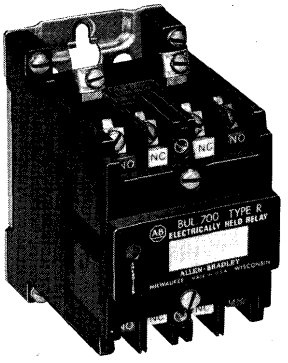
BULLETIN 700 TYPE R AND RM RELAYS TECHNICAL AND APPLICATION DATA

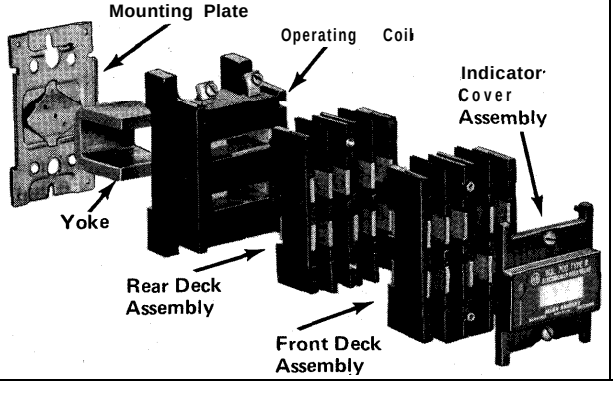


4 POLE TYPE R RELAY

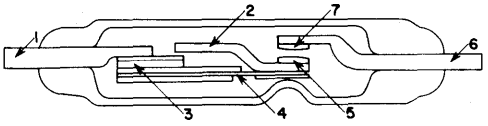
DESCRIPTION — Bulletin 700, Types R and RM relays, provide exceptional reliability and dependability of operation in dust and contaminant-laden atmospheres. The contacts, at 120 volts AC, are capable of making 30 amperes and breaking 3 amperes control circuit loads which allows direct switching of all size Bulletin 500 or 709 starter coils. This is possible on the larger starters as they are switched by pilot relays supplied with the starters.

Both the Type R and Type RM are available with one to eight electrically isolated contacts in any combination of normally open or normally closed contacts. There are no requirements for specific placement or locations of the NO or NC cartridges in the front or rear deck. For consistency with factory assembled relays, see Product Data Sheet 700-902. The Type R relay is electrically held. The Type RM relay is magnetically latched providing memory during a power loss.

CONSTRUCTION — The Type R and RM relays consist of a pressure molded coil, steel mounting plate, magnetic yoke, rear deck containing the flux finger assembly, front deck with flux finger extensions, a cover with indicator, and contact cartridges. The individual parts are keyed to provide proper orientation and correct assembly.

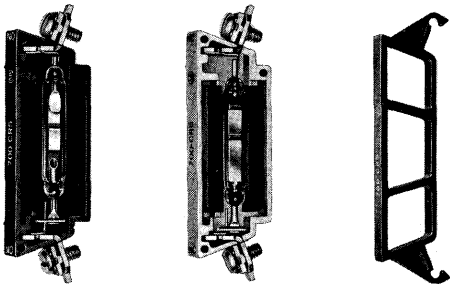


Sealed Contacts— Both of the relay configurations utilize sealed contact cartridges which contain a sealed switch. These contacts are hermetically sealed in a glass envelope which contains a controlled gas atmosphere.



The sealed contact switch is comprised of a stationary element and a movable element sealed in a glass envelope. The movable element consists of a terminal (I), an armature (2), a pole piece (30), a spring member (4), and a tungsten-tipped contact (5). The stationary element consists of a terminal (6) and a stationary tungsten-tipped contact (7).

A unique magnetic design provides snap-action contact force that establishes a current handling capability yet provides for consistent low contact resistance throughout life for reliable switching of low level circuits.



Cat. No. 700-C R5 **Cat. No. 700-CR6** **Cat. No. 700-C R9**

Electrically Held Contact Cartridges Type R — The sealed contact is mounted in a polycarbonate cartridge housing. A clear polycarbonate cover is joined to the housing allowing a visual inspection of the contact. The terminals with a self-lifting pressure plate will accept two AWG #12 through AWG #18 wires. If two wires are used, they must be within one wire size of each other.

The cartridges are color coded, green for NO (Cat. No. 700-CR5) and yellow for NC (Cat. No. 700-CR6) and marked either NO or NC for quick identification.

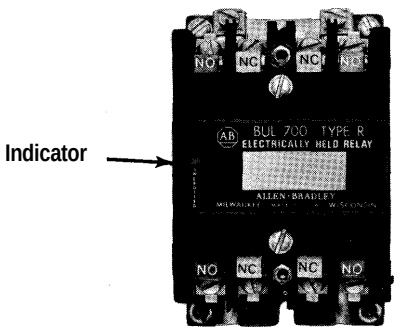
The NO cartridge has no biasing permanent magnet and is operated directly by the coil flux.

The NC cartridge contains two ferrite permanent magnets, holding the contacts in the closed position. During energization, the flux produced by the coil opposes and nullifies the magnet field produced by the permanent magnets and the sealed contact opens. When the relay is de-energized, the sealed contacts return to their closed position.

Publication 700-2.1 — January, 1981
Supersedes Publication 700-2.1 Dated April, 1977

Magnetically Latched Contact Cartridge Type RM – The magnetically latching cartridges are also color coded, blue for NO (Cat. No. 700-CR7) and red for NC (Cat. No. 700-CR8) Each bistable cartridge contains a permanent magnet which provides the proper bias flux to hold the sealed contact in either the open or closed position. When the latch or reset coil is energized, the flux produced by the coils will add to or subtract from the biasing flux causing the sealed contacts to switch accordingly.

Dummy Cartridge For Types R and RM – A black dummy cartridge (Cat. No. 700-CR9) must be placed in unused cartridge slots in the front or rear deck to keep foreign material out of the relay. When the Type R or RM is factory ordered, dummies are automatically supplied in the unused slots. They can be easily removed and replaced with a NO or NC contact cartridge.



Indicator – An indicator in the cover is provided on both the Type R and Type RM relays. In the case of the Type R relay, a visual red indicator will appear through the transparent window when the coil is energized. When power is removed from the coil, the red indicator will pivot away from the window.

The Type RM relay has two red indicators visually displaying which coil was energized last (either the latch or reset coil).

In both cases, the indicator operates on the magnetic flux produced by the coil and does not indicate contact condition or whether contacts are operating.

Note: When the Bulletin 852S Timer is mounted on the relay, the indicator will no longer be visible.

OPERATION OF TYPE R ELECTRICALLY HELD RELAY - **AC Operation –** When an AC power source is connected to the coil terminals, a full wave rectifier converts the AC to the required DC voltage to operate the relay. This DC voltage is applied to two series connected bobbin wound coils each surrounding one leg of a U-shaped magnetic yoke. The two ends of the yoke are extended by properly placed flux fingers mounted in the rear deck assembly. The contact cartridges are mounted between these spaced flux fingers. The magnetomotive force produced by the coil induces a magnetic flux in the flux fingers which is directed through the sealed contact switches,thus causing them to operate.

The front deck contains flux finger extensions which provide a magnetic flux path for proper operation of the front mounted contact cartridges.

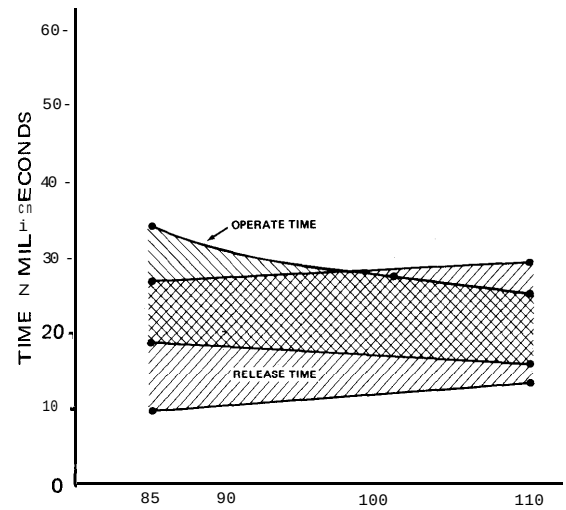
DC Operation – The DC relay operates exactly the same as the AC relay except the AC to DC rectifier circuit is omitted. The polarity markings on the coil must be followed for proper operation.

OPERATE AND RELEASE TIMES FOR TYPE R RELAY – The definition of operate time and release time is as follows:

Operating Time – The time interval from coil energization to the functioning time of the last contact on the relay to operate.

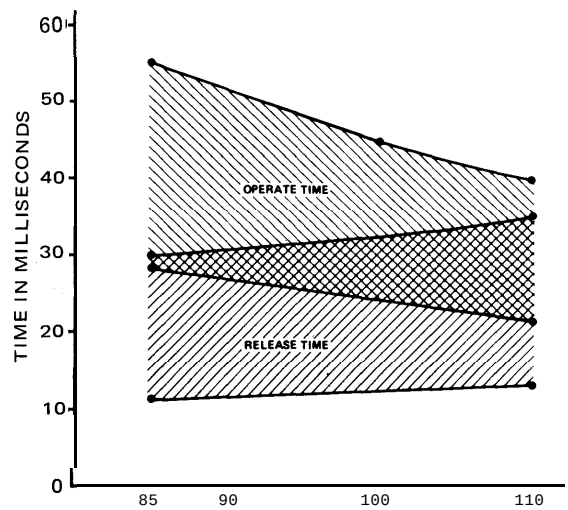
Release Time – The time interval from coil de-energization to the functioning time of the last contact on the relay to release.

The operating and release curves shown in Figures 1 and 2 below and in Figures 3 and 4 on Page 3 include variations within any given type relay including any combination of NO and NC cartridges, and it also includes variation from relay to relay.



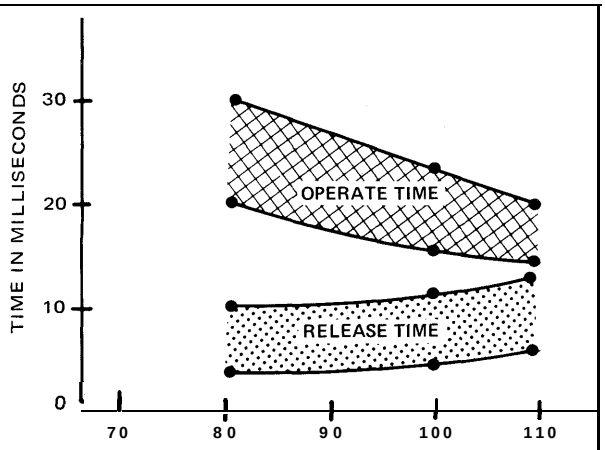
BULLETIN 700 TYPE R AC 1-4 POLE OPERATE AND RELEASE CHARACTERISTICS

Figure 1



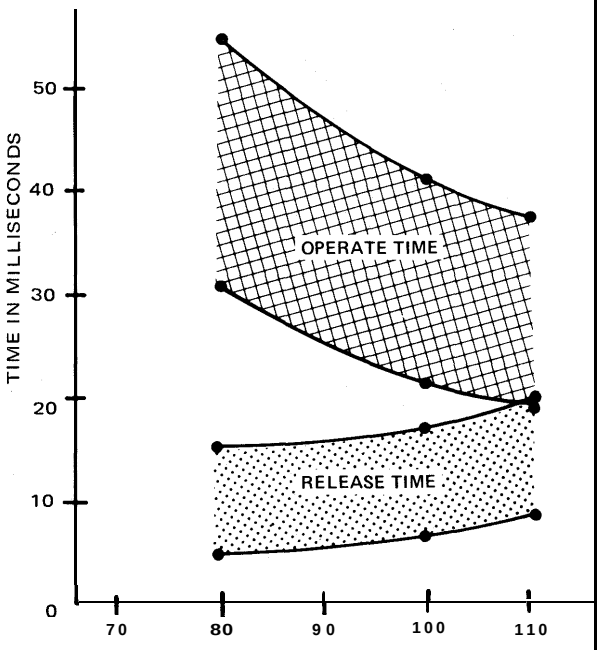
BULLETIN 700 TYPE R 5-8 POLE OPERATE AND RELEASE CHARACTERISTICS

Figure 2



BULLETIN 700 DC TYPE R 1-4 POLE
OPERATE AND RELEASE CHARACTERISTICS

FIGURE 3



BULLETIN 700 DC TYPE R 5-8 POLE
OPERATE AND RELEASE CHARACTERISTICS

FIGURE 4

OPERATION OF TYPE RM MAGNETICALLY LATCHED RELAY — **AC Operation** — The operating coil of the magnetically latching relay utilizes a similar AC to DC rectifier circuit and two bobbin wound coils similar to the electrically held relay coil except that each coil has a rectifier circuit and is used independent of each other. A magnetic shield is secured to the sides of the front and rear deck to prevent against any interaction from stray magnetic fields. When the latch coil is energized, the direction of the produced flux adds to the biasing flux of the NO cartridge causing the contacts to close and subtract from the biasing flux of the NC cartridges causing the contacts to open. If the power is removed from the latch coil, the biasing magnets are designed to hold the contacts in the same position. When the reset coil is energized, the direction of the produced flux will be opposite to that of the latch coil which will cause the contacts to return to their normal position.
For reliable operation, the latch and reset coils must be energized for at least the maximum time period shown on the latch and reset time curves.

Note: During installation and whenever the relay is disassembled for adding or replacing cartridges, the cartridges and indicator must be conditioned after reassembly by energizing either the reset or latch coil to establish proper contact state.

DC Operation — The DC relay operates the same as the AC relay except for the AC to DC rectifier circuits which are omitted. The polarity markings on the coil must be followed for proper operation.

LATCH AND RESET TIMES FOR TYPE RM RELAY — The definition of latch time and reset time is as follows:

Latching Time — The time interval from latch coil energization to the functioning time of the last contact on the relay to latch.

Reset Time — The time interval from reset coil energization to the functioning time of the last contact on the relay to reset.

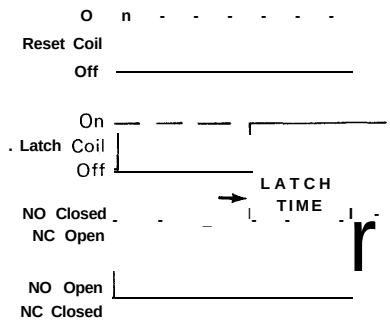
The latch and reset curves shown in Figures 5 thru 10 on Pages 4 and 5 include variations within any given type relay including any combination of NO and NC cartridges, and it also includes variation from relay to relay.

Note: The latch and reset curves for the Bulletin 700DC Type RM relay were not available at the time of the publication of this Product Data sheet. The following curves apply to AC operation only.

The Type RM relay has three basic modes of operation designated Mode A, Mode B, and Mode C which affect the latch and reset times.

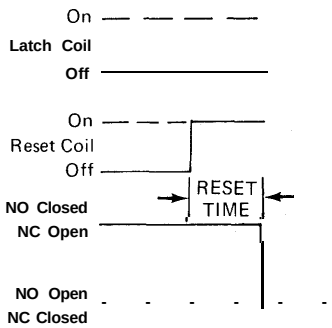
MODE A OPERATION -See Figures 5 and 6
The relay is reset. The latch and reset coils are de-energized.

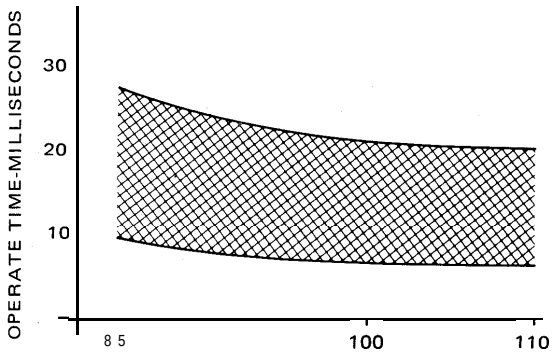
Latch time denotes the contact transfer time to latched state (i.e. NO closed, NC open) when the latch coil is energized.



The relay is latched. The latch and reset coils are de-energized.

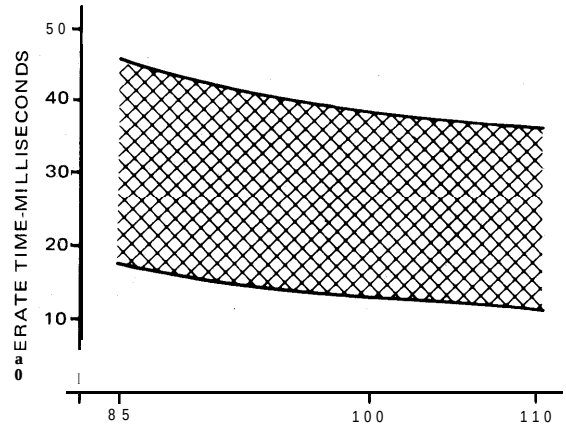
Reset time denotes the contact transfer time to reset state (i.e. NO open, NC closed) when the reset coil is energized.





% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC I-4 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 5



% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC 5-8 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 6

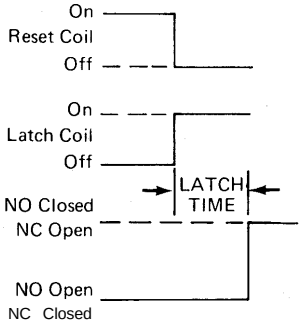
Note: 1. Latch and Reset times of a given cartridge will not necessarily be equal.

2. If the coils are energized for less than the maximum time indicated, the contact state is indeterminate (i.e. some contacts may or may not change state).

MODE B OPERATION -See Figures 7 and 8

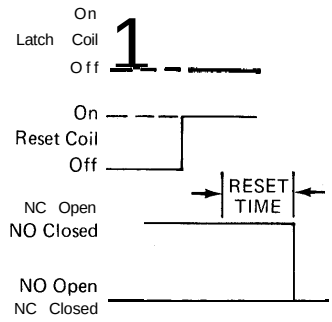
The relay is reset. The reset coil is energized.

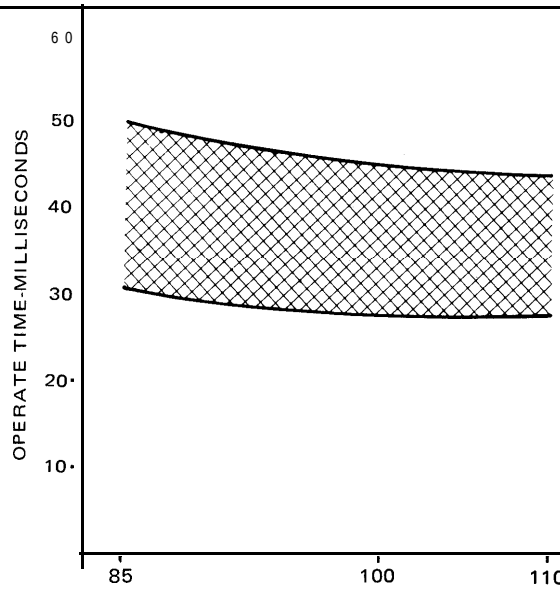
Latch time denotes the contact transfer time to latched state (i.e. NO closed, NC open) when the reset coil is de-energized at the same time (within 1 millisecond) the latch coil is energized.



The relay is latched. The latch coil is energized.

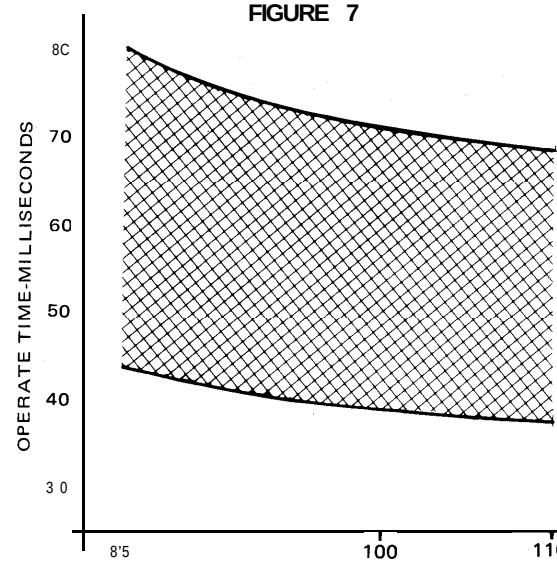
Reset time denotes the contact transfer time to reset state (i.e. NO open, NC closed) when the latch coil is de-energized at the same time (within 1 millisecond) the reset coil is energized.





% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC 1-4 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 7



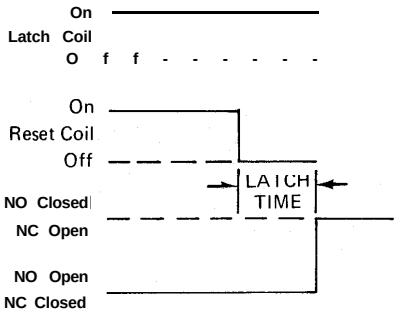
% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC 5-8 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 8

Note: Latch and reset times of a given cartridge will not necessarily be equal.

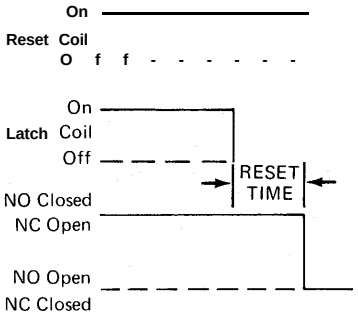
MODE C OPERATION -See Figures 9 and 10
The relay is reset. Latch and reset coils are energized.

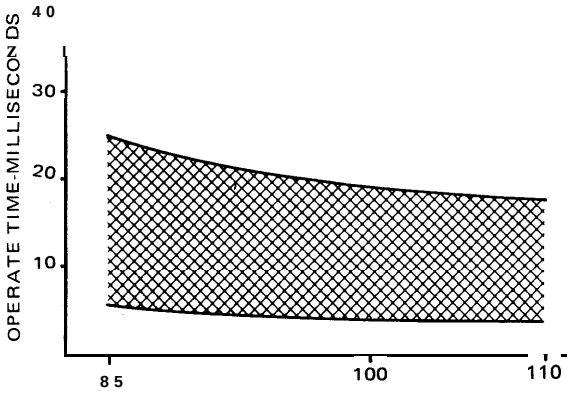
Latch time denotes the contact transfer time to the latched state (i.e. NO closed, NC open) when the reset coil is de-energized with the latch coil remaining energized.



The relay is latched. Latch and reset coils are energized.

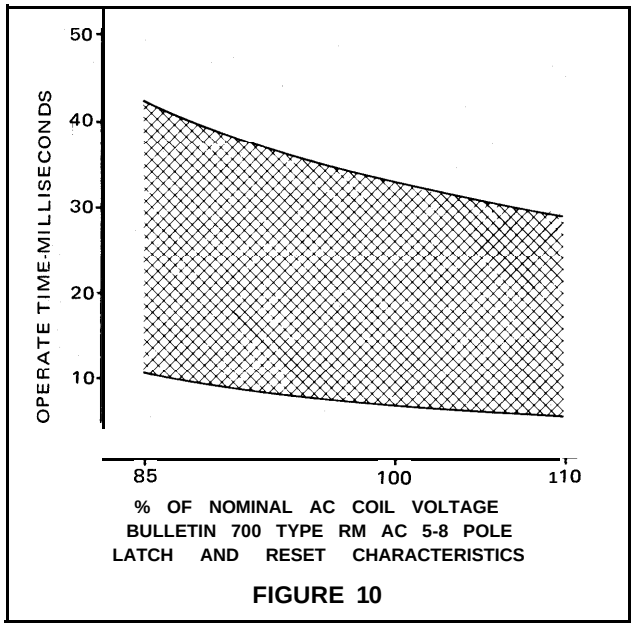
Reset time denotes the contact transfer time to the reset state (i.e. NO open, NC closed) when the latch coil is de-energized with the reset coil remaining energized.





% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC I-4 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 9



% OF NOMINAL AC COIL VOLTAGE
BULLETIN 700 TYPE RM AC 5-8 POLE
LATCH AND RESET CHARACTERISTICS

FIGURE 10

Note: **1.** Latch and reset times of a given cartridge will not necessarily be equal.

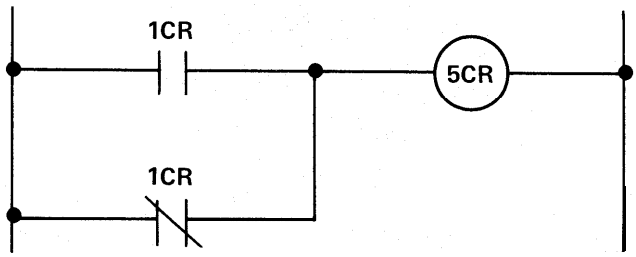
2. If the coils are de-energized for less than the maximum time indicated, the contact state is indeterminate (i.e. some contacts may or may not change state).

CONTACT OVERLAP – Type R Electrically Held AC 1-4 **Pole Relay** – Statistical data taken on the 4 pole relays at 100% rated operating voltage (i.e. 120 vrms) shows that typically the maximum operate non-overlap which will occur between any NO and NC pair on a given relay is 3 milliseconds, The typical maximum operate overlap which will occur between any NO and NC pair on a given relay is 8 milliseconds. Typically on the average a given relay will exhibit an operate overlap of 3 milliseconds between any NO and NC contact pair.

This data shows that typically the maximum release non-overlap which will occur between any NO and NC pair on a given relay is 6 milliseconds. The typical maximum release overlap which will occur between any NO and NC pair on a given relay is 6 milliseconds. Typically on the average a given relay will exhibit neither overlap or non-overlap between any NO and NC contact pair (i.e. change state at approximately the same time).

From Figure 1, it can be determined that the minimum release time for the 4-pole Type R relays is 12 milliseconds. A NO and NC pair of contacts from a given 4 pole Type R relay will not drop out another 4 pole Type R AC relay when connected as shown below.

CAUTION: It is highly recommended that this circuit should not be used where a malfunction could result in bodily injury or damage to equipment.

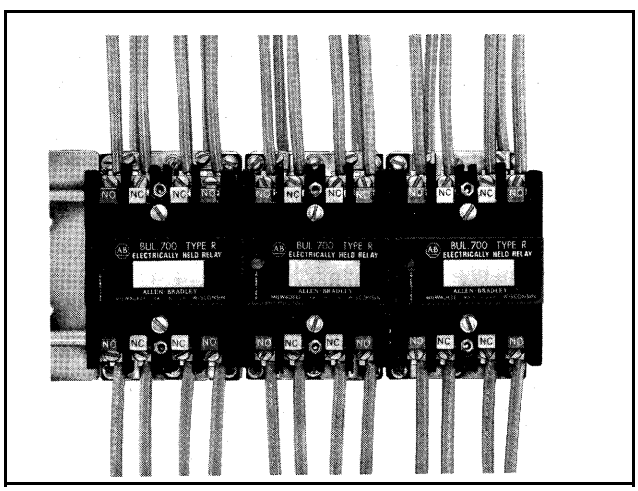


Type R Electrically Held AC 5-8 Pole Relay — The cartridges located in the rear deck will operate similar to the l-4 pole AC relay described on Page 5. They can be used in the circuit shown on Page 5 provided the relay connected to those contacts is a 4 pole Type R AC relay and subject to the caution note on Page 5. Contact overlap or non-overlap between the cartridges located in the front deck and those in the rear deck of the same relay cannot be assured. The operate and release times of those contacts will fall within the curve shown in Figure 2 on Page 2.

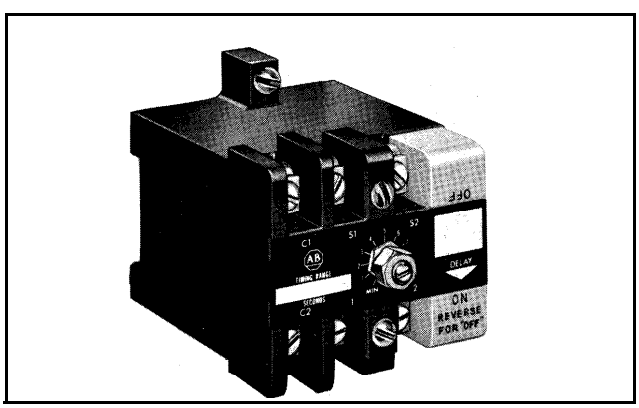
Type RM Relay — Because of the inherent characteristics of this device, the normally open contacts may close before the normally closed contacts open on energization of the latch coil and the normally closed contacts may close before the normally open contacts open on energization of the reset coil. The latch and reset times of these contacts will fall within the curves shown in Figures 5 thru 10 on Pages 4 and 5.

MOUNTING AND WIRING — The Type R and Type RM relays are designed for straight-through wiring and have identical mounting dimensions as the popular Bulletin 700 Type N relay. The Type RM does not require any special mounting hardware for protection against shock.

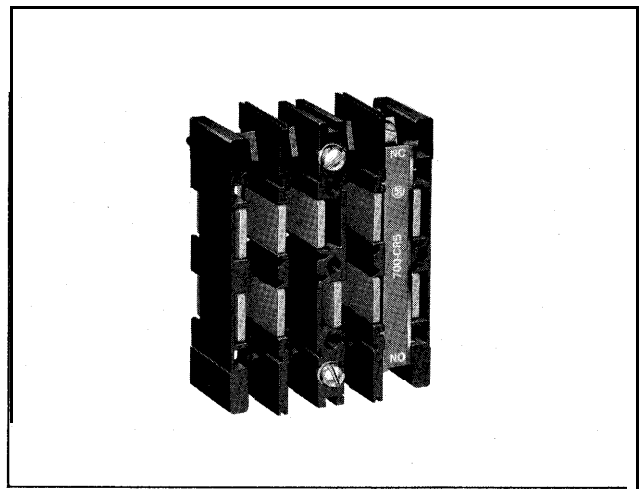
Mounting strips can be used to simplify a panel layout. The strips can be cut to the required length and bolted, riveted, or spot-welded in place. Relays are installed adjacent to one another on the mounting screws provided. Rows of relays on mounting strips form their own wiring trough.



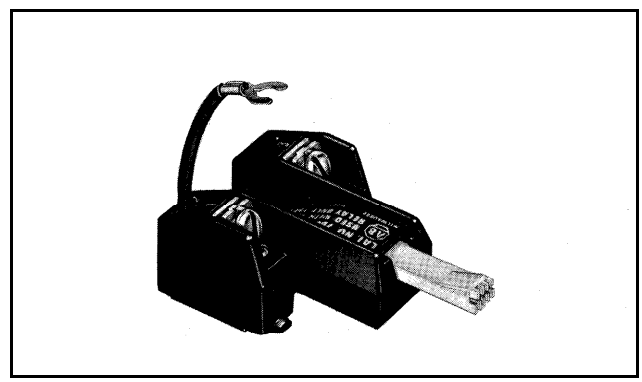
FIELD MODIFICATIONS —



Solid State Timer — The Bulletin 852S Solid State Timer may be added to the Type R and RM single deck relay. The Timer has the same sealed contact as used in the cartridges as an output and is On-Delay to Off-Delay convertible.

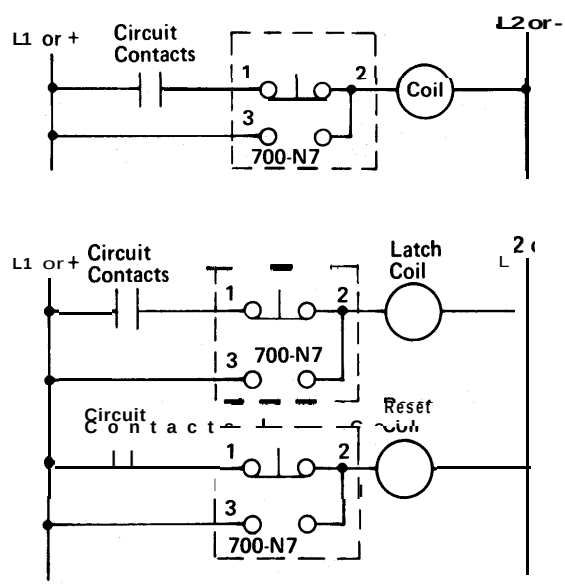


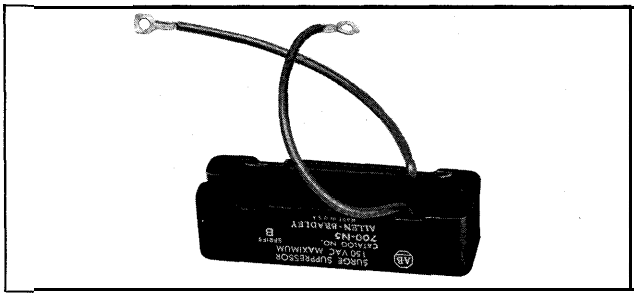
Front Deck — A second or front deck may be added to any relay having a rear deck only, increasing the maximum number of poles available to a total of eight, either NO or NC or combination thereof.



Manual Actuator — A Manual Actuator, Catalog No. 700-N7, is available for manual energization of the relay coils. It can be factory or field installed on both the Type R and RM, Series A and B relays, 24 to 120 volts AC or DC. Separate actuators are required for the latch and reset coils on the Type RM relays.

The actuator is connected as shown below. Note: the actuator can only switch the relay coil, no other connection can be made to lead terminal No. 2.





Surge Suppressor— Type R and RM relays with AC coils are designed not to generate transients because of rectifier circuits integrally molded into the coils and, therefore, external suppression is not necessary. An internal Metal Oxide Varistor (MOV) is provided to protect the rectifier circuit from most externally generated transients.

The DC coils may require suppression in certain applications. The table below lists the contact protector/surge suppressor which can be used with the corresponding DC coil. This will increase the release and reset times of the Type R and Type RM relays by as much as 75%.

Contact Protector/Surge Suppressor for DC Relay

Volts DC	Type R Relay	Type RM Relay
24	Cat. No. 700-N10	Cat. No. 700-N13
48	N16	N17
115/125	N11	N14
230/250	N12	N15

UNDERWRITERS' LABORATORIES, INC. AND CSA LISTED— Bulletin 700 Type R and RM relays are listed by Underwriters' Laboratories, Inc. for use in Class I, Division 2, Groups A, B, C and D hazardous locations temperature code T4A as defined by the National Electrical Code.

OPERATING ENVIRONMENT — **Temperature Ratings** — All devices are designed to meet UL 508 temperature rises in a 40°C ambient temperature, All devices are designed to function properly in an ambient temperature range of -20°C to +60°C (0°F to + 140°F).

Vibration — A vibration test consists of subjecting a device to sinusoidal vibrations that changes frequency either logrithmically or linearly over a given period of time. During the test the maximum excursion D and/or maximum acceleration in G's is controlled.

The intensity of vibration is defined as follows when the device is vibrated sinusoidally:

$A = .0511\ DF^2$

Where D = excursion or peak-to-peak amplitude in inches.
Where F = frequency of vibration in Hertz.
Where A = acceleration in G's.
Where G = $32 ft/sec.^2$

The test sensitivity is given in terms of the maximum time the contacts might abnormally open or close during the vibration test.

The Type R electrically held and Type RM magnetic latching relay are designed to exhibit a maximum abnormal contact opening or closing of less than 10 microseconds when vibrated in all three mutually perpendicular directions; the frequency varying between 5 and 60 Hz logarithmically in a one minute time period and with a maximum acceleration of 5.5 G's and maximum excursion of inches.

Shock— The Type R and RM are designed to withstand without harm or without false contact operation (less than 10 microseconds) in anyone of three mutually perpendicular directions three sinusoidal shocks of magnitudes shown.

Direction ❑	Type R	Type RM
Vertical	50G	40G
Horizontal (Perpendicular to mounting plate)	50G	40G
Horizontal (parallel to mounting plate)	30G	10G

❑ **All directions are with respect to normal relay mounting on mounting plate in control panels.**

OPERATING COILS — Type R and RM operating coils are rated in accordance with NEMA standards. AC coils are designed to withstand 110% of the rated voltage and to operate properly at 85% of rated voltage. DC coils are designed to withstand 110% of rated voltage and to operate properly at 80% of rated voltage.

The following tables list the power consumption of the Type R and Type RM operating coils. There is no inrush.

OPERATING COILS — TYPE R

Volts	Hz	Coil Number	Amperes	Volt-Amperes
24	50	77AB27	.27	6.5
	60			
120	60	77AB86	.048	5.85
110	50		.044	4.90
240	60	77AB83	.020	4.95
220	50		.018	4.15
24	DC	77D152	.23	5.5
115-125	DC	77D155	.042-.045	4.9-5.7
230-250	DC	77D156	.019-.021	4.4-5.3

OPERATING COILS — TYPE RM

Volts	Hz	Coil Number	Amperes		Voltamperes	
			Latch	Reset	Latch	Reset
24	50/60	78AB27	.224	.224	5.4	5.4
120	60	78AB86	.043	.043	5.2	5.2
110	50		.040	.040	4.4	4.4
240	60	78AB83	.022	.022	5.3	5.3
220	50		.020	.020	4.4	4.4
12	DC	78D151	.145	.145	1.7	1.7
24	DC	78D152	.074	.074	1.8	1.8
28	DC	78D204	.055	.055	1.5	1.5
32	DC		.062	.062	2.0	2.0
48	DC	78D166	.036	.036	1.7	1.7
115	DC	78D155	.013	.013	1.5	1.5
125	DC		.014	.014	1.8	1.8
230	DC	78D156	.006	.006	1.5	1.5
250	DC		.007	.007	1.8	1.8

CONTACT RATINGS-

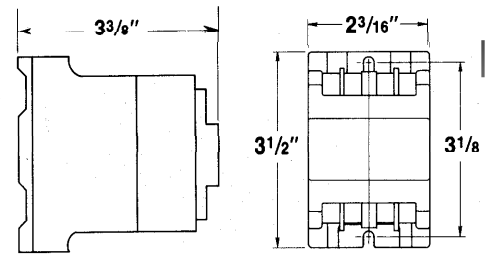
Maximum AC Contact Rating Per Pole 50 or 60 Hertz						
NEMA Rating Designation	Maximum Voltage	Amperes		Continuous Carrying Current (Amperes)	Voltamperes	
		Make	Break		Make	Break
— 8300	120	30	3.00	5	3600	360
— 8300	240	15	1.50	5	3600	360
C600 —	480	3.75	0.375	2.5 [1]	1800	180
C600 —	600	3.00	0.30			
Maximum DC Contact Rating Per Pole						
P300	125	1 1		5.0	138	
	250	0.55		5.0	138	

[1] Bulletin 700 Type R and RM relays have a continuous current rating of 5 amps.

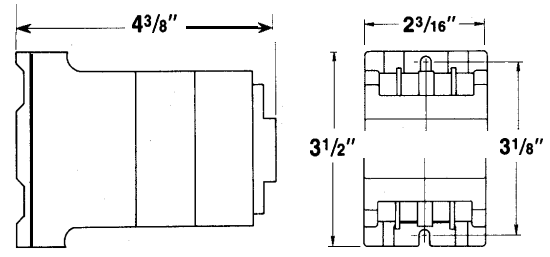
The following fuses are recommended for protection of the sealed contacts under short circuit conditions.

FUSE TYPE	RATING
250 Volt Bussman Class H	NON6
250 Volt Bussman TRON rectifier	KAB, 10, KAB 15, KAB 20
250 Volt Bussman Fuse-tron Dual-element	FRM 2.8
250 Volt Chase-Shawmut Amptrap Form 101	A25X20

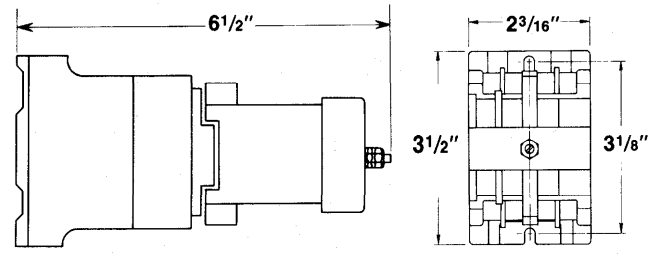
DIMENSIONS-



Relay with 2-4 Poles



Relay with 5-8 Poles



Relay with Solid State Timer