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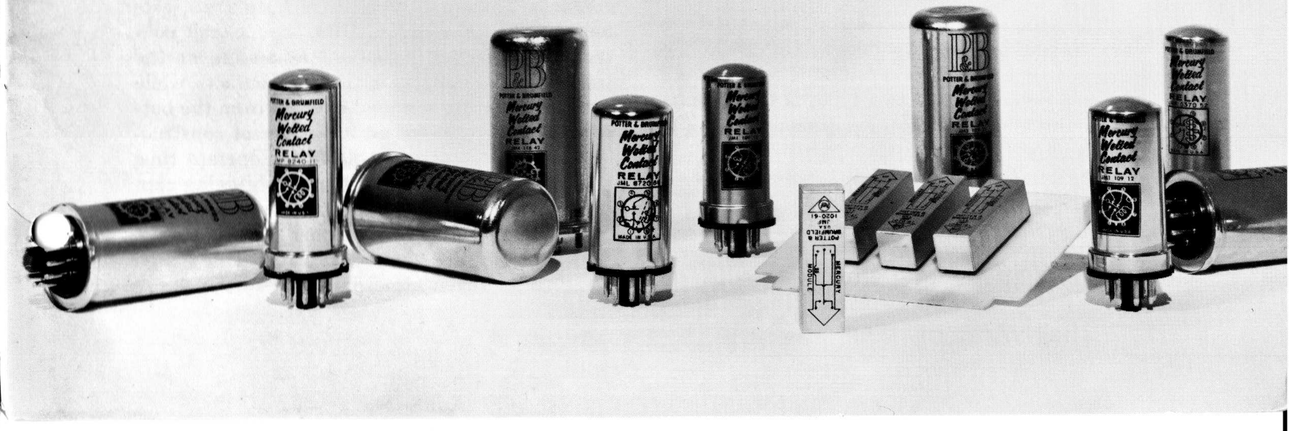
POTTER & BRUMFIELD

MERCURY WETTED CONTACT RELAYS



JM series relays

technical advantages

Potter & Brumfield offers a wide range of mercury-wetted contact relays for practically any application where extreme longevity, high speed and unvarying dependability are required. Properly applied, these relays will operate billions of times at extremely high speeds without any form of maintenance, without bounce or chatter, and with super-sensitivity. The many outstanding characteristics of the JM series combine to set a new standard of relay excellence.

The basic component of these relays is a slim glass capsule. It contains the contact arrangement, a single movable armature, and a small reservoir of mercury — all hermetically sealed in a high pressure hydrogen atmosphere.

The use of mercury assures continual renewal of contact material, as well as constant contact characteristics and permanent low contact resistance. It accounts for the total absence of contact pitting, and precludes deposit of foreign particles on contact surfaces. Mercury accounts for the absence of contact bounce and makes for positive contact closure. The capillary action of mercury renews the mercury film for every operation thereby preventing mechanical wear and contact erosion.

TWO TYPES OF GLASS CAPSULES

The wide range of mercury-wetted contact relay designs is made possible by the use of two distinct types of glass capsules. The major difference between these two types is that one has a non-bridging contact arrangement, the other has bridging contacts.

The *non-bridging* capsule is super-sensitive and is used in the JML, JMC and JMF series. The JML, JMC and JMF series operate at speeds to 200ops. They have a Form C, single-pole double-throw, break-before-make contact arrangement.

The *bridging* capsule has a higher contact rating and is used in the JMP polarized series. The letter "P" is indicative of polarization. The two Alnico magnets in this series are factory adjusted and arranged for either single-side stable, bi-stable or chopper operation.

The bridging capsule is also used in the JM1, JM2, JM3, and JM4 series, denoting one, two, three, or four capsules within a single coil and in a single enclosure, respectively. Contact arrangements are Form D, make-before-break, from single-pole double-throw to four-pole double-throw, respectively.

CONSTRUCTION OF CAPSULES

The basic operation of both the non-bridging and bridging contacts is identical. A reservoir of mercury in the lower part of the capsules serves, by capillary action, to mercury-wet the contact arrangement, assuring renewal of contact material for every operation. Inside the capsules, projecting from the top downward, are the fixed contacts. These are interposed by the movable contacts. The armature of both capsules projects upward, its upper end carrying the movable contacts. Outside the capsules, protruding at the top, are the terminals for the fixed contacts, while a single armature terminal extends from the bottom. There are, however, a number of construction differences that enable faster operate time and greater sensitivity in the non-bridging capsule, while the bridging capsule has lower sensitivity but a considerably higher contact rating. Both capsules are hermetically sealed in a high pressure hydrogen atmosphere.

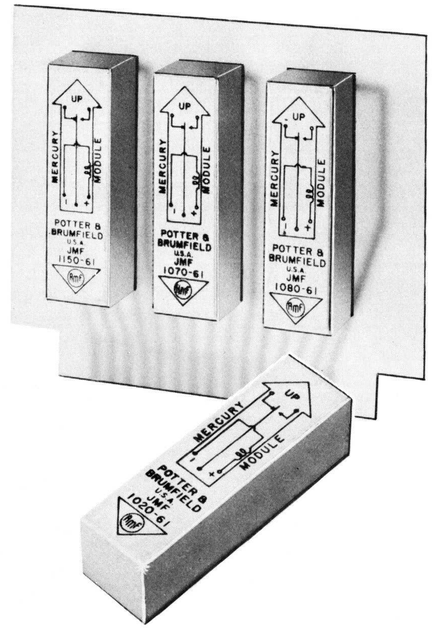
**These factory-sealed, potted relays must not be disassembled unless safety precautions are taken against breakage of glass capsule filled with hydrogen under high pressure.*

MERCURY-WETTED CONTACT RELAY

modules

- **FOR PRINTED CIRCUIT BOARD APPLICATIONS**
- **SINGLE, BIFILAR OR CONCENTRIC COILS**
- **FOR SINGLE-SIDE STABLE, BI-STABLE OR CHOPPER OPERATION—NON-BRIDGING CAPSULE**

Designed especially for printed circuit board mounting applications, the JMF series mercury-wetted contact relay modules differ from other JM series in their physical configuration. Rectangular in shape, with printed circuit board termination pins, they are particularly desirable where high component density is a requisite. JMF modules are available with single-, bifilar-, or concentric-wound coils; they are furnished for single-side stable, bi-stable or chopper operation. A non-bridging Form C, single-pole double-throw break-before-make contact arrangement is used.



WIDE RANGE OF ASSEMBLIES

The two types of basic glass capsules are utilized to produce the following wide range of assemblies of mercury-wetted contact relays:

SERIES	Contact Arrangement	Single-Side Stable	Bi-Stable	Chopper	Single-Wound Coil	Dual Wound Coil	Shielded Contacts	Inverted Construction
JML	Form C SPDT	✓	✓	✓	✓	✓	✓	
JMC	Form C SPDT	✓	✓	✓	✓	✓	✓	
JMF	Form C SPDT	✓	✓	✓	✓	✓		
JM1	Form D SPDT				✓	✓	✓	✓
JM2	Form D DPDT				✓		✓	✓
JM3	Form D 3PDT				✓		✓	✓
JM4	Form D 4PDT				✓		✓	✓
JMP	Form D SPDT	✓	✓	✓	✓	✓	✓	

JML
JMC
JMF
series

Three outstanding characteristics mark the performance of JML, JMC and JMF series mercury-wetted contact relays: high speed, super sensitivity, wide applicability to critical control equipment where non-bridging contact operation is mandatory. Added to these are the time-proven advantages of mercury-wetted contact relays: billions of trouble- and maintenance-free operations, no bounce or chatter and total absence of pitting of contact surfaces.

Applicable to many types of high-speed devices, the operate time of JML, JMC and JMF relays may be as fast as 1 millisecond. Bi-stable adjustment for the JML and JMC may require as little as ±2.5 milliwatts, and single-side stable adjustment as little as 5 milliwatts. Contact rating for the JML, JMC and JMF is for loads up to 2 amperes, 500 volts, 100 volt amperes with contact protection. (See pages 16 & 17)

The non-bridging capsule of the JML, JMC and JMF is located inside the coil bobbin. A single, bifilar or concentric double wound coil is used. Attached to each fixed contact terminal is an Alnico magnet. This arrangement provides for either single-side stable, bi-stable or chopper operation, depending on the magnetization of each of the magnets, and permits factory adjustment of operate or release characteristics within narrow limits. When energized, the magnetic field of the coil opens or closes the contacts.

A high melting point compound is used to pot the entire assembly within a steel container. The steel enclosure provides both magnet shielding and mechanical protection. The JMF modules for printed circuit board mounting are provided with .040″ diameter x .125″ pins. The JML and JMC series are equipped with eight-pin bakelite plugs. The major difference between the JML and JMC is that the JMC is smaller in height (at a slight loss in sensitivity), for applications where space is at a premium.

SPECIFICATIONS

GENERAL

Life Expectancy: More than one billion operations. Maximum variation of contacts from original values is only two milliohms during life of relay.

Frequency of Operation: to 200 operations per second.

Shock Resistance: Non-operating up to 30g for 11 milliseconds duration. Withstand vibrations up to 10g, 10-500 Hz without mechanical damage.

Dielectric: 1,000 volts rms 60 Hz between mutually insulated terminals.

Temperatures: −39°C minimum ambient (freezing point of mercury). +107°C maximum (softening point of potting compound).

Enclosures: Coil and switch assembly potted in steel case. Use of steel increases magnetic efficiency and reduces magnetic coupling between relays.

Mounting Position: Upright mounting required, but deviation from upright up to 30° causes only minor deviations in operating characteristics.

COILS

Temperature Rise: Approximately 20°C per watt of dissipation.

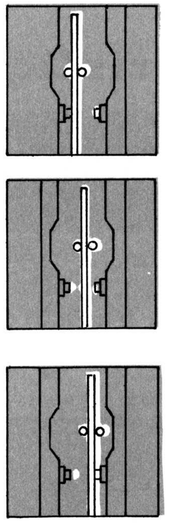
CONTACTS:

Rating: 500 volts maximum, 2 amperes maximum, 100 volt amperes with contact protection (see page 17).

Protection: A network consisting of a resistor and capacitor in series is required for the protection of relay contacts. See Nomogram on page 16 for selecting proper values.

Arrangement: SPDT, Form C break-before-make.

Resistance: Contact path, including wiring to terminals is 25 milliohms average, 50 milliohms maximum.



FORM C (BREAK-BEFORE-MAKE) ACTION OF CONTACTS

1. Capillary action draws film of mercury over all contact surfaces.

2. As armature (reed) contacts transfer, mercury filament ruptures before new contact is made in a Form C (break-before-make) action.

3. Contact surfaces meet. Contact bounce and chatter are eliminated by dampening effect of mercury wetting.

These illustrations were drawn from stroboscopic photographs.

NON-BRIDGING CAPSULE FORM C

The non-bridging capsule is used as a single unit. It contains two single fixed platinum contacts, welded to the two pole pieces projecting from the top downward. A reed, projecting from the bottom upward, is welded through the glass capsule and forms the armature, the upper end of which serves as the moving contacts. This reed is interposed between the fixed contacts with sufficient gaps to enable a Form C break-before-make contact structure.

Microscopic grooves in the armature reed provide a path for the mercury, assuring constant mercury-wetting of the contact area. Three terminals extending outside the capsule, two on top and one on the bottom, are formed by the extensions of the fixed contact and movable reed contact poles, respectively. This type capsule is contained in the JML, JMC and JMF series.

INDIVIDUAL SPECIFICATIONS FOR JML, JMC AND JMF SERIES

	JML	JMC	JMF modules
Wiring Patterns	See Page 6	See Page 8	See Page 9
Mounting	8-Pin bakelite plug	8-Pin bakelite plug	.040 diameter P.C. pins
Weight	4 ozs. net	4 ozs. net	1¼ ozs. net
Coils			
Single Wound	To 25,000 ohms	To 25,000 ohms	To 9,200 ohms
Bifilar or Dual Wound	See Pages 6 & 7	See Page 8	See Page 9
Resistances	Respective Ratings on Pages 6 & 7	Respective Ratings on Page 8	Respective Ratings on Page 9
Sensitivity			
Single Side Stable	Must operate adjustment is 27.3 ampere turns. Must release adjustment is 4.7 ampere turns	Must operate adjustment is 27.3 ampere turns. Must release adjustment is 4.7 ampere turns	Must operate adjustment is 60 ampere turns. Must release adjustment is 10 ampere turns
Bi-Stable	Adjusted to hold armature in last operated position. Must operate adjustment is ±15.3 ampere turns	Adjusted to hold armature in last operated position. Must operate adjustment is ±15.3 ampere turns	Adjusted to hold armature in last operated position. Must operate adjustment is ±28 ampere turns
Chopper	Adjusted to follow 60 Hz sinosoidal AC currents	Adjusted to follow 60 Hz sinosoidal AC currents	Adjusted to follow 60 Hz sinosoidal AC currents

JML coil and operating characteristics

Termination Diagrams

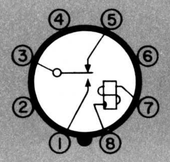


Fig. 81

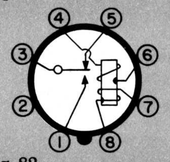


Fig. 82

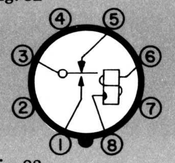


Fig. 83

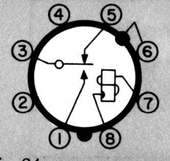


Fig. 84

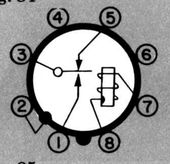


Fig. 85

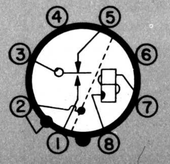


Fig. 86 *

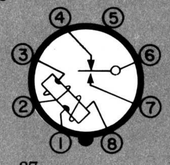


Fig. 87

SERIES			COIL CHARACTERISTICS		OPERATE CHARACTERISTICS		
Capsule	Coil	Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	SOAK ma DC	MUST OPERATE ma DC	MUST RELEASE ma DC
SINGLE-SIDE-STABLE							
JML 1010			2	600	167	45.5	7.8
JML 1030			12	1400	71.5	19.5	3.35
JML 1040			22	2040	40	14.6	3.4
JML 1060			40	2800	34	12.2	3.8
JML 1061			40	2800	36	9.75	1.68
JML 1070			60	3380	29.6	8.1	1.39
JML 1080			90	4325	23.2	6.31	1.1
JML 1090			130	4900	20.4	5.58	0.96
JML 1100			200	6000	16.7	4.55	0.78
JML 1110			350	7660	13.1	3.56	0.61
JML 1120			500	9450	10.6	2.89	0.50
JML 1130			600	10450	9.6	2.92	0.69
JML 1140			700	9500	10.5	2.88	0.49
JML 1150			800	11500	8.7	4.40	2.3
JML 1151			800	11500	8.7	3.60	1.6
JML 1160			1000	12350	8.1	2.21	0.38
JML 1161			1000	12350	8.1	3.10	1.25
JML 1162			1000	12350	8.1	3.80	1.97
JML 1180			1900	17800	5.6	1.66	0.39
JML 1190			2500	18800	4.0	1.43	0.17
JML 1191			2500	18800	5.3	2.50	1.37
JML 1192			2500	18800	5.3	2.80	1.40
JML 1200			4000	23400	3.4	1.25	0.25
JML 1201			4000	23400	6.0	2.00	1.00
JML 1220			7000	31675	3.2	0.87	0.14
JML 1240			11000	38050	2.6	0.72	0.12
JML 1241			11000	38050	2.6	1.20	0.60
JML 1250			17000	44250	2.3	0.62	0.10
JML 1260			25000	53000	1.9	0.52	0.09
JML 1261			25000	53000	1.9	0.85	0.42
JML 1262			25000	53000	1.9	0.94	0.52
* JML 1610			22	1440	69.0	19.0	3.26
* JML 1680			350	5977	16.7	4.39	0.60
* JML 1730			650	8630	11.6	4.62	2.0
* JML 1750			1400	10150	9.9	3.70	0.80
* JML 1790			4200	17300	5.8	1.58	0.27
* JML 1800			5000	20200	4.9	1.35	0.23
JML 1390	1.		700	5925	16.9	4.61	0.79
	2.		3300	16950		1.61	
JML 1380	1.		250	4100	24.4	6.66	1.14
	2.		250	5000		5.46	
JML 1420	1.		700	7100	14.1	3.84	0.66
	2.		700	7150		3.84	

* shielded coils

*JML series can be supplied with a shielded capsule (See Fig. 86). For data on relays requiring a shielded capsule consult factory as special adjustments are required.

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◡ will close contacts shown open on diagrams.

SERIES			COIL CHARACTERISTICS		OPERATE CHARACTERISTICS		
Capsule	Coil	Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	SOAK ma DC	MUST OPERATE ma DC	MUST RELEASE ma DC
JML 1440			1. 4000	23400	2.7	0.86	0.10
			2. 800	2000		11.6	
BI-STABLE							
JML 5010			2	600		+25.5	−25.5
JML 5030			12	1400		+10.6	−10.6
JML 5040			22	2040		+ 7.5	− 7.5
JML 5060			40	2800		+ 5.47	− 5.47
JML 5080			90	4325		+ 3.54	− 3.54
JML 5090			130	4900		+ 3.00	− 3.00
JML 5100			200	6000		+ 2.55	− 2.55
JML 5110			350	7660		+ 2.00	− 2.00
JML 5120			500	9450		+ 1.62	− 1.62
JML 5130			600	10450		+ 1.47	− 1.47
JML 5140			700	9500		+ 1.61	− 1.61
JML 5150			800	11500		+ 1.33	− 1.33
JML 5160			1000	12350		+ 1.24	− 1.24
JML 5180			1900	17800		+ 0.86	− 0.86
JML 5190			2500	18800		+ 0.82	− 0.82
JML 5200			4000	23400		+ 0.53	− 0.53
JML 5220			7000	31675		+ 0.48	− 0.48
JML 5240			11000	38050			
JML 5260			25000	53000		+ 0.29	− 0.29
JML 5350	1.		100	3015		+ 5.08	− 5.08
	2.		100	3050		+ 5.08	− 5.08
JML 5380	1.		250	4100		+ 3.74	− 3.74
	2.		250	5000		+ 3.10	− 3.10
JML 5420	1.		700	7100		+ 2.28	− 2.28
	2.		700	7150		+ 2.28	− 2.28
JML 5390	1.		700	5925		+ 2.58	− 2.58
	2.		3300	16950		+ 0.90	− 0.90
JML 5430	1.		1100	8700		+ 1.76	− 1.76
	2.		1100	8700		+ 1.76	− 1.76
CHOPPER						Voltage RMS 60 cps	
JML 8130			600	10450		6.3	
* JML 8720			600	8960		6.3	
JML 8220			7000	31675		18.5	
* JML 8730			650	8630		6.3	
* JML 8790			4200	17300		18.5	

JMC TERMINATION DIAGRAMS

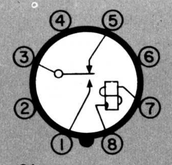


Fig. 81

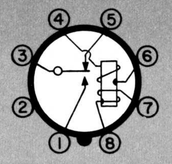


Fig. 82

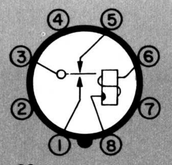


Fig. 83

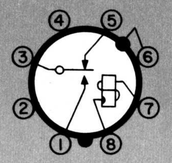


Fig. 84

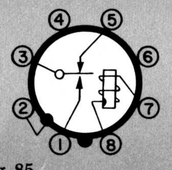


Fig. 85

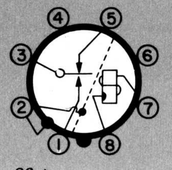


Fig. 86 *

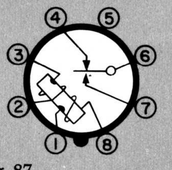


Fig. 87

JMC NON-BRIDGING SENSITIVE SMALL

SERIES			COIL CHARACTERISTICS		OPERATE CHARACTERISTICS		
Capsule	Coil	Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	SOAK ma DC	MUST OPERATE ma DC	MUST RELEASE ma DC
SINGLE-SIDE-STABLE							
JMC	1010		2.8	550	182.0	49.7	8.55
JMC	1020		6.6	770	130.0	35.5	6.10
JMC	1030		12	1130	88.5	24.2	4.16
JMC	1040		22	1540	65	17.7	3.05
JMC	1050		33	1850	54	14.8	2.54
JMC	1060		50	2380	42	11.5	1.97
JMC	1070		70	2690	37.2	10.2	1.75
JMC	1080		110	3300	29.4	8.28	1.42
JMC	1090		195	4200	23.8	6.5	1.12
JMC	1110		330	5750	17.4	4.75	0.82
JMC	1120		440	6350	15.8	4.30	0.74
JMC	1130		550	6800	14.7	4.02	0.69
JMC	1150		1050	9740	10.3	2.80	0.48
JMC	1160		1375	10380	9.65	2.64	0.45
JMC	1170		2200	12900	7.75	2.11	0.36
JMC	1180		3850	17400	5.75	1.57	0.27
JMC	1200		6000	20500	4.9	1.33	0.23
JMC	1210		9400	24400	4.1	1.12	0.19
JMC	1240		14000	29200	3.4	0.94	0.16
JMC	1191		4000	23400	4.3	1.25	0.25
JMC	1190		4000	23400	6.0	2.00	1.00
JMC	1220		10000	33500	2.98	0.82	0.14
JMC	1230		11000	38050	2.6	0.72	0.12
JMC	1250		17000	44250	2.3	0.62	0.10
JMC	1260		25000	53000	1.9	0.52	0.09
JMC	1261		25000	53000	1.9	0.85	0.42
JMC	1262		25000	53000	1.9	0.94	0.52
JMC	1100		275	5200	19.2	5.50	1.20
JMC	1140		900	8620	11.6	4.41	1.79
JMC	1300		1. 1000	5780	17.3	4.72	0.81
			2. 1000	6020			
JMC	1330		1. 11500	29800	3.4	0.92	0.15
			2. 11500	19430		1.40	0.24
BI-STABLE							
JMC	5010		2.8	550		+27.8	−27.8
JMC	5020		6.6	770		+19.9	−19.9
JMC	5030		12	1130		+13.5	−13.5
JMC	5040		22	1540		+ 9.95	− 9.95
JMC	5050		33	1850		+ 8.27	− 8.27
JMC	5060		50	2380		+ 6.43	− 6.43
JMC	5070		70	2690		+ 5.68	− 5.68
JMC	5080		110	3300		+ 4.64	− 4.64
JMC	5090		195	4200		+ 3.64	− 3.64
JMC	5110		330	5750		+ 2.66	− 2.66
JMC	5120		440	6350		+ 2.41	− 2.41
JMC	5130		550	6800		+ 2.25	− 2.25
JMC	5150		1050	9740		+ 1.57	− 1.57
JMC	5160		1375	10380		+ 1.47	− 1.47
JMC	5170		2200	12900		+ 1.18	− 1.18
JMC	5180		3850	17400		+ 0.88	− 0.88
JMC	5200		6000	20500		+ 0.75	− 0.75
JMC	5210		9400	24400		+ 0.63	− 0.63
JMC	5240		14000	29200		+ 0.52	− 0.52
JMC	5190		4000	23400		+ 0.65	− 0.65
JMC	5220		10000	33500		+ 0.46	− 0.46
JMC	5230		11000	38050		+ 0.40	− 0.40
JMC	5250		17000	44250		+ 0.35	− 0.35
JMC	5260		25000	53000		+ 0.29	− 0.29
JMC	5300		1. 1000	5780		+ 2.65	− 2.65
			2. 1000	6020		+ 2.70	− 2.70
*JMC	5310		1. 1100	8700		+ 1.76	− 1.76
			2. 1100	8700			
JMC	5320		1. 7500	20400		+ 0.73	− 0.73
			2. 7500	22250		+ 0.73	− 0.73
JMC	5330		1. 11500	29800		+ 0.51	− 0.51
			2. 11500	19430		+ 0.79	− 0.79

*BIFILAR COIL

*JMC series can be supplied with a shielded capsule (See Fig. 86). For data on relays requiring a shielded capsule consult factory as special adjustments are required.

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◠ will close contacts shown open on diagrams.

JMF TERMINATION DIAGRAMS

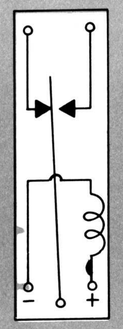


Fig. 61

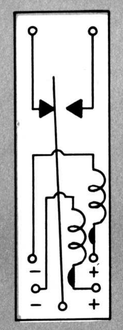


Fig. 62

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◠ will close contacts shown open on diagrams.

NOTE:
For optimum results, the bi-stable and single-side stable JMF series modules should not be operated more than five times the **MUST OPERATE** current.

JMF NON-BRIDGING MODULE

SERIES			COIL CHARACTERISTICS		OPERATE CHARACTERISTICS	
Capsule	Coil	Terminal Fig. No.	RESISTANCE (OHMS ±10%)	TURNS	MUST OPERATE ma DC	MUST RELEASE ma DC
SINGLE SIDE STABLE						
JMF	1010	61	18	900	66.8	11.1
JMF	1020	61	65	1575	38.1	6.3
JMF	1030	61	85	1800	33.3	5.5
JMF	1040	61	90	1590	37.8	6.3
JMF	1050	61	115	2000	30.0	5.0
JMF	1060	61	275	3525	17.0	2.8
JMF	1070	61	450	4650	12.9	2.1
JMF	1080	61	675	5200	11.6	1.9
JMF	1090	61	940	5800	10.4	1.7
JMF	1100	61	950	4950	12.1	2.0
JMF	1110	61	1250	6400	12.1	1.6
JMF	1120	61	1425	7125	8.4	1.4
JMF	1130	61	1800	6400	9.4	1.5
JMF	1140	61	1950	7375	8.2	1.3
JMF	1150	61	2400	7700	7.8	1.3
JMF	1160	61	4000	15000	4.0	0.67
JMF	1170	61	9200	21000	1.4	0.20
BI-STABLE						
JMF	5010	61	18	900	+31.1	−31.1
JMF	5020	61	65	1575	+17.8	−17.8
JMF	5030	61	85	1800	+15.6	−15.6
JMF	5040	61	90	1590	+17.6	−17.6
JMF	5050	61	115	2000	+14.0	−14.0
JMF	5060	61	275	3525	+ 8.0	− 8.0
JMF	5070	61	450	4650	+ 6.0	− 6.0
JMF	5080	61	675	5200	+ 5.4	− 5.4
JMF	5090	61	940	5800	+ 4.9	− 4.9
JMF	5100	61	950	4950	+ 5.7	− 5.7
JMF	5110	61	1250	6400	+ 4.4	− 4.4
JMF	5120	61	1425	7125	+ 4.0	− 4.0
JMF	5130	61	1800	6400	+ 4.4	− 4.4
JMF	5140	61	1950	7375	+ 3.8	− 3.8
JMF	5150	61	2400	7700	+ 3.7	− 3.7
JMF	5160	61	4000	15000	+ 1.9	− 1.9
JMF	5170	61	9200	21000	+ 1.3	− 1.3
JMF	5311	62	1. 460	3600	+ 7.8	− 7.8
			2. 460	3600	+ 7.8	− 7.8
JMF	5321	62	1. 1100	5000	+ 5.6	− 5.6
			2. 1100	5000	+ 5.6	− 5.6
JMF	5331	62	1. 1100	3860	+ 7.3	− 7.3
			2. 1100	4975	+ 5.6	− 5.6

JM1, JM2, JM3, JM4 series

The unusual combination of advantages found only in mercury-wetted contact relays is represented by the JM series. The capability of these relays to function for billions of dependable operations, their wide applicability to modern electronic industrial and communications equipment, and their remarkable operational versatility have resulted in their acceptance by many discriminating design engineers.

Able to handle contact loads up to 5 amperes, with an operating time as short as 3 milliseconds, JM relays are offered in a wide range of coil resistances. Their contacts utilize the bridging Form D make-before-break arrangement, allowing single capsule SPDT, 2-capsule DPDT, 3-capsule 3PDT, and 4-capsule 4PDT construction. The capsules, from one to four, are always surrounded by a single coil bobbin. Relays with the single capsule may have single or double concentric wound coils. When energized, the magnetic field of the coil opens the normally closed contacts. When de-energized, the tension of the reed in the armature assembly returns the movable contacts to the closed position. Switching causes a filament of mercury to be drawn between them and both sets of fixed contacts, momentarily joining all contacts. An extremely rapid breaking action is produced when this filament is ruptured.

The entire assembly is potted in a high melting point compound within a steel container. A great variety of wiring configurations and terminations is available.

JM1, JM2, JM3, JM4 SPECIFICATIONS

GENERAL

Life Expectancy: More than one billion operations at rated load.

Operate and Release Times: Operate time JM1: as short as 3 ms. JM2 and JM3: as short as 4 ms. JM4: as short as 5 ms. Bridging time JM1, 2, 3 and 4: 1 ms maximum. Constancy for specific capsule: within 0.1 ms under continuous drive conditions. Repetitive accuracy: within 1% of its must operate current. Release time: 3.2 ±0.6 ms.

Frequency of Operation: 100 operations per second for JM1. 60 operations per second for JM2, JM3 and JM4.

Shock Resistance: Non-operating up to 30 Gs for 11 ms durations. Withstand vibrations up to 100 Gs, 10-500 Hz without mechanical damage.

Dielectric Strength: Single wound coils: between mutually insulated terminals: 1000 volts rms 60 cycles. Between windings on double-wound coils: 500 volts rms 60 cycles. Between windings on bifilar coils: 200 volts rms 60 cycles.

Temperatures: −39°C minimum ambient (freezing point of mercury). +107°C maximum (softening point of potting compound).

Basic Wiring Circuits: FOR FLEXIBILITY: Individual terminals use all five capsule leads. FOR HIGH POWER: Power handling characteristics used most efficiently. FOR LOW-LEVEL: Ideal for micropower circuits such as thermocouples and strain gages.

Enclosures: **Coil and switch assemblies potted in steel cases. See page 18 for outline diagrams.**

Mountings: Octal-type plugs, 8 and 11-pin; solder lugs; 14 or 20-pin miniatures; and AN connectors. Others upon application.

Mounting Position: Upright mounting required, but deviation from upright up to 30° causes only minor deviation in operating characteristics.

Sizes: See outline diagrams page 18

Weights: JM1: 4 ozs. net; JM2 and JM3: 8 ozs. net; JM4: 10 ozs. net.

COILS

Resistances: Single wound: JM1: to 25,000 ohms. JM2 and JM3: to 45,000 ohms. JM4: to 58,000 ohms. See pages 12 and 13 for detail listings of single and dual wound coils.

Temperature Rise: Approximately 20°C per watt of dissipation.

SENSITIVITY

JM1: Must operate—190 ampere turns; Hold—147 ampere turns; Non-operate—124 ampere turns; Must release—84 ampere turns; For No. 2 winding of dual wound, concentric coils: Must operate: 208 ampere turns.

JM2 and JM3: Must operate—250 ampere turns; Hold—190 ampere turns; Non-operate—145 ampere turns; Must release—105 ampere turns.

JM4: Must operate—265 ampere turns; Hold—190 ampere turns; Non-operate—145 ampere turns; Must release—115 ampere turns.

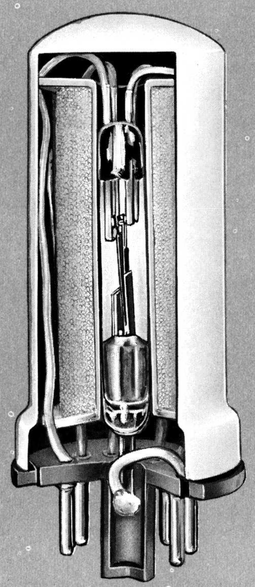
CONTACTS:

Ratings: 5 amperes maximum, 500 volts maximum, not to exceed 250 voltamperes with required contact protection (See page 17). Opening current: not to exceed 5 amperes for any single contact. Closing voltage: not to exceed 500 volts.

Protection: A network consisting of a resistor and capacitor in series is required for the protection of relay contacts. See Nomogram page 16 for selecting proper values.

Arrangement: JM1: SPDT; JM2: DPDT; JM3: 3PDT; JM4: 4PDT. All Form D make-before-break.

Resistance: Contact path, including wiring to terminals is 25 milliohms average, 50 milliohms maximum.



ASSEMBLY DETAILS

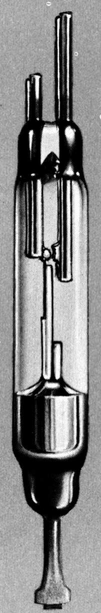
Glass capsule hermetically seals mercury-wetted contacts under high pressure hydrogen atmosphere.

Moving contacts consist of armature, supported by spring. Holds platinum contacts in normally closed position.

Two pairs of lead wires support four platinum fixed contacts.

Small pool of mercury coats all metal parts inside capsule with mercury. Mercury-wetting by capilliary action.

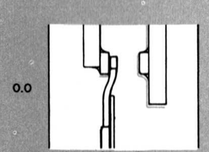
Extremely rapid breaking action is the result when filament of mercury between contacts is ruptured as coil, or spring action, causes contact movement.



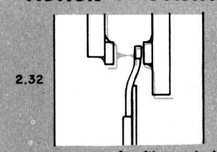
BRIDGING CAPSULE FORM D

The bridging capsule is used as one single unit as well as in two-, three- and four-capsule assemblies, each assembly in a single enclosure. It contains two normally open and two normally closed fixed platinum contacts projecting from the top downward. The armature projects from the bottom upward and is supported by a flat cantilever reed assembly. Two moving platinum contacts are fixed to the upper end of the spring-supported armature. The armature and moving contacts interpose between the fixed contacts, providing a Form D make-before-break contact structure. Parallel wires along one side of the armature form a path for mercury-wetting all metal surfaces within the capsule. Outside the capsule, protruding at the top, are four terminals for the fixed contacts, while a single armature terminal extends from the bottom. This type capsule is contained in all JMP and JM1, JM2, JM3 and JM4 relays.

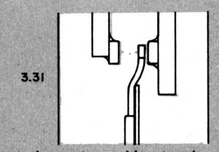
FORM D (MAKE-BEFORE-BREAK) ACTION OF CONTACTS



1. Capillary action draws film of mercury over all contact surfaces.



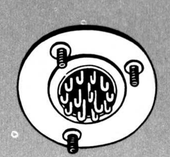
2. As armature contacts transfer, filament is drawn between them and normally closed contacts, momentarily joining all contacts.



3. Filament then ruptures with extremely rapid breaking action. This speed is equalled on release.

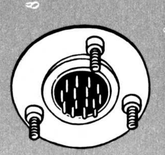
These illustrations, drawn from stroboscopic photographs, show action of mercury on contact surfaces at time intervals indicated in milliseconds.

TERMINATIONS

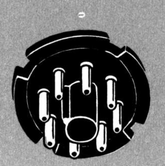


Solder Lugs

AN Connectors



14 or 20 Pin Miniatures



Octal-Style Plug

JM1 TERMINATIONS SINGLE-WOUND COIL

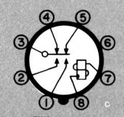


Fig. 11

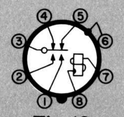


Fig. 12

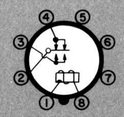


Fig. 13

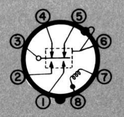


Fig. 14 *

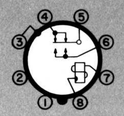


Fig. 15

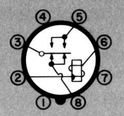


Fig. 16

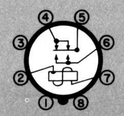


Fig. 17

JM1 TERMINATIONS DUAL-WOUND COIL

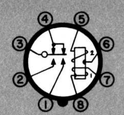


Fig. 51

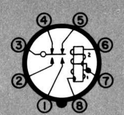


Fig. 52

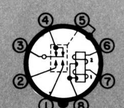


Fig. 53 *

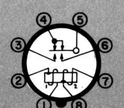


Fig. 54

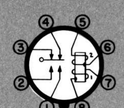


Fig. 55

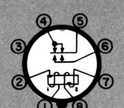


Fig. 56

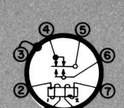


Fig. 57

operating characteristics

JM1 BRIDGING SINGLE CAPSULE

SERIES	COIL CHARACTERISTICS			
Capsule Coil Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	MUST OPERATE (Milliamps)	MAX. VOLTAGE (at 35°C)
Single Pole Double Throw				
JM1 101	2	600	315.0	2.0
JM1 102	5	1000	190.0	3.1
JM1 103	12	1400	136.0	4.9
JM1 104	22	2040	93.1	6.6
JM1 105	34	2630	72.3	8.3
JM1 106	40	2800	67.7	9.0
JM1 107	60	3380	56.2	11.0
JM1 108	90	4325	44.0	13.4
JM1 109	130	4900	38.8	16.1
JM1 110	200	6000	31.7	20.0
JM1 111	350	7660	24.8	26.5
JM1 112	500	9450	20.1	31.6
JM1 113	600	10450	18.2	34.7
JM1 114	700	9500	20.0	37.4
JM1 115	800	11500	16.5	40.0
JM1 116	1000	12350	15.4	44.7
JM1 117	1900	17800	10.7	61.7
JM1 118	2500	18800	10.1	70.7
JM1 119	4000	23400	8.1	89.5
JM1 120	7000	31675	6.0	117.0
JM1 121	11000	38050	5.0	148.0
JM1 122	17000	44250	4.3	184.0
JM1 123	25000	53000	3.6	224.0
JM1 401	1. 100	3015	63.0	14.2
	2. 100	3050		14.2
JM1 402	1. 100	2700	70.4	14.2
	2. 1000	9000		44.7
JM1 403	1. 120	3450	55.2	15.5
	2. 125	2850		15.8
JM1 404	1. 250	4100	46.4	22.4
	2. 250	5000		22.4
JM1 405	1. 700	5925	32.0	37.4
	2. 3300	16950		81.0
JM1 406	1. 1020	8630	22.1	45.0
	2. 970	8630		44.0
JM1 407	1. 1800	10540	18.0	60.0
	2. 1775	10980		59.5
JM1 408	1. 7500	20400	9.3	122.0
	2. 7500	22250		122.0

Note: Only series JM1 300 single capsule relays can be supplied with electrostatically shielded capsule. JM1 terminations Figs. 14 & 53 apply only to the JM1 300 series relay. The coil data above does not apply to a shielded capsule relay. For data on series JM1 300, consult the factory.

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◠ will close contacts shown open on diagrams.

JM2 TERMINATIONS


Fig. 21

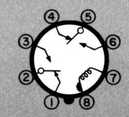


Fig. 22

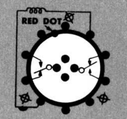


Fig. 23 *

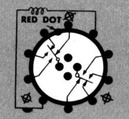


Fig. 24 *


Fig. 25

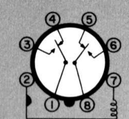


Fig. 26


Fig. 27

JM3 TERMINATIONS

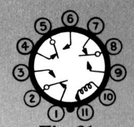


Fig. 31

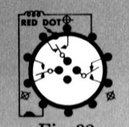


Fig. 32 *

Fig. 33

JM4 TERMINATIONS

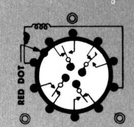


Fig. 41 **

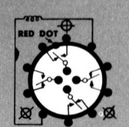


Fig. 42 *

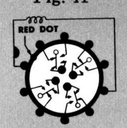


Fig. 43 **

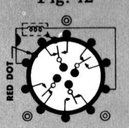


Fig. 44 **

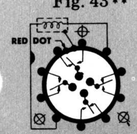


Fig. 45 *

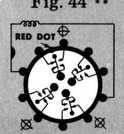


Fig. 46 *

* Hook solder
** Miniature plug

operating characteristics

JM2/JM3 BRIDGING TWO & THREE CAPSULES

SERIES	COIL CHARACTERISTICS			
Capsule Coil Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	MUST OPERATE (Milliamps)	MAX. VOLTAGE (at 35°C)
Double Pole Double Throw				
JM2 101	3	550	455.0	3.0
JM2 102	14	1270	197.0	6.5
JM2 103	35	2000	125.0	10.25
JM2 104	50	2280	110.0	12.25
JM2 105	85	3025	82.7	16.0
JM2 106	140	3760	66.5	20.5
JM2 107	215	4600	54.4	25.4
JM2 108	250	4700	53.2	27.4
JM2 109	315	5680	44.0	30.7
JM2 110	500	7190	34.8	38.7
JM2 111	700	8200	30.5	45.8
JM2 112	1250	11300	22.1	61.2
JM2 113	2000	13800	18.1	77.5
JM2 114	2500	15000	16.7	86.7
JM2 115	5000	22100	11.3	122.0
JM2 116	7100	25200	9.9	146.0
JM2 117	10000	29200	8.6	173.0
JM2 118	12500	35100	7.1	194.0
JM2 119	20000	45800	5.5	245.0
JM2 120	32000	56250	4.5	310.0
JM2 121	45000	63600	3.9	367.0

Three Pole Double Throw

JM3 Coil numbers and characteristics are identical in every respect to JM2 series.

JM4 BRIDGING FOUR CAPSULES

SERIES	COIL CHARACTERISTICS			
Capsule Coil Terminal Fig. No.	RESISTANCE (Ohms ±10%)	TURNS	MUST OPERATE (Milliamps)	MAX. VOLTAGE (at 35°C)
Four Pole Double Throw				
JM4 101	8	870	305.0	5.3
JM4 102	10	1025	259.0	5.9
JM4 103	15	1200	221.0	7.25
JM4 104	25	1580	168.0	9.3
JM4 105	40	2050	130.0	11.8
JM4 106	65	2650	100.0	15.1
JM4 107	100	3220	82.3	18.7
JM4 108	150	3600	73.6	23.0
JM4 109	230	4760	55.7	28.4
JM4 110	390	6310	42.0	37.0
JM4 111	645	8110	32.7	47.5
JM4 112	700	7500	35.4	49.5
JM4 113	900	7860	33.7	56.2
JM4 114	1400	11550	23.0	70.0
JM4 115	2400	15100	17.6	91.6
JM4 116	3500	18200	14.6	111.0
JM4 117	4000	17000	15.6	118.0
JM4 118	6500	25300	10.5	151.0
JM4 119	10000	30900	8.6	187.0
JM4 120	14000	38000	7.0	221.0
JM4 121	23000	45000	5.9	284.0
JM4 122	58000	72400	3.66	452.0

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◠ will close contacts shown open on diagrams.

JMP series

Of particular use in polarity detecting devices and memory circuits, JMP relays feature all of the advantages of the bridging capsule as used in the JM series described in pages 11 and 10 .

In addition, however, the JMP series has greater sensitivity. Its design includes Alnico magnets attached to two of the fixed contact terminals. These magnets may be adjusted over a wide range of operating characteristics for individual requirements. Providing for either single-side stable, bi-stable, or chopper operation, this arrangement permits adjustment of operate or release times within sensitive and narrow limits, depending upon the magnetization of each of the magnets. When energized, the magnetic field of the coil opens or closes the contacts.

The ability of JMP relays to handle contact loads up to 5 amperes, and with an operating time as short as 3 milliseconds, together with the addition of polarized operation widens greatly the range of applications of mercury-wetted contact relays.

Available with either single or dual wound coils surrounding a single capsule, the JMP series uses an elongated steel case to accommodate the Alnico magnets. Potted in a high melting point compound, the entire assembly is housed in a steel case. An eight-pin bakelite plug accommodates mounting.

JMP SPECIFICATIONS

GENERAL

Life Expectancy: More than one billion operations at rated load.

Operate and Release Times: The adjustment of the Alnico magnets determines operate times. A minimum of 3 milliseconds is possible.

Alnico Magnets Adjustments: A wide range of operating characteristics for individual requirements is available in three basic adjustment classes:

A. Single-Side Stable Adjustment: The Alnico magnets are adjusted to release (open) the front contacts when the coil current is reduced to less than must operate value. The range of the operate adjustment is 70 to 110 ampere turns. A tolerance of ±4 ampere turns is required for a given operate or release current value.

B. Bi-Stable Adjustment: The Alnico magnets are adjusted to lock the armature in the last operated position until an adequate current value of opposite polarity energizes the coil. Must operate adjustment for coil No. 1 is ±35.1 ampere turns. Must operate adjustment for coil No. 2 is ±40.7 ampere turns.

C. Chopper Adjustment: The Alnico magnets are adjusted for equal dwell on the front and back contacts driven by 60 Hz AC sine wave with the specified voltage.

For typical listings of relays in classes A, B, and C, see page 15.

For all other specifications of JMP relays please turn to pages 10 and 11 and note specifications applying to JM1 relays.

JMP TERMINATIONS SINGLE-WOUND COIL

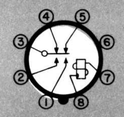


Fig. 11

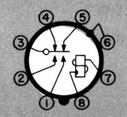


Fig. 12


Fig. 13

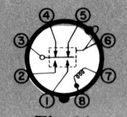


Fig. 14 *

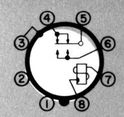


Fig. 15

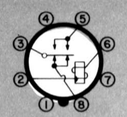


Fig. 16

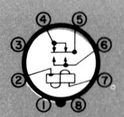


Fig. 17

JMP TERMINATIONS DUAL-WOUND COIL


Fig. 51

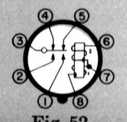


Fig. 52

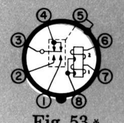


Fig. 53 *

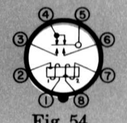


Fig. 54

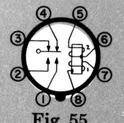


Fig. 55

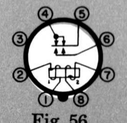


Fig. 56

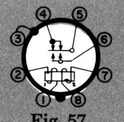


Fig. 57

JMP BRIDGING POLARIZED

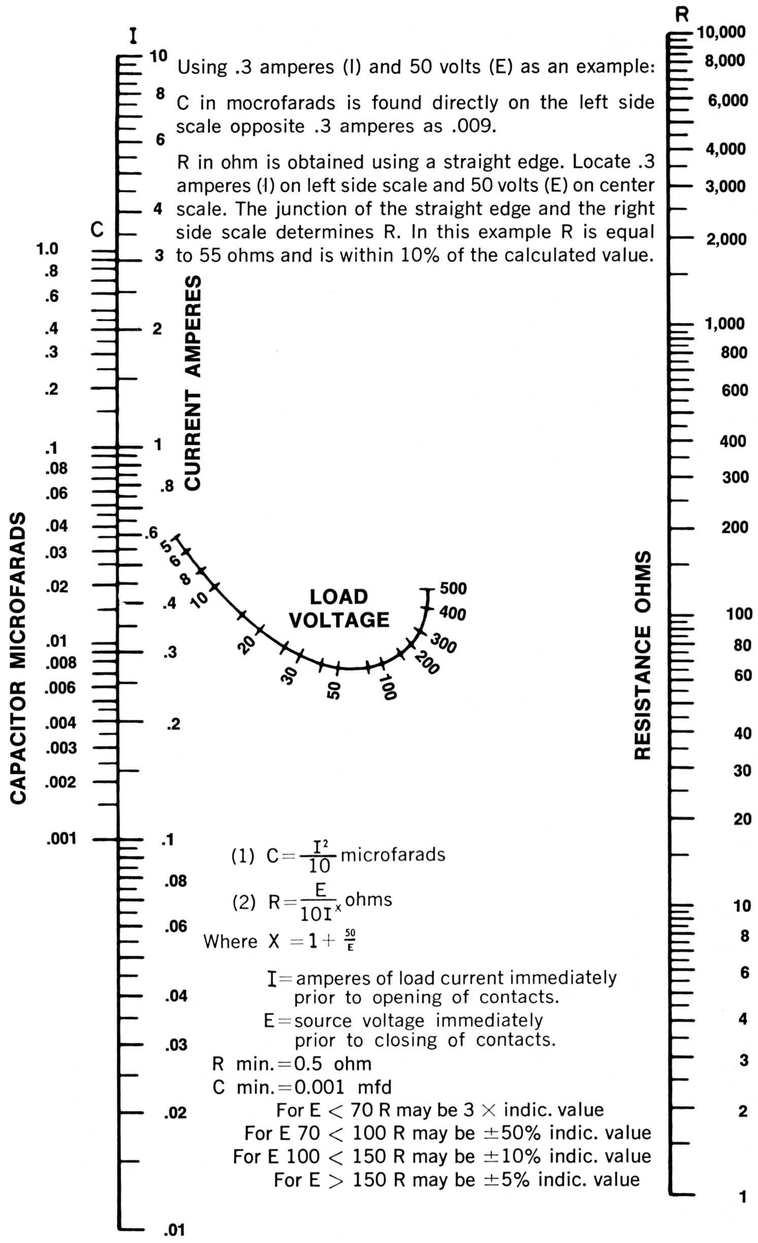
SERIES Capsule	Coil	Terminal Fig. No.	COIL CHARACTERISTICS RESISTANCE (Ohms ±10%)	TURNS	OPERATE CHARACTERISTICS SOAK ma DC	OPERATE ma DC	NON-OP ma DC	HOLD ma DC	RELEASE ma DC
SINGLE-SIDE-STABLE									
JMP 1010			2	600	334	125			15.0
JMP 1020			5	1000	200	88			15.0
JMP 1050			34	2630	76.0	41.5			15.5
JMP 1080			90	3230	61.8	32.0		18.5	15.0
JMP 1081			90	4325	46.25	16.0	12.8		1.3
JMP 1090			130	4900	40.8	15.1	13.5		0.81
JMP 1100			200	6000	33.3	11.7			0.6
JMP 1110			350	7660	26.1	12.8	11.7		4.0
JMP 1111			350	7660	26.1	9.65	8.51		0.5
JMP 1120			500	9450	21.2	7.83	7.0		0.42
JMP 1150			800	11500	17.4	6.09			0.52
JMP 1160			1000	12350	16.2	5.6			0.4
JMP 1161			1000	12350	16.2	6.0	4.8		0.6
JMP 1162			1000	12350	16.8	8.7	7.9		3.0
JMP 1180			1900	17800	11.25	4.2	3.3		0.4
JMP 1190			2500	18800	10.6	3.94	3.51		0.21
JMP 1200			4000	23400	8.55	2.96	2.38		0.24
JMP 1201			4000	23400	8.55	4.7		2.28	1.7
JMP 1202			4000	23400	8.55	5.9		3.4	2.8
JMP 1203			4000	23400	8.55	3.24		0.58	0.24
JMP 1204			4000	23400	8.55	4.0		2.7	1.1
JMP 1204			4000	23400	8.55	4.0		2.7	1.1
JMP 1220			7000	31675	6.31	2.21	1.83		0.19
JMP 1221			7000	31675	6.31	3.57	3.32		1.42
JMP 1222			7000	31675	6.31	3.20		1.38	1.12
JMP 1260			25000	53000	3.77	1.32			0.15
JMP 1261			25000	53000	3.77	1.98		0.86	0.65
JMP 1410			1100	12660	15.8	6.0	4.8		0.6
JMP 1420			3750	22725	8.8	3.0	2.81		0.35
JMP 1430			11300	33915	5.9	2.06			0.17
JMP 1330		1.	250	4100	48.8	18.0			1.6
		2.	250	5000		18.0			1.6
JMP 1340		1.	700	5925	33.8	14.2	7.7	5.1	2.8
		2.	3300	16950		5.7			
JMP 1360		1.	1800	10540	19.0	6.65	6.06		1.14
		2.	1775	10980		6.76			
JMP 1370		1.	7500	20400	9.8	3.63			0.20
		2.	7500	22250		3.63			
JMP 1470		1.	1020	7950	25.2	14.0		7.5	6.0
		2.	970	8200		16.0			
BI-STABLE									
JMP 5050			34	2630		+ 13.3			−13.3
JMP 5100			200	6000		+ 5.85			− 5.85
JMP 5130			600	10450		+ 3.36			− 3.36
JMP 5200			4000	23400		+ 1.50			− 1.50
JMP 5240			11000	38050		+ 0.92			− 0.92
JMP 5300		1.	100	3015		+ 11.7			−11.7
		2.	100	3050		+ 13.4			−13.4
JMP 5330		1.	250	4100		+ 8.6			− 8.6
		2.	250	5000		+ 8.2			− 8.2
JMP 5340		1.	700	5925		+ 6.0			− 6.0
		2.	3300	16950		+ 2.4			− 2.4
JMP 5360		1.	1800	10540		+ 3.34			− 3.34
		2.	1775	10980		+ 3.76			− 3.76
JMP 5370		1.	7500	20400		+ 1.72			− 1.72
		2.	7500	22250		+ 1.83			− 1.83
JMP 5380		1.	11500	29800		+ 1.18			− 1.18
		2.	11500	19450		+ 1.80			− 1.80
JMP 5470		1.	1020	7950		+ 4.41			− 4.41
		2.	970	8200		+ 4.96			− 4.96
						Voltage RMS 60cps			
CHOPPER									
JMP 8120			500	9450		6.3			
* JMP 8400			600	8960		6.3			
JMP 8200			4000	23400		18.5			
* JMP 8420			3750	22725		18.5			
JMP 8240			11000	38050		117.0	with 12000 ohm (±5%) ½ watt resistor in series with coil		
* JMP 8440			21000	45450		117.0			

*shielded capsule

Note: Only series JMP 300 single capsule relays can be supplied with electrostatically shielded capsule. JMP terminations Figs. 14 & 53 apply only to the JMP 300 series relay. The coil data above does not apply to a shielded capsule relay. For data on series JMP 300, consult the factory.

Termination Diagrams: Positive potential applied to the start of windings indicated by the symbol ◠ will close contacts shown open on diagrams.

R & C NOMOGRAM



Using .3 amperes (I) and 50 volts (E) as an example:

C in mocrofarads is found directly on the left side scale opposite .3 amperes as .009.

R in ohm is obtained using a straight edge. Locate .3 amperes (I) on left side scale and 50 volts (E) on center scale. The junction of the straight edge and the right side scale determines R. In this example R is equal to 55 ohms and is within 10% of the calculated value.

(1) $C = \frac{I^2}{10}$ microfarads

(2) $R = \frac{E}{10I^X}$ ohms

Where $X = 1 + \frac{50}{E}$

I = amperes of load current immediately prior to opening of contacts.

E = source voltage immediately prior to closing of contacts.

R min. = 0.5 ohm

C min. = 0.001 mfd

For E < 70 R may be 3 × indic. value

For E 70 < 100 R may be ±50% indic. value

For E 100 < 150 R may be ±10% indic. value

For E > 150 R may be ±5% indic. value

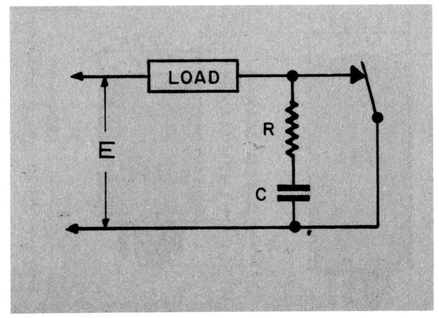
The nomogram shown here affords a convenient method of selecting the proper contact protection.

PROTECTIVE CIRCUIT REQUIREMENTS

To achieve the ultimate in longevity—in excess of a billion operations—contact protection is required for mercury-wetted relays. However, on dry circuits (very light loads), such as thermocouples or strain gages, these relays are ideal and require no contact protection.

The contact protection circuit should consists of a resistor and capacitor in series. Installation as close as possible to the relay terminals is required. The peak voltages in inductive circuits can be reduced to safe levels by increasing the value of C in the protective circuit. Nominal values can be calculated by using the equations in the nomogram.

Contact protection requirements are especially important if circuit applications involve a source of power across the normally open and normally closed contacts. Occasionally, a current limiting impedance in the power circuit may be advisable.



PROTECTIVE CIRCUIT

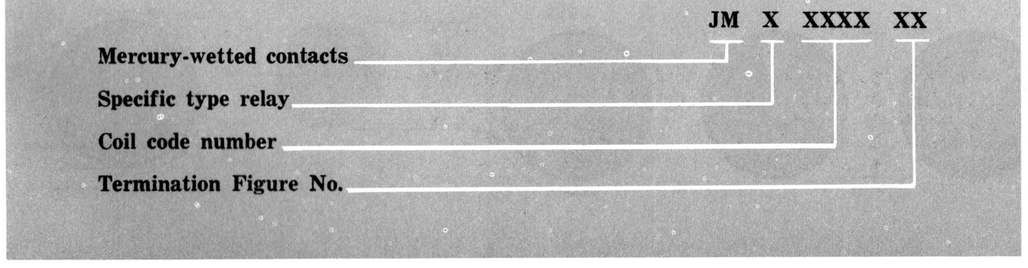
Data required for proper selection

Specific data regarding the conditions under which the relay must operate is essential for fulfillment of the utmost in performance and long relay life. Please explain:

1. What is the application of the relay?
2. How many capsules in each relay, 1, 2, 3, or 4?
3. Which wiring diagram was selected? Give Termination Figure Number required.
4. Does coil require single winding, or two independent windings?
5. What is the value of operating currents?
6. Maximum ambient operating temperature?
7. Type of base required?
8. Special requirements:

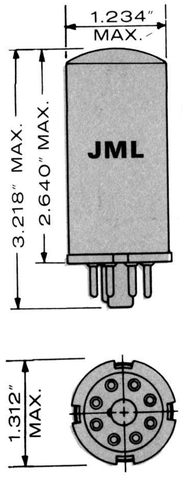
A. Hermetic sealing of case?
B. Fungus inhibitor in potting compound?
C. Inverted construction?
D. Special electrostatic shields?
E. Special termination plug?
F. Mounting?
G. Finish?
H. Marking?

CODING OF JM SERIES

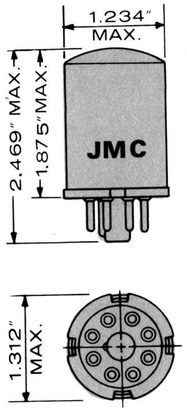


DIMENSION DIAGRAMS

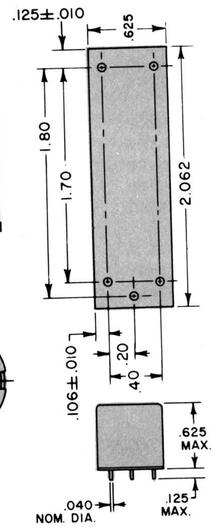
JML



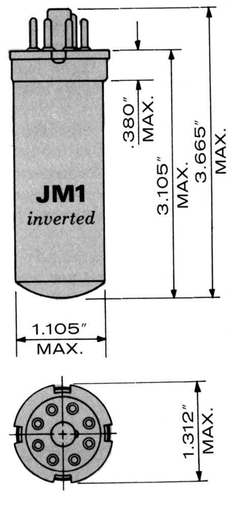
JMC



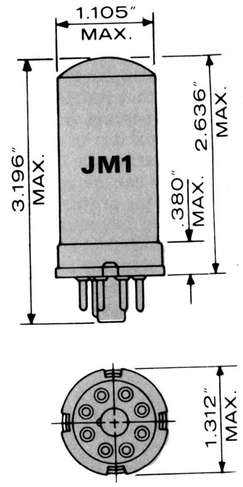
JMF



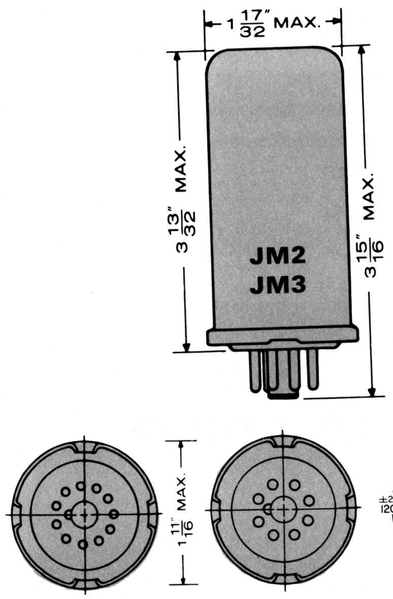
JM1 *inverted*



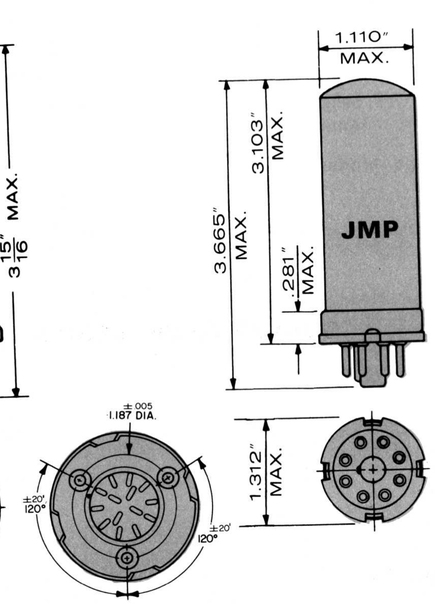
JM1



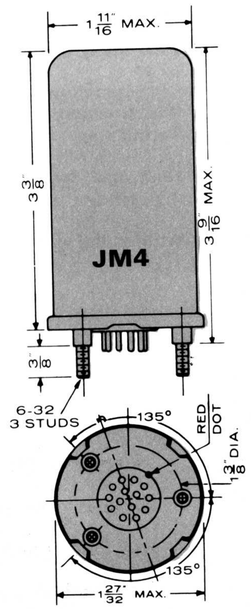
JM2/3



JMP



JM4



ENGINEERING CAPABILITIES

JM series mercury-wetted contact relay designs lend themselves to modifications for adaptation to individual requirements. If compatible with general JM designs, Potter & Brumfield can furnish any other resistance value desired in addition to the coil resistances shown. Special termination configurations and shielded contacts or coils are also available.

Inspection and test procedures—of vital concern in the production of mercury-wetted contact relays—are extensive and thorough. Our scope of testing capabilities includes vibration, acceleration, shock, humidity, altitude, reliability, contact resistance, mechanical and electrical life and others. A complete Standards Room is maintained to keep all test equipment in meticulous calibration.