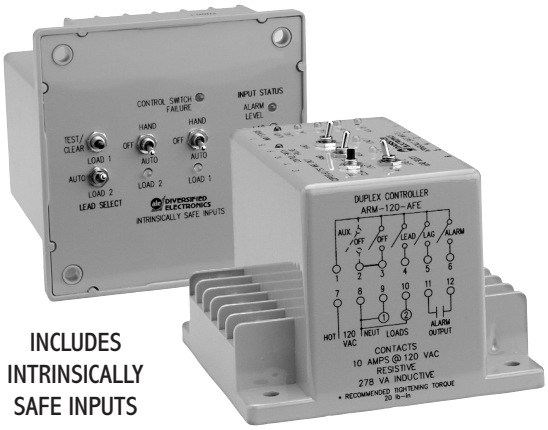
Process Control Equipment for Hazardous Locations
7M26
UL913



INCLUDES INTRINSICALLY SAFE INPUTS

Integrated Duplex Controller
SOSO Operation
(Sequence-on, Simultaneous-off)

The **ARM Series** Alternating Relay is a **microprocessor-based controller** designed for use in dual load installations to assure equal run time on each load. LED indicators show the status of the unit's five intrinsically safe control switch inputs, one alarm, and two load outputs. H-O-A switches, a lead select switch, and a test/clear button are provided for manual control. The ARM Series reduces the number of components required for this application by combining many functions into one unit.

TWO PUMP SEQUENCING: Evenly distributes run time by automatically alternating lead and lag load designations when the off control switch input opens.

UL913 INTRINSICALLY SAFE: Control switch inputs are low voltage/low current and are electronically isolated from the control voltage and load alarm contacts.

H-O-A Switches: Hand-Off-Automatic switches allow for manual operation.

LEAD SELECT SWITCH: Disables the automatic sequencing function and allows loads to be locked into the 2-1 or 1-2 sequence.

CONTROL SWITCH FAULT DETECTION: Unit detects open and shorted control switch failures.

TEST/CLEAR SWITCH: Verifies function and resets the control switch fault detection algorithm.

ALARM OUTPUT: Alarm contacts close when a control switch fails or the system's capacity is exceeded.

INRUSH CURRENT DELAY: Reduces line sags by preventing both loads from energizing simultaneously.

VERSATILE MOUNTING: Two (2) mounting configurations are available. The standard surface mount has top access to controls and indicators and is intended for back panel mounting. The panel mount option is intended for front panel or door cutout access to controls and indicators.

SPECIAL CONTROLS: ARM-2003 and **ARM-2010**–Standard operation without the H-O-A switches **ARM-2011**–Standard operation without the Control Switch Failure feature.

SPECIFICATIONS

CONTROL VOLTAGE	24 or 120 VAC ±10%, 50/60 Hz			
CONTROL SWITCH	Open Circuit Voltage	5 VDC		
	Short Circuit Voltage	0.1mA		
POWER REQUIRED	4 VA Maximum			
DUTY CYCLE	Continuous			
RESPONSE	Power Up	3 SEC. ±5%		
	Inrush Current	5 SEC. ±5%		
CONTACT RATING	(3) SPST-N.O. 10 Amp Resistive, 1/4 hp, 278 VA Inductive @ 120 VAC			
LED INDICATORS	Designation	Color	State	Condition
	Level/Alarm	Red	ON	cs5 Closed
	Lag	Green	ON	cs4 Closed
	Lead	Green	ON	cs3 Closed
	Off	Green	ON	cs2 Closed
	Aux. Off	Green	ON	cs1 Aux./cs2 Closed
	Load 1	Green	ON	Load ON
	Load 2	Green	ON	Load ON
	Ctrl. Switch	Red	ON	Failure Open/Closed
LIFE EXPECTANCY	Mechanical	20 Million Operations		
	Electrical	75,000 @ Rated Load		
TEMPERATURE RATING	Operate	-4° to 131°F (-20° to +55°C)		
	Storage	-40° to 185°F (-40° to +85°C)		
TERMINATIONS	(12) #8-32 Screw Terminals			
WEIGHT	16 oz.			

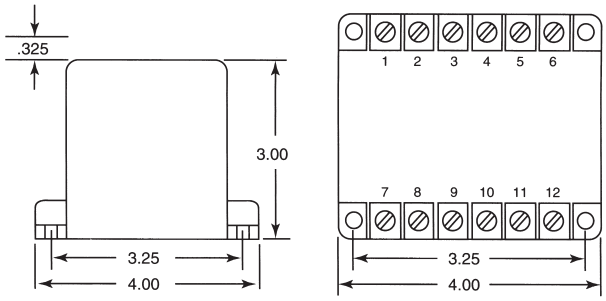
ORDERING INFORMATION

MODEL NUMBER	CONTROL VOLTAGE	MOUNTING	COMMENTS
ARM-XXX-AFE*	24 or 120 VAC	Surface	Standard
ARM-XXX-AFEP*	24 or 120 VAC	Panel	Standard
ARM-2003	120 VAC	Surface	Special: w/o H-O-A switches
ARM-2010	120 VAC	Panel	Special: w/o H-O-A switches
ARM-2011	120 VAC	Surface	Special: w/o Control switch failure feature

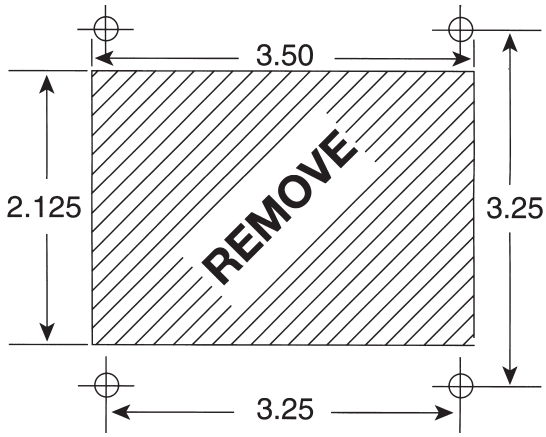
*Replace XXX with desire control voltage (24, 120)

The ARM Series is UL Listed under UL File Number E151578.

DIMENSIONS (INCHES)



*Panel Mount Cutout



*Greenlee punch #60071 or equivalent

OPERATION

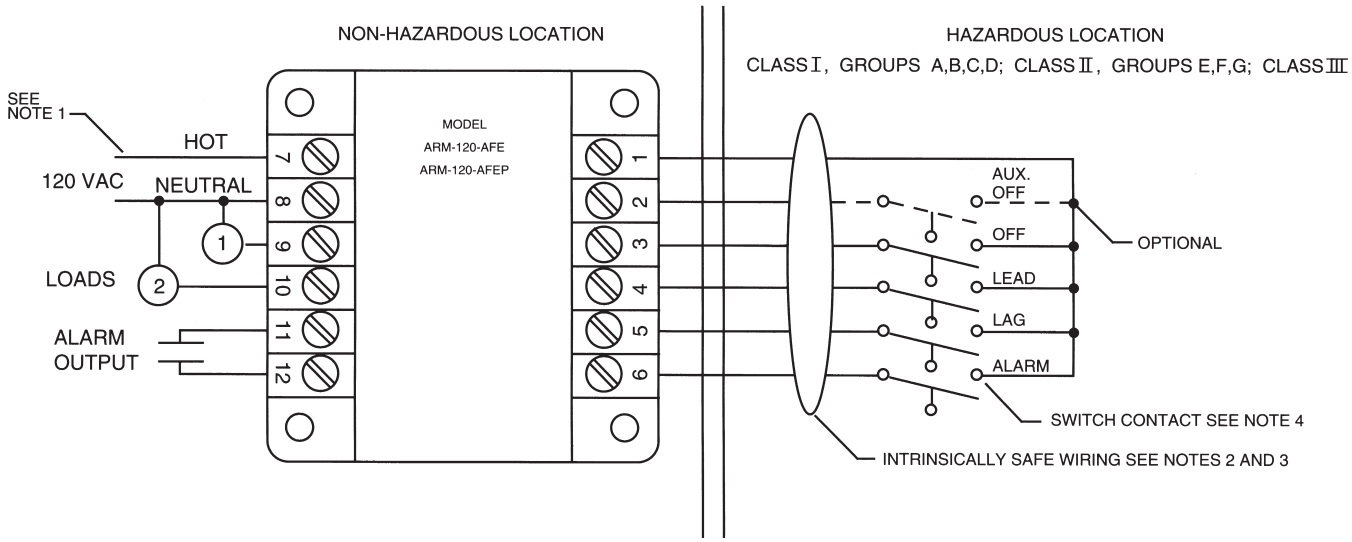
FOUR CONTROL SWITCHING: Do not remove factory-installed jumper between terminals 2 and 3. The control switches connected to terminals 3 through 6 are labeled OFF (CS2), LEAD (CS3), LAG (CS4) and ALARM (CS5). Under normal operation the lead load energizes when the off and lead control switches close in order. The lag load energizes when the lag closes and the alarm load energizes when the alarm switch closes. When all four switches reopen in the proper order all outputs are de-energized and the lead/lag output designations reverse.

FIVE CONTROL SWITCHING: Remove factory installed jumper between terminals 2 and 3. After the jumper has been removed, the additional control switch is connected to terminal 2. The extra switch functions as an AUXILIARY OFF (CS1) switch. It is used to prevent loads from running continuously if the primary OFF (CS2) switch fails to open properly.

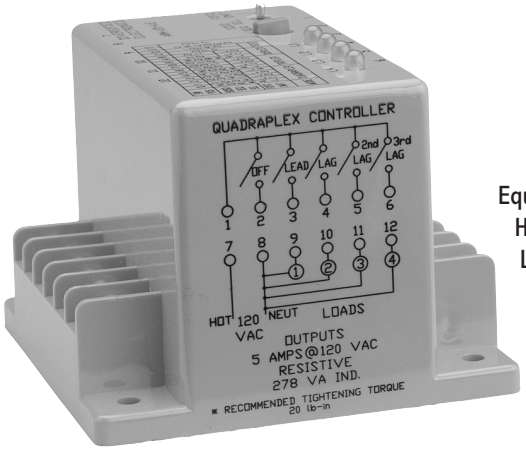
FAULT DETECTION ALGORITHM: If any of the control switches open or close out of order, the alarm output energizes and a fault detection algorithm is used to identify the faulty switch. The faulty switch is then ignored and the OFF, LEAD, and LAG control switch designations are altered to maintain safe operation.

WIRING

CONTROL DRAWING 190



1. To maintain intrinsic safety, connect the Controller's Earth Ground Terminal 8 to the earth ground of the AC Power Supply feeder. The resistance between the Controller's Earth Ground Terminal and Earth Ground shall be less than 1 ohm.
2. Maximum distance between Controller and switch contact is 1000 feet.
3. All intrinsically safe wiring shall be separated from non-intrinsically safe wiring. Refer to article 504 of the National Electrical Code ANSI/NFPA 70 on procedures for intrinsically safe wiring.
4. Switch contact shall be any non-energy storing or generating mechanical switch type device containing no capacitance or inductance.
5. Connections to terminals 5, 6, 9, 10, 11, and 12 are optional. If the Aux. Off switch is omitted, terminals 2 & 3 must be jumpered.



Process Control Equipment for Hazardous Locations
7M26
UL913

These **TRIPLEX** and **QUADRAPLEX CONTROLLERS** are available with either Sequence-On-Simultaneous-Off **(SOSO)** or First-On-First-Off **(FOFO)** output logic. The special function models are differentiated by a rotary switch that allows any output to be locked as the lead load or any one load to be omitted while sequencing only the remaining loads. In addition to load omission and lead selection, the expandable model can be set for 2, 3, or 4 load operation with either SOSO or FOFO logic.

All models feature **INTRINSICALLY SAFE INPUTS** and logic that allows the outputs to operate properly even if one of the inputs fails to open or close. For example: if the off switch fails to close, the lead load will not energize until both the lead and the lag switches close. An inrush delay on all models reduces line sags by preventing multiple loads from energizing simultaneously.

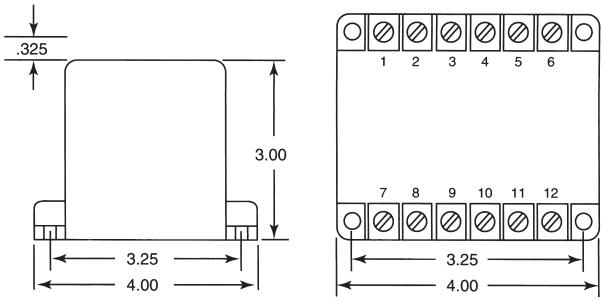
Alternating Controllers

- 3 and 4 Load Output Models
- Intrinsically Safe Inputs

SPECIFICATIONS

CONTROL VOLTAGE	24 or 120 VAC ±10%, 50/60 Hz	
SWITCH VOLTAGE	5.1 Volts open circuit	
SWITCH CURRENT	10 µAmps short circuit	
POWER REQUIRED	2.5 VA	
SENSITIVITY	100 k ohm	
ISOLATION	2500V Input to Output	
DUTY CYCLE	Continuous	
RESPONSE	Power Up	< 1 SEC
	Operate	< 25 mSEC (switch closure)
	Inrush	5 SEC
	Release	< 150 mSEC
CONTACT RATING	All channels, SPST-N.O., 5 Amps per channel @ 24 or 120 VAC, Resistive; 278 VA, Inductive	
LED INDICATORS	ON when corresponding output is ON	
LIFE EXPECTANCY	Mechanical	20 Million Operations
	Electrical	50,000 Operations
TEMPERATURE RATING	Operate	-4° to 131°F (-20° to +55°C)
	Storage	-40° to 185°F (-40° to +85°C)
TERMINATIONS	(12) #8-32 Screw terminals with pressure clamps	
ENCLOSURE	Style "E" Surface mount	
WEIGHT	16 oz.	

DIMENSIONS (INCHES)



MODEL NUMBER

MODEL NUMBER	ARM			E	
CONTROL VOLTAGE					
24 VAC		24A			
120 VAC		120A			
NO. OF LOADS	**OUTPUT LOGIC**	**SPECIAL FUNCTIONS**			
3	SOSO	none	A		
3	FOFO	none	B		
3	SOSO	Omit/Lead Select	C		
3	FOFO	Omit/Lead Select	D		
4	SOSO	none	G		
4	FOFO	none	H		
ENCLOSURE STYLE				E	
MOUNT					
No Suffix Surface Mount					
P Suffix Panel Mount					P

The ARM Series is UL Listed under UL File Number E151578.

The **ARM-120-AAE** and **ARM-120-ABE** Triplex Controllers have four switch inputs and three load outputs. The inputs are designated off, lead, lag and 2nd lag. If the off switch fails to close, the lead load will not energize until both the lead and lag switches close. De-energization of the loads depends on the output logic of the selected controller.

ARM-120-AAE (SOSO): The **ARM-120-AAE** has sequence-on simultaneous off output logic. As the 2nd lag, lag and lead switches open, the loads remain energized. When the off switch opens, all three loads de-energize simultaneously. If any switch fails to open, the loads still de-energize when the off switch opens. The lead advances one position each time the loads de-energize.

ARM-120-ABE (FOFO): The **ARM-120-ABE** has first-on-first-off output logic. When the 2nd lag switch opens, all three loads remain energized. The lag switch opens next, and the lead load de-energizes. When the lead switch opens, the lag load de-energizes. Finally, the off switch opens, and the second lag load de-energizes. At the end of each cycle the lead advances one position for each load energized during the cycle. For example: if loads one and two cycle on and off, the lead will advance two positions. Load three will be the lead load for the next cycle.

The **ARM-120-ACE (SOSO)** and **ARM-120-ADE (FOFO)** Special Function Triplex Controllers have the same features and operations as the ARM-120-AAE and ARM-120-ABE respectively with the addition of an eight-position field selection switch. The switch allows any one load to be omitted from the sequence or locked in the lead position. An automatic test mode is also provided for system verification and troubleshooting.

LOAD OMIT MODE: One load may be omitted from the sequence for general or emergency maintenance while alternating the remaining loads.

LEAD SELECT MODE: The controller may be locked into a desired sequence to equalize motor run time.

AUTOMATIC TEST MODE: The controller energizes the loads one at a time for five second intervals.

OPERATION TRIPLEX CONTROLLERS

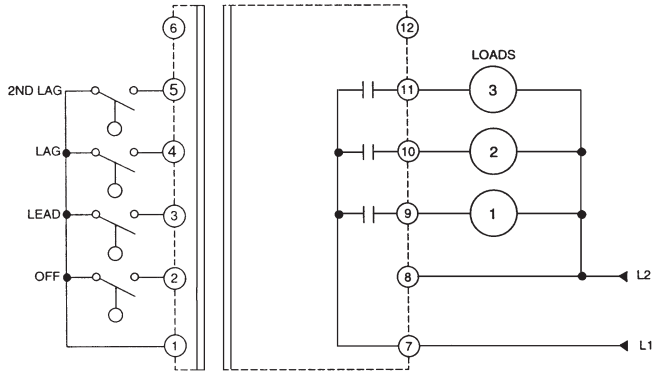
Intrinsically safe equipment and wiring is equipment and wiring which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most ignitable concentration. Intrinsically safe terminations and wiring may be brought into any hazardous location of any group classification for which it is accepted without requiring explosion-proof housing or other means of protection.

Hazardous locations are classified by the National Electrical Code according to the level of hazard that may exist in the area. A hazardous location is designated by its class, group and division. The class and group specify the specific hazardous substances that may exist in the classified location.

- Class I, Groups A through D – Flammable gasses
- Class II, Groups E through G – Combustible dusts
- Class III, Easily ignitable fibers or flyings

  The division indicates the conditions under which the hazardous substance may be present.
- Division I–Hazardous substances exist continuously or intermittently under normal operating conditions.
- Division II – Hazardous substances exist within closed containers or systems from which they can escape only in case of accidental rupture or breakdown.

WIRING



FIELD SELECTION SWITCH

POS.	FUNCTION
0	NORMAL
1	1 2 3
2	2 3 1
3	3 1 2
4	OMIT L1
5	OMIT L2
6	OMIT L3
7	TEST

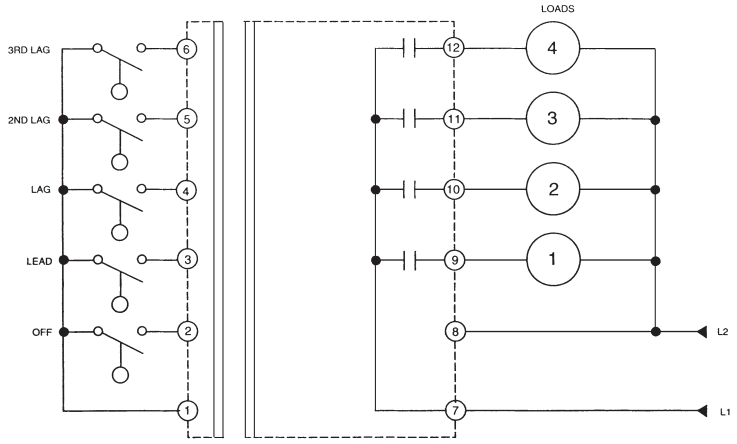
OPERATION QUADRAPLEX CONTROLLERS

The **ARM-120-AGE** and **ARM-120-AHE Quadraplex Controllers** have five switch inputs and four load outputs. The inputs are designated off, lead, lag, 2nd lag, and 3rd lag. With the off switch closed, the loads energize in sequence upon closure of the lead, lag, 2nd lag, and 3rd lag inputs. If the off switch fails to close, the lead load will not energize until both the lead and lag switches close. De-energization of the loads depends on the output logic of the selected controller.

ARM-120-AGE (SOSO): The **ARM-120-AGE** has sequence-on simultaneous off output logic. As the 3rd lag, 2nd lag, lag and lead switches open, the loads remain energized. When the off switch opens, all four loads de-energize simultaneously. If any switch fails to open, the loads still de-energize when the off switch opens. The lead advances one position each time the loads de-energize.

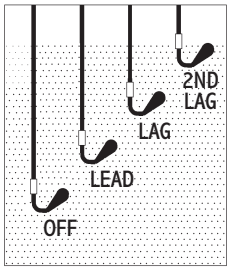
ARM-120-AHE (FOFO): The **ARM-120-AHE** has first-on-first-off output logic. When the 3rd lag switch opens, all four loads remain energized. The 2nd lag switch opens next, and the lead load de-energizes. When the lag switch opens, the lag load de-energizes. Next, the lead switch opens, and the 2nd lag load de-energizes. Finally, the off switch opens, and the 3rd lag load de-energizes. At the end of each cycle the lead advances one position for each load energized during the cycle. For example: if loads one and two cycle on and off, the lead will advance two positions. Load three will be the lead load for the next cycle.

WIRING



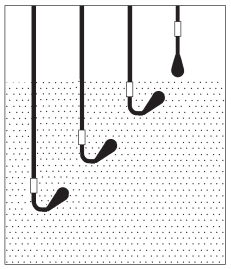
FOFO OPERATION

STEP 1



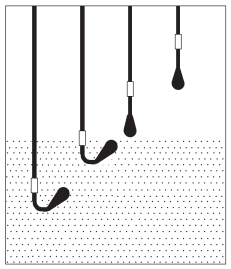
This example continues from SOSO operation step four. With all float switches closed, all loads are energized.

STEP 2



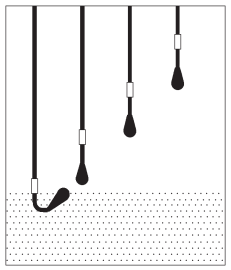
As the fluid level falls, the 2nd lag switch opens. All loads remain energized. Each float switch in descending order acts as the OFF switch for the preceding float.

STEP 3



When the lag switch opens, load 1 de-energizes. Loads 2 and 3 remain energized.

STEP 4



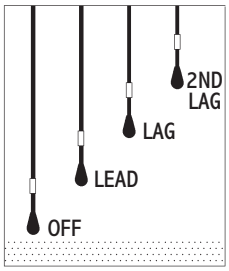
When the lead switch opens, load 2 de-energizes. Load 3 is held on by the OFF switch.

STEP 5

When the OFF switch opens, load 3 de-energizes and the lead advances three positions. At the end of each cycle the lead advances one position for each load energized during the cycle. This particular example reverts back to SOSO OPERATION 1-4 wherein load 1 would again be the lead load.

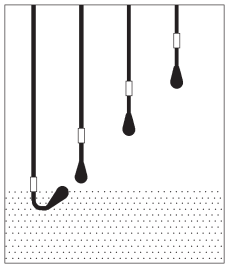
SOSO OPERATION

STEP 1



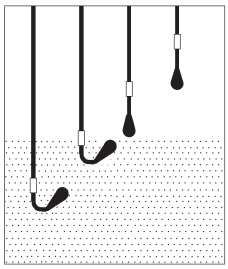
This example illustrates the normal operation of the Triplex Controller in a pump down application with four normally open dry float switches. The switches are designated off, lead, lag, and 2nd lag. The example begins with all switches open and all loads de-energized.

STEP 2



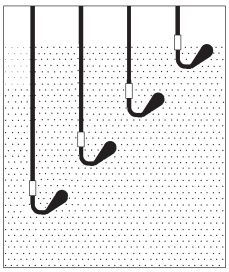
As the fluid level rises, the OFF switch closes, no loads are energized.

STEP 3



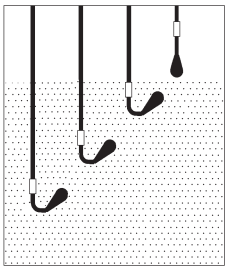
If the fluid level continues to rise, the lead switch closes and load 1 energizes.

STEP 4



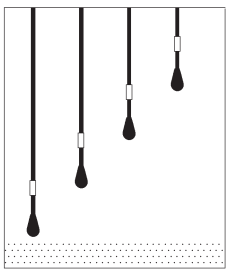
As the fluid level continues to rise each successive float switch closure sequentially energizes a corresponding load.

STEP 5



When the fluid level falls and each float switch opens, the loads remain energized so long as the OFF switch remains closed. No external auxiliary contacts are required to accomplish this latch feature.

STEP 6



When the fluid level falls below the OFF switch, all loads simultaneously de-energize, and the alternating logic advances one position. The next rise and fall in fluid level and successive operation of load switches will result in the SOSO load operation as follows: 2-3-1, 3-1-2, and back to 1-2-3 as in Step 1.