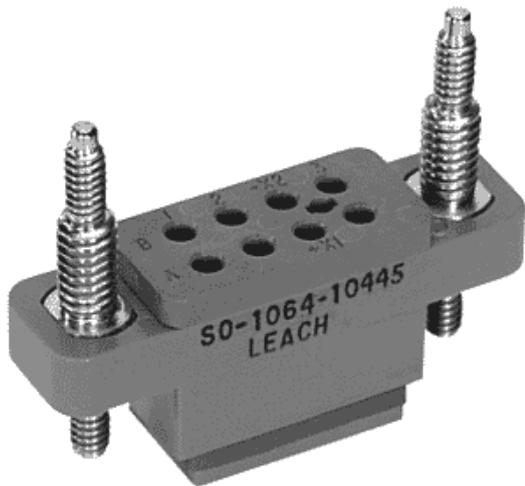
BASIC SOCKET SERIES DESIGNATION FOR:

Series XA

MEETS THE REQUIREMENTS OF:

MIL-DTL-12883
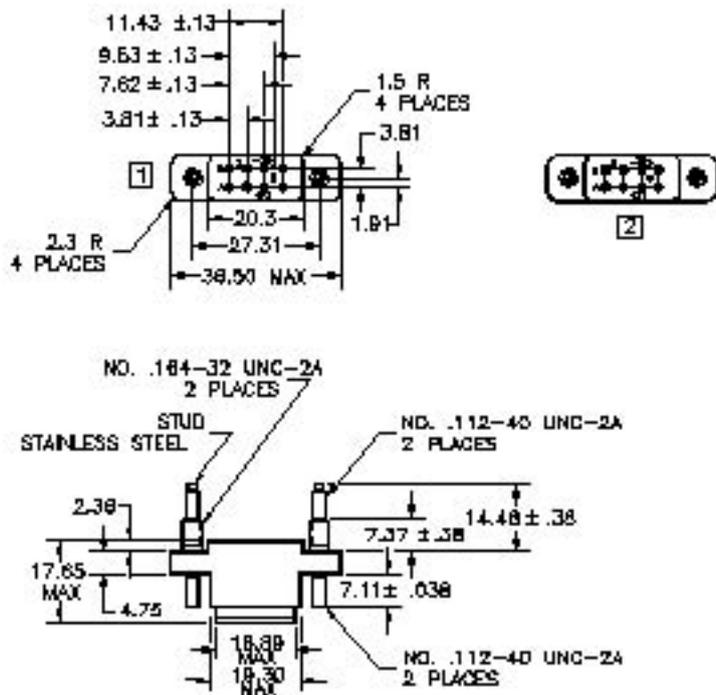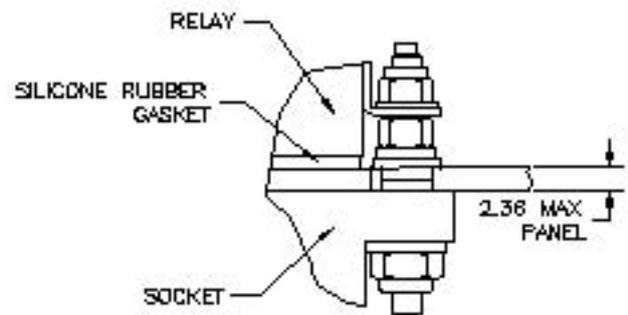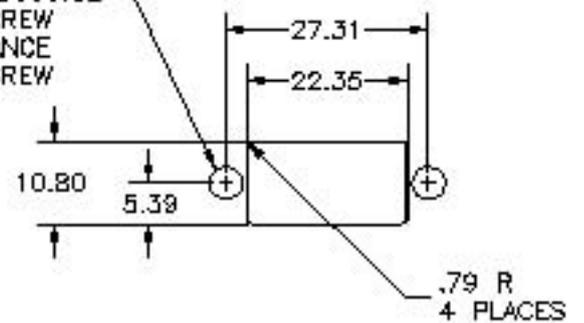
GENERAL CHARACTERISTICS

[1]. Supplied with mounting hardware and NO. 20 contacts and crimp for coil code J (SO-1064-10444).	
[2]. Supplied with mounting hardware and NO. 20 contacts and crimp for coil codes F,K (SO-1064-10445).	
3. Standard tolerances	.xx ±.25; xxx ±.13 mm
4. Weight	15 grams max.
5. Temperature range	-70° C to +125° C.

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