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iKnow® Guide to Machine Safety

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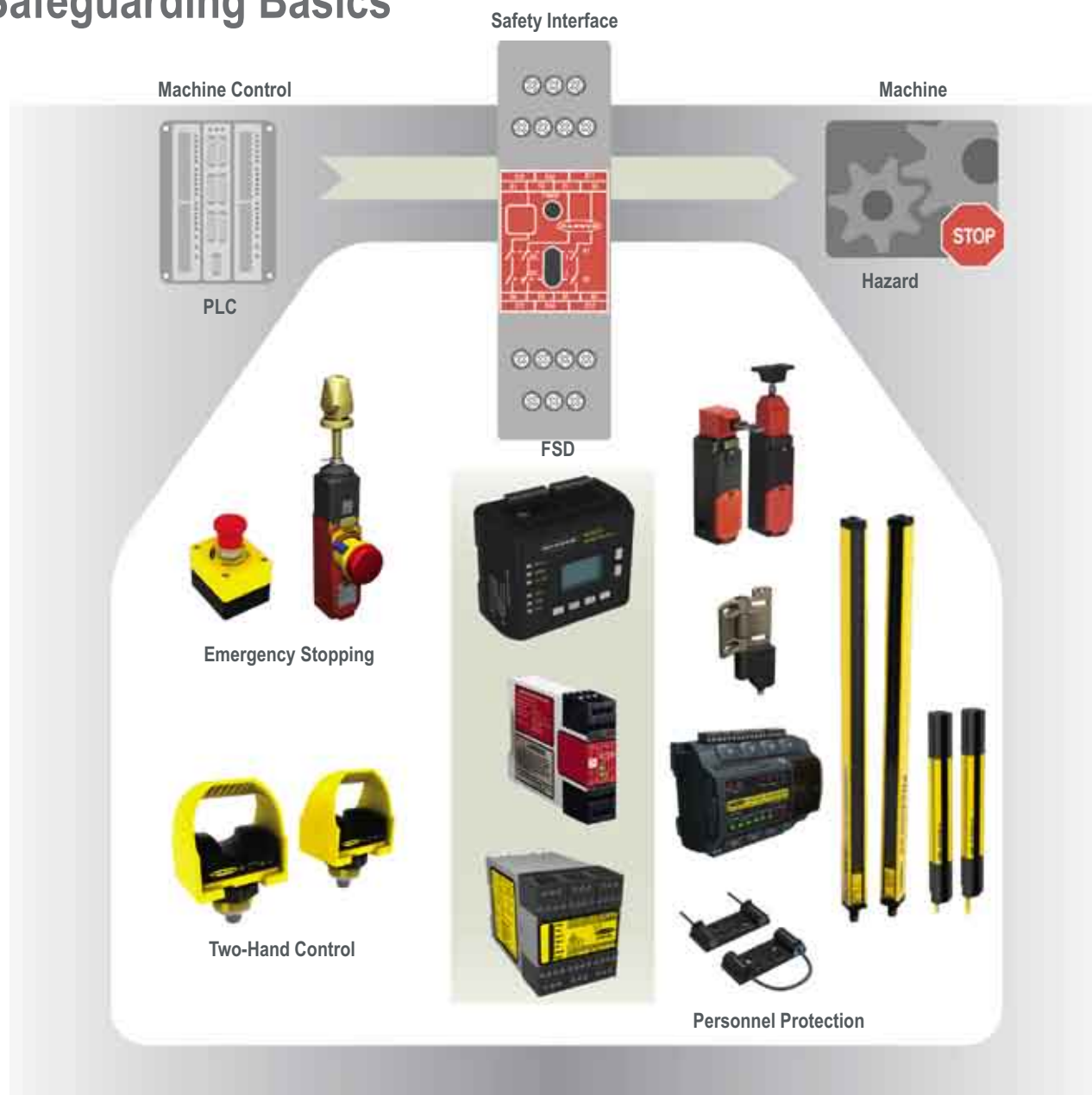
International Representatives

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Safeguarding Basics



Basics of Safeguarding

Machine and Personnel safeguarding refers to the combination of requirements, methods and solutions used to protect people who come in contact with dangerous machines in the industrial environment.

Requirements

National and regional governmental bodies have regulations, mandates, standards and recommendations for implementing a safety method or a solution.

Key regulations regarding general machine guarding include the following:

- Machinery Directive - EU
- OSHA General Duty Clause – USA

(see page 210 for an abridged version list of industry safety standards)

Device Requirements

Safety devices must be able to consistently and reliably bring a machine hazard to an orderly stop.

To be considered a safety device, the following methods must be used to ensure reliable operation: fault exclusion, redundancy, and self-checking.

Safety Circuit Requirements

A safety stop circuit typically comprises of 2 normally open contact from mechanically-linked relays. The circuit is monitored to detect certain failures that could lead to the loss of the safety function.

Methods: Risk Assessment

The Risk Assessment Process in machine safeguarding is a process used to identify hazards through each phase of the machine's life cycle and to minimize dangers to personnel and equipment.

The basic steps in a Risk Assessment Process:

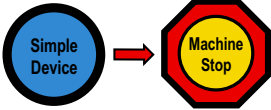
1. Identify hazards and where they occur.
2. Assess risk by severity of harm and probability of occurrence.
3. Reduce the risk through the use of protective measures.
4. Validate and document results.

Risk Assessment Standards

- OSHA 3071, Job Hazard Analysis
- MIL-STD-8820, US DOD System Safety Program
- ANSI/RIA R15.06-1999, Safety Requirements for Industrial Robots and Robot Systems
- ANSI B11.TR3, Risk Assessment and Risk Reduction
- ISO 14121 (EN 1050), Principles of Risk Assessment
- SEMI S10, Risk Assessment, Semiconductor Manufacturing Equipment

Methods: Safety Circuits

Depending on the level of risk associated with the machine or operations, an appropriate level of control circuitry performance must be incorporated into safety device design.

	Basic	Single	Single with Monitoring	Dual with Monitoring
Generic	Stop Command	Safety Stop Command	Safety Stop Command Monitoring Signal	Redundant Safety Stop Commands Monitoring Signal
	 • Non safety-rated components • Integrated in accordance with relevant standards • Reliability depends on robust components • Redundancy not required	 • Safety-rated components • Integrated in accordance with safety principles and design • Redundancy not required	 • Safety-rated components • Conducts periodic test of system • Normal operation allowed if no faults are found • If unsafe fault is found, system will default to safe state or indicate that unsafe system exists	 • Safety-rated components • Greatest degree of fault tolerance • Redundancy and self-checking • Single failure cannot cause loss of safety function • Faults detected immediately or at next demand on system
Fault	Possible loss of safety function	Greater reliability, but possible loss of safety function	Fault detected at each test	Safety function is ensured with a single fault. An accumulation of faults is not possible or detected.
Risk	Very Low Minor bump or bruise with no lost time	Low Minor first aid, infrequent exposure, or high likelihood of avoiding the hazard	Mid Range Injuries that are slight or normally reversible, requiring normal healing or only first aid.	High or Very High Normally reserved for hand-fed applications where injuries could be severe to irreversible
ANSI / B11	—	—	—	Control Reliable ANSI B11.19 (Clause 6.1 and Annex C) Not directly comparable to the requirements of ISO 13849-1 and exceeds a Category 2
ANSI / RIA	Simple	Single Channel	Single Channel with Monitoring	Control Reliable ANSI/RIA R15.06 (Clause 4.5) Control reliability for robots typically exceeds a Cat 3 but is not necessarily intended to be a Cat 4
ISO / EN	Category B ISO 13849-1/EN 954-1	Category 1 ISO 13849-1/EN 954-1	Category 2 ISO 13849-1/EN 954-1	Category 3 & 4 ISO 13849-1/EN 954-1

Solutions: Comparing Guards and Devices

Type	Safety Function	Advantages	Limitations	Requirements	Standards
<i>Guards: protective physical barrier used to prevent access.</i>					
Fixed Guard 	Provides a fixed barrier to the hazard	• Low maintenance • Long life • Low cost for small areas • Protects all individuals • Can contain ejected materials	• Poor ergonomics • Limited visibility • Limited access • Costly for large areas • Maintenance may require removal of guard	• Protect from identified hazard • Prevent user from reaching over, under, around or through the barrier • Provide safe openings	• ANSI B11.19 • ISO 14120 • ISO 13852 • ISO 13853 • ASME B15.1
Interlocked Guard 	Interrupts power to machine when guard is opened	• Low initial investment • Can be placed close to hazard • Protects all individuals • Can contain ejected materials	• Costly for large areas • Increased maintenance	• Must be difficult to defeat • Guard may open only after machine has stopped– or must be installed at a safe distance	• ANSI B11.19 • NFPA 79 • ISO 14119 • IEC 60204-1
<i>Safeguarding Devices: components, attachments or mechanisms designed to perform a specific safeguarding function.</i>					
Safety Light Screen 	Arrests power to machine when sensing field is interrupted	• Excellent ergonomics • Allows frequent access • Protects all individuals • Cost effective for large areas • Allows for good visibility	• Limited to machines that can be stopped quickly • No protection from ejected parts • May require the use of additional guards • May create a pass-through hazard	• Initiate immediate stop when sensing field is interrupted • Appropriate resolution required to detect objects the size of a torso, ankle, hand or finger	• ANSI B11.19 • IEC 61496 • ISO 13855
Multiple-Beam System: • Grids • Points 	Arrests power to machine when sensing field is interrupted	• Low initial investment • Allows frequent access • Allows for good visibility • Protects all individuals	• Limited to machines that can be stopped quickly • No protection from ejected parts • Large safety distance • May create a pass-through hazard	• Initiate immediate stop when sensing field is interrupted • Appropriate resolution required to detect objects the size of a torso	• ANSI B11.19 • IEC 61496 • ISO 13855
Two-Hand Control 	Operator must use both hands to actuate machine motion hereby preventing operator access to hazardous area	• Operator's hands are away from hazardous area • Low initial investment • Low maintenance	• Potential ergonomic impact • Provides protection only for operator • No protection from ejected parts	• Concurrent actuation • Release and reactivation required before machine motion may be reinitiated	• ANSI B11.19 • NFPA 79 • ISO 13855 • ISO 13856 • IEC 60204-1
Safety Mat Monitor 	Interrupts power to machine when a minimum pressure is applied	• Excellent ergonomics • Protects all individuals • Allows for good visibility	• Costly for large areas • Maintenance intensive • Large safety distance	Minimum object sensitivity of 66 lbs on and 3-1/8" surface to detect a foot	• ANSI B11.19 • ISO 13855 • ISO 13856
<i>Complementary Safety Devices: used to supplement a primary safeguard.</i>					
E-Stop • Button • Rope-Pull  	Operator activates button in emergency situation to shut off power to machine	• Immediate response • Safe shutdown of machine process	• Not considered a safeguard • Requires conscious act of operator • Limits injury or machine damage but typically does not prevent it	• Overrides all other functions and operations • Reset of E-stop doesn't initiate machine motion • Button must be red with yellow background • Should be located at each operation station • Final removal of power done by electromechanical components	• ANSI B11.19 • NFPA 79 • ISO 12100 • IEC 60204-1 • ISO 13850

*This represents a partial list of available safeguards & devices.

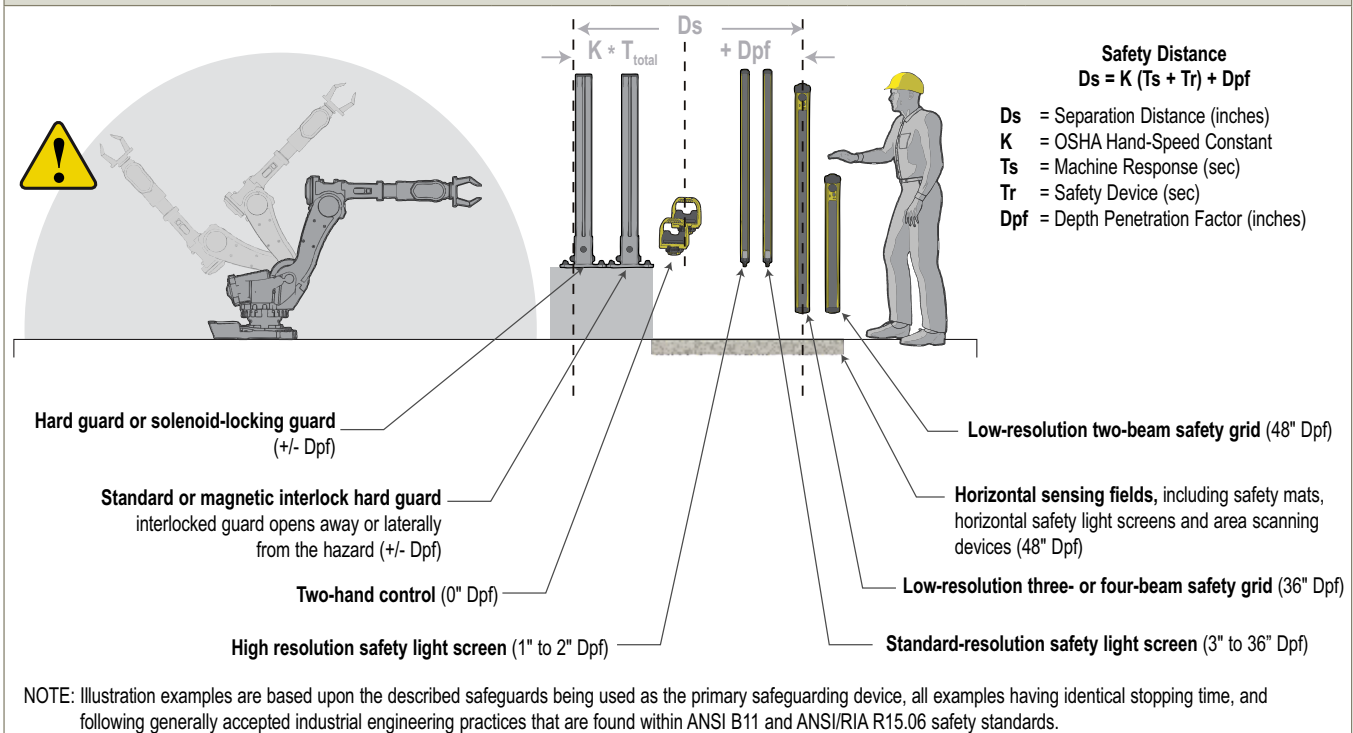
Solutions: Choosing and Locating a Safeguard

When choosing a safeguard, ask yourself the following questions:

1) is it safe, 2) is it legal, and 3) does it make sense for the application.

Choosing a Safety Product										
☐ Who will use it? ☐ How will they use it? ☐ What hazards are associated with which task? ☐ What are the types of hazards? ☐ Where will the safeguard be located?	■ E = Excellent ■ A = Acceptable ■ P = Poor ■ X = Not Acceptable									
	Guarding Solutions	Maintenance \$	Frequent Access	Infrequent Access	Locate Close to Hazard	Long Machine Stop Time	Ergonomic	Visibility	Multiple Operators	Guards Against Ejected Material
	Fixed Hard Guard	P	P	E	E	E	P	P	E	E
	Locking Guard	P	P	E	E	E	P	P	E	E
	Interlock Guard	P	P	A	E	A	P	P	E	E
	2-Hand Control	A	A	A	A	A	A	A	P	P
	High-Resolution SLS	E	E	P	E	P	E	E	E	X
	Low-Resolution SLS	E	E	P	E	P	E	E	E	X
	3- or 4-Beam Perimeter	E	A	A	P	A	E	E	E	X
	2-Beam Perimeter	E	A	A	P	A	E	E	E	X
	Safety Mats	P	A	A	P	A	E	E	E	X
		Comments								
		• Limited access • Limited visibility to the machine • Limited visibility to the machine • Costly for large areas • Costly to maintain and fix								
		• Only protects operator(s)								
		• Locate closer to hazard								
		• Costs less than high resolution SLS								
		• Takes less space than 2-beam								
		• Costs less than 3- or 4-beam								
		• Maintenance-intensive								

Locating a Safety Product



Requirements: Standards

Safeguarding standards are minimum requirements for product and machine design, manufacture, use and evaluation that guide the methods used to improve safety.

Go online for a more comprehensive and up-to-date list of standards.

General Requirements

U.S.

OSHA 29CFR1910.212
General Requirements for (Guarding of) All Machines

International/European

ISO 12100-1&2 (EN 292)
Safety of Machinery: Basic Concepts, General Principles for Design
ISO 14121 (EN 1050)
Safety of Machinery: Risk Assessment

Standards: Safeguarding Design

U.S.

ANSI/NFPA 79
Electrical Standard for Industrial Machinery
ANSI Z535
Safety Signs, Symbols and Color Codes
ANSI Z136.1
Safe Use of Lasers
ANSI Z244.1 Lockout/Tagout of Energy Sources
ANSI B11.21
Machine Tools Using Lasers – Safety
OSHA 29CFR1910.147
Control of Hazardous Energy
OSHA 29CFR1910.219
Mechanical Power Transmission Apparatus
ANSI/ASME B15.1
Mechanical Power Transmission Apparatus
ANSI B11.19
Safeguarding (Machine Tools)
ANSI B11.TR1
Ergonomic Guidelines
ANSI B11.TR3
Risk Assessment / Risk Reduction
ANSI B11.TR4
Programmable Electronic Systems (PES/PLC)
OSHA 3071
Job Hazard Analysis
International/European
IEC 60204-1
Electrical Equipment of Machines
ISO 14118 (EN 1037)
Prevention of Unexpected Start Up
ISO 13849-1 (EN 954-1)
Safety Related Parts of Control Systems
ISO 14120 (EN 953)
Guards – General Requirements for the Design and Construction

Standards: Specific Machine Applications, Grouped by Type

Machine Tools

OSHA 29CFR1910.217
(Guarding of) Mechanical Power Press
ANSI B11.1
Mechanical Power Presses
EN 692
Mechanical Power Presses
More online....

Conveyors

ANSI/ASME B20.1
Conveyors and Related Equipment
ISO 4123
Belt Conveyors
ISO 9851
Overhead Electrical Monorail Conveyors

Industrial Robots

ANSI/RIA R15.06
Industrial Robots and Robot Systems
ISO 10218
Manipulating Industrial Robots – Safety

Injection Molding

ANSI B151.1
Horizontal Injection Molding Machines
ANSI B151.21
Injection Blow Molding Machines – Safety
ANSI B151.26
Dynamic Reaction – Injection Molding Machines
ANSI B151.27
Plastics Machinery – Robots Used With HIM
Machines – Safety

Mills and Calenders

OSHA 29CFR1910.261
Pulp, Paper, and Paperboard Mills

OSHA 29CFR1910.216
Mills and Calenders in the Rubber and Plastics Industry

ANSI B28.1

Safety Code for Rubber Mills and Calenders
EN 1417
Rubber and Plastics Machines – Two-Roll Mills

Packaging

ANSI/PMMA B155.1
Packaging and Packaging-Related Converting Machinery – Safety
EN 415
Safety of Packaging Machines

Semiconductor

SEMI S1
Safety Guideline for Equipment Safety Labels
SEMI S2
Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment
SEMI S3
Safety Guidelines for Heated Chemical Baths
SEMI S7
Safety Guidelines for Environmental, Safety, and Health (ESH) Evaluation of Semiconductor Manufacturing Equipment
SEMI S8
Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment
SEMI S9
Safety Guideline for Electrical Design Verification Tests for Semiconductor Manufacturing Equipment
SEMI S10
Safety Guideline for Risk Assessment

And More...

Cranes, Printing, Woodworking, Lumber and Logging

Safety Standards Acronyms

ANSI: American National Standards Institute
CE: Mark of European Conformity
CEN: European Committee for Standardization
CENELEC: European Committee for Electrotechnical Standardization
CSA: Canadian Standards Association
EN: European Norm
IEC: International Electrotechnical Commission
ISO: International Organization for Standardization
MIL-STD: USA Military Standard
OSHA: Occupation Safety and Health Administration
UL: Underwriters Laboratory

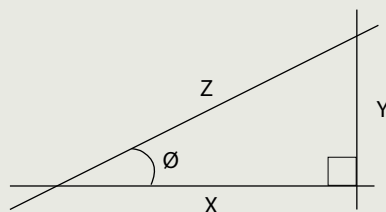
Copper Wire Information

AWG	Solid Wire Diameter American Wire or Brown and Sharpe Gage		Approximate Stranded Wire Diameter ¹		Approximate Resistance per 100 feet (30 meters) ²
	Inches	Millimeters	Inches	Millimeters	Ohms
0000	0.4601	11.687	0.522	13.26	0.0050
000	0.4097	10.406	0.464	11.79	0.0060
00	0.3648	9.266	0.414	10.52	0.0080
0	0.3249	8.252	0.368	9.35	0.010
1	0.2893	7.348	0.328	8.33	0.012
2	0.2576	6.543	0.292	7.42	0.016
3	0.2294	5.827	—	—	0.020
4	0.2043	5.189	0.232	5.89	0.025
5	0.1819	4.620	—	—	0.030
6	0.1620	4.115	0.184	4.67	0.040
7	0.1443	3.665	—	—	0.050
8	0.1285	3.264	0.147	3.73	0.060
9	0.1144	2.906	—	—	0.080
10	0.1019	2.588	0.116	2.95	0.10
11	0.0907	2.304	—	—	0.13
12	0.0808	2.052	0.095	2.41	0.16
13	0.0720	1.829	—	—	0.20
14	0.0641	1.628	0.073	1.85	0.25
15	0.0571	1.450	—	—	0.32
16	0.0508	1.290	0.059	1.50	0.40
17	0.0453	1.151	—	—	0.50
18	0.0403	1.024	0.048	1.22	0.64
19	0.0359	0.912	—	—	0.80
20	0.0320	0.813	0.036	0.91	1.0
21	0.0285	0.724	—	—	1.3
22	0.0253	0.643	0.030	0.76	1.6
23	0.0226	0.574	—	—	2.0
24	0.0201	0.511	0.024	0.61	2.6
25	0.0179	0.455	—	—	3.2
26	0.0159	0.404	0.020	0.51	4.1
27	0.0142	0.361	0.018	0.46	5.2
28	0.0126	0.320	0.015	0.38	6.5
29	0.0113	0.287	—	—	8.2
30	0.0100	0.254	0.012	0.30	10

¹ Exact diameter is dependent upon the wire gage used for the strands. Diameter listed represents the most common wire type for AWG.

² Resistance values assume the resistivity of solid copper wire. Stranding and/or copper alloy increase the resistance values.

Trigonometric Formulas for Distance or Angle Calculation



Given $\emptyset$ and X: $Y = X \tan \emptyset$
Given $\emptyset$ and Y: $X = Y \cot \emptyset$

$Z = X \sec \emptyset$
 $Z = Y \csc \emptyset$

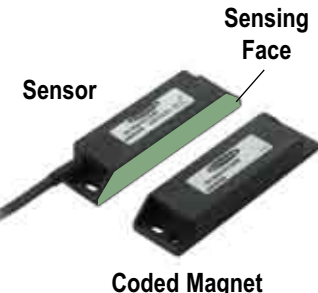
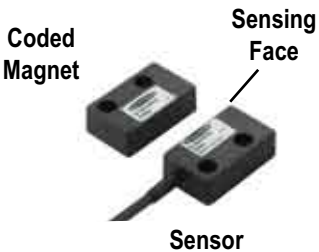
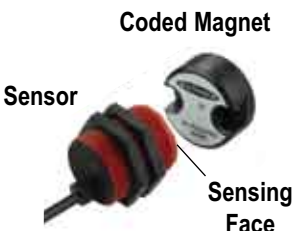
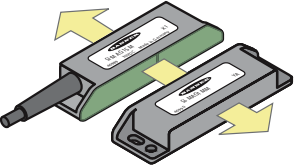
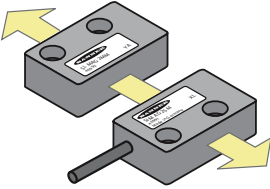
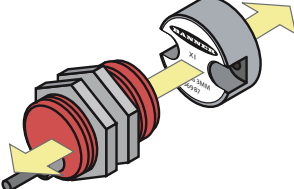
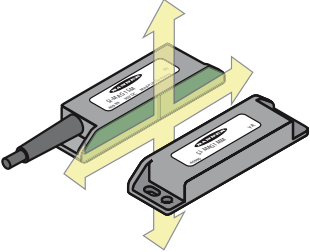
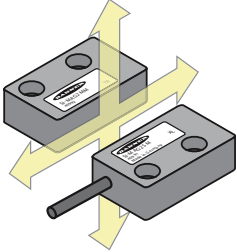
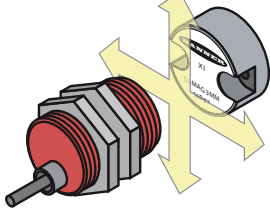
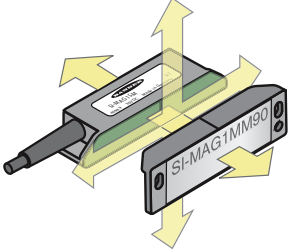
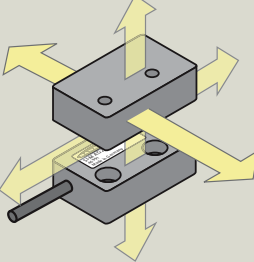
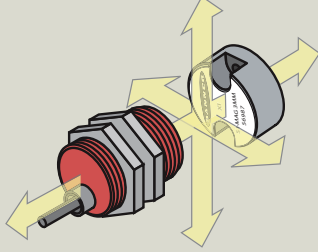
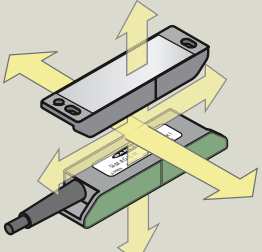
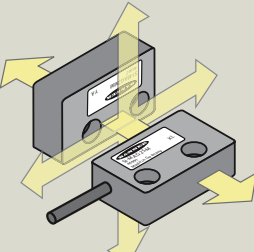
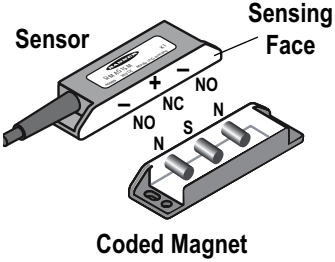
Relationships:

$\sin \emptyset = Y/Z$
 $\cos \emptyset = X/Z$
 $\tan \emptyset = Y/X$
 $\csc \emptyset = Z/Y = 1/\sin \emptyset$
 $\sec \emptyset = Z/X = 1/\cos \emptyset$
 $\cot \emptyset = X/Y = 1/\tan \emptyset$

Given $\emptyset$ and Z: $X = Z \cos \emptyset$
Given X and Y: $Z = \sqrt{X^2 + Y^2}$

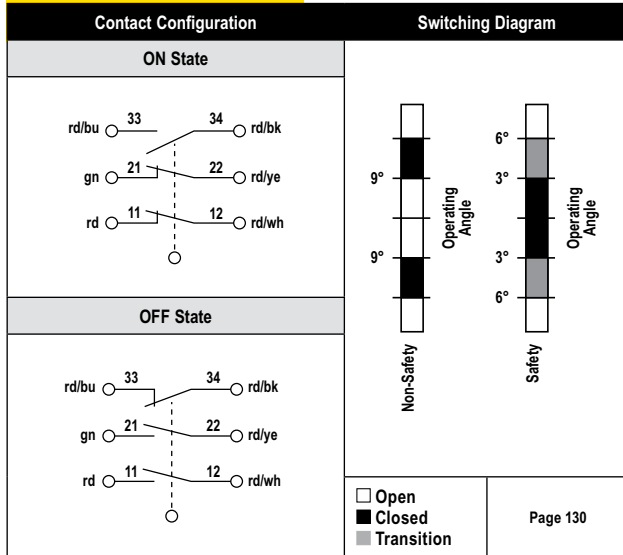
$Y = Z \sin \emptyset$
 $\emptyset = \arctan (Y/X)$

Magnet-Style Interlocks: Direction of Approach for Sensor/Magnet Pairs

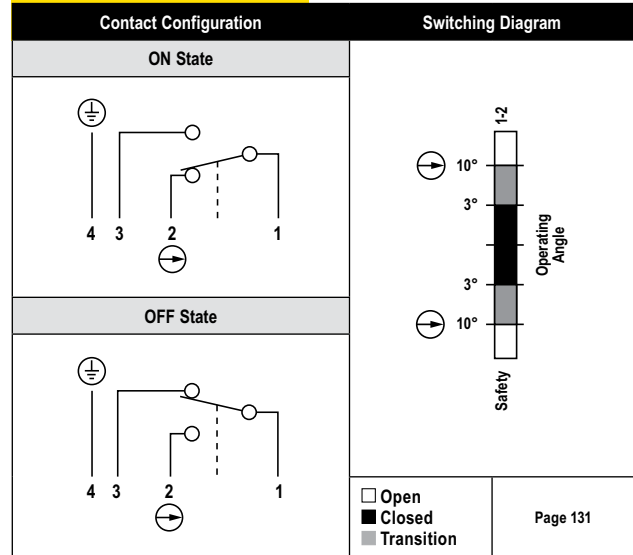
Model SI-MAG1	Model SI-MAG1	Model SI-MAG1
 Sensing Face Sensor Coded Magnet	 Coded Magnet Sensing Face Sensor	 Coded Magnet Sensor Sensing Face
Correct Movement is perpendicular to the sensing face. 	Correct Movement is perpendicular to the sensing face. 	Correct Movement is perpendicular to the sensing face. 
Correct Movement is parallel to the sensing face. 	Correct Movement is parallel to the sensing face. 	Correct Movement is parallel to the sensing face. 
Correct 90° approach of sensor and magnet is approved only for model SI-MAG1MM90. 	Incorrect Label to label approach of sensor and magnet is not possible. 	Incorrect Magnet orientation relative to magnet sensor cable is incorrect. 
Incorrect Label to label approach of sensor and magnet is not possible. 	Incorrect 90° approach of sensor and magnet is not possible. 	Detail of Interiors  Sensor Sensing Face Coded Magnet

NOTE: With SI-MAG1C Controller, approach speed for all magnet-style switches must be greater than 0.2 ms.
With GM-FA-10J Controller, approach speed must be greater than 0.1 ms.

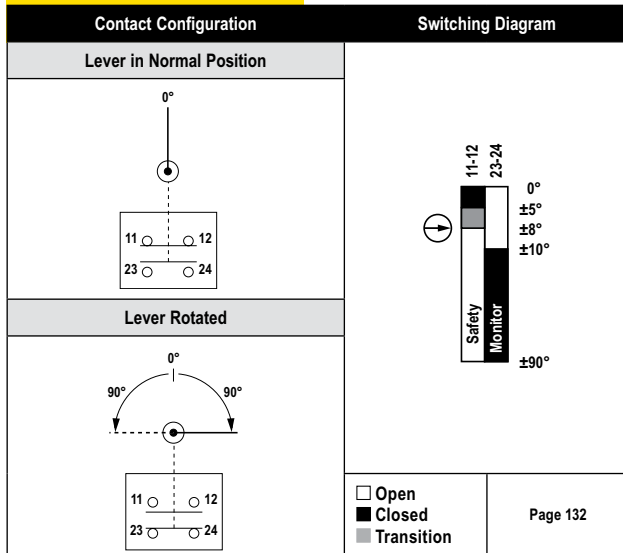
SD001 - SI-HG63 Series



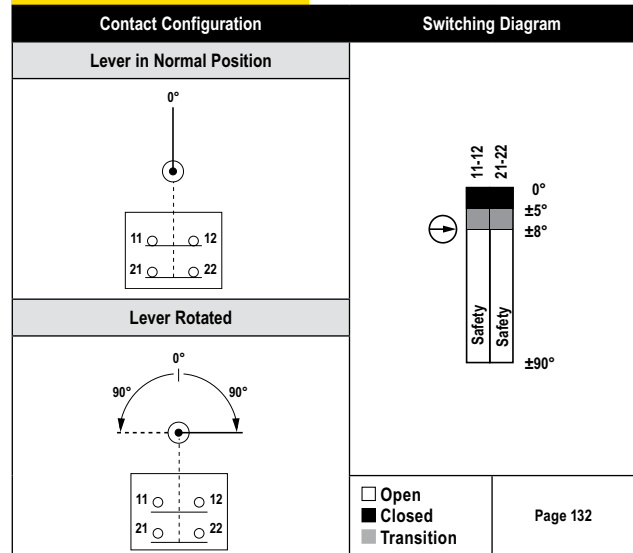
SD002 - SI-HG80 Series



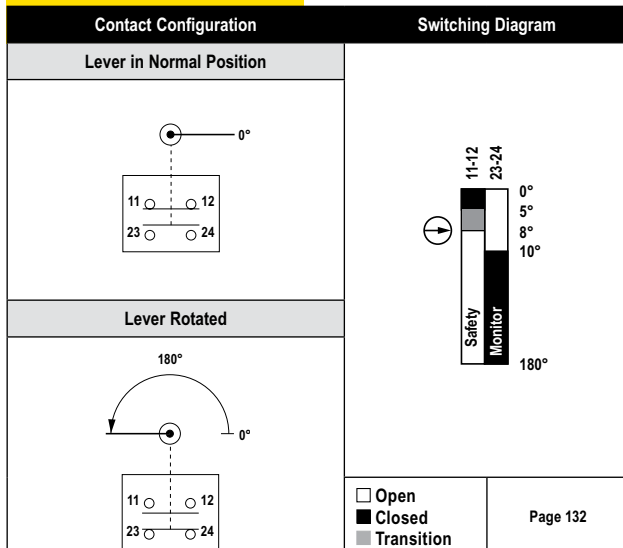
SD003 - SI-LS31HGD Series



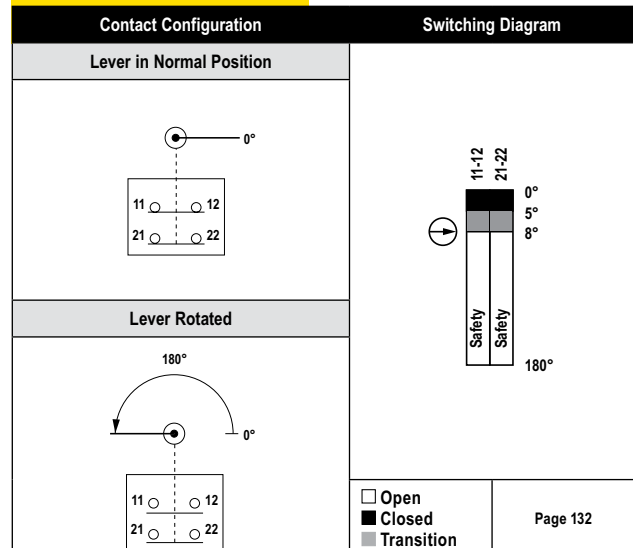
SD004 - SI-LS31HGE Series



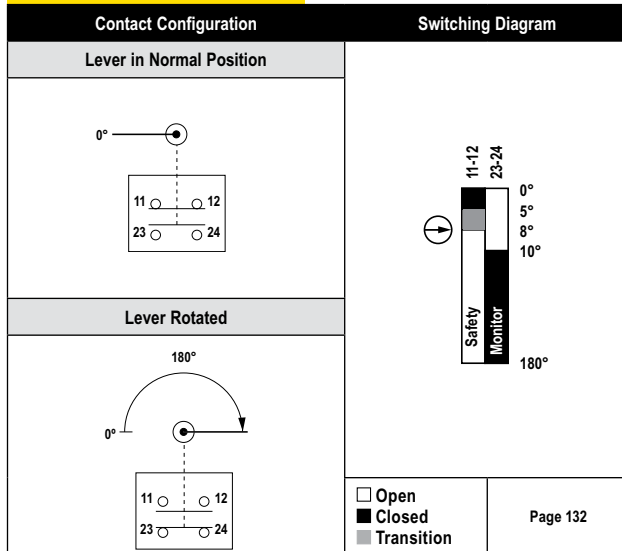
SD005 - SI-LS31HGRD Series



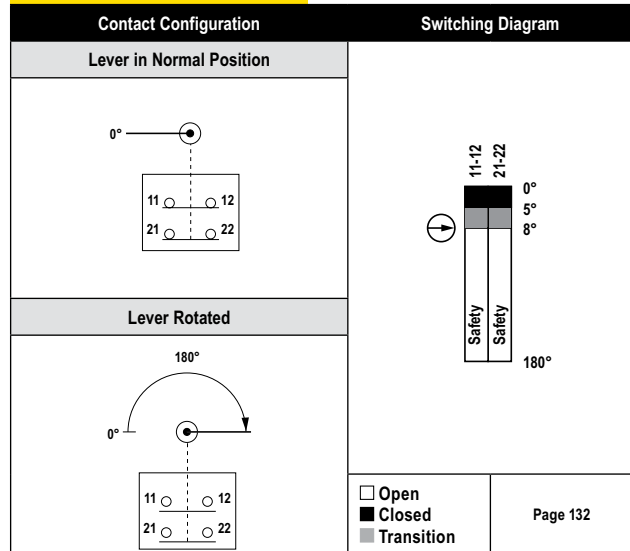
SD006 - SI-LS31HGRE Series



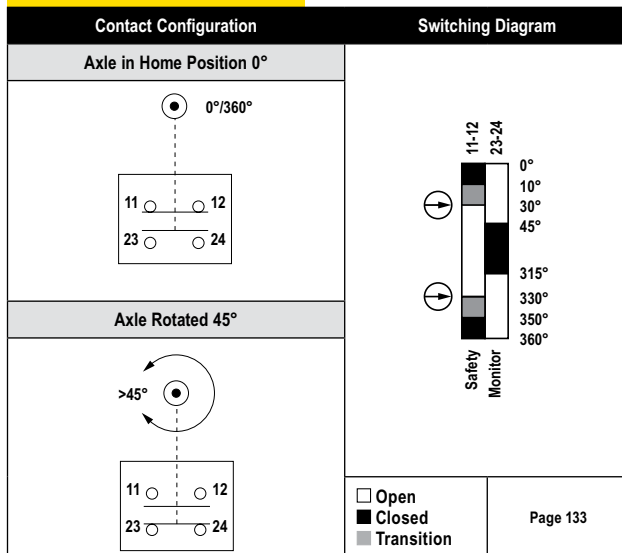
SD007 - SI-LS31HGLD Series



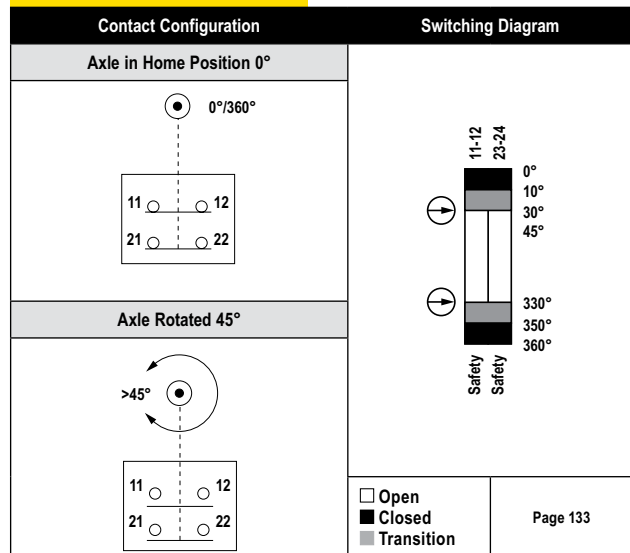
SD008 - SI-LS31HGLE Series



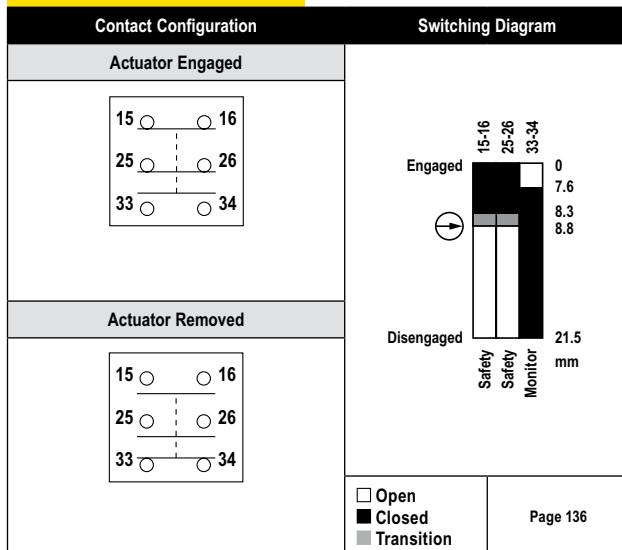
SD009 - SI-LS31RTD Series



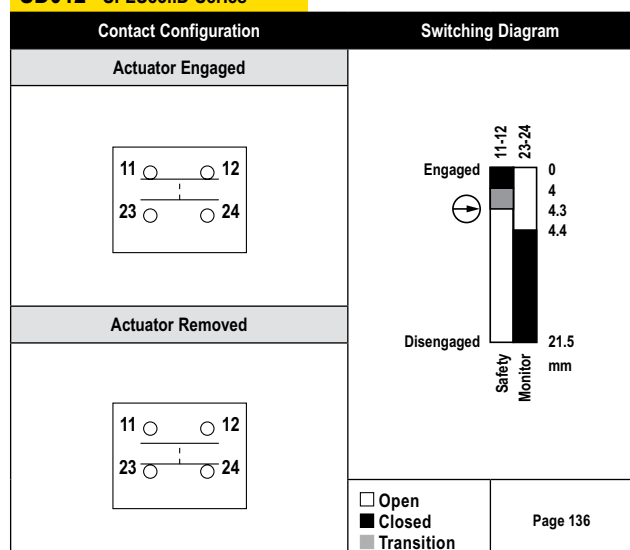
SD010 - SI-LS31RTE Series



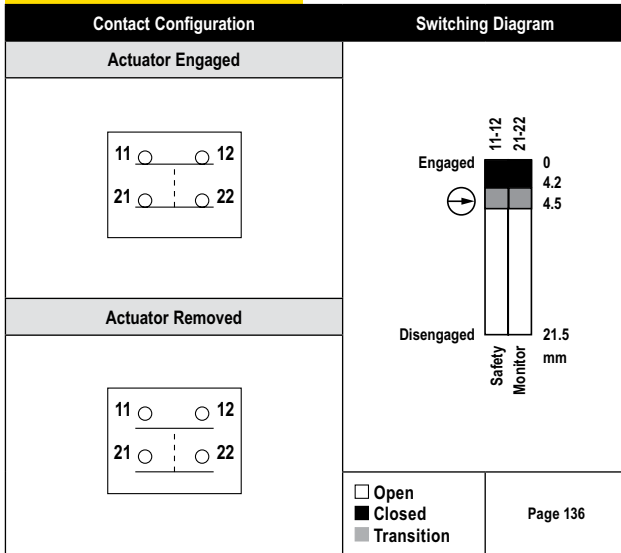
SD011 - SI-LS100 Series



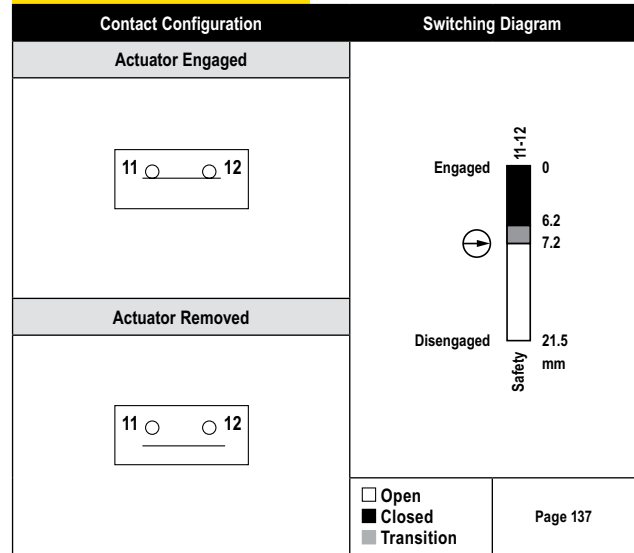
SD012 - SI-LS83..D Series



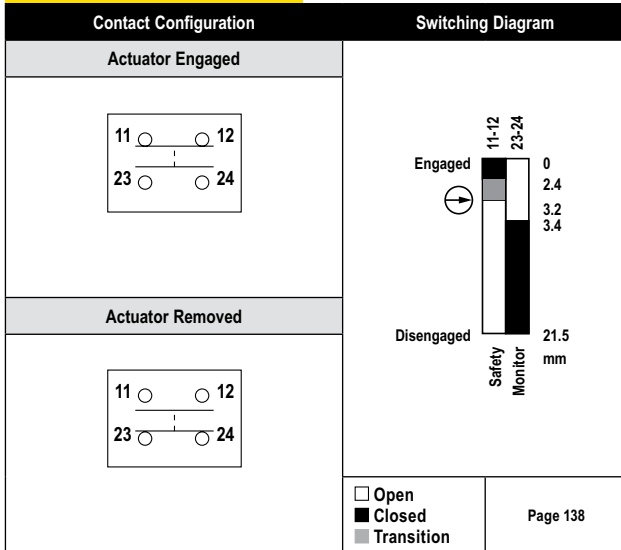
SD013 - SI-LS83..E Series



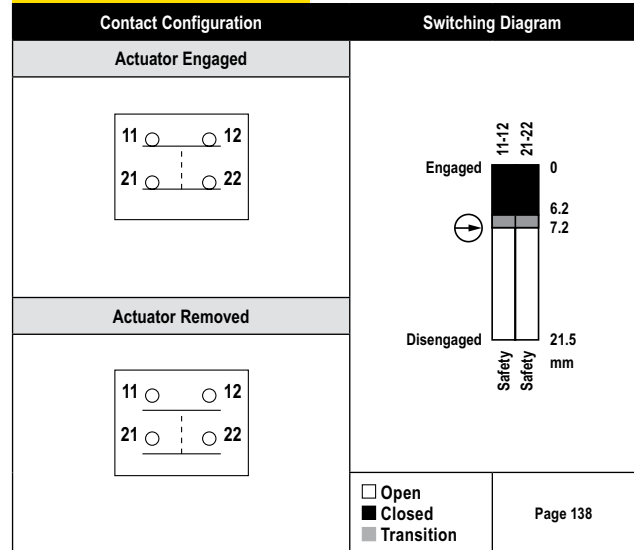
SD014 - SI-QS75 Series



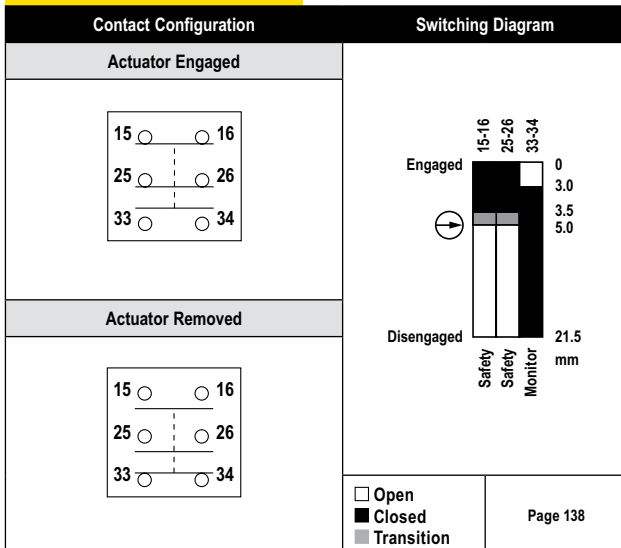
SD015 - SI-QS90MD Series



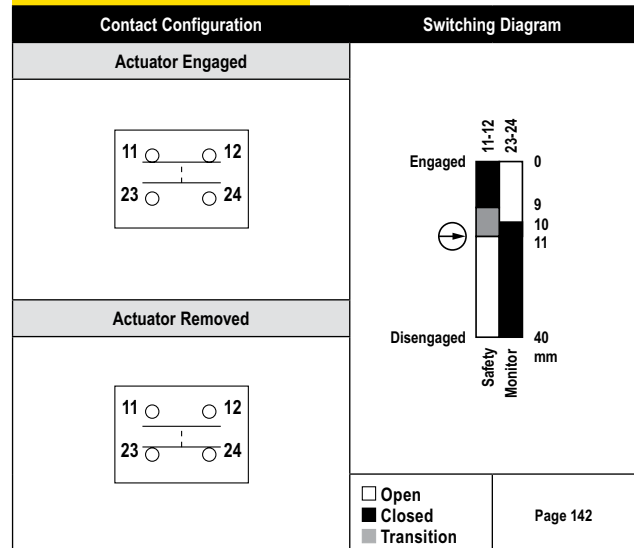
SD016 - SI-QS90ME Series



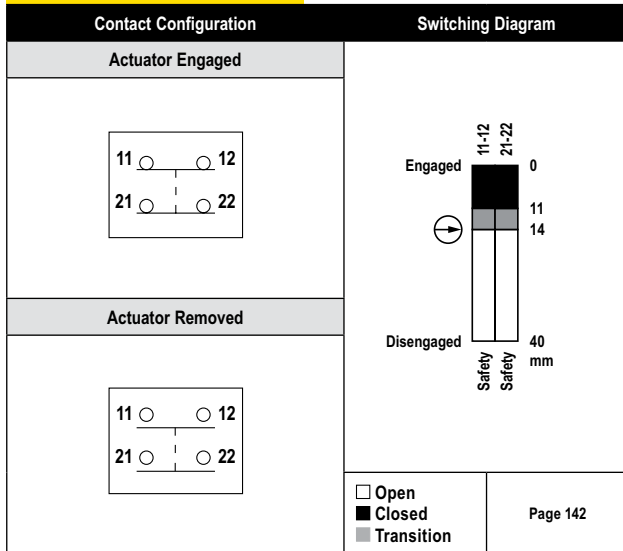
SD017 - SI-QS90MF Series



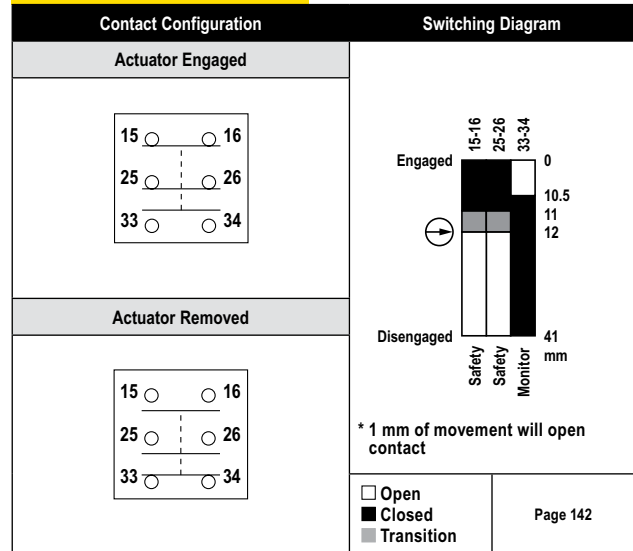
SD018 - SI-LM40MKHD Series



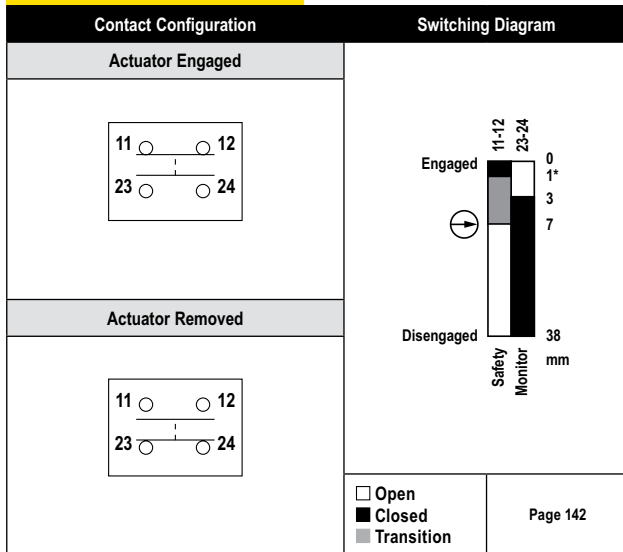
SD019 - SI-LM40MKHE Series



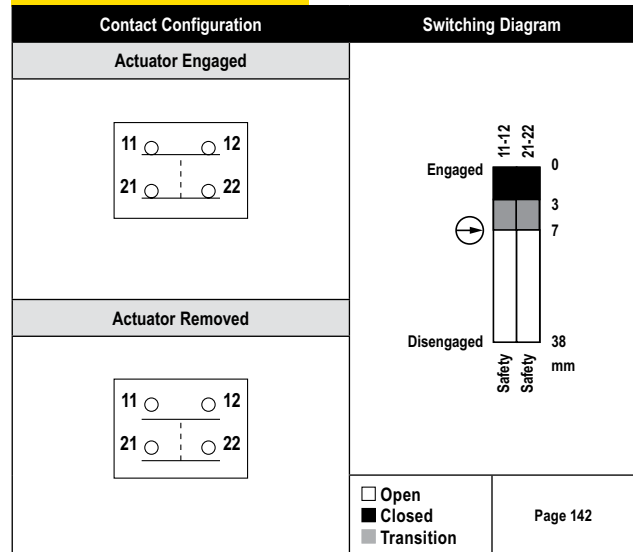
SD020 - SI-LM40MKF Series



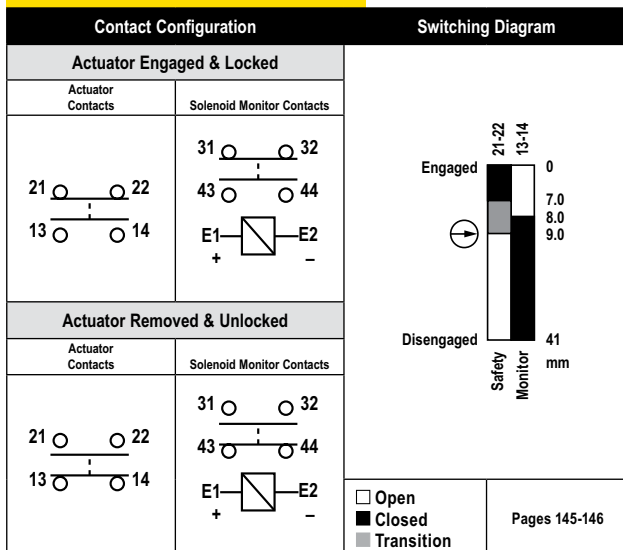
SD021 - SI-LM40MKVD Series



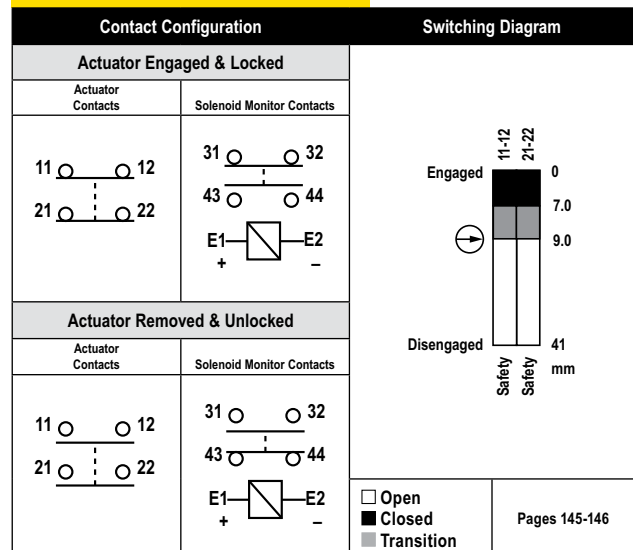
SD022 - SI-LM40MKVE Series



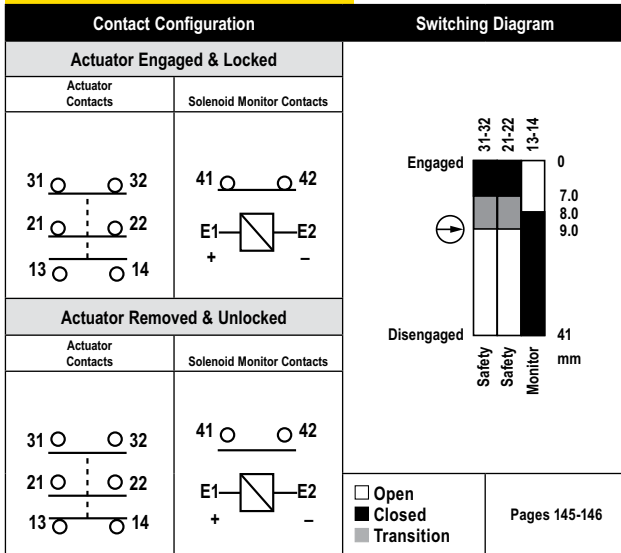
SD023 - SI-LS42..MSG/MMG Series



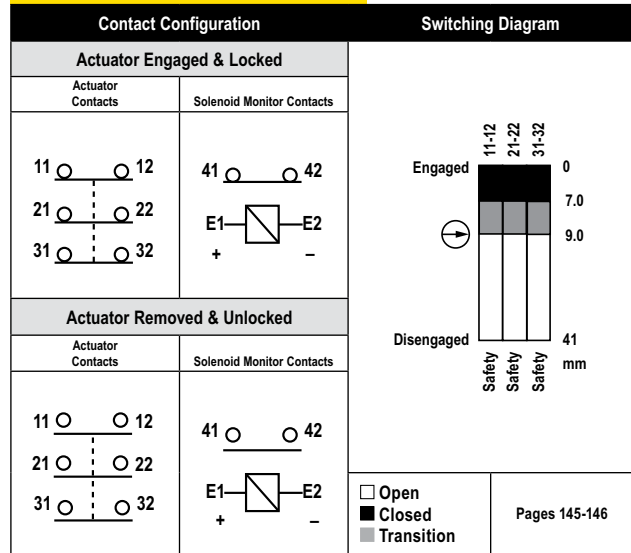
SD024 - SI-LS42..MSH/MMH Series



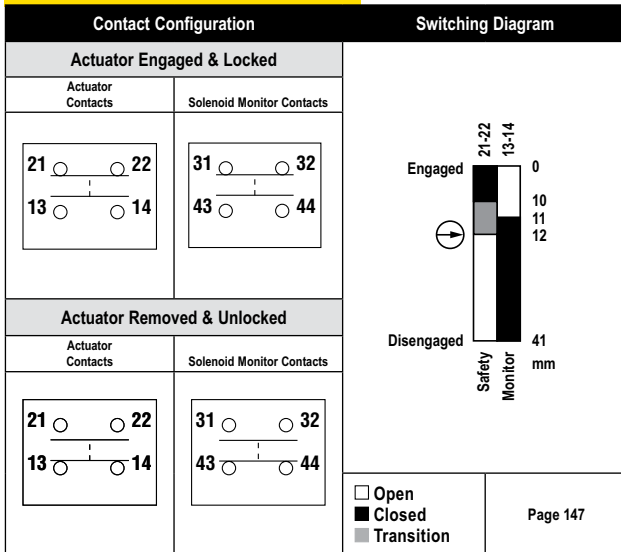
SD025 - SI-LS42..MSI/MMI Series



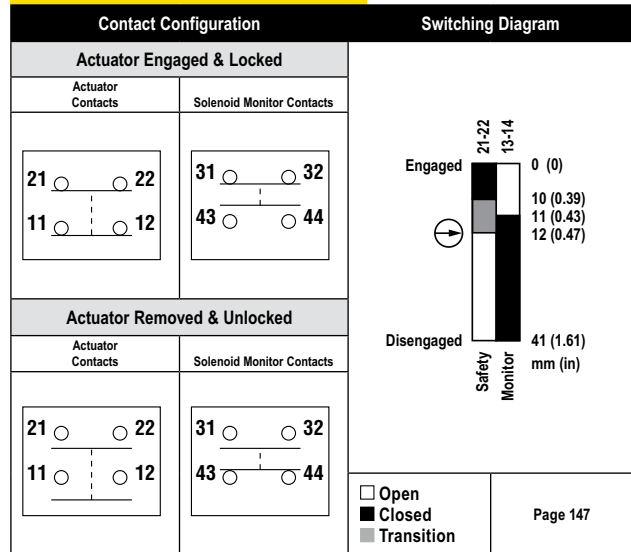
SD026 - SI-LS42..MSJ/MMJ Series



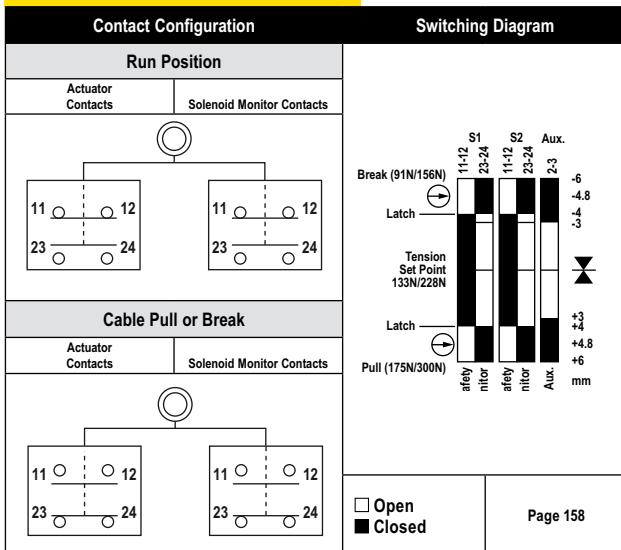
SD027 - SI-QM100..MSG/MMG Series



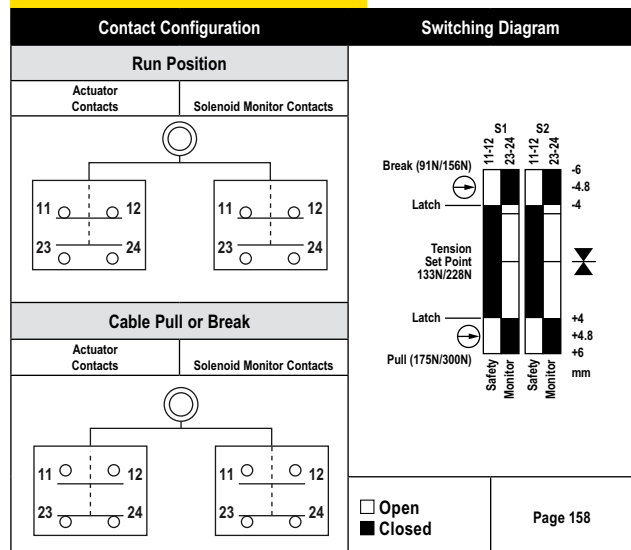
SD028 - SI-QM100..DMSH Series



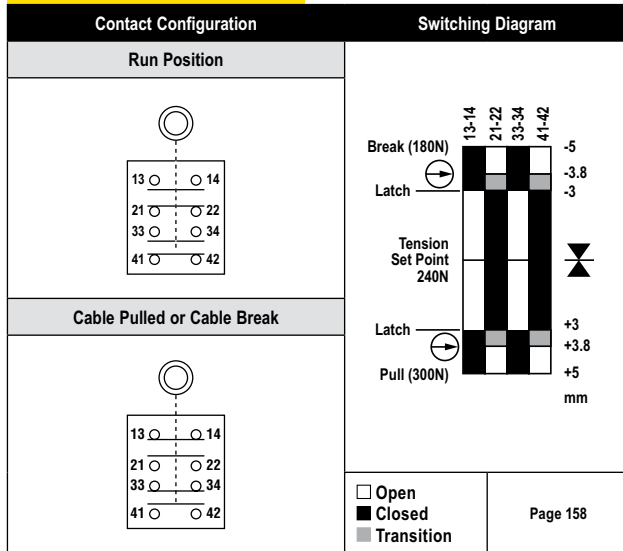
SD029 - RP-RM83..LTE/LTR Series



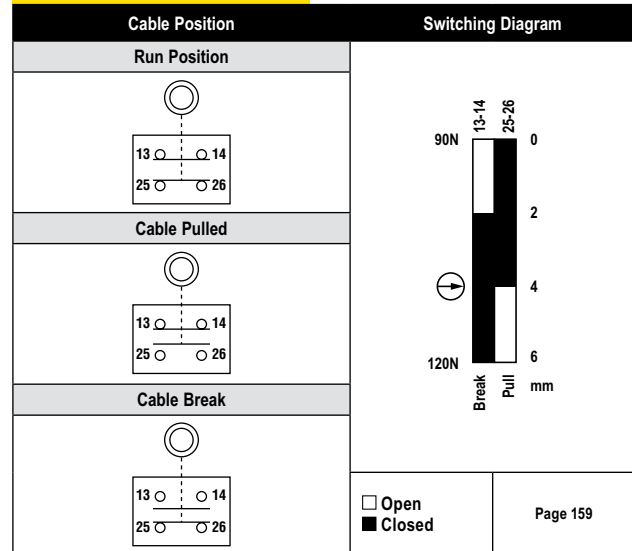
SD030 - RP-RM83..LT/LR Series



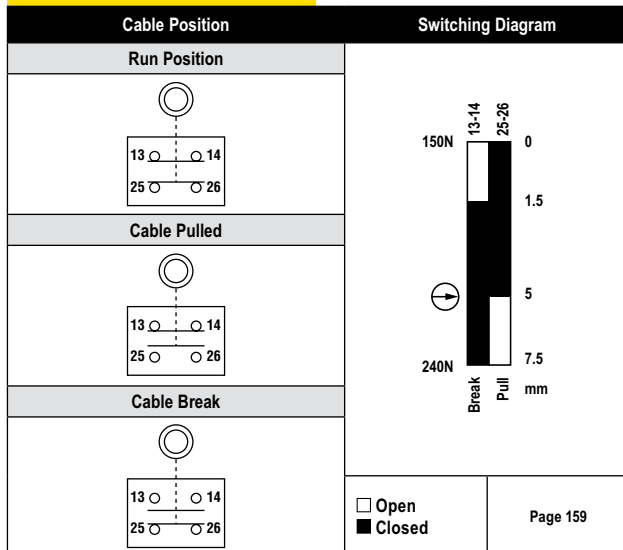
SD031 - RP-LS42F-75L Series



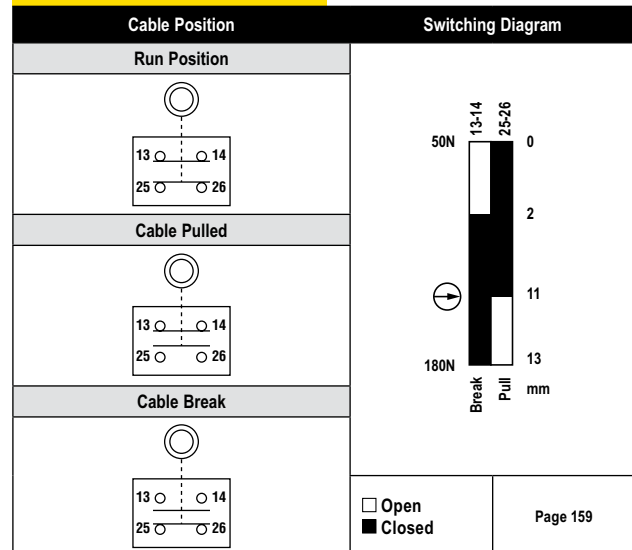
SD032 - RP-QM72D-6L Series



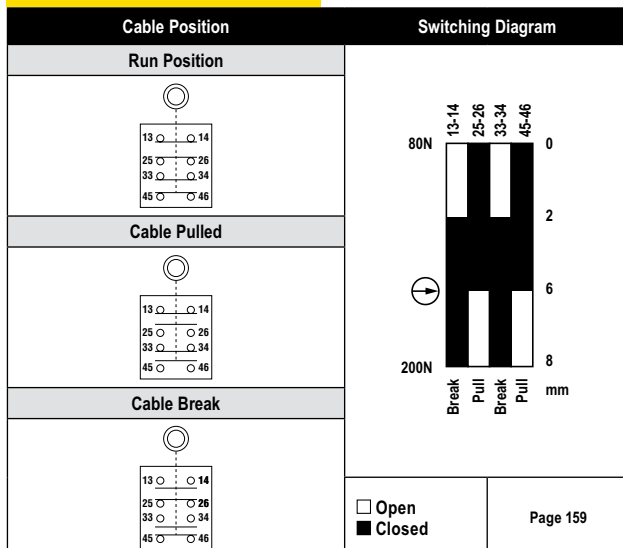
SD033 - RP-QM72D-12L Series



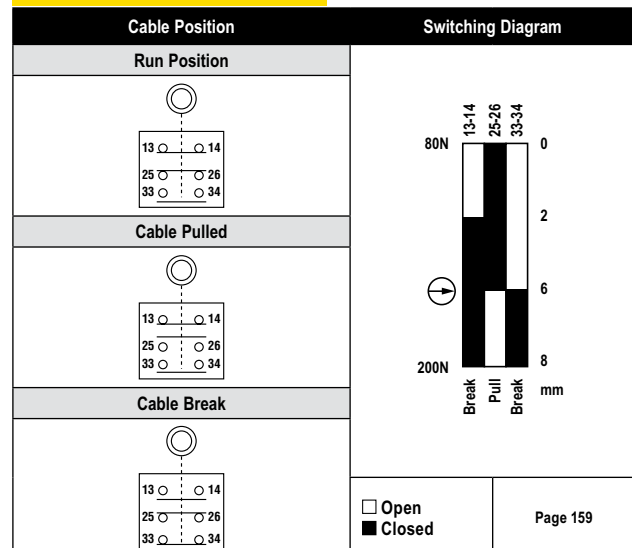
SD034 - RP-QMT72D-20L Series



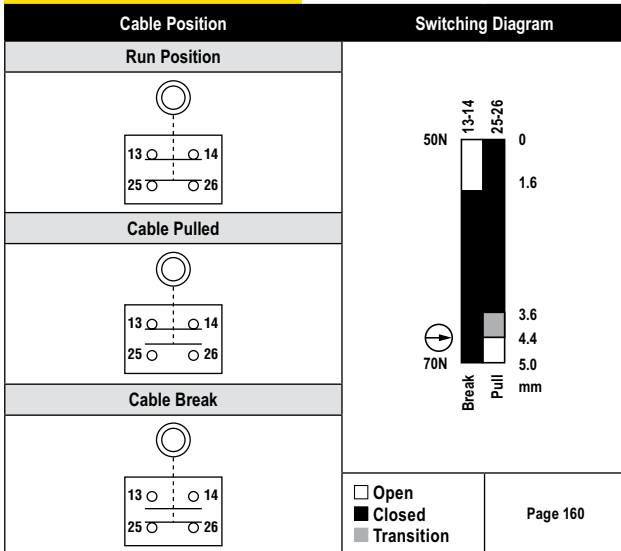
SD035 - RP-QMT72F-12L Series



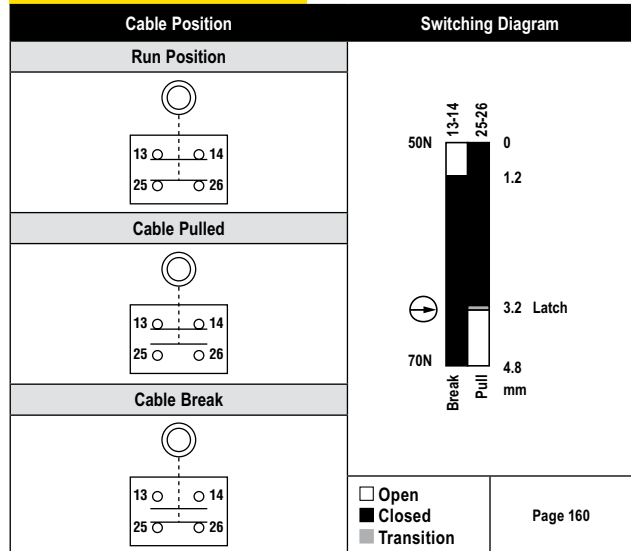
SD036 - RP-QMT72E-12L Series



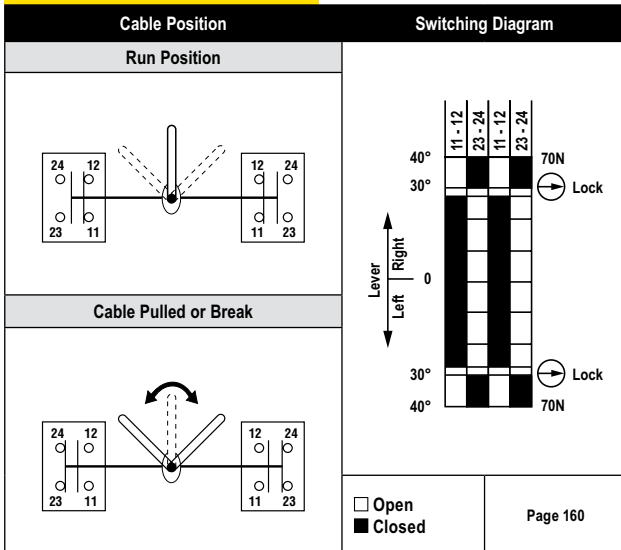
SD037 - RP-LM40D-6 Series



SD038 - RP-LM40D-6L Series



SD039 - RP-QM90F-100L Series



WD001



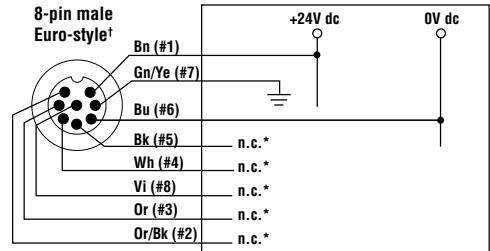
Page 23

Models

- EZ-SCREEN 14 & 30 mm emitter models with 8-pin Euro QD

EZ-SCREEN® System (Type 4)

8-Pin Euro-Style (Standard Emitter)



*NOTE: Pins 2, 3, 4, 5, and 8 are not connected, or are paralleled to same color wire from the 8-pin receiver cable

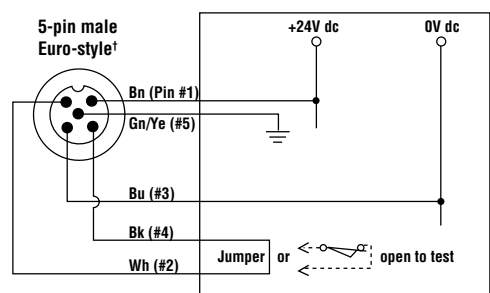
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

Models

- EZ-SCREEN 14 & 30 mm emitter models with 5-pin Euro QD

EZ-SCREEN® System (Type 4)

5-Pin Euro-Style (Emitter with Test)



*NOTE: Pins 2, 3, 4 and 5 either are not connected, or are paralleled to same color wire from the 8-pin receiver cable

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

† See Euro-style connectors on page 179 for female mating cordset.

WD002



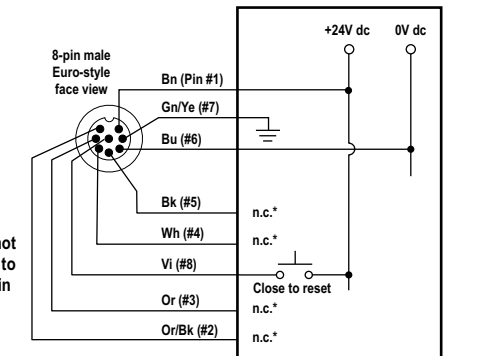
Page 31

Models

- EZ-SCREEN LP 14 & 25 mm emitter models with 8-pin Euro QD

EZ-SCREEN® LP System (Type 4)

8-Pin Euro-Style (Reset Hookup)



*NOTE: Pins 2, 3, 4 and 5 either are not connected, or are paralleled to same color wire from the 8-pin receiver cable

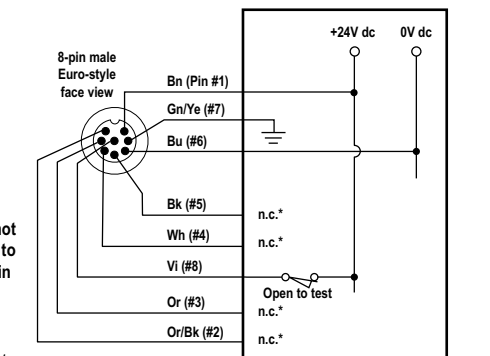
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

Models

- EZ-SCREEN 14 & 25 mm emitter models with 8-pin Euro QD

EZ-SCREEN® LP System (Type 4)

8-Pin Euro-Style (Test Hookup)



*NOTE: Pins 2, 3, 4 and 5 either are not connected, or are paralleled to same color wire from the 8-pin receiver cable

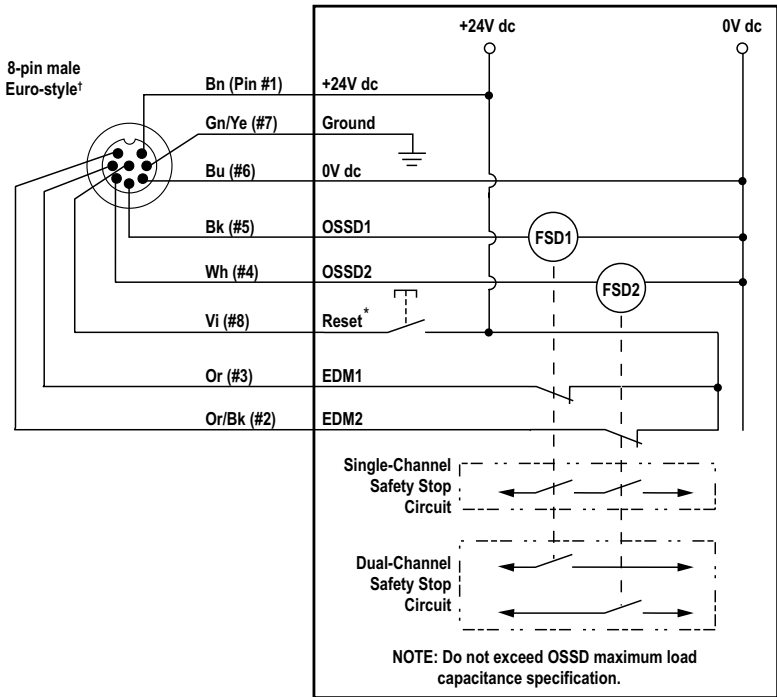
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

† See Euro-style connectors on page 179 for female mating cordset.

WD003

EZ-SCREEN® System (Type 4)

Receiver with 2 Solid-State OSSDs, 2 FSDs and 2-Channel EDM



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

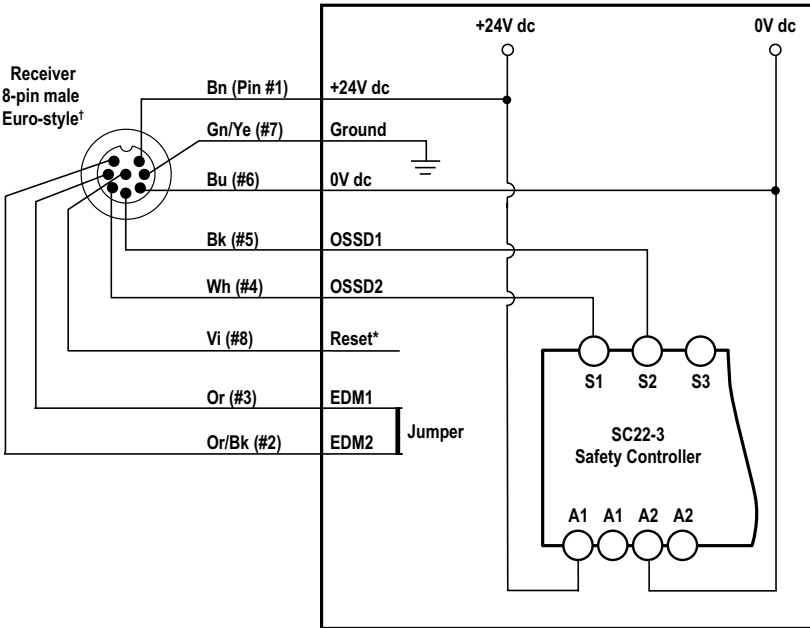
* Trip (auto reset) not connected.

† See Euro-style connectors on page 179 for female mating cordset.

WD004

EZ-SCREEN® System (Type 4)

2 Solid-State OSSDs and 2-Channel EDM of SC22-3



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Trip (auto reset)- Not connected

† See Euro-style connectors on page 179 for female mating cordset.

WD005



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Models

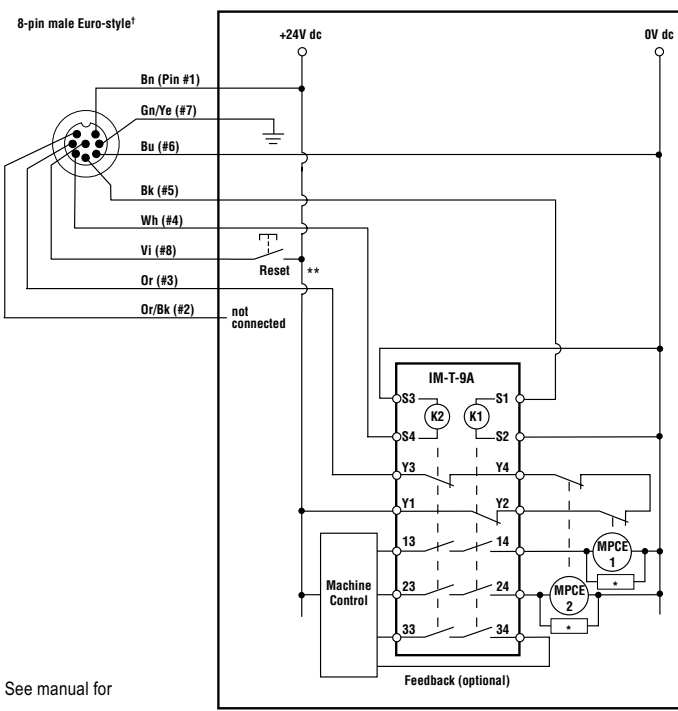
- EZ-SCREEN 14 & 30 mm models with 8-pin Euro QD
- EZ-SCREEN LP 14 & 25 mm models with 8-pin Euro QD

IM-T-9A Terminal Locations

S1	S2	Y1
13	23	33
IM-T-9A		
Y4	14	24
Y3	S3	S4

EZ-SCREEN® System (Type 4)

1-Channel EDM of IM-T-9A Interface Module



* Arc Suppressors. See manual for specific warnings.

** Trip (auto reset) not recommended.

† See Euro-style connectors on page 179 for female mating cordset.



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD006



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Models

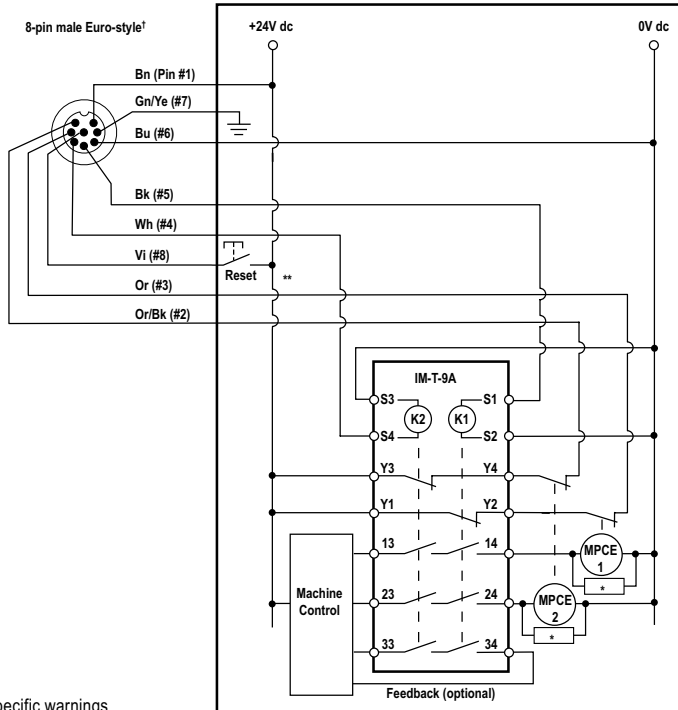
- EZ-SCREEN 14 & 30 mm models with 8-pin Euro-style QD
- EZ-SCREEN LP 14 & 25 mm models with 8-pin Euro QD

IM-T-9A Terminal Locations

S1	S2	Y1
13	23	33
IM-T-9A		
Y4	14	24
Y3	S3	S4

EZ-SCREEN® System (Type 4)

2-Channel EDM of IM-T-9A Interface Module



* Arc Suppressors. See manual for specific warnings.

** Trip (auto reset) not recommended.

† See Euro-style connectors on page 179 for female mating cordset.



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD007

EZ-SCREEN® System (Type 4)

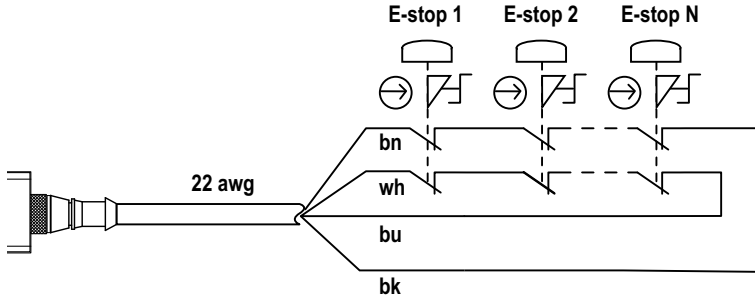
Hookup of E-Stop Button to the Last Receiver in a Cascade



Page 22

Models

- EZ-SCREEN 14 & 30 mm models
- EZ-SCREEN LP 14 & 25 mm models



QDE2R4-8..D Cable Pinout*

Pin #1 – Brown (Ch 1a)	Pin #5 – n.c.
Pin #2 – Black (Ch 1b)	Pin #6 – n.c.
Pin #3 – Blue (Ch 2b)	Pin #7 – n.c.
Pin #4 – n.c.	Pin #8 – White (Ch 2a)

* Standard M12/Euro-style cables (8-pin male QD) can also be used, although pin number/wire color must be verified.



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD008

EZ-SCREEN® System (Type 2)

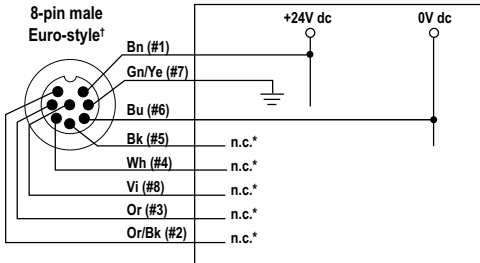
Emitter



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Models

- EZ-SCREEN Type 2 30 mm models



* NOTE: Pins 2, 3, 4, 5 and 8 are not connected, or are paralleled to same color wire from the receiver cable.



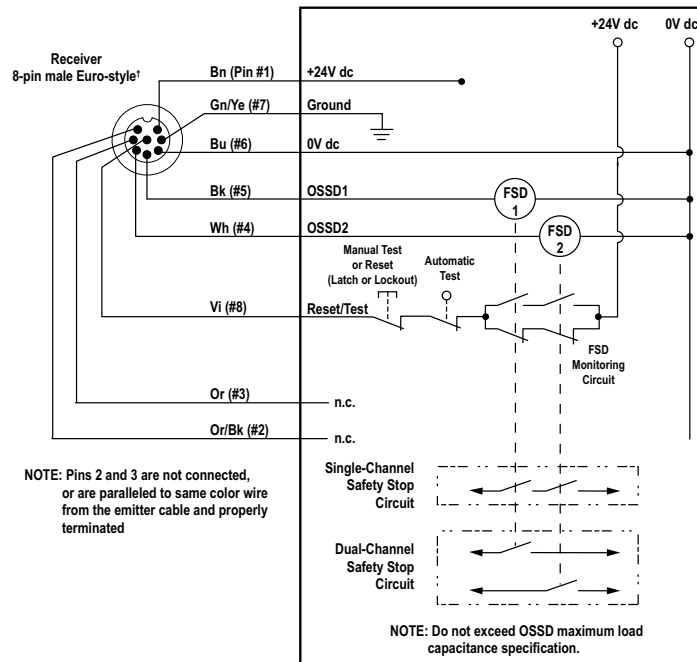
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

† See Euro-style connectors on page 179 for female mating cordset.

WD009

EZ-SCREEN® System (Type 2)

Receiver with 2 Solid-State OSSDs, 2 FSDs and Power Monitoring



NOTE: Pins 2 and 3 are not connected, or are paralleled to same color wire from the emitter cable and properly terminated

NOTE: Do not exceed OSSD maximum load capacitance specification.



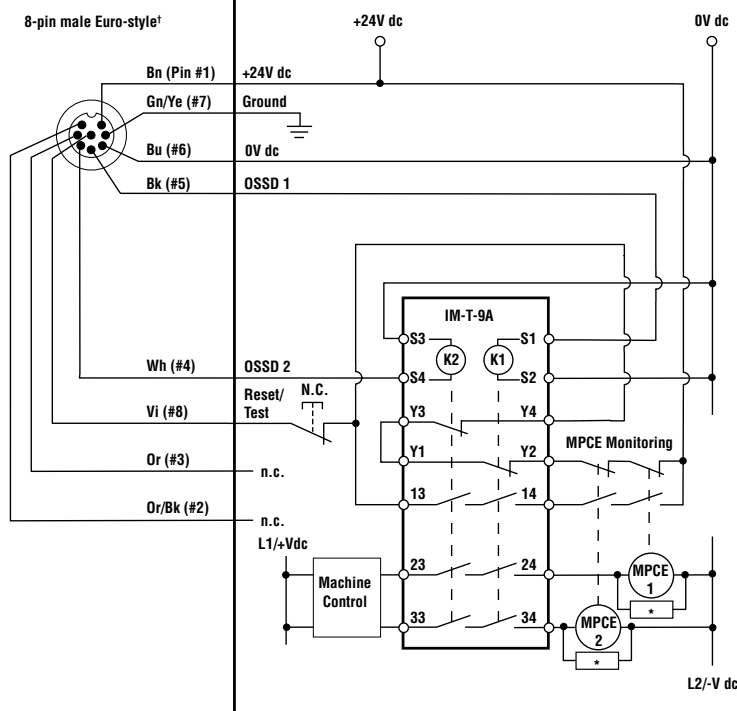
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

† See Euro-style connectors on page 179 for female mating cordset.

WD010

EZ-SCREEN® System (Type 2)

Power Monitoring of IM-T-9A Interface Module



NOTE: Pins 2 and 3 are not connected, or are paralleled to same color wire from the emitter cable and properly terminated.



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

† See Euro-style connectors on page 179 for female mating cordset.



WD011

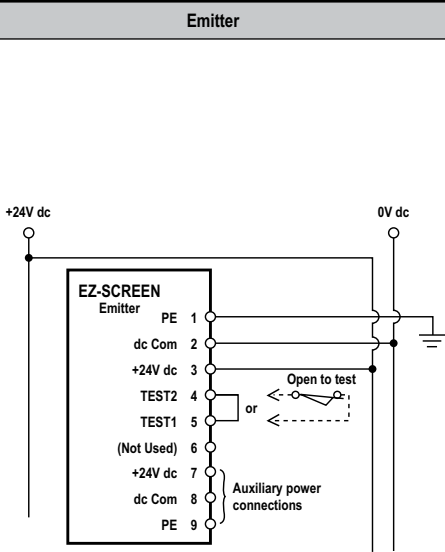
EZ-SCREEN® System (Type 4)



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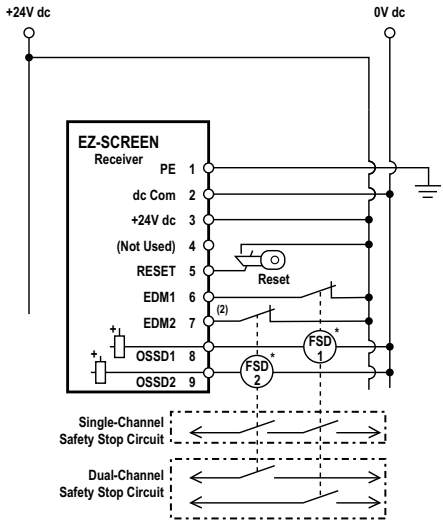
Models

• EZ-SCREEN Grid & Point



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

Receiver with 2 Solid-State OSSDs, 2 FSDs and 2-Channel EDM



NOTE: Do not exceed OSSD maximum load capacitance specification.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

WD012

EZ-SCREEN® System (Type 4)



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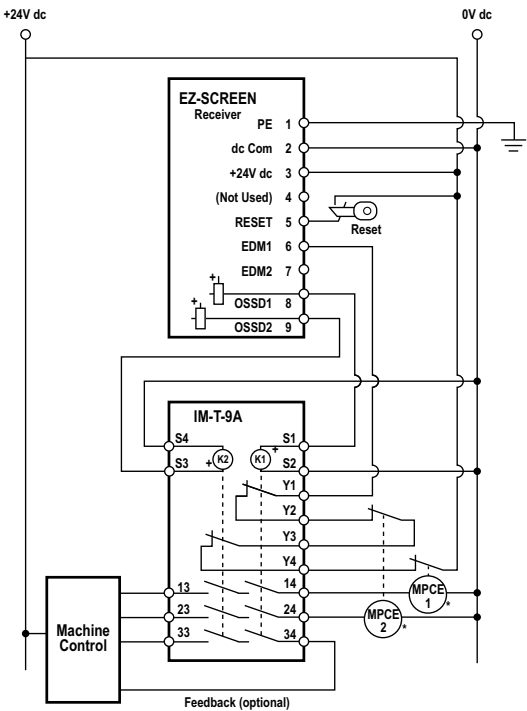
Models

• EZ-SCREEN Grid & Point

IM-T-9A
Terminal Locations



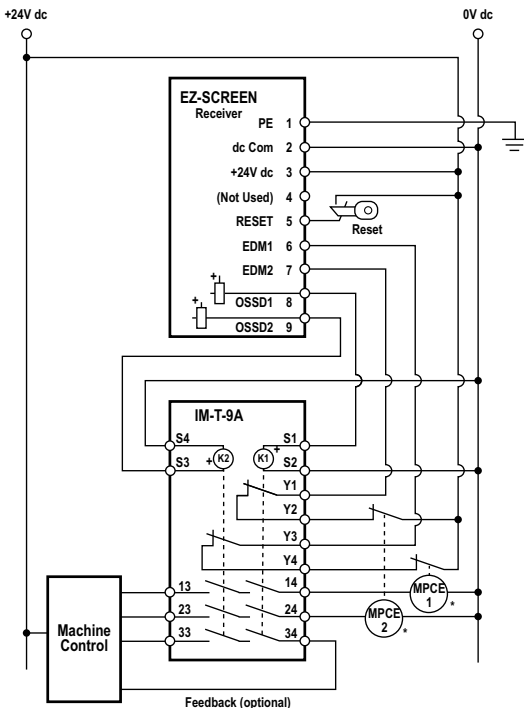
1-Channel EDM of IM-T-9A Interface Module



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

2-Channel EDM of IM-T-9A Interface Module



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD013

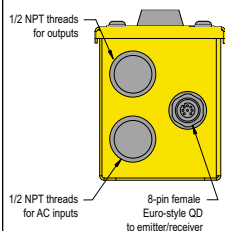


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Models

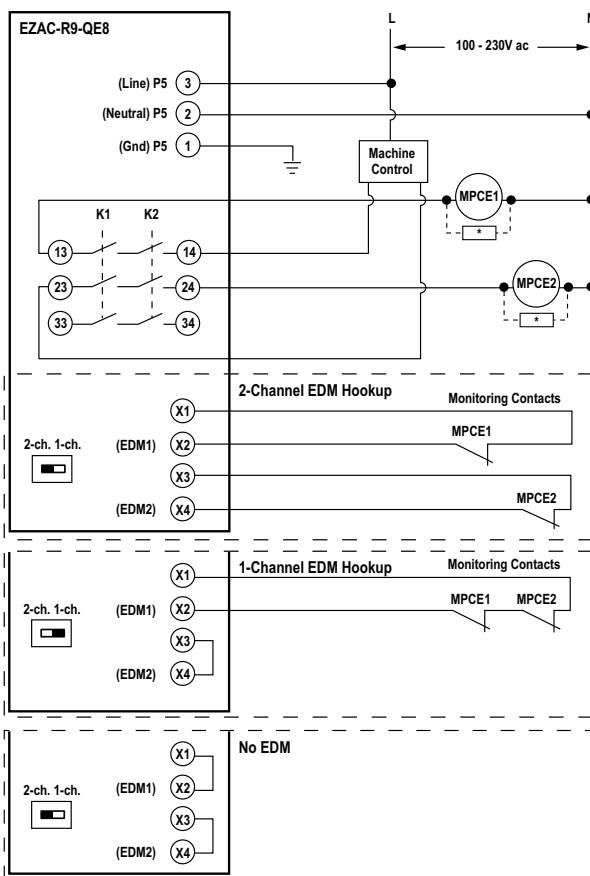
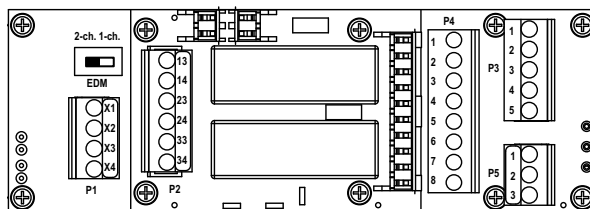
- EZAC-R9-QE8

Connections (Hard Wired)



EZ-SCREEN® AC Interface Box

EZAC-R9-QE8 – Hard-Wired with 3 NO and EDM



* Arc Suppressors. See manual for specific warnings.



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

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DIAGRAMS

HOOKUP
DIAGRAMS

GLOSSARY

INTERNATIONAL
REPRESENTATIVES

WD014

EZ-SCREEN® AC Interface Box

EZAC-R11-QE8 – Hard-Wired with 2 NO, 1 NC and EDM

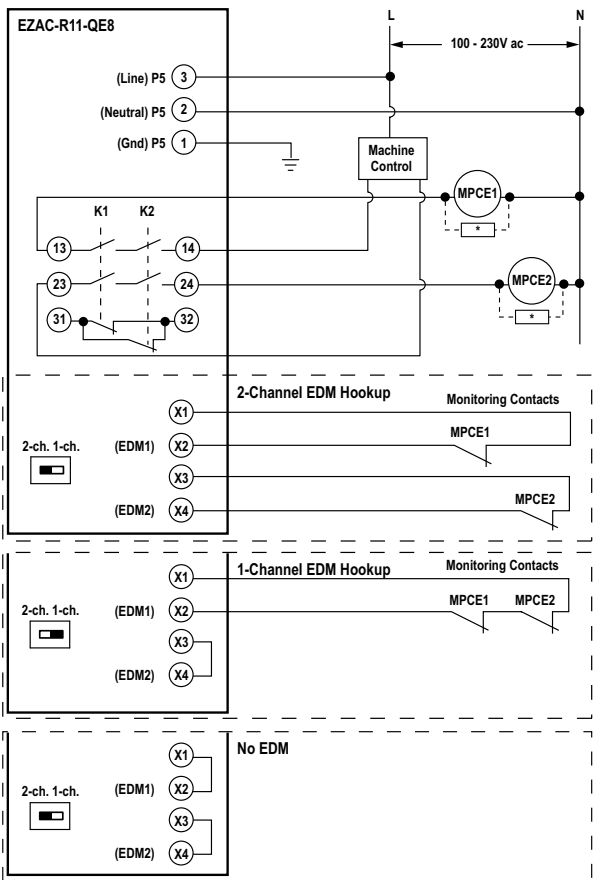
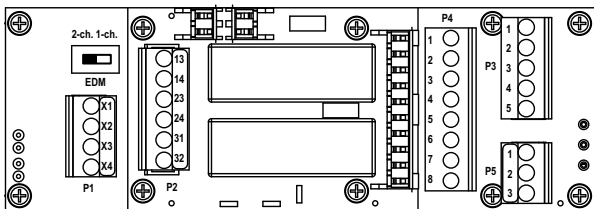
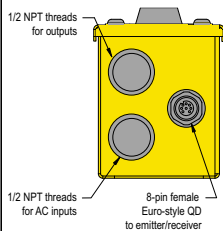


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Models

• EZAC-R11-QE8

Connections
(Hard Wired)



* Arc Suppressors. See manual for specific warnings.



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

WD015

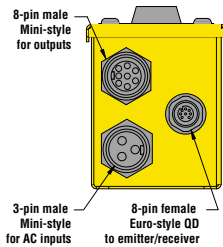


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Models

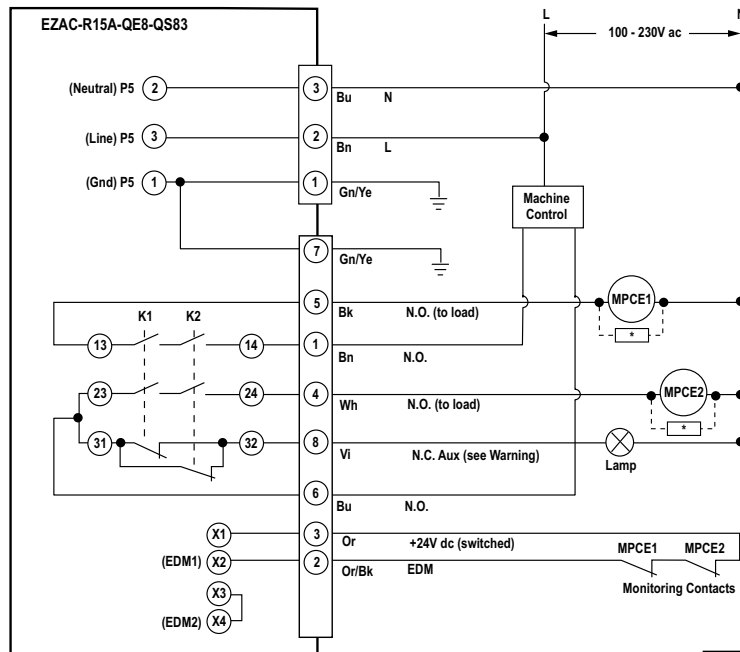
• EZAC-R15A-QE8-QS83

Connections (8-Pin Mini)



EZ-SCREEN® AC Interface Box

EZAC-R15A-QE8-QS83 – Mini-Style QD with 1 NO, 1 SPDT and 1-Channel EDM



**3-Pin Mini-Style Power Connector
Male Face View**

Green/Yellow wire
Brown wire
Blue wire

Mating Cordset: QDS-3-C

Pin	Color	Function
1	Green/Yellow	Gnd/PE
2	Brown	Line
3	Blue	Neutral

**8-Pin Mini-Style Output Connector
Male Face View**

Green/Yellow
Blue
Black
Orange
White
Violet

Mating Cordset: QDS-8-C

Pin	Color	Function
1	Brown	N.O.
2	Orange/Black	+24V dc (EDM)
3	Orange	EDM
4	White	N.O. (to load)
5	Black	N.O. (to load)
6	Blue	Common
7	Green/Yellow	Gnd/PE
8	Violet	N.C. Aux.

* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD016

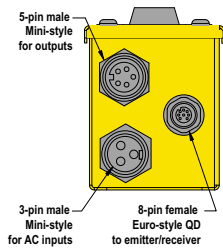


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Models

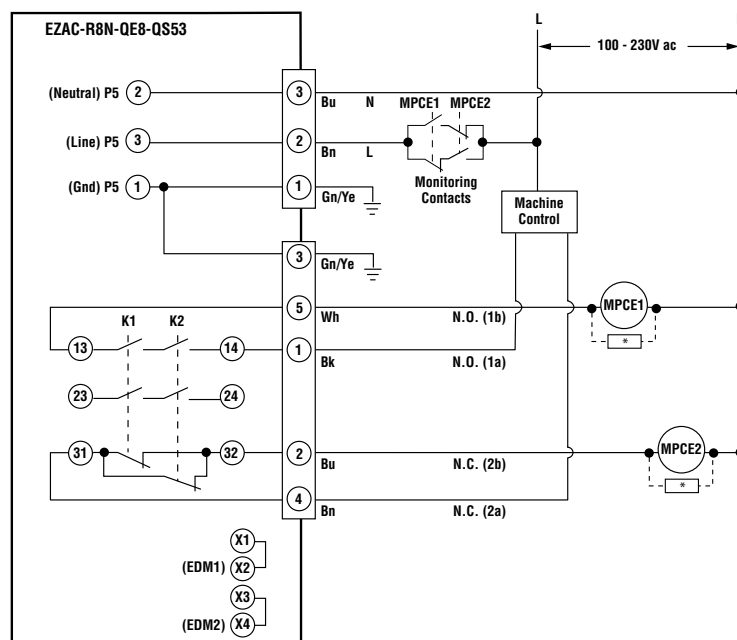
• EZAC-R8N-QE8-QS53

Connections (5-Pin Mini)



EZ-SCREEN® AC Interface Box

EZAC-R8N-QE8-QS53 – Mini-Style QD with 1 NO, 1 NC and Power Monitoring



**3-Pin Mini-Style Power Connector
Male Face View**

Green/Yellow wire
Brown wire
Blue wire

Mating Cordset: QDS-3-C

Pin	Color	Function
1	Green/Yellow	Gnd/PE
2	Brown	Line
3	Blue	Neutral

**5-Pin Mini-Style Output Connector
Male Face View**

Black
Blue
Green/Yellow
Brown

Mating Cordset: QDS-5-C

Pin	Color	Function
1	Black	N.O. (1a)
2	Blue	N.C. (2a)
3	Green/Yellow	Gnd/PE
4	Brown	N.C. (2b)
5	White	N.O. (1b)

* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD017

EZ-SCREEN® AC Interface Box

EZAC-R10N-QE8-QS53 – Mini-Style QD with 2 NO and Power Monitoring

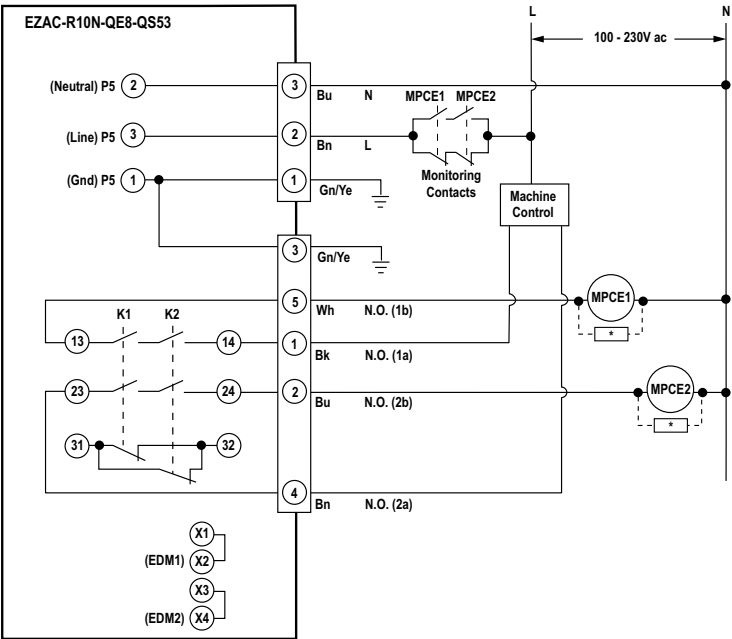
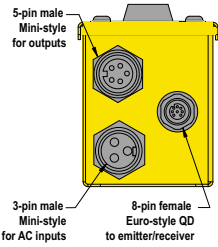


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Models

- EZAC-R10N-QE8-QS53

Connections
(5-Pin Mini)



3-Pin Mini-Style Power Connector
Male Face View

Mating Cordset: QDS-3.C

Pin	Color	Function
1	Green/Yellow	Gnd/PE
2	Brown	Line
3	Blue	Neutral

5-Pin Mini-Style Output Connector
Male Face View

Mating Cordset: QDS-5.C

Pin	Color	Function
1	Black	N.O. (1a)
2	Blue	N.C. (2a)
3	Green/Yellow	Gnd/PE
4	Brown	N.C. (2b)
5	White	N.O. (1b)

* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD018

EZ-SCREEN® AC Interface Box

EZAC-E-QE.. – Hard-Wired Emitters with or without Test



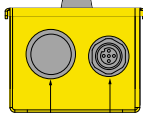
Page 189

Models

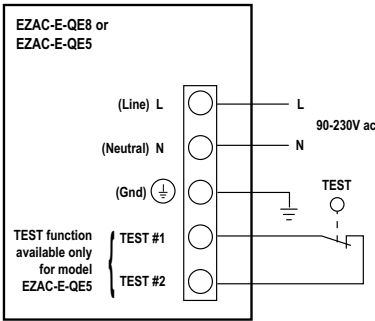
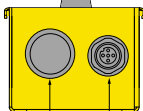
- EZAC-E-QE8
- EZAC-E-QE5

Connections

5-Pin Euro



8-Pin Euro



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD019



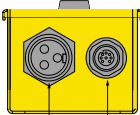
Page 189

Models

- EZAC-E-QE8-QS3
- EZAC-E-QE5-QS5

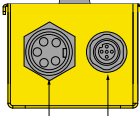
Connections

(3-Pin Mini)



3-pin male Mini-style AC inputs
5-pin Euro-style QD to emitter

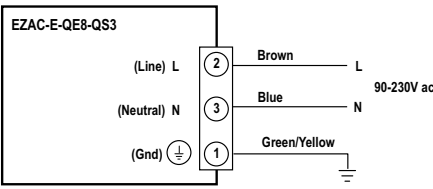
(5-Pin Mini)



5-pin male Mini-style AC inputs
5-pin Euro-style QD to emitter

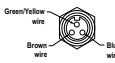
EZ-SCREEN® AC Interface Box

EZAC-E-QE8-QS3 – Mini-Style QD Emitter



90-230V ac

3-Pin Mini-Style Power Connector
Male Face View



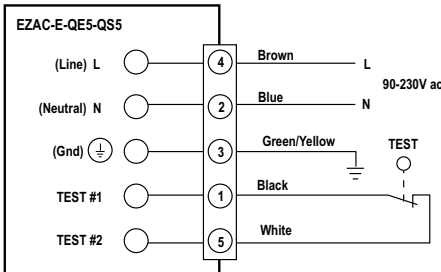
Pin	Color	Function
1	Green/Yellow	Gnd/PE
2	Brown	Line
3	Blue	Neutral

Mating Cordset: QDS-3..C



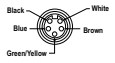
Wiring diagrams are for information only.
See appropriate manuals for all specific warnings, cautions and information for use.

EZAC-E-QE5-QS5 – Mini-Style QD Emitter with Test



90-230V ac

5-Pin Mini-Style Output Connector
Male Face View



Pin	Color	Function
1	Black	N.O. (1a)
2	Blue	N.C. (2a)
3	Green/Yellow	Gnd/PE
4	Brown	N.C. (2b)
5	White	N.O. (1b)

Mating Cordset: QDS-5..C



Wiring diagrams are for information only.
See appropriate manuals for all specific warnings, cautions and information for use.

WD020



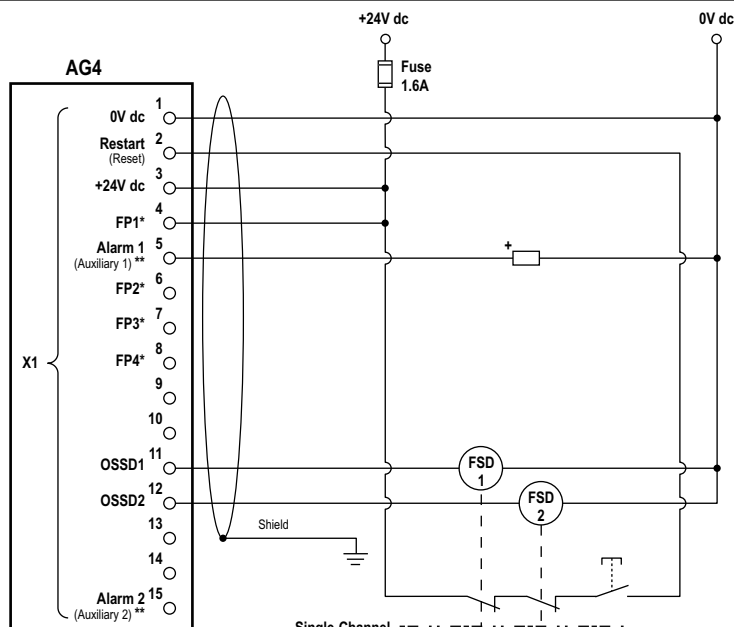
Page 53

Models

- AG4-4E

AG4-4E Laser Scanner

AG4-4E to FSD1 & FSD2



+24V dc Fuse 1.6A 0V dc

AG4

0V dc 1
Restart (Reset) 2
+24V dc 3
FP1* 4
Alarm 1 (Auxiliary 1)** 5
FP2* 6
FP3* 7
FP4* 8
9
10
OSSD1 11
OSSD2 12
13
14
Alarm 2 (Auxiliary 2)** 15

Shield

FSD 1 FSD 2

Single-Channel
Safety Stop
Circuit

Dual-Channel
Safety Stop
Circuit

* Figure shows Field Pair #1 selected. See manual for further information on Zone Pair Changeover.

** See manual for further information on the non-safety Alarm/Auxiliary outputs.

Warning: Monitoring FSDs
FSDs must be monitored for proper

NOTE: Do not exceed OSSD maximum load capacitance specification.



Wiring diagrams are for information only.
See appropriate manuals for all specific warnings, cautions and information for use.

WD021



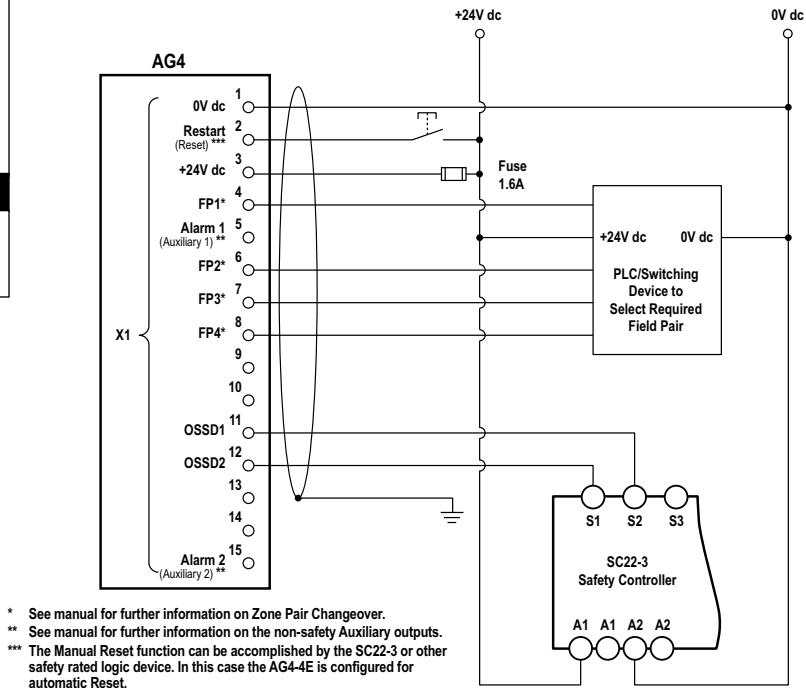
Page 53

Models

• AG4-4E

AG4-4E Laser Scanner

AG4-4E to SC22-3



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD022



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Models

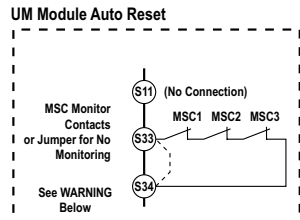
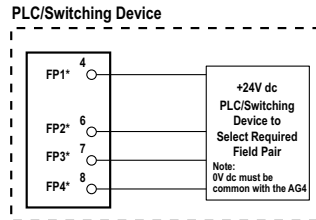
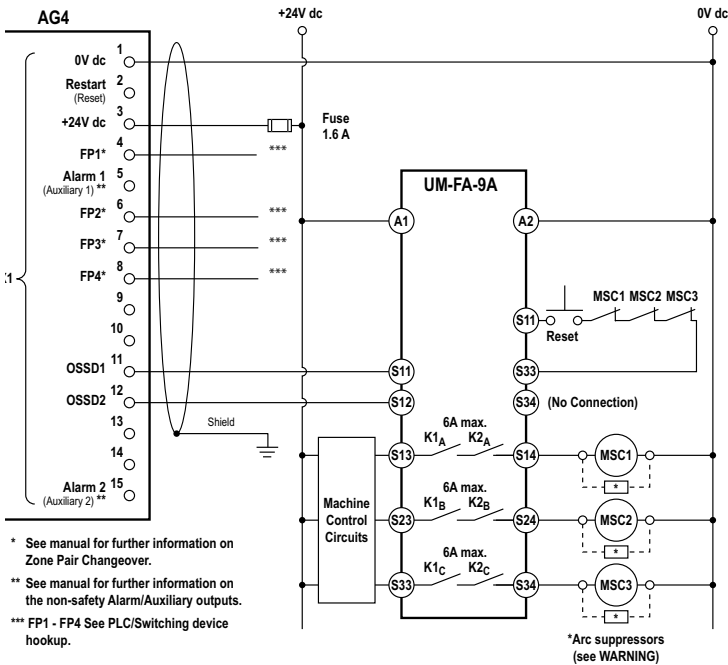
• AG4-4E

UM-FA...A
Terminal Locations



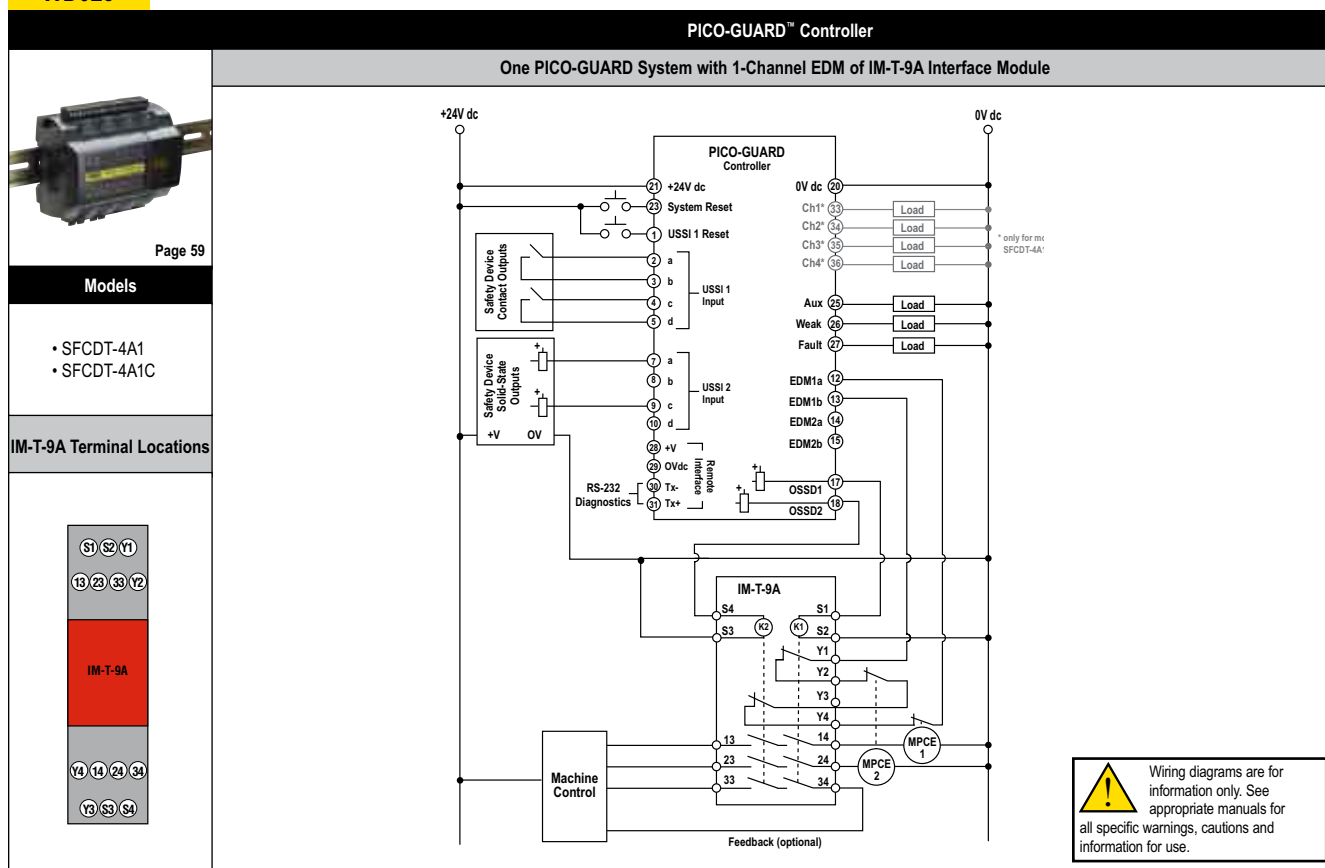
AG4-4E Laser Scanner

AG4-4E to UM Modules

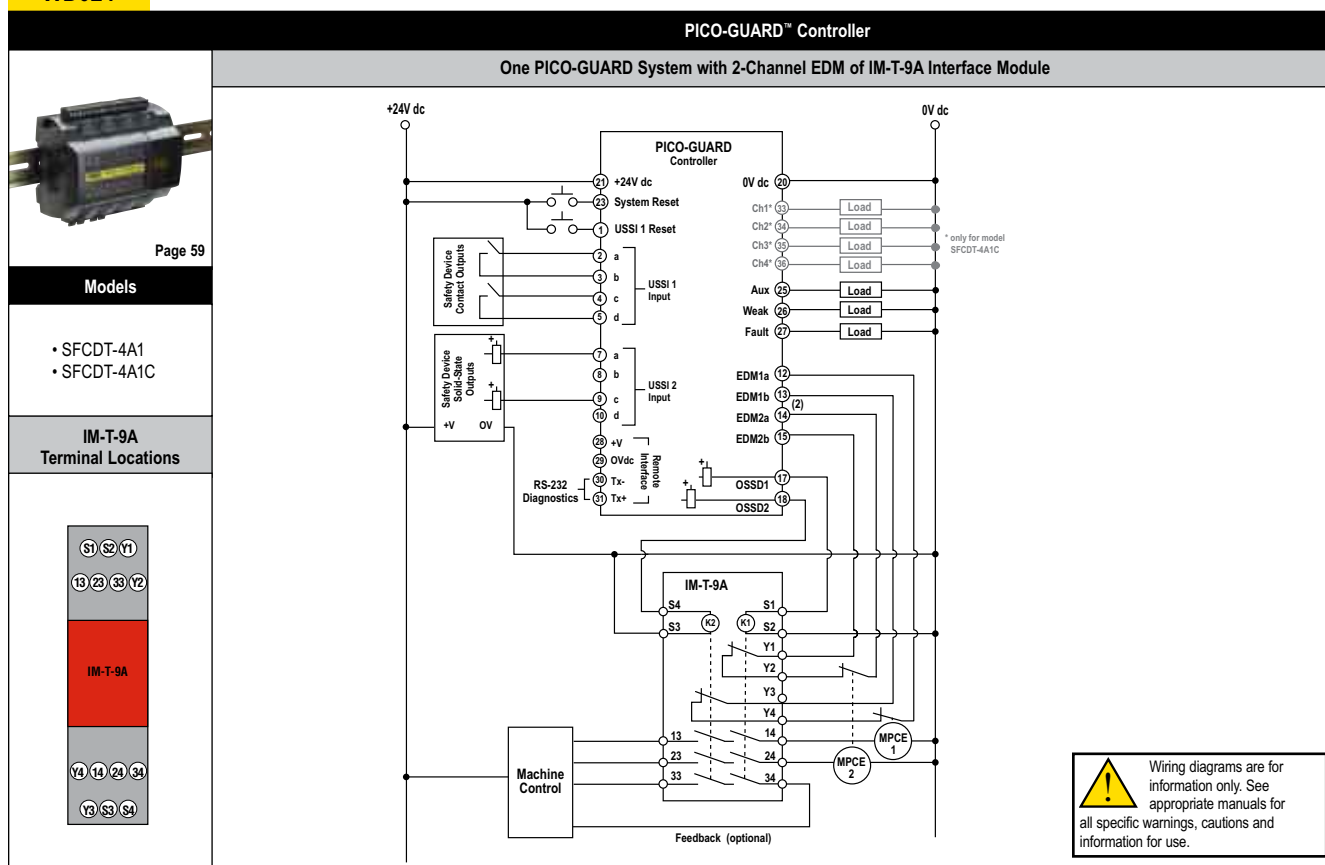


Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD023



WD024



WD025

PICO-GUARD™ Controller

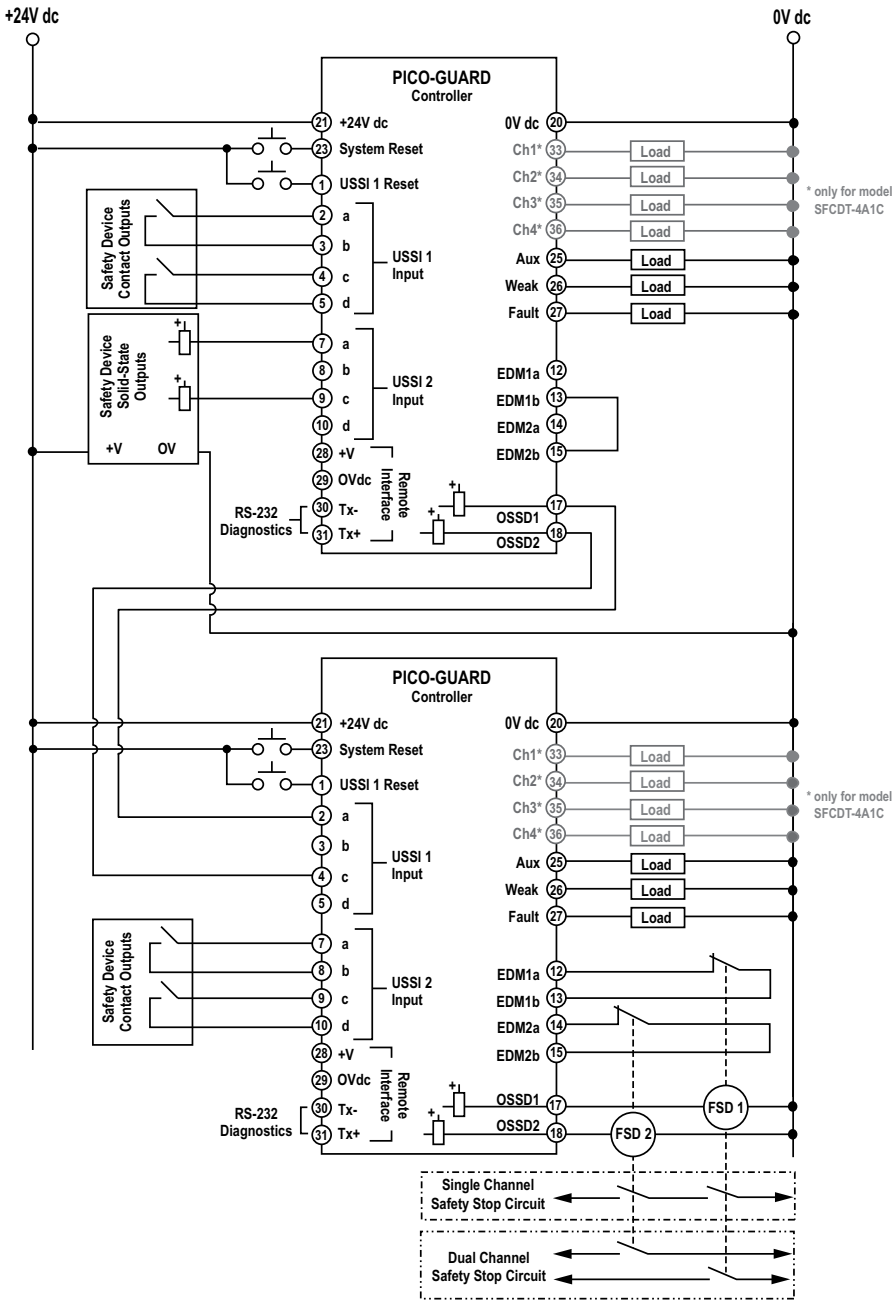
Two PICO-GUARD Systems with 2-Channel EDM



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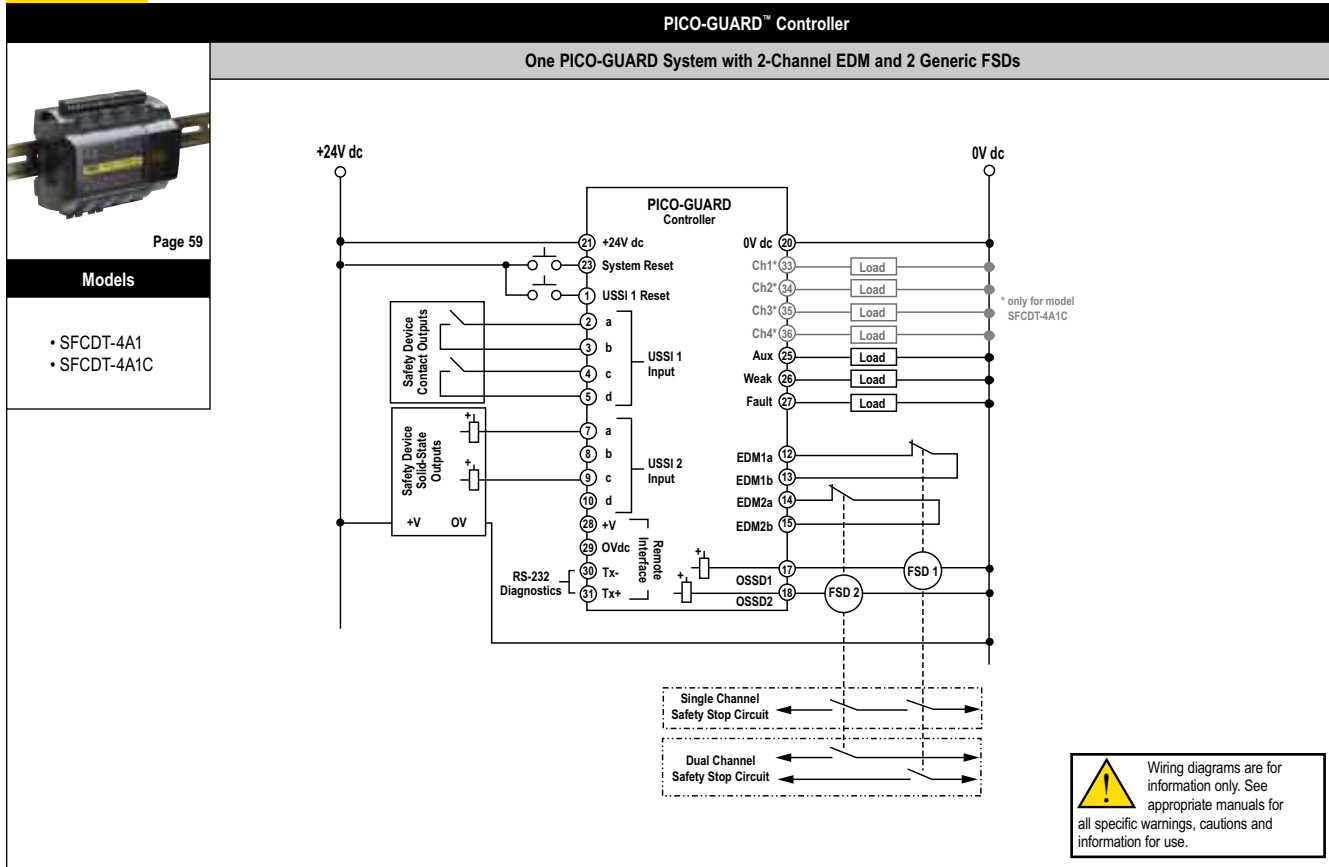
Models

- SFCDT-4A1
- SFCDT-4A1C

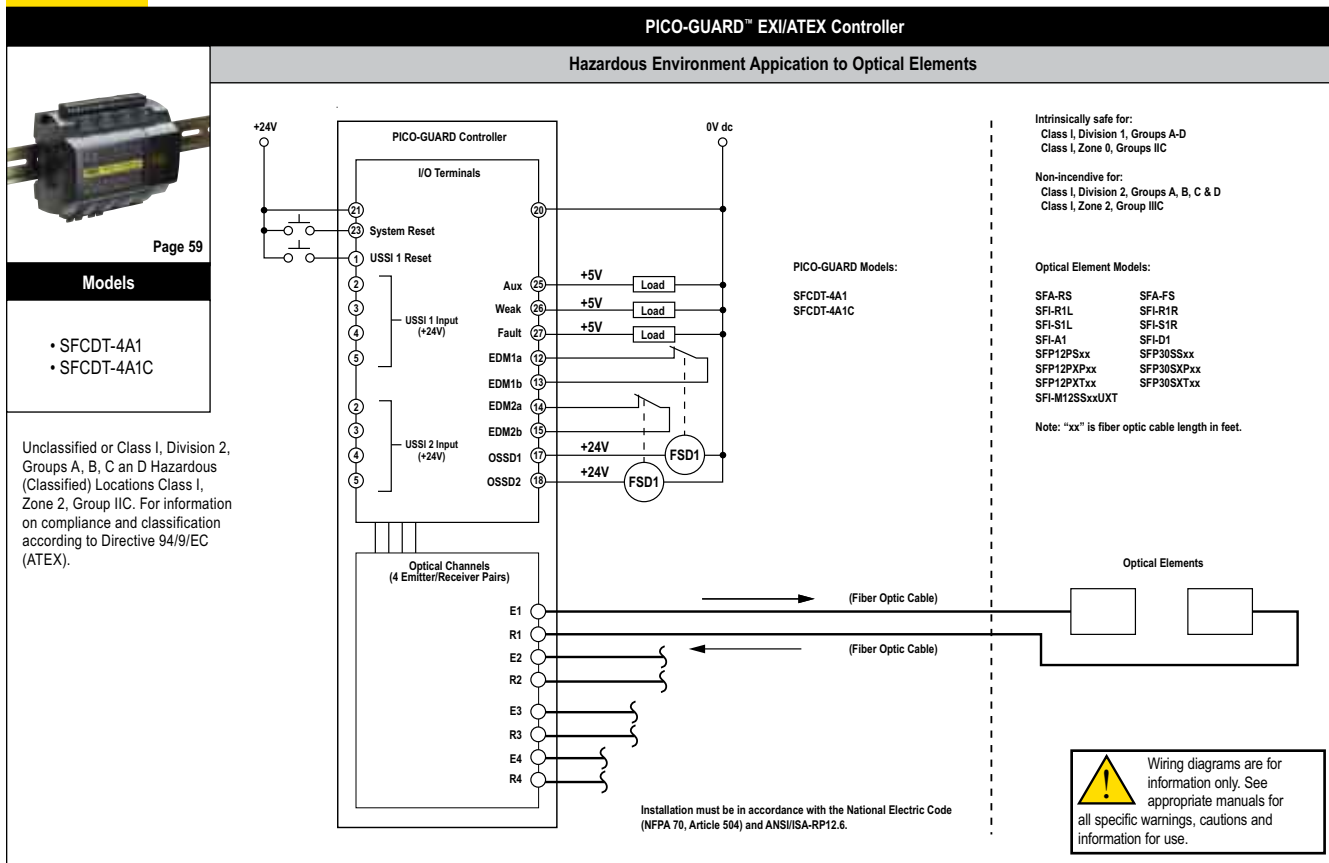


 Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

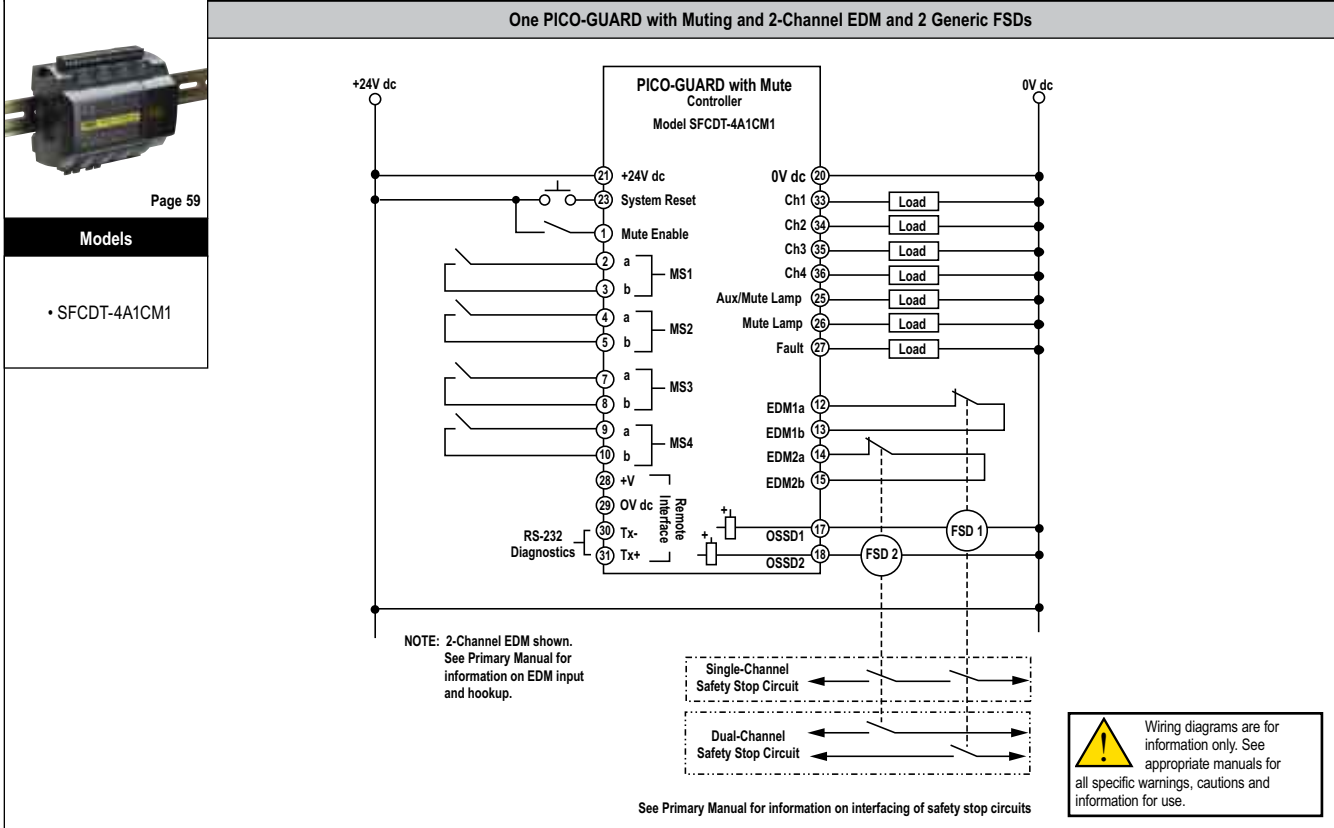
WD026



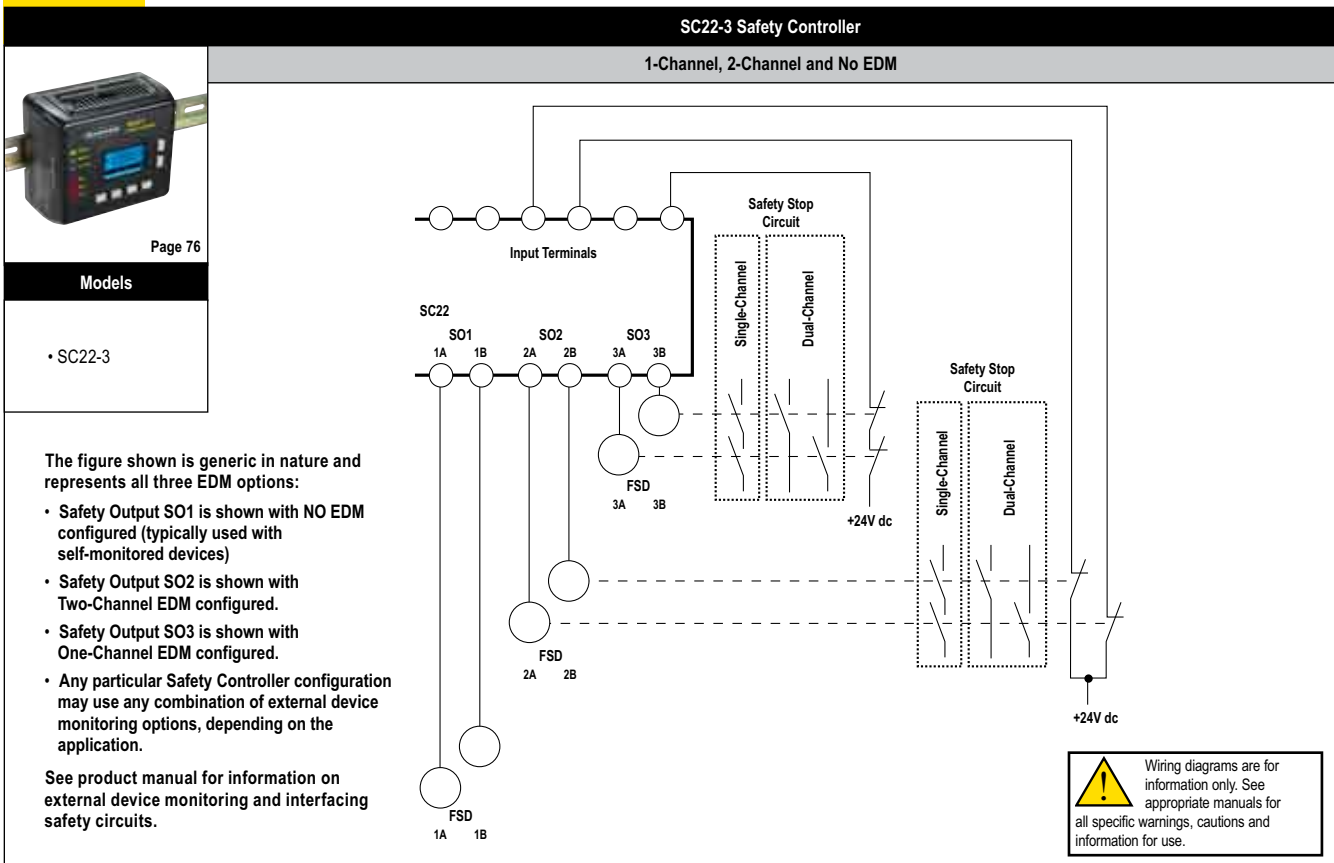
WD027



WD028



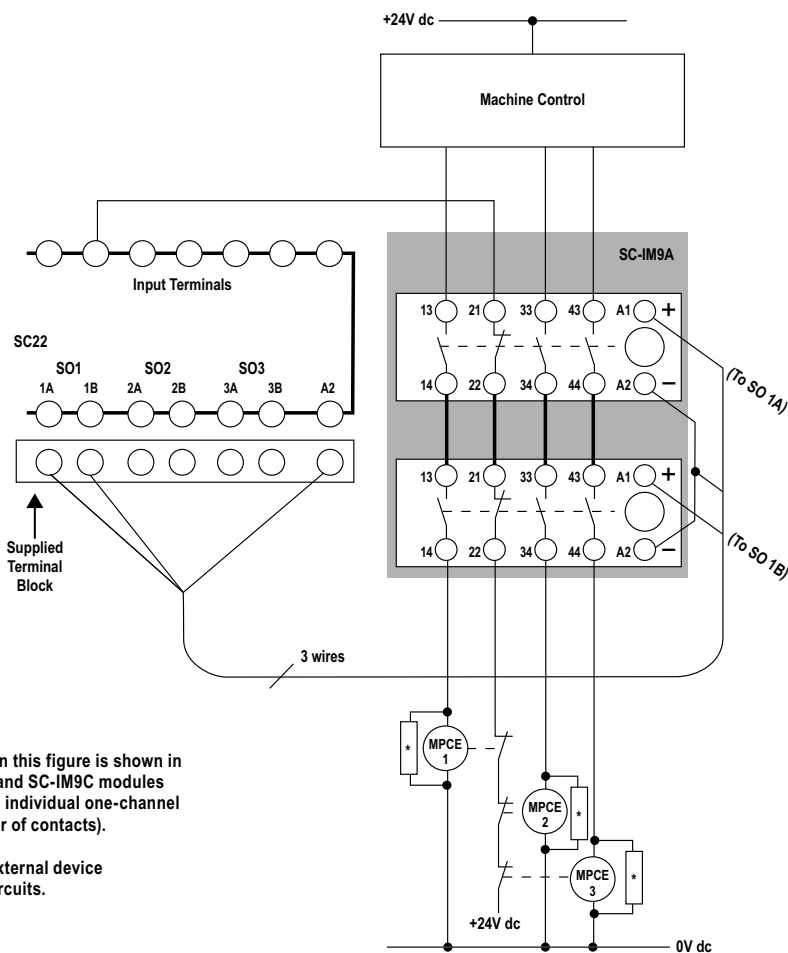
WD029



WD030

SC22-3 Safety Controller

1-Channel EDM to SC-IM9A



The SC-IM9A interface module depicted in this figure is shown in one-channel EDM hookup. The SC-IM9B and SC-IM9C modules are connected in the same manner, using individual one-channel EDM circuits (terminals 21/22 on each pair of contacts).

See product manual for information on external device monitoring and interfacing safety stop circuits.

* Arc Suppressors. See manual for specific warnings.

! Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

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WD031

SC22-3 Safety Controller

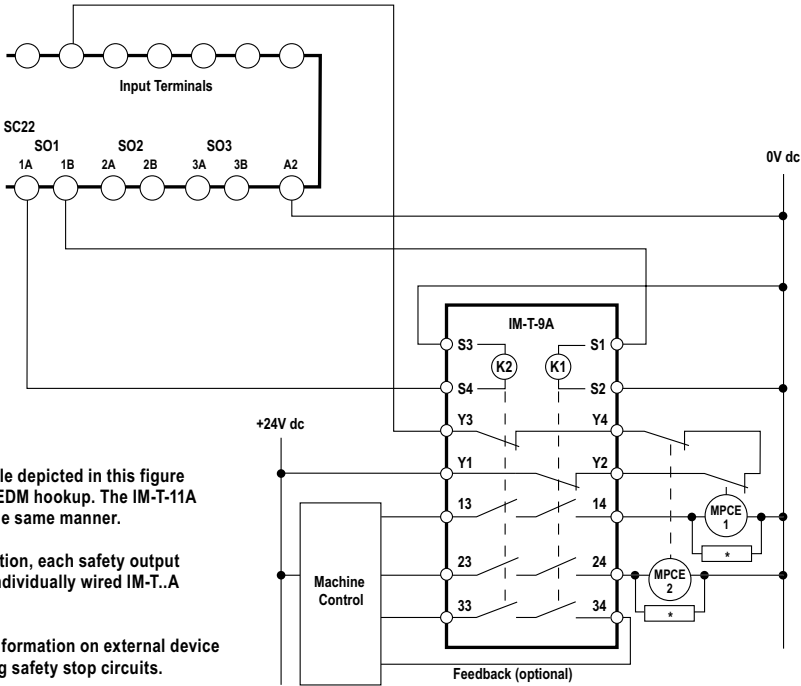
1-Channel EDM to IM-TA-9A



Page 76

Models

- SC22-3



The IM-TA interface module depicted in this figure is shown in one-channel EDM hookup. The IM-T-11A module is connected in the same manner.

Depending on the application, each safety output requires a separate and individually wired IM-T..A module.

See product manual for information on external device monitoring and interfacing safety stop circuits.

* Arc Suppressors. See manual for specific warnings.

 Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD032

SC22-3 Safety Controller

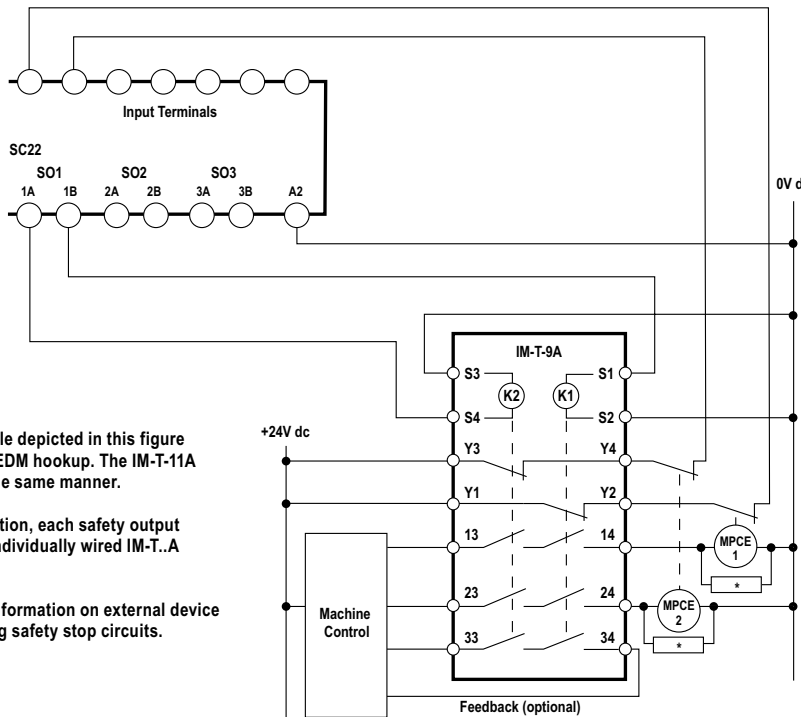
2-Channel EDM to IM-TA-9A



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Models

- SC22-3



The IM-TA interface module depicted in this figure is shown in two-channel EDM hookup. The IM-T-11A module is connected in the same manner.

Depending on the application, each safety output requires a separate and individually wired IM-T..A module.

See product manual for information on external device monitoring and interfacing safety stop circuits.

* Arc Suppressors. See manual for specific warnings.

 Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD033

GM-FA-10J Guard Monitoring Safety Module

GM-FA-10J 1-Channel Monitoring to Two 4-Wire Coded Magnetic Safety Switches

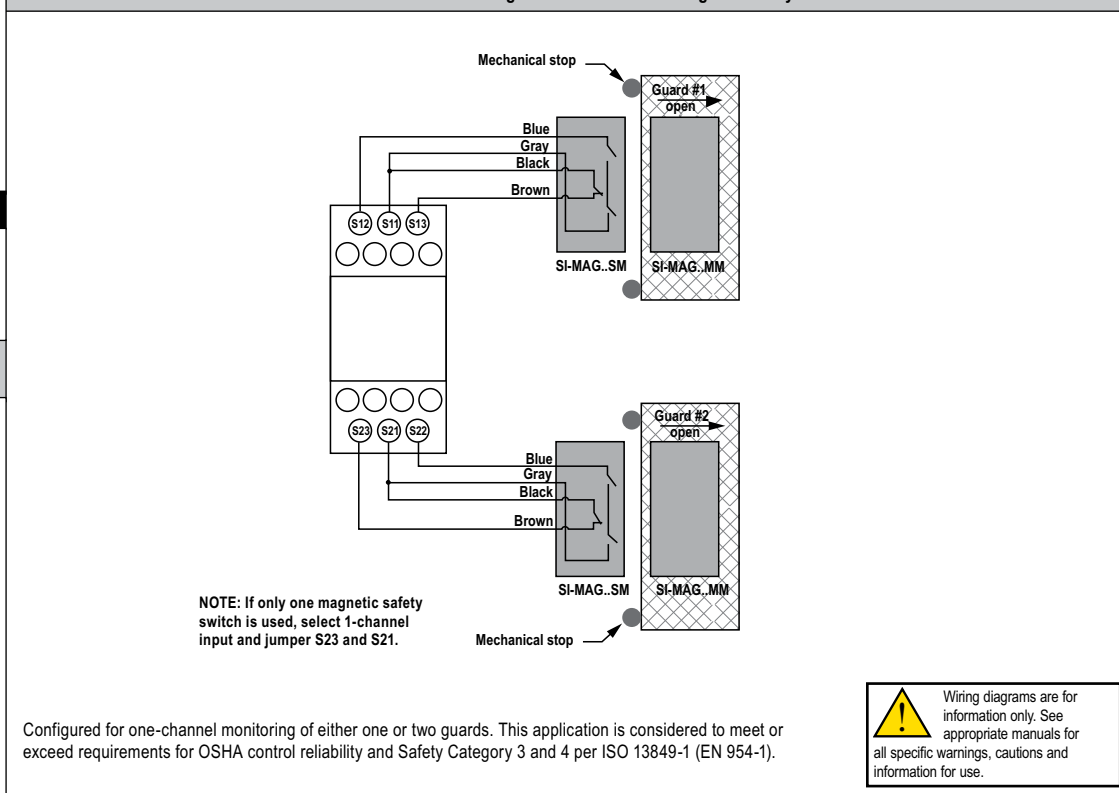


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Models

- GM-FA-10J

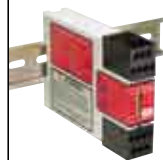
GM-FA-10J Terminal Locations

WD034

GM-FA-10J Guard Monitoring Safety Module

GM-FA-10J 2-Channel Monitoring to Two Positive-Opening Safety Interlock Switches

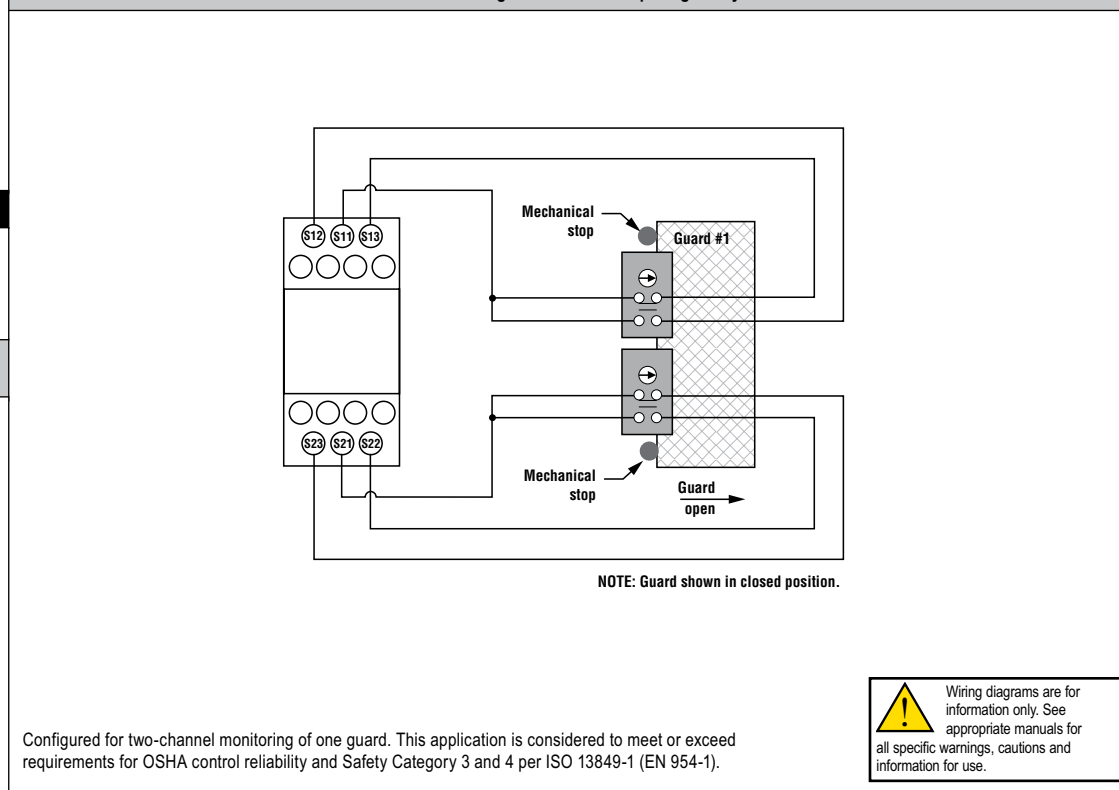


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Models

- GM-FA-10J

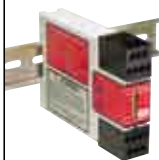
GM-FA-10J Terminal Locations

WD035

GM-FA-10J Guard Monitoring Safety Module

GM-FA-10J Alternate Wiring for 1-Channel Monitoring of Multiple Guards

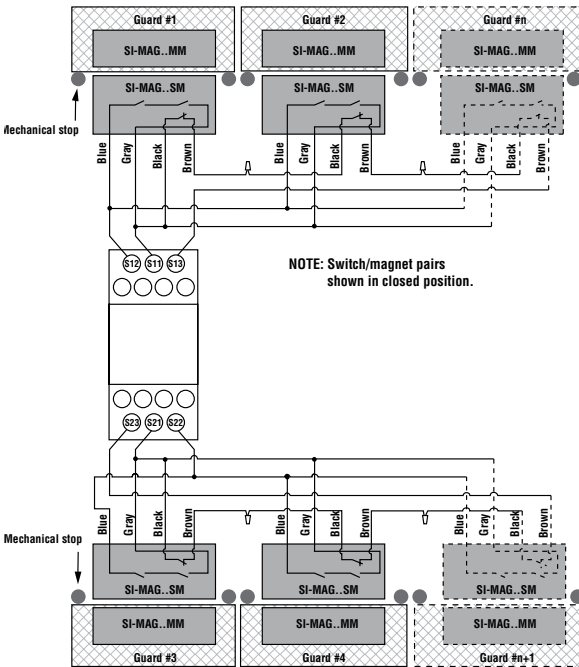


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Models

• GM-FA-10J

GM-FA-10J
Terminal Locations



Configured for one-channel monitoring of multiple guards with single switches at each guard. Up to 10 Banner magnetic switches may be connected to each channel in this series/parallel method. If other than Banner magnetic switches are used, a total resistance of 270 ohms between S11/S13, S11/S12, S21/S22 and S21/S23 must not be exceeded. **Note: Not a Category 4 application per ISO 13849-1 (EN 954-1).**

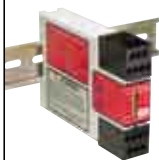


Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD036

GM-FA-10J Guard Monitoring Safety Module

GM-FA-10J Alternate Wiring for 2-Channel Monitoring of Multiple Guards

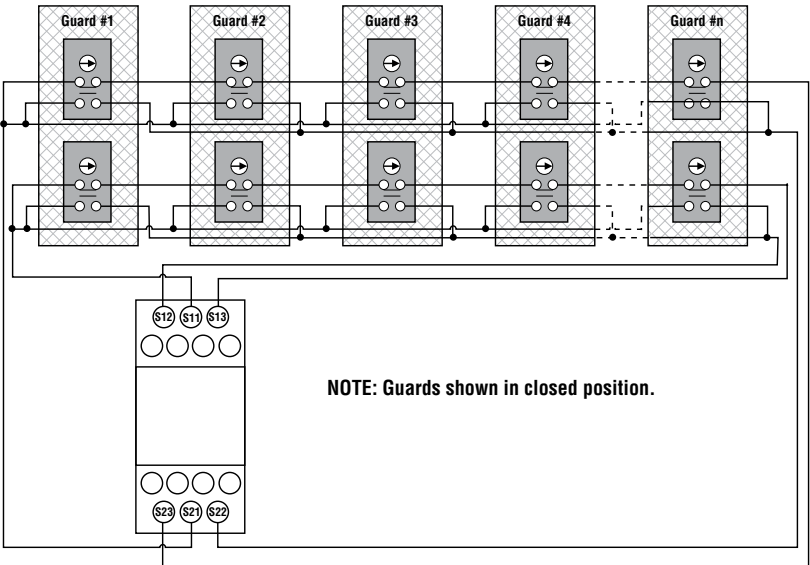


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Models

• GM-FA-10J

GM-FA-10J
Terminal Locations



Configured for two-channel monitoring of multiple guards with two safety switches mounted individually on each guard. The number of mechanical switches is limited by the max. resistance of 270 ohm between S11-S13, S11-S12, S21-S22 and S21-S23. The total resistance is calculated by adding the resistance of all guard switch contacts and the resistance of the cables that connect the switches and the switches to the module. **Note: Not a Category 4 application per ISO 13849-1 (EN 954-1).**



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD037

GM-FA-10J Guard Monitoring Safety Module

GM-FA-10J to Guarded Machine

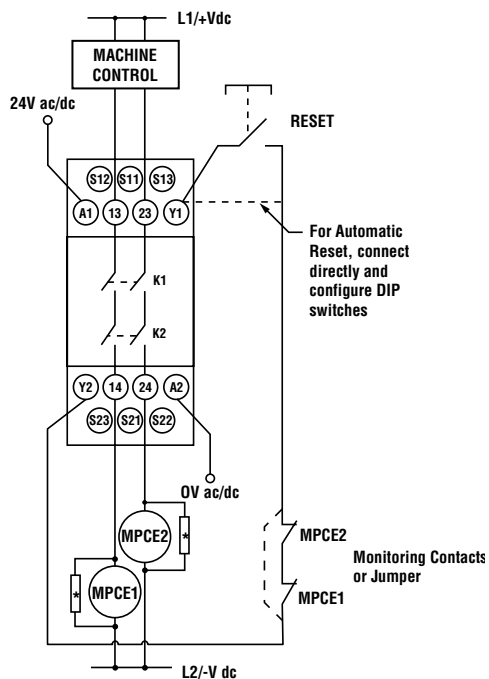


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Models

- GM-FA-10J

GM-FA-10J Terminal Locations



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

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WD038

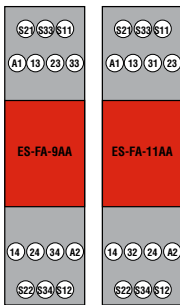


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Models

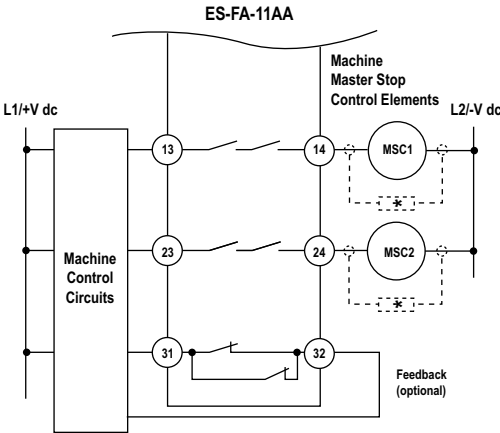
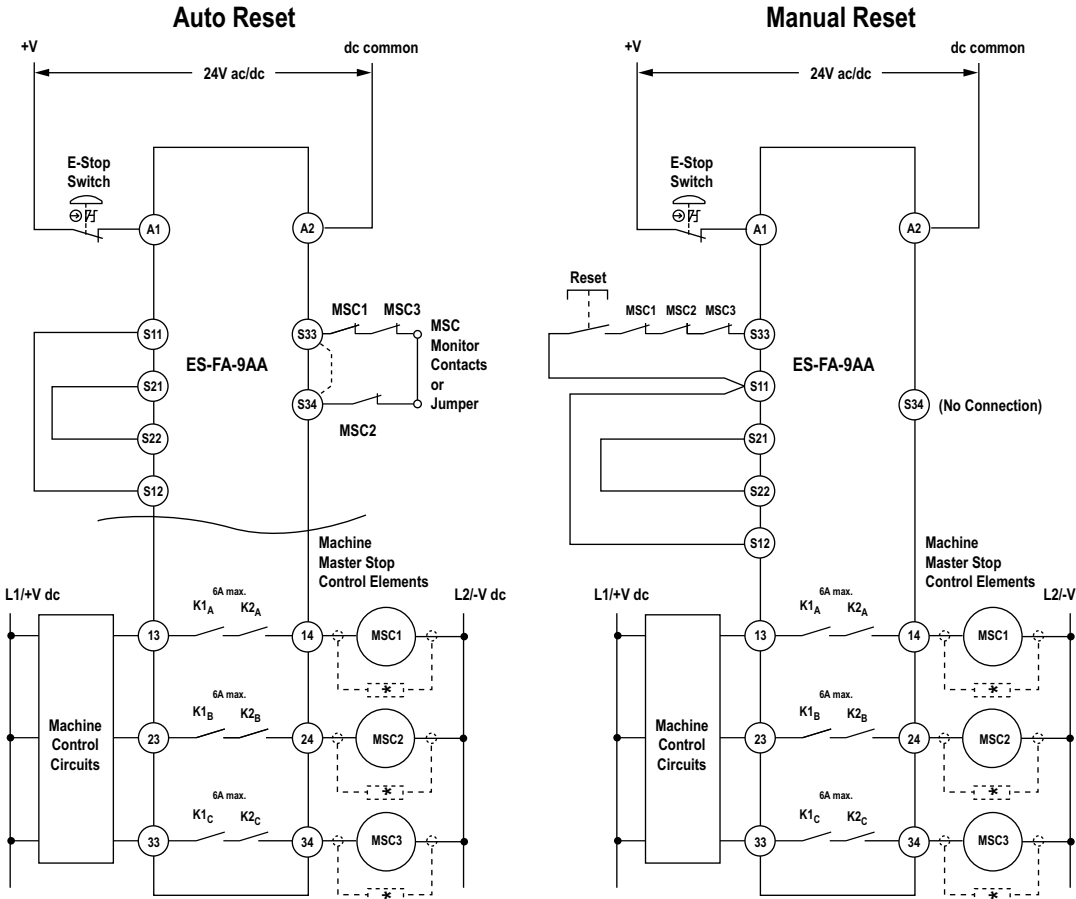
- ES-FA-9AA
- ES-FA-11AA

ES-FA-AA
Terminal Locations



ES-FA-AA E-Stop Safety Module

ES-FA-AA 1-Channel



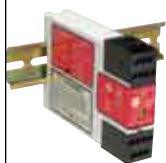
* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD039

ES-FA-...AA E-Stop Safety Module

ES-FA-...AA 2-Channel

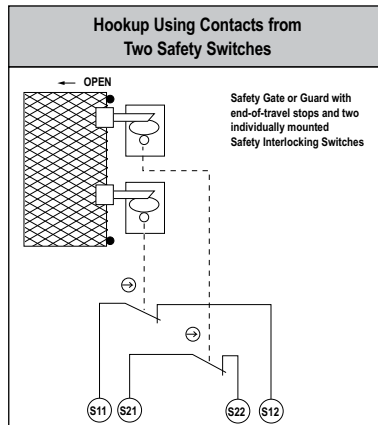
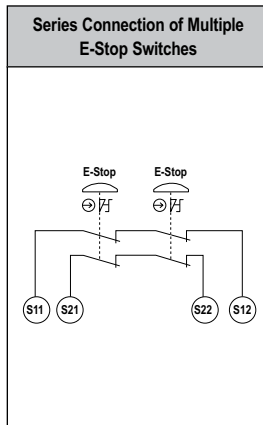
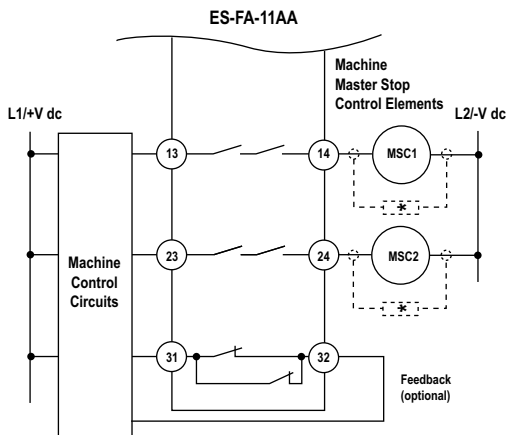
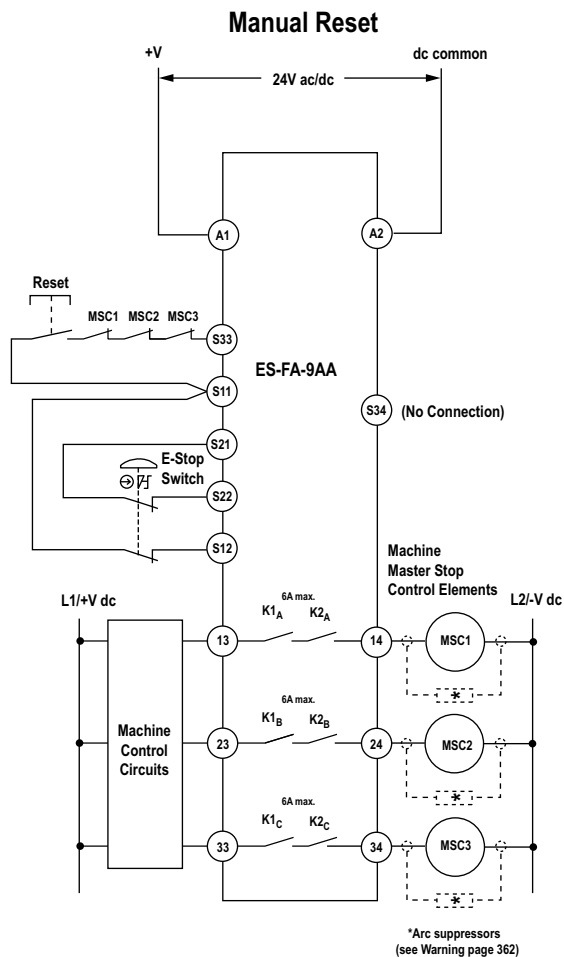
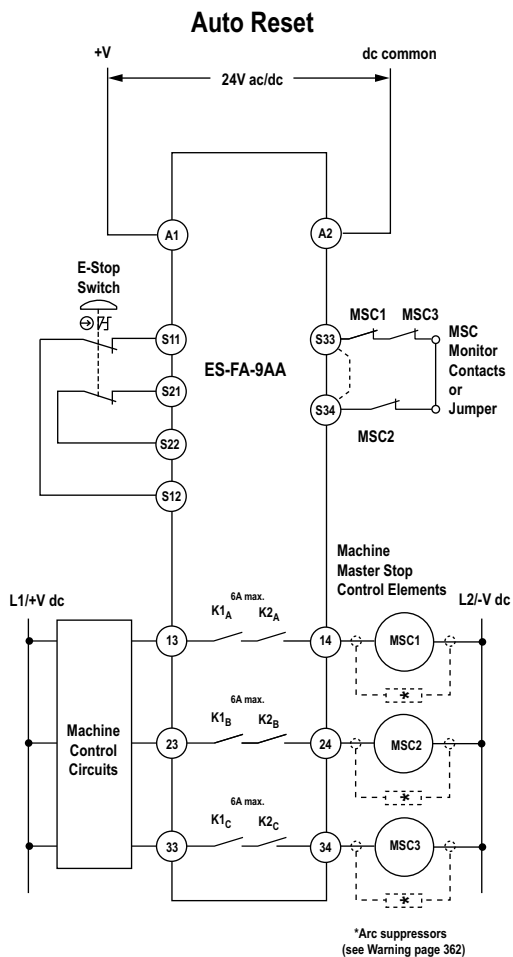
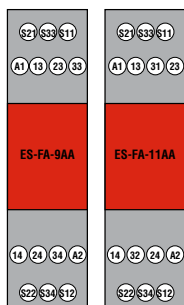


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Models

- ES-FA-9AA
- ES-FA-11AA

ES-FA-...AA
Terminal Locations



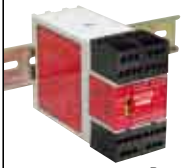
* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD040

ES...A-5 E-Stop Safety Module

ES...A-5A 1-Channel

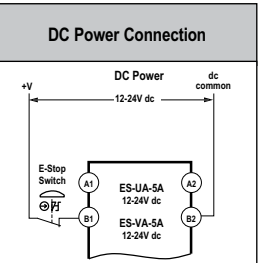
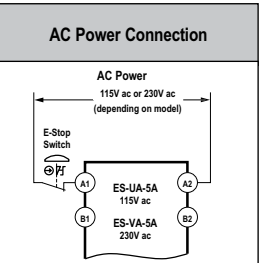
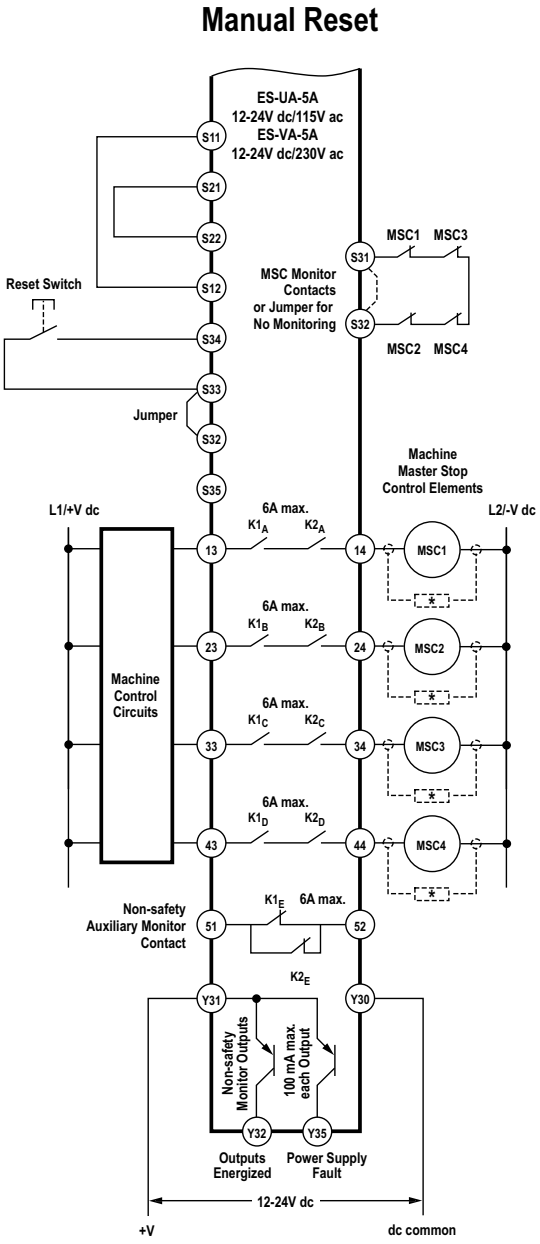
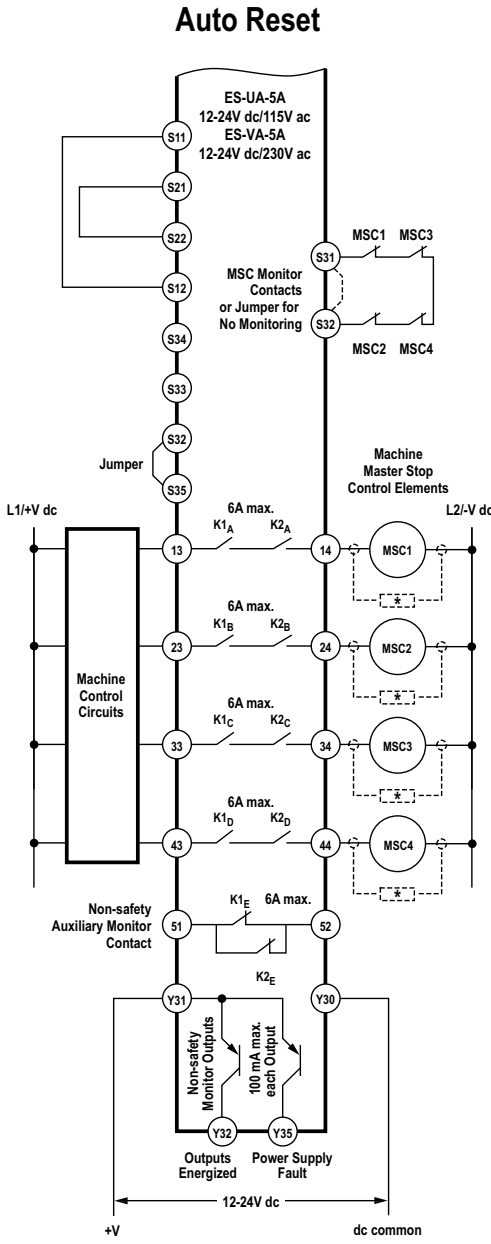
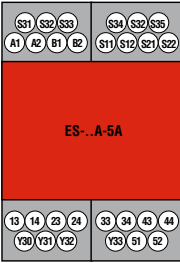


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Models

- ES-UA-5A
- ES-VA-5A

ES...A-5A
Terminal Locations



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

WD041

ES...A-5 E-Stop Safety Module

ES...A-5A 2-Channel

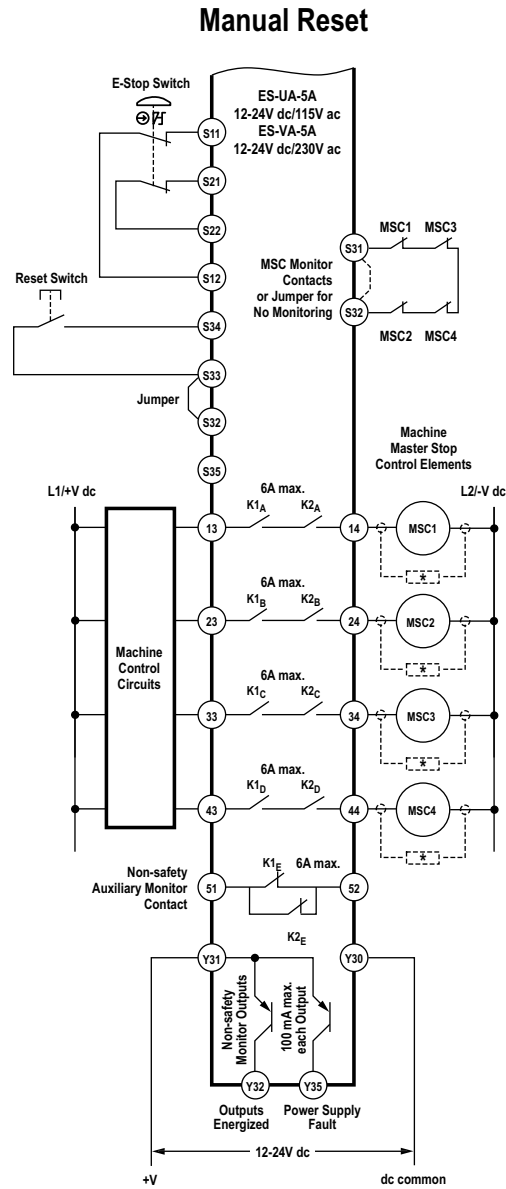
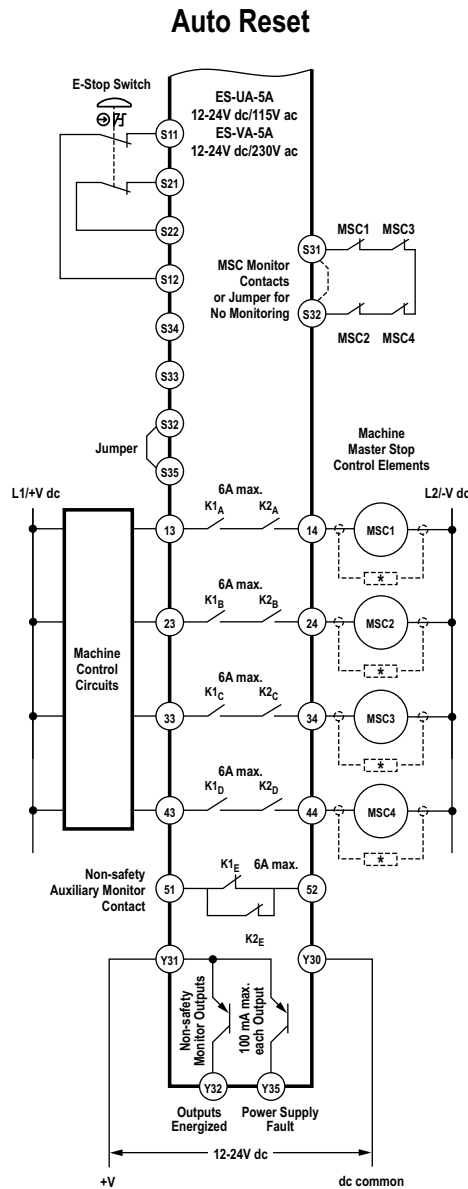
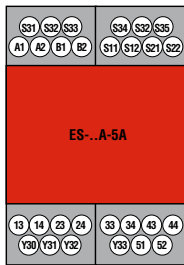


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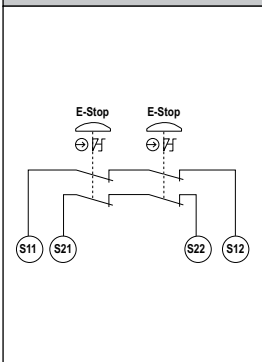
Models

- ES-UA-5A
- ES-VA-5A

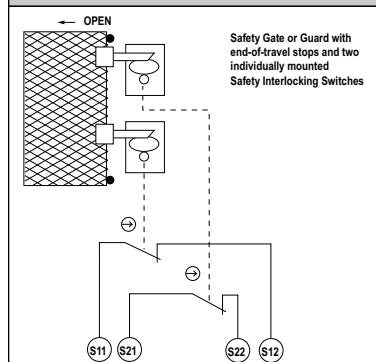
ES...A-5A
Terminal Locations



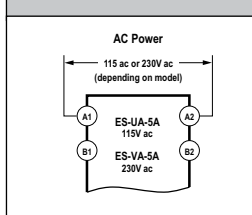
Series Connection of Multiple
E-Stop Switches



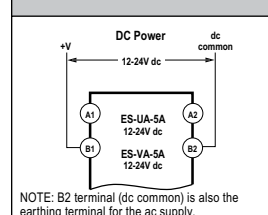
Hookup Using Contacts from
Two Safety Switches



AC Power Connection



DC Power Connection



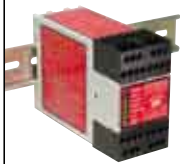
* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD042

ES-TN-1H.. E-Stop Safety Module

ES-TN-1H.. 2-Channel

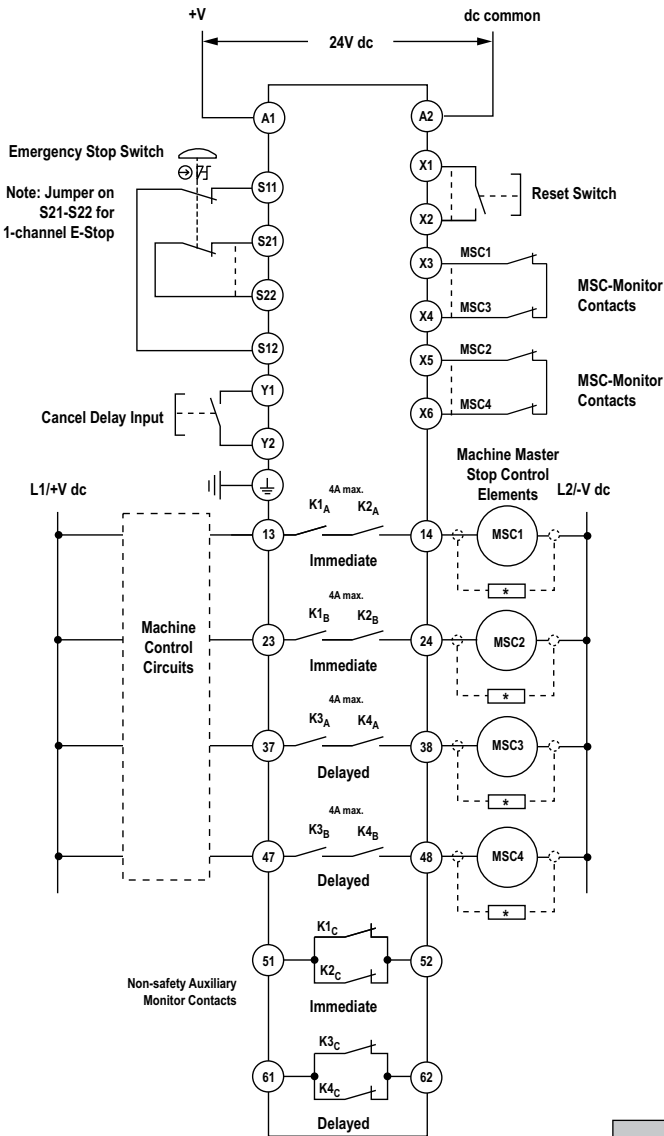
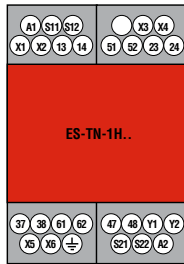


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Models

- ES-TN-1H1
- ES-TN-1H2
- ES-TN-1H3
- ES-TN-1H4
- ES-TN-1H5
- ES-TN-1H6
- ES-TN-1H7
- ES-TN-1H8
- ES-TN-1H9
- ES-TN-1H10
- ES-TN-1H11
- ES-TN-1H12

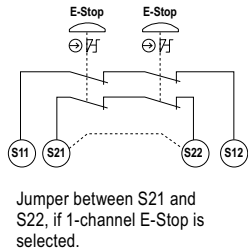
ES-TN-1H.. Terminal Locations



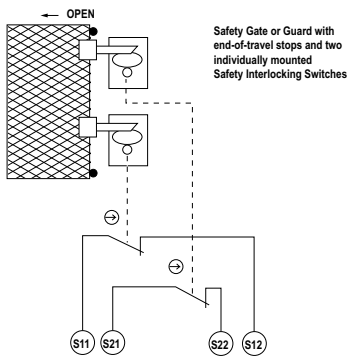
Note: Jumper on X1-X2 for Auto-reset.

Note: Jumper on X3-X4 and/or X5-X6 if no feedback contacts are monitored

Series Connection of Multiple E-Stop Switches



Hookup Using Contacts from Two Safety Switches



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

WD043

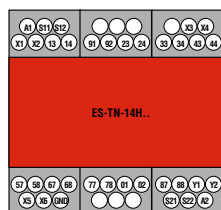


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Models

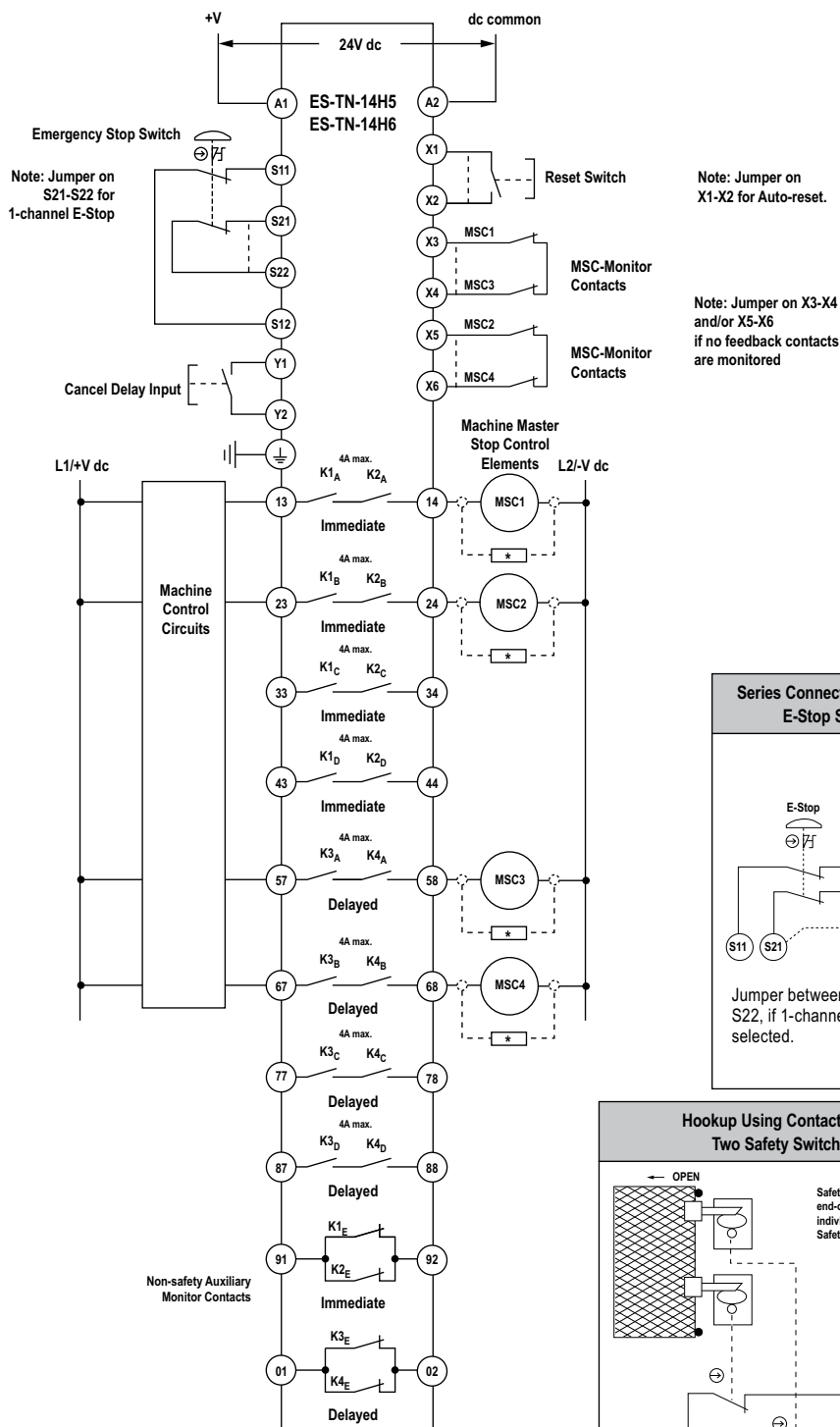
- ES-TN-14H5
- ES-TN-14H6

ES-TN-14H.
Terminal Locations

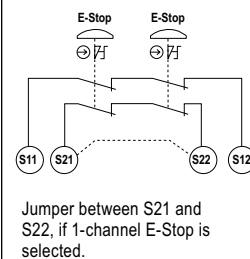


ES-TN-14.. E-Stop Safety Module

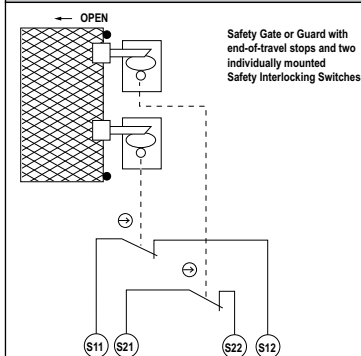
ES-TN-14H.. 2-Channel



Series Connection of Multiple E-Stop Switches



Hookup Using Contacts from Two Safety Switches



* Arc Suppressors. See manual for specific warnings.

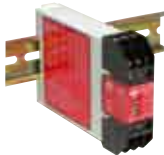


Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

WD044

ES-FA-6G E-Stop Safety Module

ES-FA-6G 1-Channel

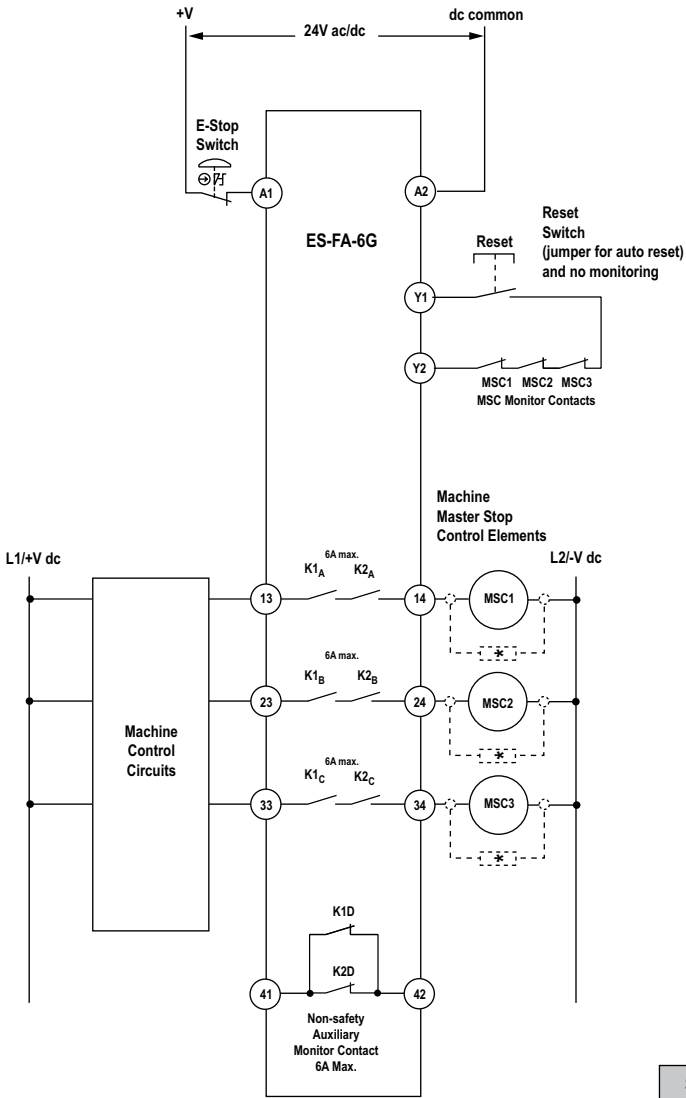


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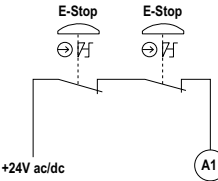
Models

• ES-FA-6G

ES-FA-6G
Terminal Locations



Series Connection of Multiple
E-Stop Switches



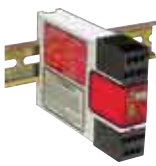
Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

WD045

UM-A... Universal Safety Module

UM-FA-..A Hard Contact, 2-Channel



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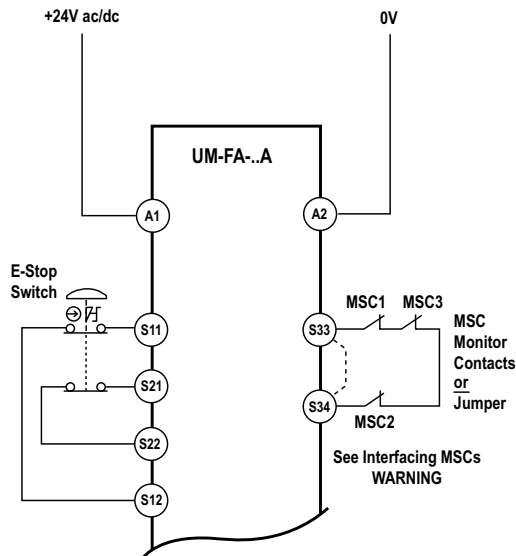
Models

- UM-FA-9A
- UM-FA-11A

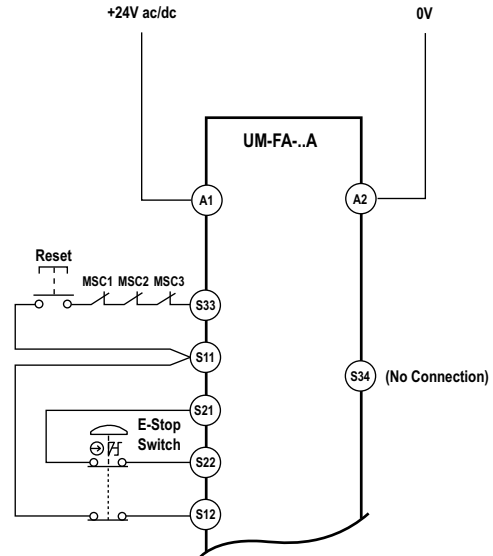
UM-FA-..A
Terminal Locations



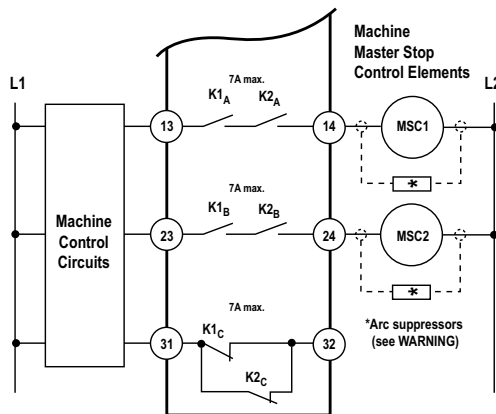
Auto Reset



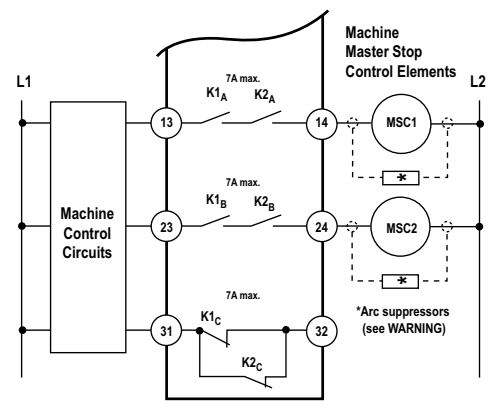
Manual Reset



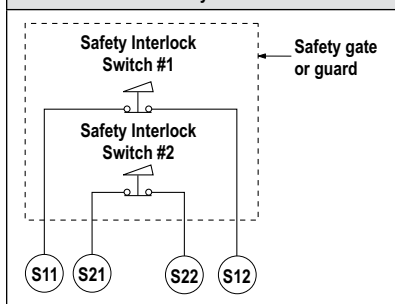
UM-FA-9A Machine Connection



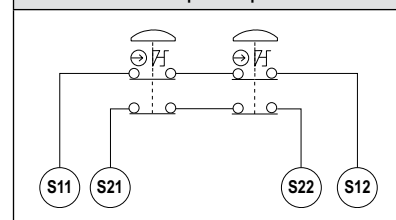
UM-FA-11A Machine Connection



Two Safety Switches



Multiple E-stops



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD046



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Models

- UM-FA-9A
- UM-FA-11A

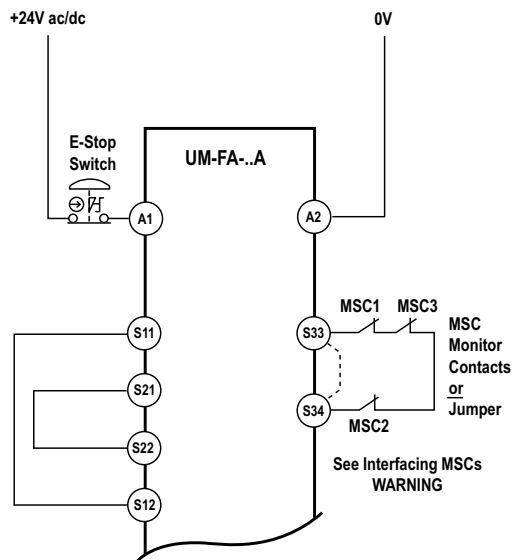
UM-FA-...A
Terminal Locations



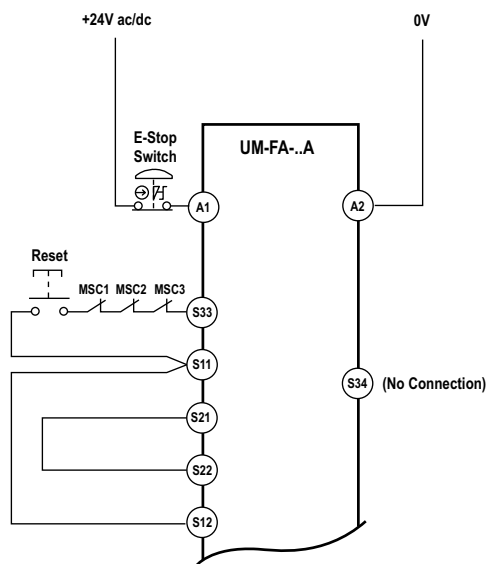
UM-FA-...A Universal Safety Module

UM-FA-...A Hard Contact, 1-Channel

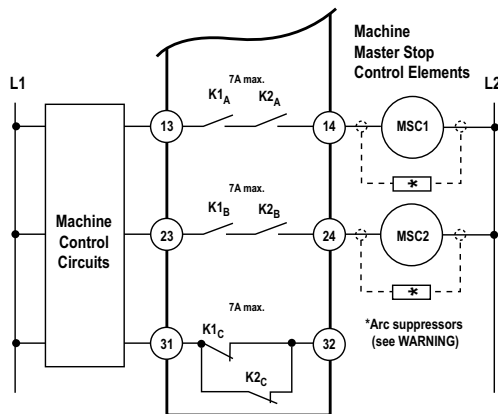
Auto Reset



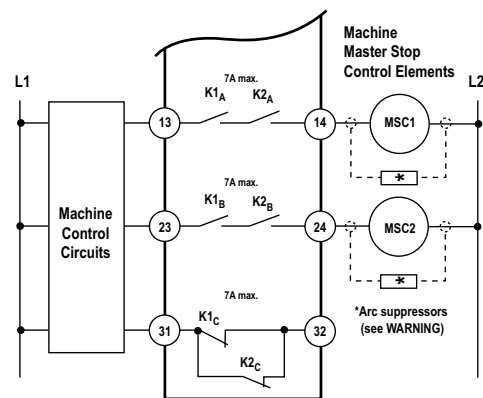
Manual Reset



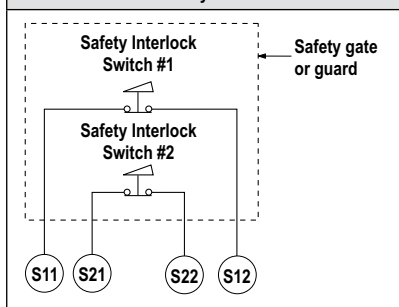
UM-FA-9A Machine Connection



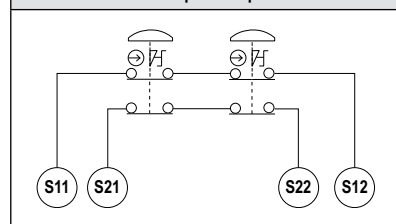
UM-FA-11A Machine Connection



Two Safety Switches



Multiple E-stops



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

* Arc Suppressors. See manual for specific warnings.

WD047



Page 89

Models

- UM-FA-9A
- UM-FA-11A

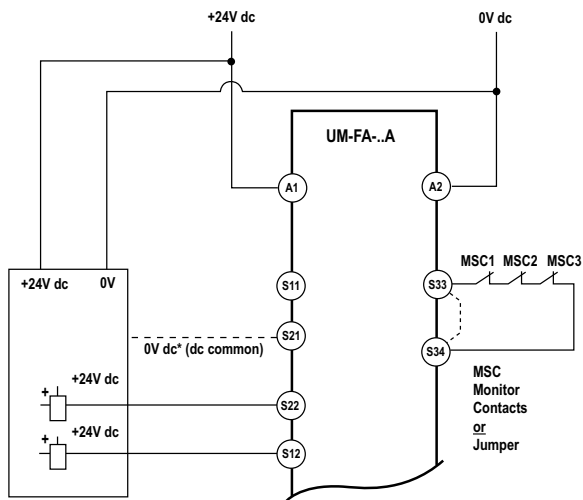
UM-FA-...A Terminal Locations



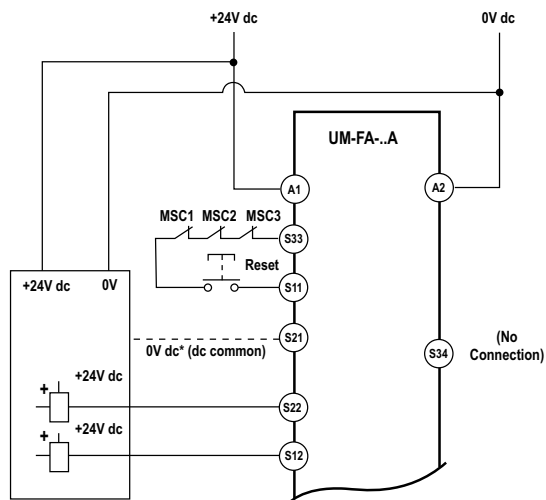
UM-FA-...A Universal Safety Module

UM-FA-...A Solid-State, 2 channel

Auto Reset

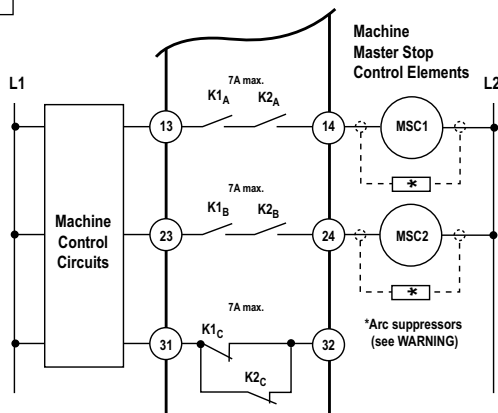


Manual Reset

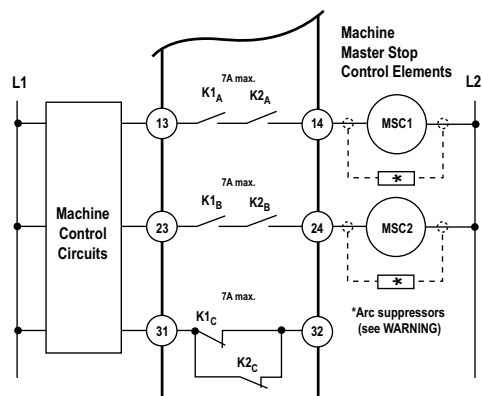


* S21 must be connected to 24V dc output common only in 24V ac supply applications.

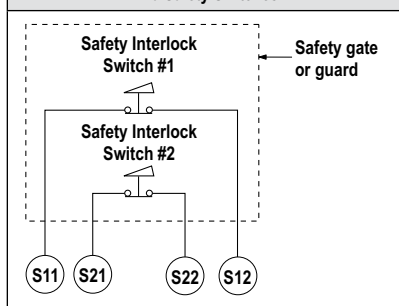
UM-FA-9A Machine Connection



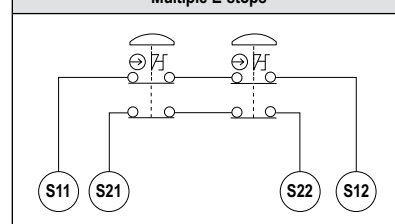
UM-FA-11A Machine Connection



Two Safety Switches



Multiple E-stops



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

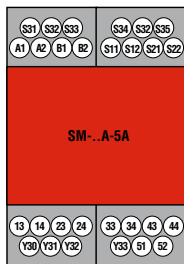


Page 91

Models

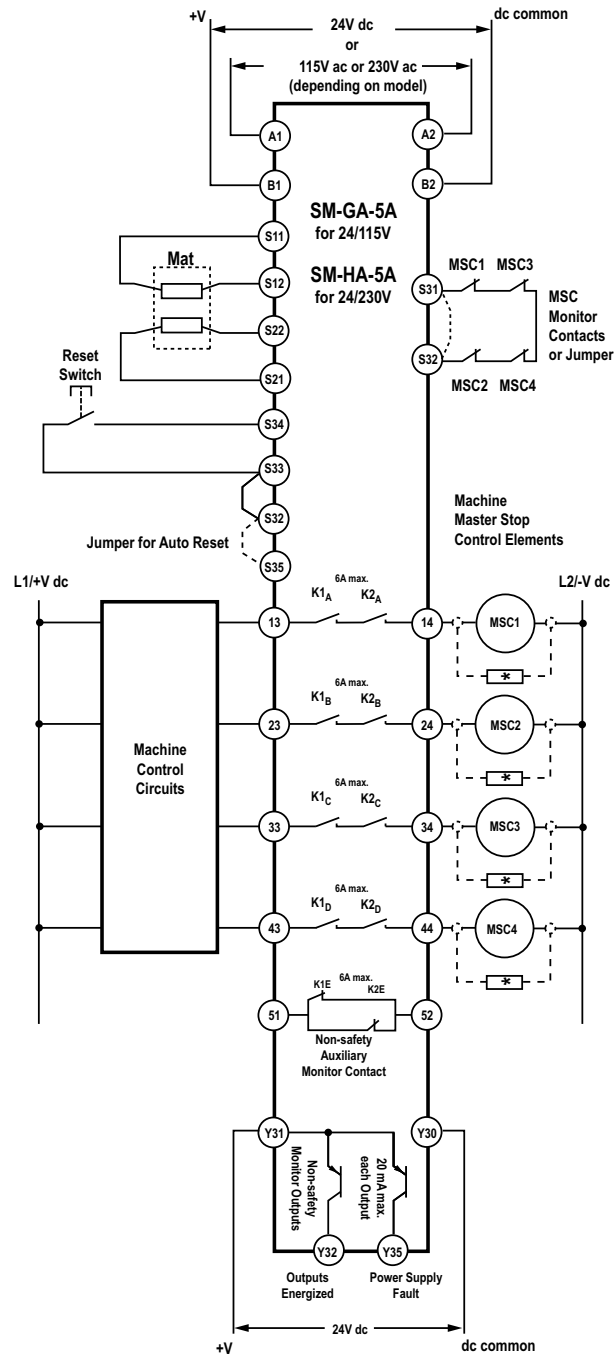
- SM-GA-5A
- SM-HA-5A

SM-..A-5A
Terminal Locations

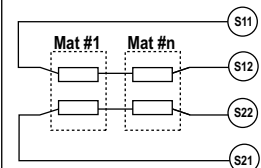


SM-...A-5A Safety Mat Monitoring Module

SM-...A-5A to 4-Wire Safety Mat



Series Connection of Multiple E-Stop Switches



NOTE: The number of mats is limited by the total series resistance per input channel.



Wiring diagrams are for information only. See appropriate manuals for warnings, cautions and instructions for use.

* Arc Suppressors. See manual for specific warnings.

WD049



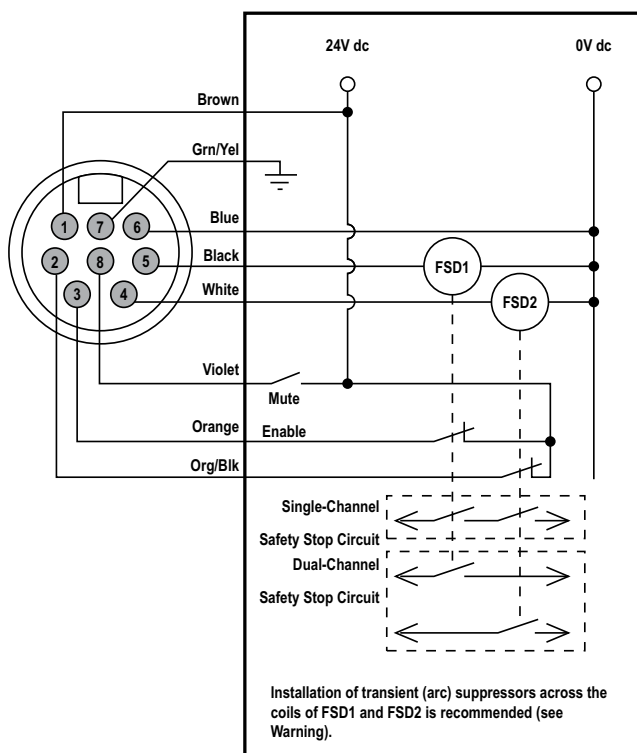
Page 94

Models

- MM-TA-12B
- MM2-TA-12B

MM-TA-12B and MM2-TA-12B Muting Modules

2 FSDs, 2-Channel EDM, Mute Enable



WD051



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Models

- MMD-TA-12B

MMD-TA-12B
Terminal Locations

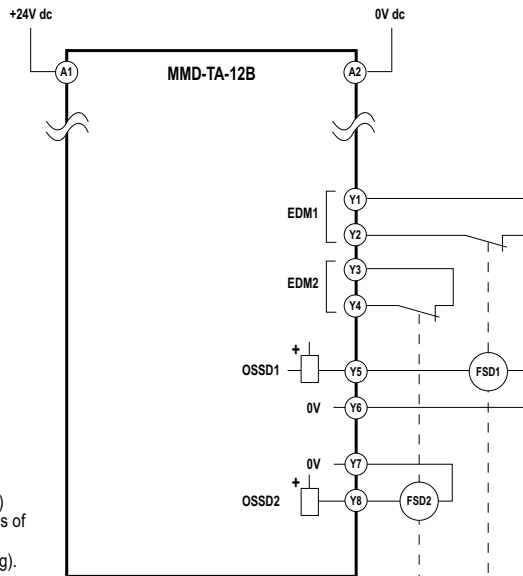
A1	X1	A2	Z11	M1	Z11	Z12	M2	Z22			
S11	S12	S21	S22	X5	X6	X7	X8	X9	X10	X11	X12

MMD-TA-12B

Y1	Y2	Y3	Y4	X3	X4	Z31	Z34	Y5	Y6	Y7	Y8
Z23	M3	Z13	Z14	M4	Z24	Z13	X14	A2			

MMD-TA-12B DIN-Rail Muting Module

Solid-State Output, 2 FSDs and 2-Channel EDM



Installation of transient (arc) suppressors across the coils of FSD1 and FSD2 is recommended (see Warning).

NOTE: Do not exceed OSSD maximum load capacitance specifications.

Single-Channel Safety Stop Circuit

Dual-Channel Safety Stop Circuit

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD052



Page 94

Models

- MMD-TA-11B

MMD-TA-11B
Terminal Locations

A1	X1	A2	Z11	M1	Z11	Z12	M2	Z22			
S11	S12	S21	S22	X5	X6	X7	X8	X9	X10	X11	X12

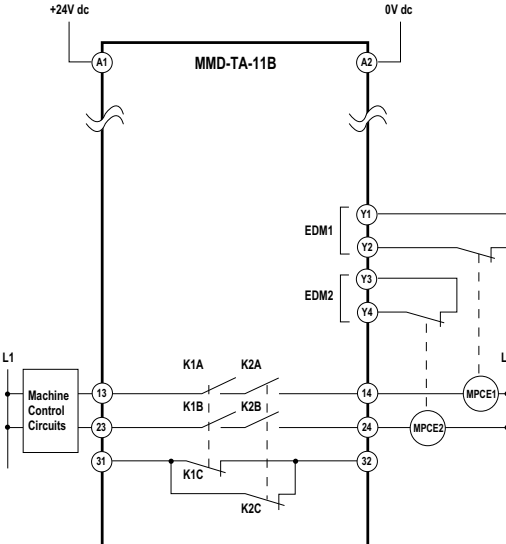
MMD-TA-11B

Y1	Y2	Y3	Y4	X3	X4	Z31	Z34	Y5	Y6	Y7	Y8
Z23	M3	Z13	Z14	M4	Z24	Z13	X14	A2			

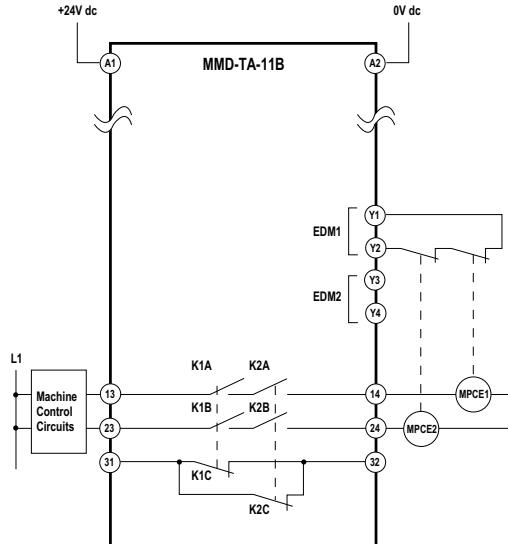
MMD-TA-11B DIN-Rail Muting Module

Relay Outputs

2-Channel EDM



1-Channel EDM



Installation of transient (arc) suppressors recommended across MPCE1 and MPCE2.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD053

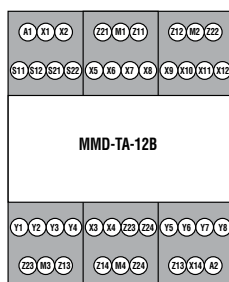


Page 94

Models

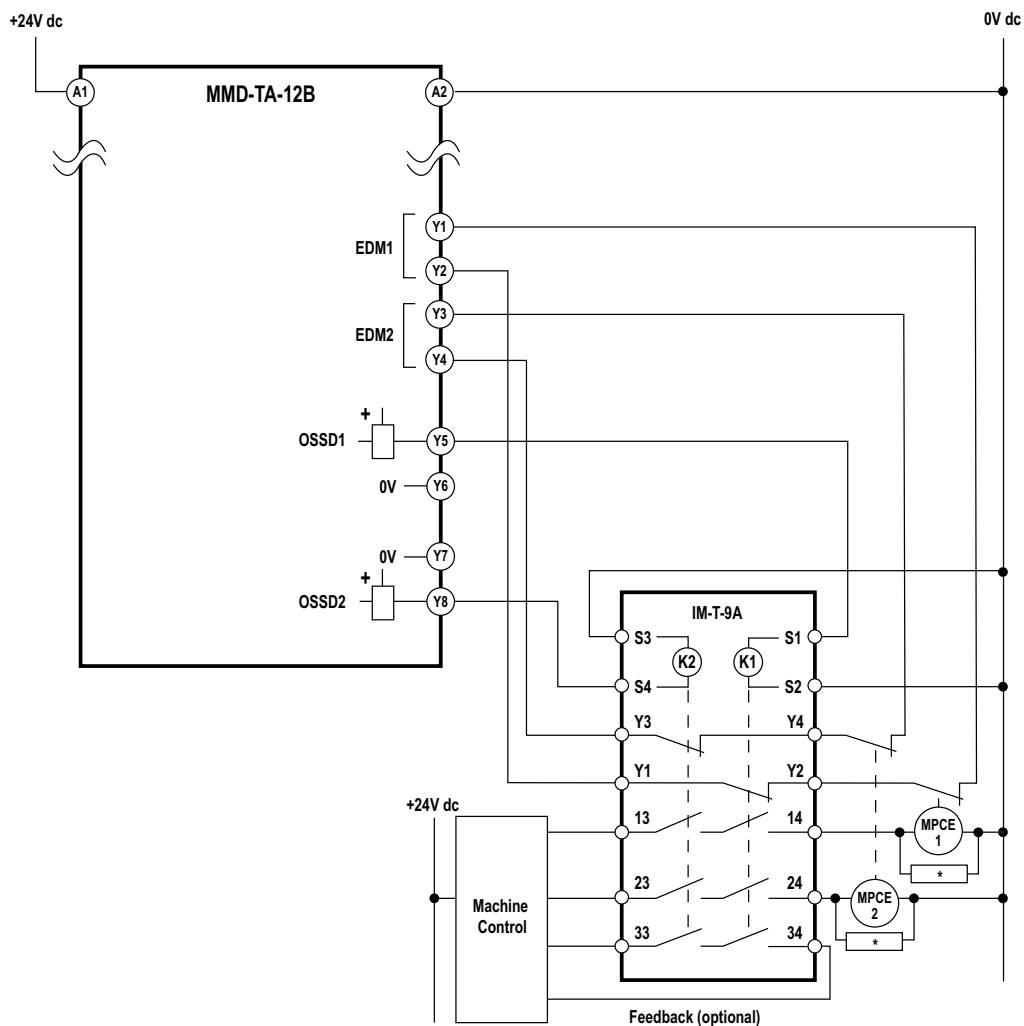
- MMD-TA-12B

MMD-TA-12B Terminal Locations



MMD-TA-12B DIN-Rail Muting Module

2-Channel EDM with Interface Model



* Arc Suppressors. See manual for specific warnings.

! Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

iKNOW®

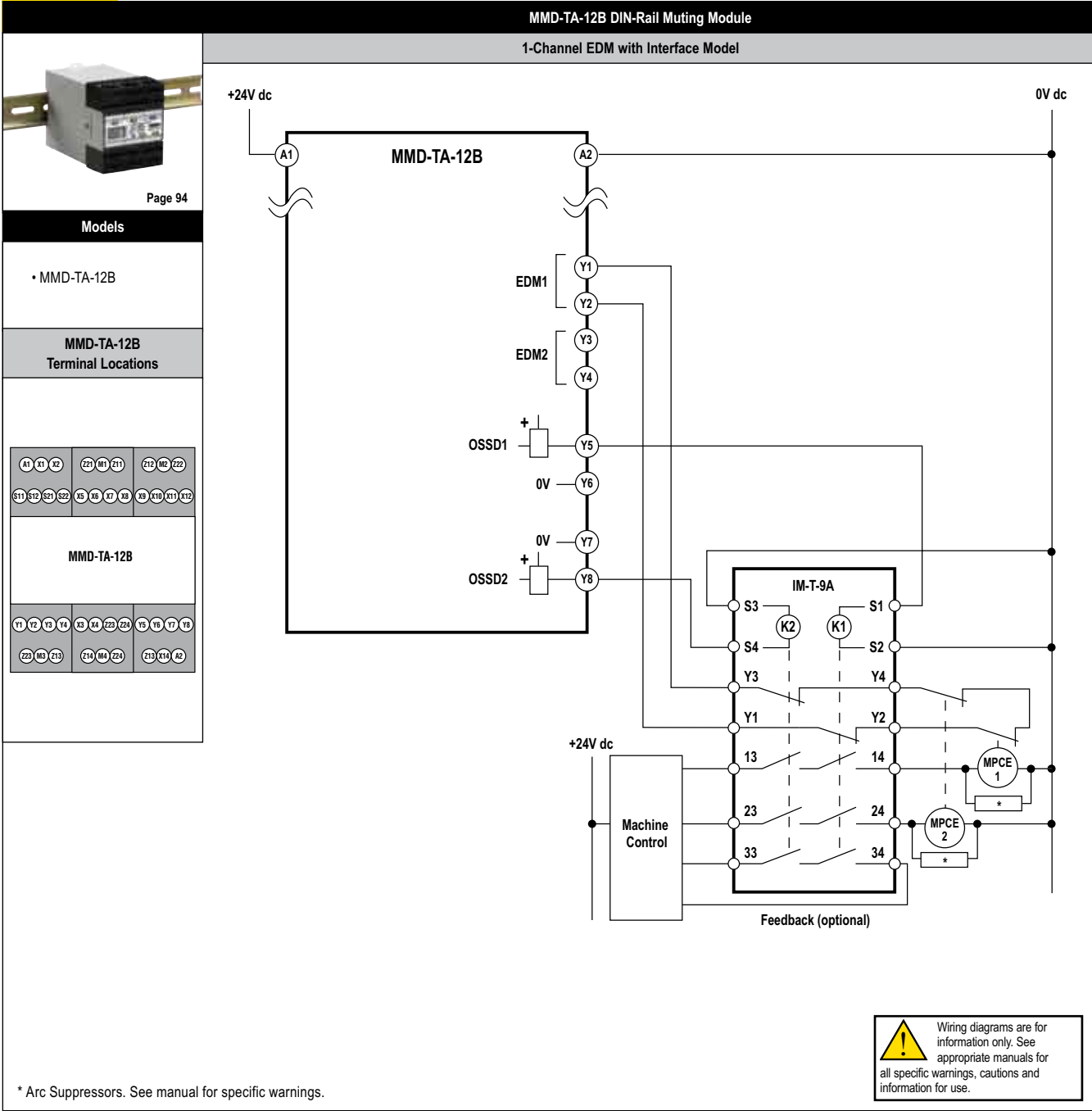
CONTACT/SWITCHING
DIAGRAMS

HOOKUP
DIAGRAMS

GLOSSARY

INTERNATIONAL
REPRESENTATIVES

WD054



* Arc Suppressors. See manual for specific warnings.

WD055

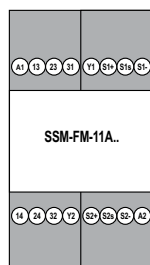


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Models

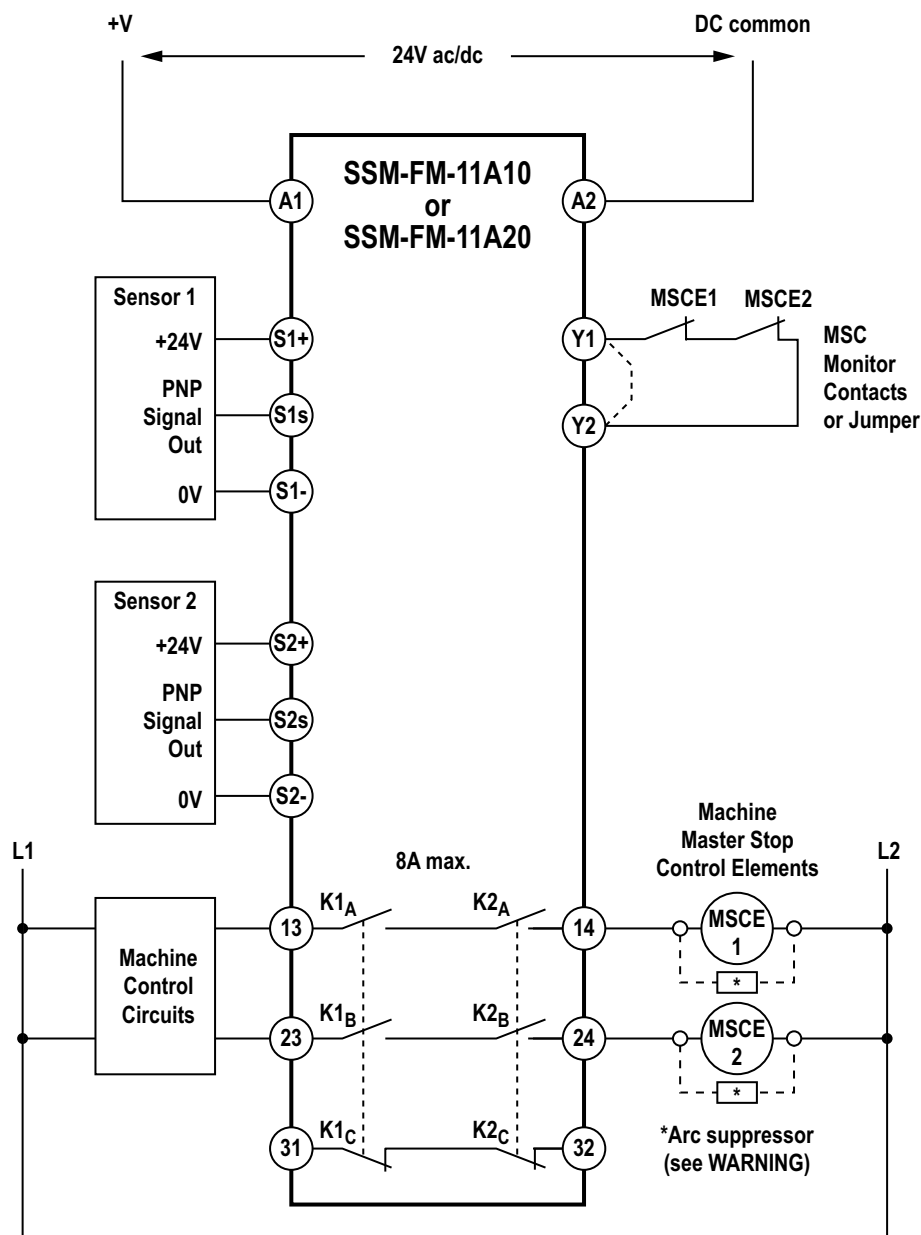
- SSM-FM-11A10
- SSM-FM-11A20

SSM-FM-11A.. Terminal Locations



SSM Safe Speed Monitor Module

SSM-FM-11.. to Two PNP Sensors



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD056



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Models

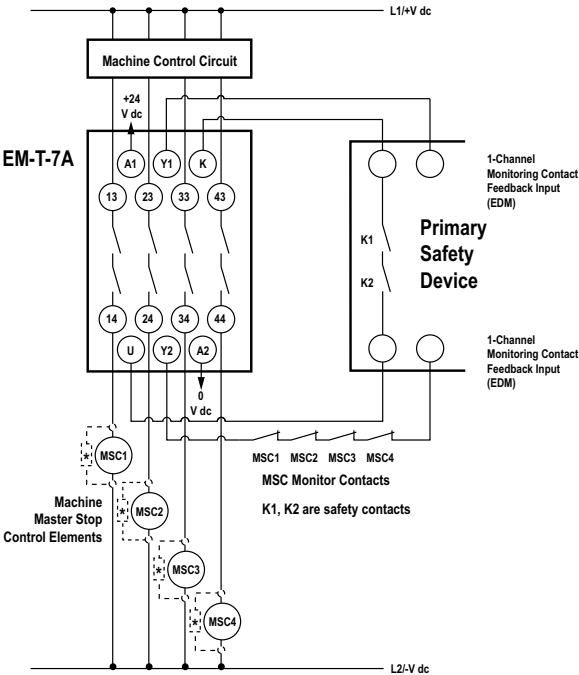
• EM-T-7A

EM-T-7A
Terminal Locations



EM-T-7A Extension Module

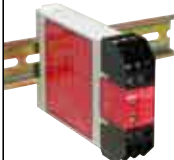
EM-T-7A 1-Channel EDM



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD057



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Models

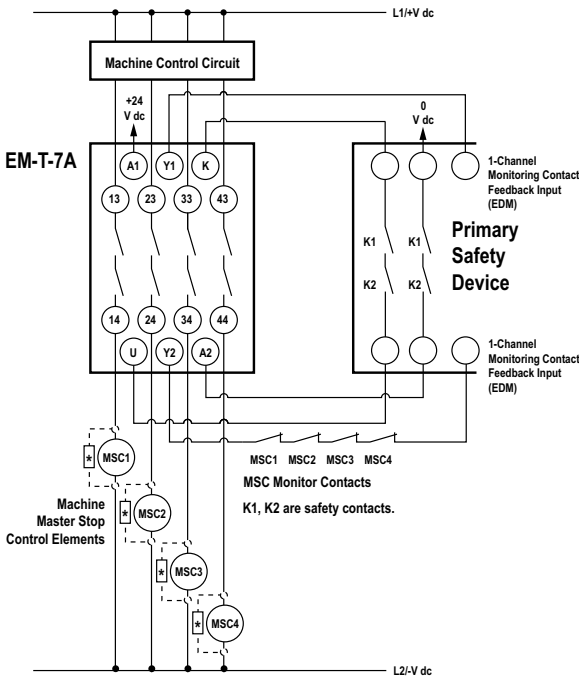
• EM-T-7A

EM-T-7A
Terminal Locations



EM-T-7A Extension Module

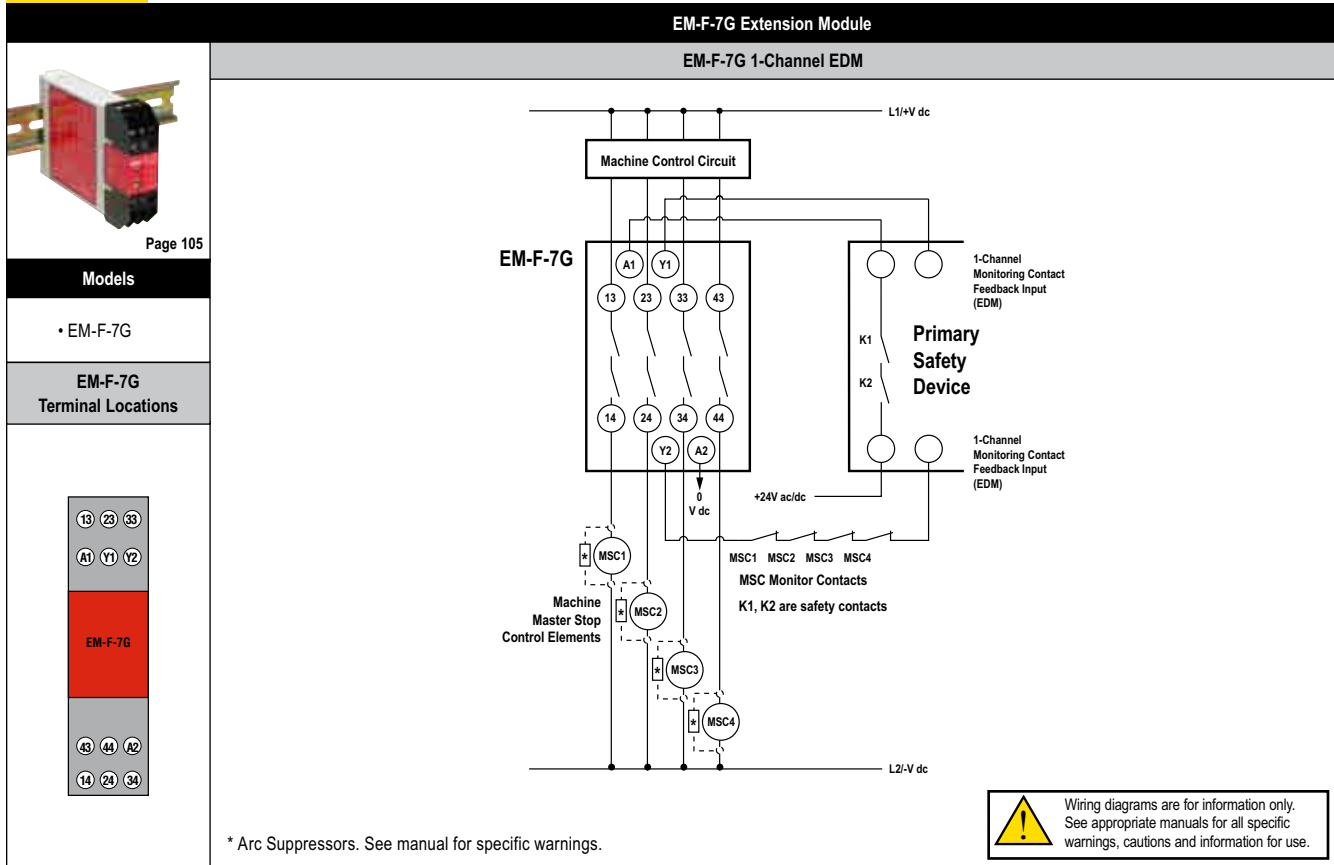
EM-T-7A 2-Channel EDM



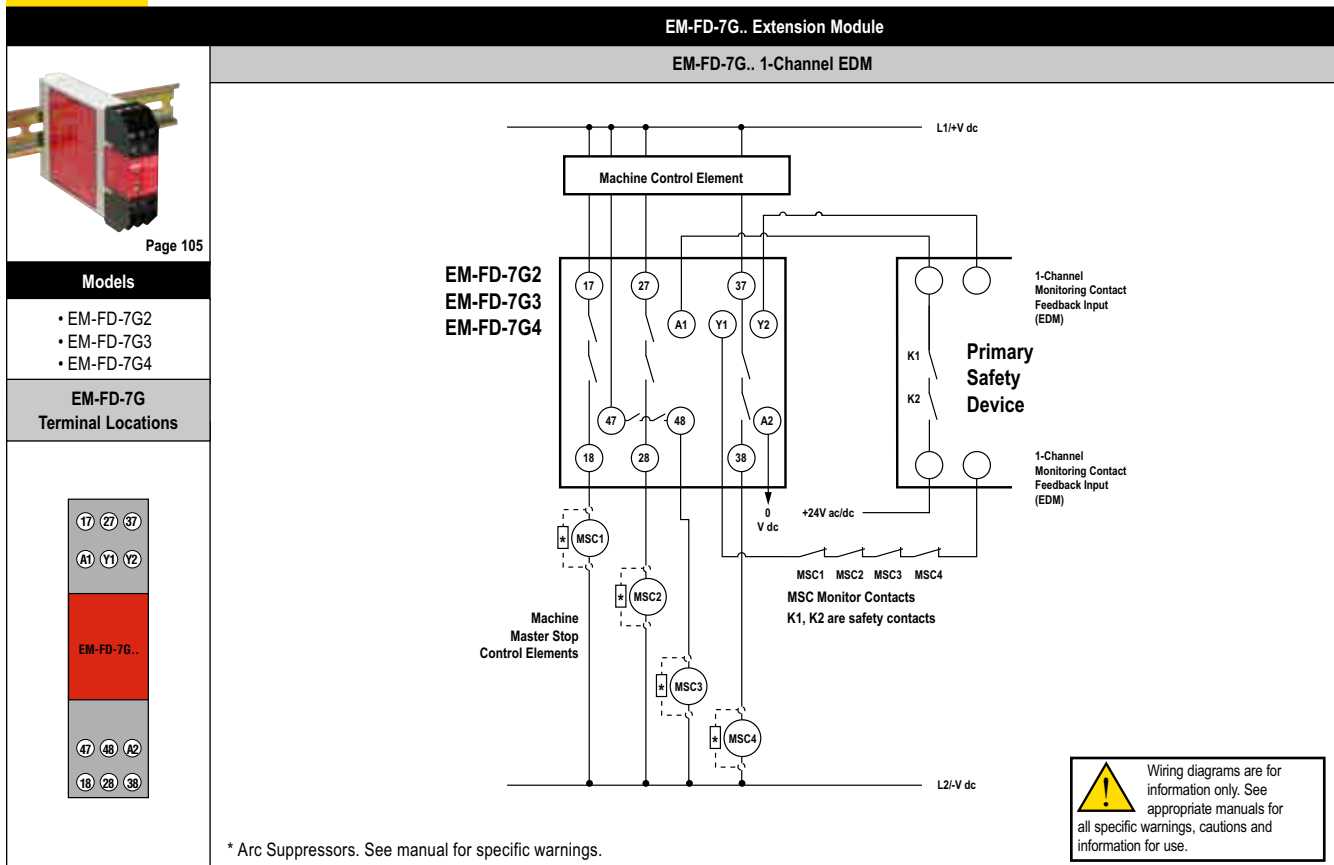
* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

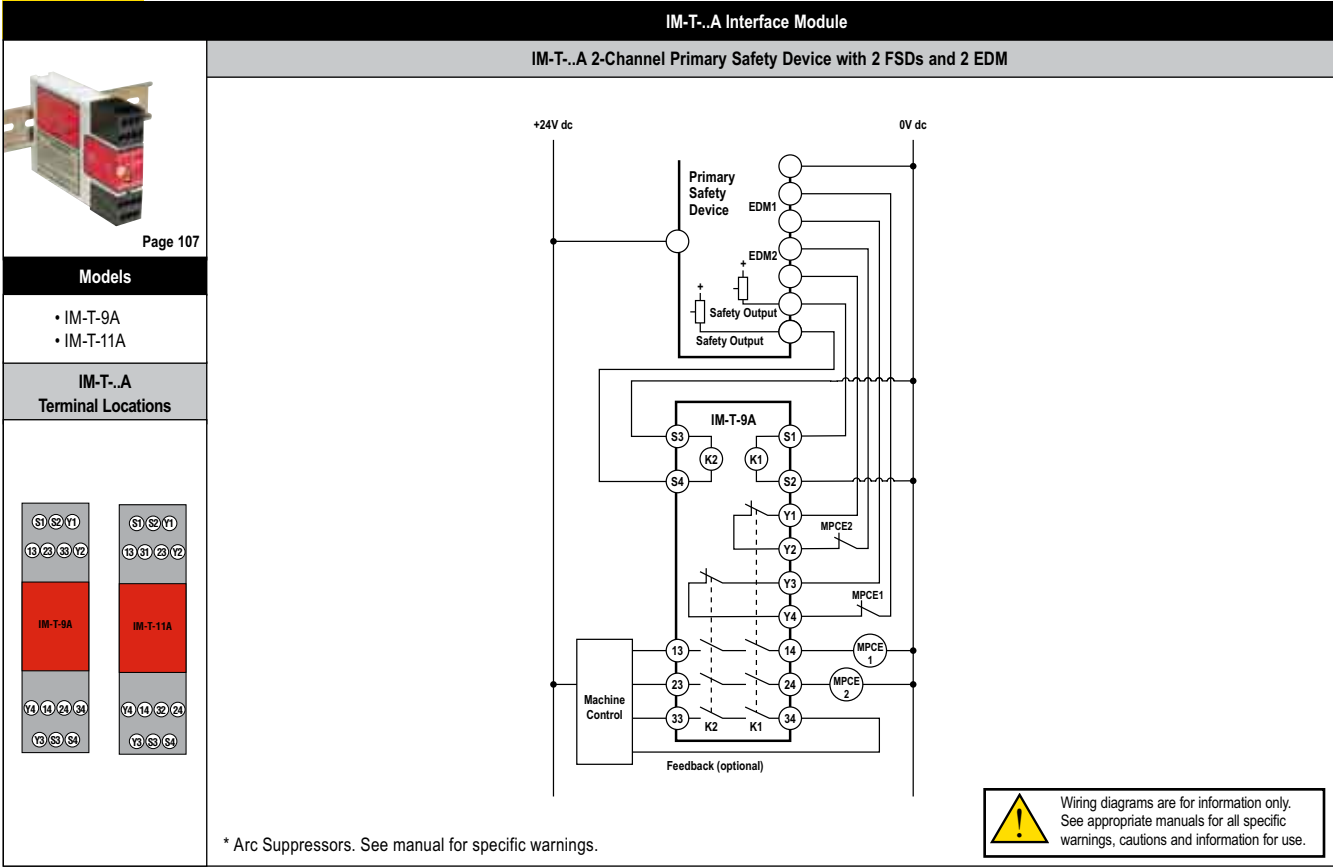
WD058



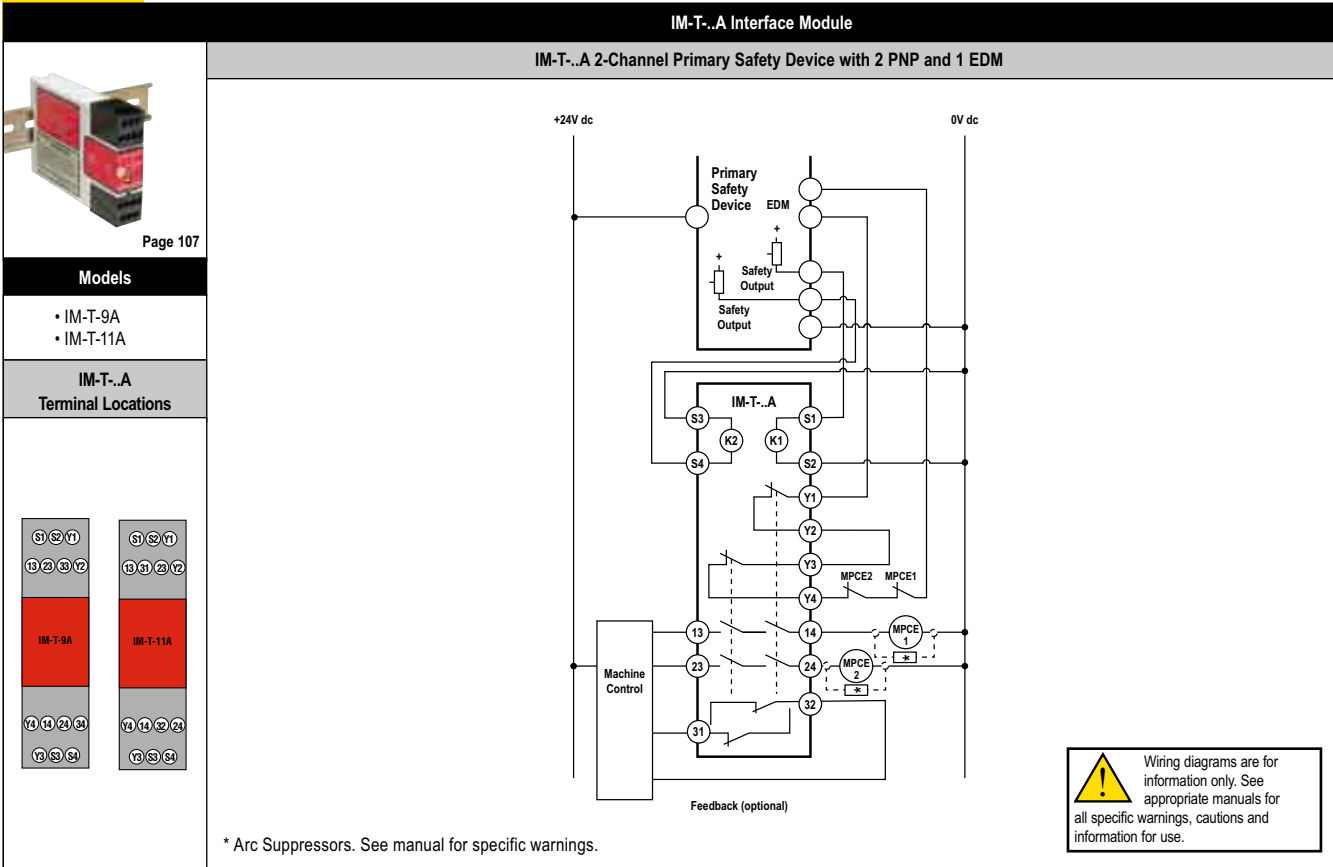
WD059



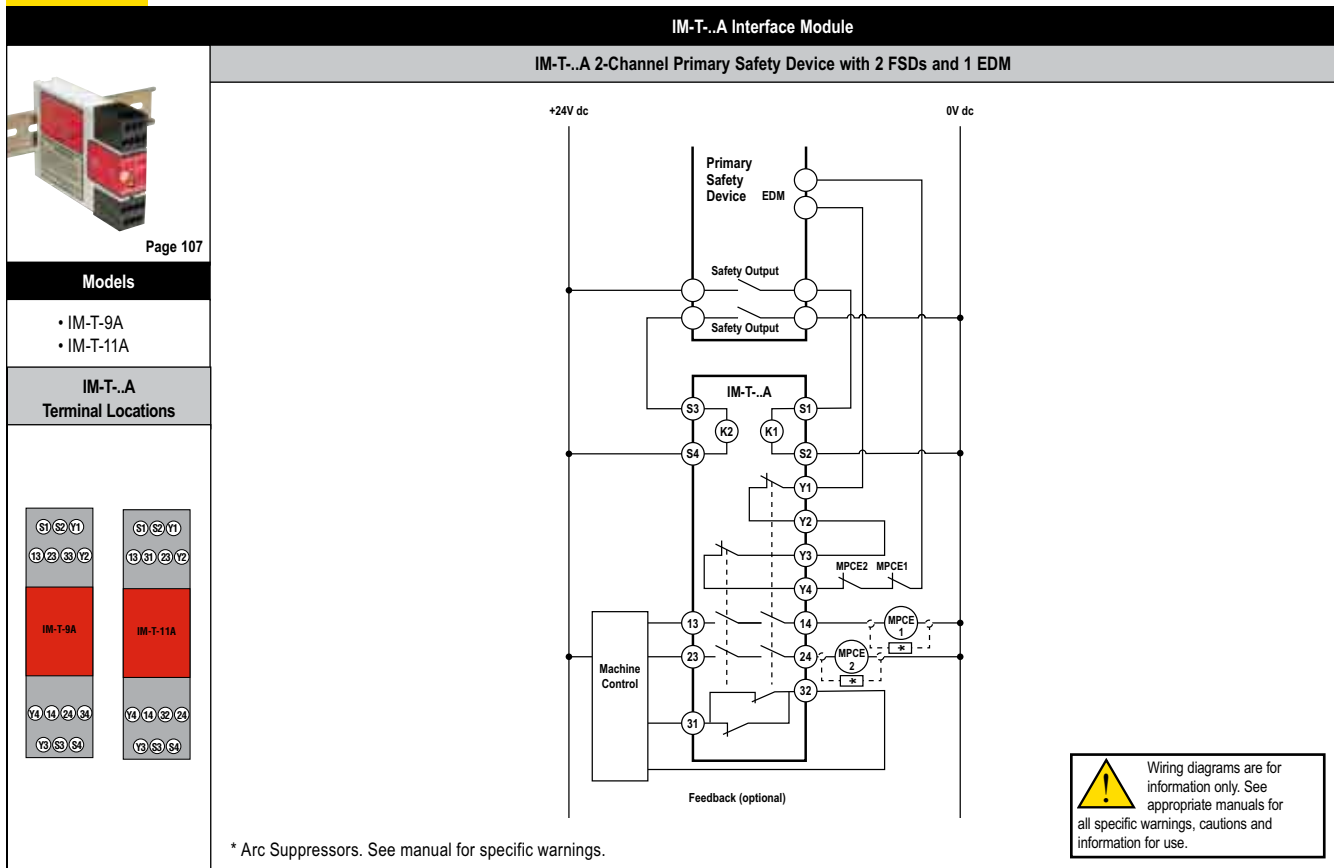
WD060



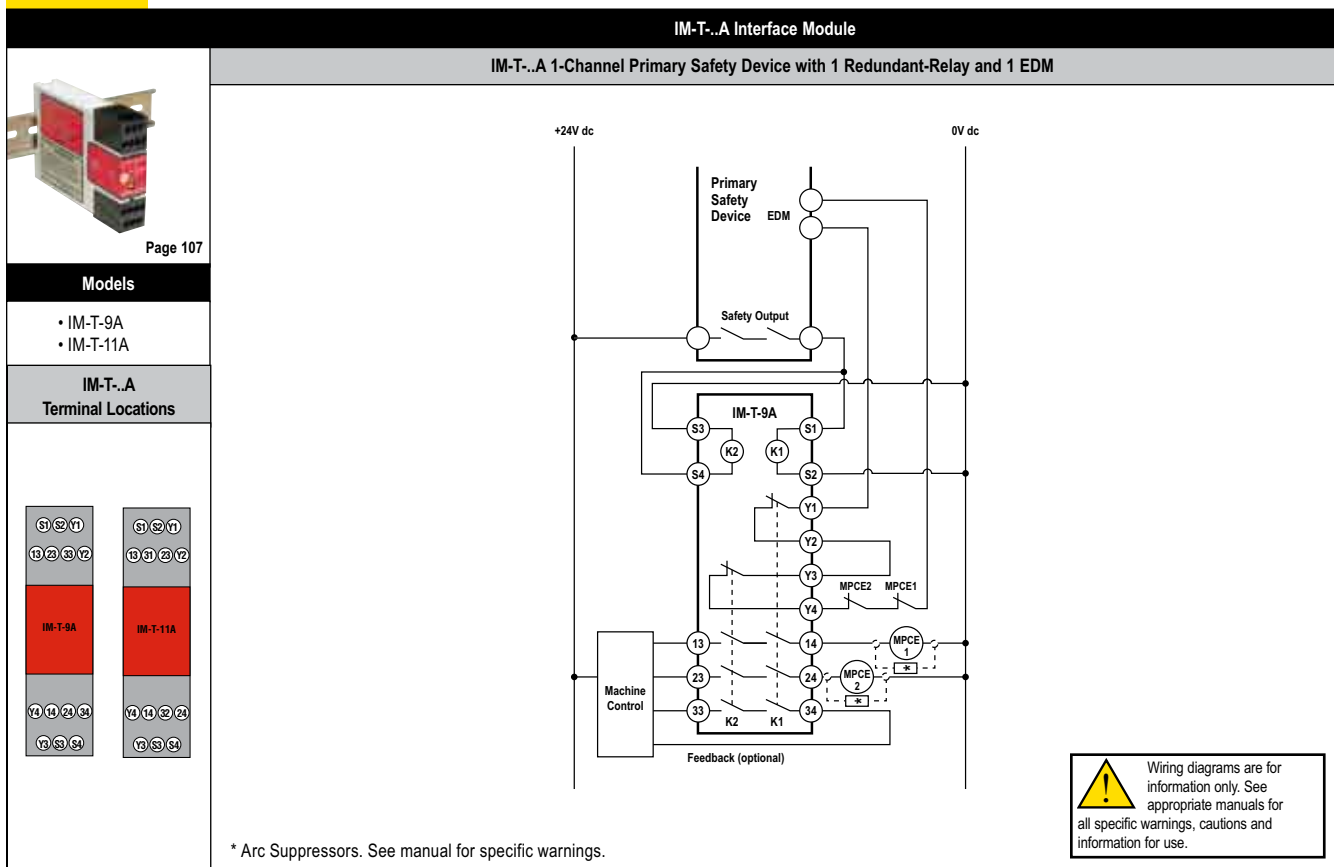
WD061



WD062



WD063



WD064

DUO-TOUCH® SG Two-Hand Control Modules, STB Compatible

AT-FM-10K to Two STB Touch Buttons with Contact Outputs

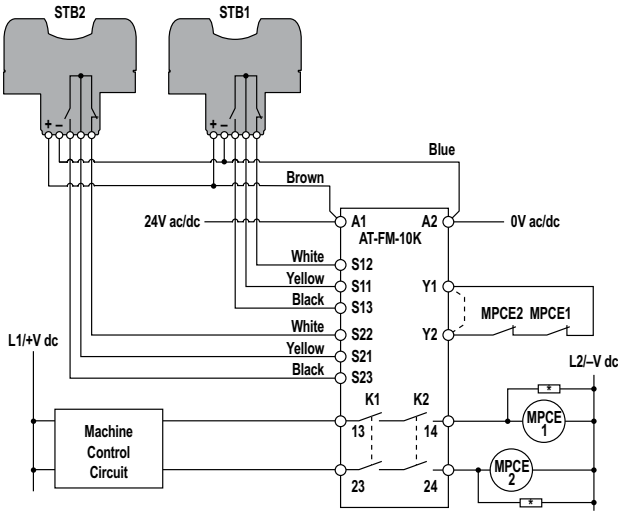


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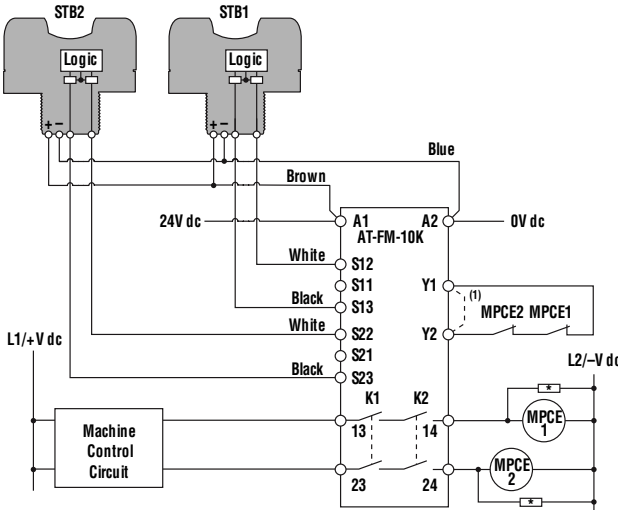
Models

• AT-FM-10K

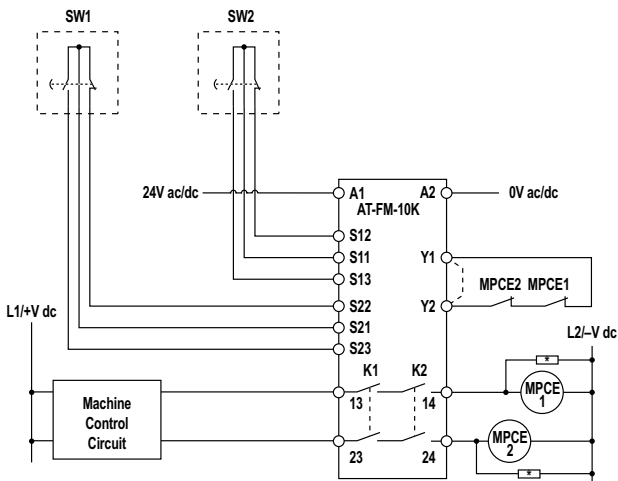
AT-FM-10K
Terminal Locations



AT-FM-10K to Two STB Touch Buttons with PNP (Sourcing) Outputs



AT-FM-10K to Two Mechanical Push Buttons with Contact Outputs



* Arc Suppressors. See manual for specific warnings.

WD065

STB Self-Checking Touch Buttons

Solid-State Sourcing (PNP) Outputs



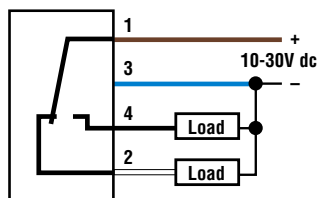
Page 117

Models

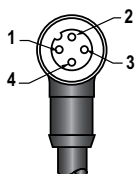
• STBVP6.. models

Key

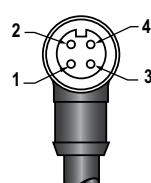
1 = Brown
2 = White
3 = Blue
4 = Black



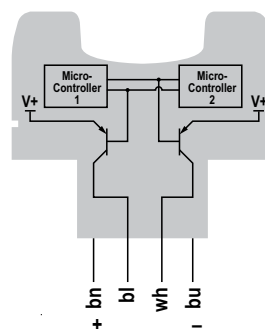
4-Pin Euro



4-Pin Mini



Solid-State
10-30V dc



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

WD066

STB Self-Checking Touch Buttons

Electromechanical Relay Output



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Models

• STBVR81.. models

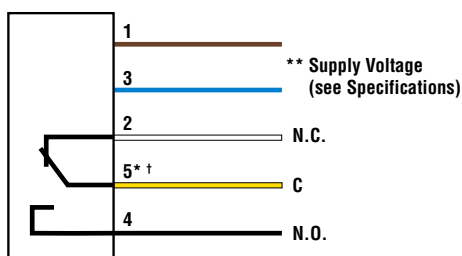
Key

5-Pin Euro

1 = Brown
2 = White
3 = Blue
4 = Black
5 = Gray†

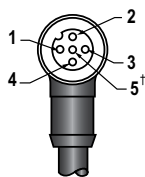
5-Pin Mini

1 = Brown
2 = White
3 = Blue
4 = Black
5 = Yellow*

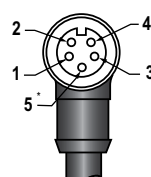


** NOTE: Connection of dc power is without regard to polarity.

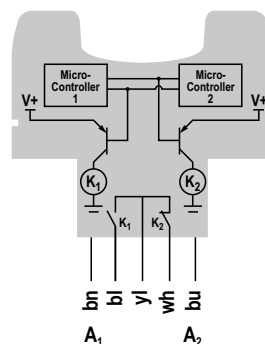
5-Pin Euro



5-Pin Mini



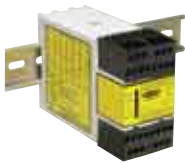
Relay
20-30V ac/dc



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

WD067

DUO-TOUCH® SG Two-Hand Control Modules, STB Compatible



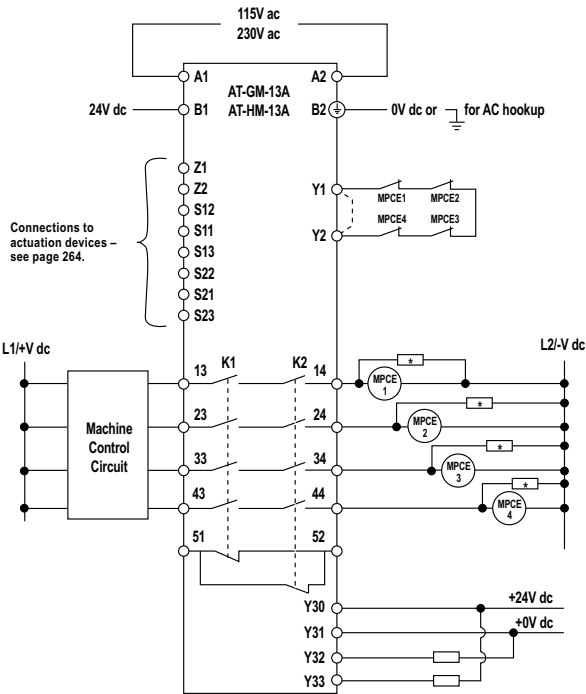
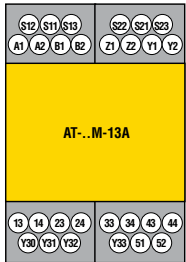
Page 111

Models

- AT-GM-13A
- AT-HM-13A

AT-M-13A

Terminal Locations



* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD068

DUO-TOUCH® SG Two-Hand Control Modules, STB Compatible



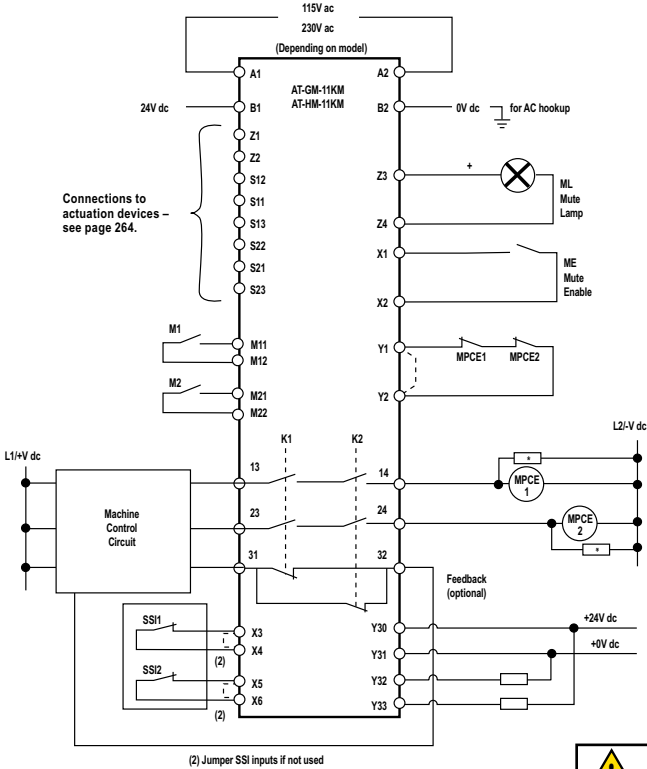
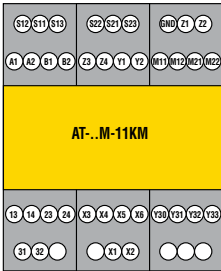
Page 111

Models

- AT-GM-11KM
- AT-HM-11KM

AT-M-10K

Terminal Locations



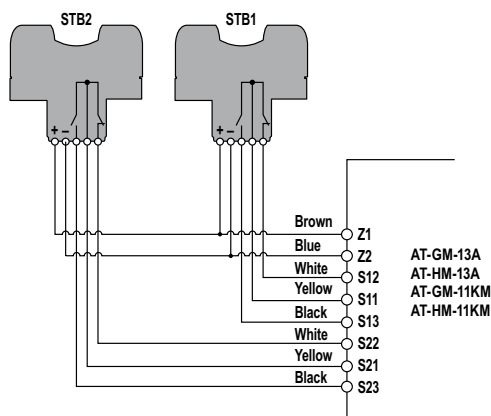
* Arc Suppressors. See manual for specific warnings.

Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD069

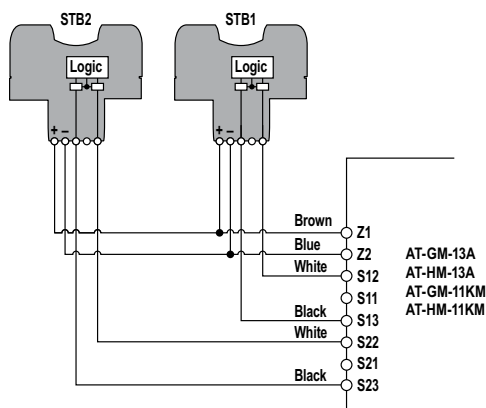
DUO-TOUCH® SG Two-Hand Control Modules, Actuation Device Hookups

AT-..M-13A and AT-..M-11KM to Two STB Touch Buttons with Contact Outputs



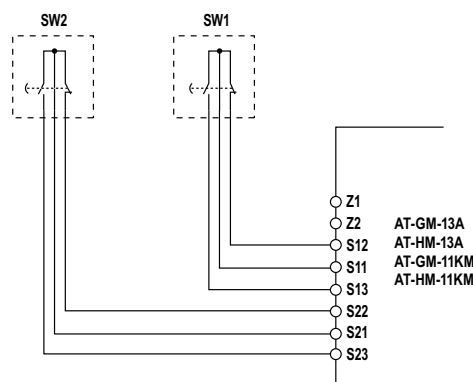
Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

AT-..M-13A and AT-..M-11KM to Two STB Touch Buttons with PNP (Sourcing) Outputs



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

AT-..M-13A and AT-..M-11KM to Two Mechanical Push Buttons with Contact Outputs



Wiring diagrams are for information only.
See appropriate manuals for all specific
warnings, cautions and information for use.

WD070

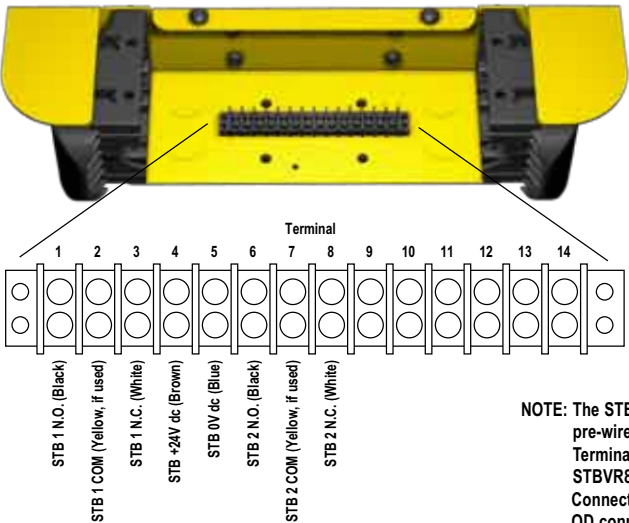
DUO-TOUCH® Run Bar with STBs



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Models

• STBVP6-RB1..



NOTE: The STBVP6 hand control buttons are pre-wired to terminals 1, 3, 4, 5, 6, and 8. Terminals 2 and 7 are reserved for use of STBVR81 buttons. Connection of EZ-LIGHT indicator(s) and QD connectores not shown. (See data sheet P/N 131634 for details)



Wiring diagrams are for information only. See appropriate manuals for all specific warnings, cautions and information for use.

WD071

EZ-LIGHT™ for Two-Hand Control



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LED Function	Brown Wire	Gray Wire	Black Wire	White Wire	Typical Function
Red ON	+V dc	—	—	—	Stop and/or Not Ready
Blue ON	+V dc	+V dc	—	—	Stopped, but Ready/Enabled
Green ON	+V dc	+V dc	+V dc	—	Go
Yellow ON	+V dc	+V dc	+V dc	+V dc	Mute Condition
Red Flashing	Any other hookup combination				Abnormal State

NOTES:

- Blue wire connected to 0V dc
- Supply Voltage and Current = 10 to 30V dc, 60 mA max.

A

Access guard

A type of perimeter guarding, typically used to guard doorways, cell entries or exits, walkways, and machine access points.

Adjustable guard

A guard that can be adjusted to accommodate various jobs or set-ups.

Angle of Divergence/Acceptance

See Effective Aperture Angle (EAA)

Anti-tie down

A feature of a two-hand control where both hand controls must be released before the machine can restart.

Antirepeat

The function of the control system designed to limit the machine to a single stroke or cycle even if the tripping or actuating means is held operated.

Area guard

A safeguarding technique that provides a means of continually sensing or detecting an individual within an area adjacent to or associated with a hazard.

Area-scanning device

A safeguarding device that creates a sensing plane to detect the presence of an individual or object.

Auto power-up

A safety light screen system feature that enables the system to be powered up into the RUN mode (or recover from a power interruption) without requiring a manual reset.

Awareness device

A barrier, signal, light or signage that warns individuals of an approaching, present, or the proximity of a hazard.

B

Beam Diameter

The portion of a beam that must be blocked to cause an individual photo receiver to change state. One of the factors in determining resolution of a safety light screen. Also known as effective beam diameter.

Beam Spacing

The distance from the center of one beam to the center of an adjacent beam, and one factor in determining resolution of a safety light screen. Also known as beam pitch.

Blanking

An optional function that allows a light screen system to ignore objects located within the sensing field so as not to create an OFF-state of the safety outputs and cause a Trip or Latch condition.

Blocked condition

A condition that occurs when an opaque object of sufficient size interrupts one or more light screen beams. When a blocked condition occurs, OSSD1 and OSSD2 outputs simultaneously turn off within the system response time.

C

Cascade

Series connection (or "daisy-chaining") of multiple sensors.

Category 0 Stop (Functional)

An uncontrolled stop produced by immediately removing power to the machine actuators.

Category 1 Stop (Functional)

A controlled stop achieved with power remaining to the machine actuators. Power is removed after the stop is achieved.

Category 2 Stop (Functional)

A controlled stop with power left available to the machine actuators.

Common mode failure

The failure of multiple components or equipment resulting from the same root cause.

Complementary Protective Equipment

Devices used to assure or supplement the operation of a primary safeguard.

Contact

One of the current-carrying parts of a relay, switch, or connector that open and close to complete associated electrical circuits.

Contact configuration

Refers to the construction of a relay or a switch, in many configurations, for example, SPDT (Form C), with one normally open, one normally closed, and one common between the two.

Control reliability

A method of ensuring the performance integrity of a control system or device. Control circuits are designed and constructed so that a single failure or fault within the system does not prevent the normal stopping action from being applied to the machine when required, or does not create unintended machine action, but does prevent initiation of successive machine action until the failure is corrected.

Control Relay (CR)

A relay that is used to perform logic functions in a machine control circuit.

Controlled stop

The stopping of machine motion while retaining power to machine actuators during the stopping process.

Crosstalk (Optical)

Optical crosstalk occurs when a photoelectric receiver responds to light from an adjacent emitter.

D

Defined area

The "screen of light" generated by a safety light screen system, defined by the height and the separation of the emitter and receiver. When the defined area is interrupted by an opaque object of a specified cross section, a Trip or Latch condition results.

Depth of field

The distance, length or the size of the sensing surface or field from the outer edge toward the hazard. Also known as "depth of detection."

Depth penetration factor

Compensation factor for distance an object can penetrate the sensing field of a Presence Sensing Safeguarding Device (PSSD) before the device reliably detects the intrusion and signals a stop. Often abbreviated as Dpf.

Diverse-redundancy

The practice of using components, circuitry or operation of different designs, architectures or functions to achieve redundancy and to reduce the possibility of common mode failures.

Dpf

See Depth Penetration Factor.

Dual channel

Duplication or redundant system that minimizes the possibility of a failure to danger in the event of a single fault. This is because the second independent channel maintains the ability to arrest dangerous motion.

E

Effective Aperture Angle (EAA)

The maximum angle of deviation from the optical alignment of the emitter and the receiver within which the safety light screen continues in normal operation. Also known as Angle of Divergence/Acceptance, or Field-of-View.

Effective beam

The "working" part of a photoelectric beam. Not to be confused with the actual radiation pattern of the emitter, or with the field of view of the receiver.

Electromechanical relay

Conventional switching relays consisting of "hard" contacts (metal-to-metal), switched to opened or closed position by applying voltage to an electromagnetic coil.

Electro-Sensitive Protective Equipment (ESPE)

An assembly of devices and/or components working together for protective tripping or presence sensing purposes and comprising as a minimum: a sensing device, controlling/monitoring devices, and output signal switching devices. See IEC61496-1

Emergency Stop

A control function that is initiated by a single human action to arrest dangerous machine motion, or otherwise avert arising or reduce existing hazards to persons, damage to machinery or to work in progress. See ANSI/NPFA79, IEC60204-1, or ISO13850.

EMI

Abbreviation for Electromagnetic Interference. Electrical "noise" which may interfere with proper operation of sensors, programmable logic controllers, counters, data recorders, and other sensitive electronic equipment.

Emitter

The light-emitting component of a safety light screen system, consisting of a row of synchronized modulated LEDs. The emitter, together with the receiver (placed opposite), creates a "screen of light" called the defined area.

Exact blanking

A configuration allowing a light screen system to ignore stationary objects (such as brackets or fixtures) that interrupt a specific number of light beams.

External device monitoring

A means by which a safeguarding device monitors the state of external devices that may be controlled by the safety device.

F

Fail-safe

A description of a circuit or system that is guaranteed not to fail in the event of a malfunction so that the catastrophic loss of function is not possible.

Fail to Safe

A design or event in which a failure or fault within a system causes the hazardous machine motion or process to achieve a safe state (Commonly confused with "fail-safe").

Failure

An event in which an item (e.g. component, circuit, or device) ceases to perform its required function.

Failure to danger

A failure which delays or prevents a safety system from arresting dangerous machine motion, thereby increasing risk to personnel.

Fault

The state of an item (e.g. component, circuit, device or machine) characterized by its inability to perform a required function. A fault is often the result of a failure of the item itself, but may exist without prior failure. See Failure.

Fault exclusion

The ability to minimize or eliminate known possible failures or faults through design, selection of components, or implementation of additional measures.

Fault tolerance

The ability of a system to function as it was designed even in the presence of faults or failures.

Final Switching Device (FSD)

Component of a safety-related control system that interrupts the circuit to the machine primary control element (MPCE) when the output signal switching device (OSSD) goes to the OFF-state.

Fixed blanking

A way to configure a light screen system to ignore stationary objects (such as brackets or fixtures) that are always present at a specific location within the defined area.

FMEA

Abbreviation for Failure Mode and Effects Analysis, a testing procedure by which potential failure modes in a system are analyzed to determine their results or effects on the system.

Forced-guided contacts

Relay contacts that are mechanically-linked, so that when the relay coil is energized or de-energized, all of the linked contacts move together. If one set of contacts in the relay becomes immobilized, no other contact of the same relay will be able to move. The function of forced-guided contacts is to enable the safety circuit to check the status of the relay. Forced-guided contacts are also known as "mechanically-linked contacts," "positive-guided contacts," "captive contacts," "locked contacts," or "safety relays."

G**General Duty Clause**

Section 5(a)(1) of the Occupational Safety and Health Act of 1970 (Public Law 91-596, 91st Congress, S.2193, 29Dec1970) places primary accountability on the employer for work place safety. "5(a)(1) Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." OSHA inspectors often use section 5(a)(1) of the "General Duty Clause" as the bases of citations resulting from on-site inspections.

General Requirements for All Machines

(29CFR1910.212) requires that one or more methods of machine guarding shall be provided to protect the operator and other employees from hazards, and the guarding device shall be in conformity with any appropriate standards.

Good Engineering Practice

Minimum guidelines that specify commonly-used and recognized design principles, well-tried and robust components, and safety practices to make the workplace free of industry recognized hazards and compliant to relevant standards.

Guard

A protective physical barrier that prevents an individual from accessing a hazardous area.

Guarded machine

The machine whose point of operation or other hazardous area is guarded by the safety system.

H**Hand control**

A hand-operated mechanism or device used as an actuating control. Two normally open "input switches" are used as hand controls in a two-hand control system

Hard guard

Screens, bars, or other mechanical barriers affixed to the frame of the machine intended to prevent entry by personnel into the hazardous area(s) of a machine.

Hazard

A potential source of harm.

Hazard point

The closest reachable point of the hazardous area.

Hazardous area

An area that poses an immediate or impending physical hazard.

Hazardous situation

A circumstance in which a person is exposed to a hazard, or any specific activity done on or around the machine during its lifecycle that results in a potential source of harm. See B11.TR3 for further information.

I**I/O**

(Input-Output) Provides communication channels to system and to manufacturing process.

Integrity

The degree to which a circuit, system or device can be expected to perform unimpaired an anticipated function in the event of a fault. Integrity depends on several characteristics including fault tolerance, fault exclusion, risk reduction, reliable and well-tried components, well-tried safety principles, and other design considerations.

Interlocked guard

A guard or barrier interfaced with a machine control system so as to restrict access to or prevent inadvertent access to the hazard.

Internal lockout

A Lockout condition due to an internal safety system problem.

Intrinsic safety

A design technique applied to electrical equipment, such as sensors, switches, and wiring for hazardous locations. The technique involves limiting energy to a level below that required to ignite a specific hazardous atmosphere. Intrinsic safety design often eliminates the requirement for explosion-proof enclosures. Also see "NAMUR".

IP rating

A rating system established by the IEC which defines the suitability of sensor and sensor system enclosures for various environments. Similar to NEMA ratings for enclosures.

K**Key reset**

A key-operated switch used to reset a safety system to the RUN mode following a Lockout condition or to reset a safety system from a Latch condition.

L**L Configuration**

In a safety light screen application, the installation of two emitter/receiver pairs to create a vertical and a horizontal sensing field. Gains advantages of both area guarding and point-of-operation guarding techniques to reduce the possibility of pass-through hazards.

Latch condition

The response of a safety or safeguarding device in which an OFF-state is maintained after the device has been actuated until the safeguard is cleared, re-closed, or re-armed and a manual reset is performed.

Legend

Any type of marking, sign, or inscription which identifies the device type, function or purpose.

Lockout Condition

A safety system condition that is automatically attained in response to certain failure modes (an internal lockout). When a Lockout condition occurs, the safety system's safety outputs turn OFF, the failure must be corrected, and a manual reset is required to return the system to RUN mode.

M**Machine response time**

The time between the activation of a stopping device and the instant when the dangerous parts of the machine reach a safe state.

Machine secondary control element (MSCE)

An electrically-powered element, independent of the machine primary control element(s), capable of removing power from the machine's actuator (prime mover) of the relevant hazardous parts and is typically controlled by the secondary switching device (SSD).

Master Control Relay (MCR)

A relay that is used to provide electrical power to the machine control circuitry. Typically interfaced with the Master Start/Stop (ON/OFF) and Emergency Stop functions.

Master Stop Control (MSC)

An electrically-powered device, external to the E-stop Safety Module, that provides a safety stop by immediately removing electrical power to the hazard and, if necessary, by applying braking to dangerous motion.

Mechanically-linked contact

See Forced-Guided Contact.

Monitoring

The verification of system components to detect failures or faults of any part of the monitored system that could affect the performance of safety-related functions.

Minimum Object Sensitivity (MOS)

The minimum-diameter object that a safety light screen system can reliably detect. Objects of this diameter or greater will be detected anywhere in the defined area. A smaller object can pass undetected through the light if it passes exactly midway between two adjacent light beams.

Machine Primary Control Element (MPCE)

An electrically-powered element, external to the safety system, which directly controls the machine's normal operating motion in such a way that the element is last (in time) to operate when machine motion is either initiated or arrested. (Examples include motor/motor contactors, magnetic clutch brake, or electrically operated valve.)

Master Stop Control (MSC)

An electrically-powered device, external to the E-stop Safety Module, that provides a safety stop by immediately removing electrical power to the hazard and, if necessary, by applying braking to dangerous motion. This stopping action is accomplished by removing power to the actuator coil of either Master Stop Control Element.

Muting

The automatic suspension of the safeguarding function of a safety device during a non-hazardous portion of the machine cycle.

N**NAMUR**

Devices and sensors designed for use with certified switching amplifiers with intrinsically-safe circuits. NAMUR sensors are most commonly used in explosive environments.

Normally Closed (NC)

Designation that states the contacts of a switch or relay are closed or connected when at rest. When activated, the contacts open or separate.

Normally Open (NO)

Designation that states the contacts of a switch or relay are normally open or not connected. When activated, the contacts close or become connected.

NPN output (Current sinking)

A transistor available as an output switch in DC sensors and logic modules. Usually configured with its collector open and its emitter connected to ground (DC common). In this configuration, a load is connected between the output (collector) and the positive of the DC supply. This output configuration is also called a "sinking" output.

O**OFF State**

The state in which the output circuit is interrupted and does not permit the flow of current.

ON State

The state in which the output circuit is complete and permits the flow of current.

Optical short circuit

Deflection of one or more beams around an object in the defined area which may result in reduced detection capability of a light screen or in the worst case, of an object being allowed to pass through undetected. The result of locating a sensing field next to a highly reflective surface e.g. stainless steel, glossy paint.

Output Signal Switching Device (OSSD)

Abbreviation for Output Signal Switching Device. The safety outputs of a safeguarding device that are used to initiate a stop signal by achieving an OFF-state. (Note: Includes, but is not limited to, solid-state outputs, relay contacts, or other electrical contacts.)

P**Pass-through hazard**

A situation that may exist when personnel pass through a safeguard (at which point the hazard stops or is removed), and then continue into the guarded area. At this point the safeguard may not be able to prevent an unexpected start or restart of the machine with personnel within the guarded area.

Perimeter guard

A safeguarding technique that provides a barrier or means of detection at the boundary of a hazard or hazardous area.

PNP output (Current sourcing)

A transistor available as an output switch in DC sensors. Usually configured with its collector open and its emitter connected to the positive of the sensor supply voltage. In this configuration, a load is connected between the output (collector) and ground (DC common). This output configuration is also called a "sourcing" output.

Point of operation

The location of a machine where material or a workpiece is positioned and a machine function is performed upon it.

Point-of-operation guarding

Safeguards, such as hard guards or safety light screens, which are designed to protect personnel from hazardous machine motion associated with the machine's point of operation.

Positive-guided contact

See Forced-guided contact.

Positive Opening (Safety Switch)

Safety switch that employs a rigid mechanical link from the actuator to open Normally Closed contacts. The normal operation of the switch will force apart contacts, even those that are welded shut.

Power monitoring

Monitoring function accomplished through a series-parallel connection of contacts that provide feedback about the machine's status. Power is supplied to the module as long as both contactors work as they should.

Power-Up/Power-Interrupt Lockout

A Lockout condition of a safety light screen system that, if Auto Power-Up is OFF, occurs when the system is powered up (including power-ups after a loss of power).

Presence-sensing device

A device that creates a sensing area to detect the presence of an individual or object.

Presence-Sensing Device Initiation (PSDI)

An application in which a presence-sensing device is used to start the cycle of a machine.

Presence-Sensing Safeguarding Device (PSSD)

Abbreviation for Presence-Sensing Safeguarding Device. A presence-sensing device used as a safeguard.

Pull-back

A safeguarding device attached to an operator's hands and wrists that withdraws the operator's hands from the hazard area during hazardous operation.

Q**Qualified Person**

An individual who, by possession of a recognized degree or certificate of professional training, or by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

R**Receiver**

The light-receiving component of a safety light screen system, consisting of a row of synchronized phototransistors. The receiver, together with the emitter (placed opposite), creates a "screen of light" called the defined area.

Reduced resolution

A configuration that allows a light screen system to intentionally ignore the interruption of consecutive light beams within the defined area. The effect is to ignore multiple objects with cross-sections less than a certain size, while increasing the size of an object that will be reliably detected anywhere within the defined area. Sometimes called "Floating Blanking."

Redundancy

The duplication of components or circuitry providing the same function should a component or circuit fail.

Reliability

The ability of a machine's circuits and components to consistently perform its stated function within its specifications without failing.

Relay

An electromechanical device that opens or closes contacts in response to a small current or voltage change of an electric circuit. This device effects the operation of other devices in the same or another electric circuit.

Reset

The use of a manually-operated switch to restore the safety outputs to the ON state from a Latch condition, or return to the RUN mode from a Lockout condition.

Resolution

The minimum size (diameter or cross section) of an object that a safety light screen will reliably detect. Calculated by adding the beam spacing dimension to effective beam diameter. Objects of this size or larger will be detected anywhere in the sensing field.

Risk

The probability of the occurrence of harm and its severity.

Risk assessment

A procedure used in machine safety to identify, document and eliminate or reduce hazards in a particular machine or process.

S**Safeguard**

A guard (barrier) or safeguarding device used to protect personnel from hazards by preventing or restricting access, or by detecting the presence of an individual.

Safeguarding

Measures (including guards, safeguarding devices, awareness devices, safeguarding methods, or safe work procedures) used to protect personnel from hazards which cannot reasonably be eliminated, or from the risks which cannot be sufficiently reduced by inherently safe design measures.

Safeguarding device

A device that detects or prevents inadvertent access to a hazard (i.e. not a guard or a barrier). Also known as a Protective Device.

Safety device

A technique or means to reduce the risk of harm to personnel from a machine hazard which includes but is not limited to Safety Light Screens, Emergency Stop Buttons, Guards (barriers), Interlocking, Enabling Pendants, Two-hand Control, Restraints, or Lockout/Tagout equipment.

Safety distance

The calculated distance between a hazard and its associated safeguard.

Safety edge

A safeguarding device consisting of a sensing edge and a control, used to detect individuals who comes into contact with the sensing edge.

Safety interlock switch

A switch on a guard barrier used to detect if the guard is opened. Designed to prevent intentional defeat. Electromechanical safety interlock switches use positive opening contacts. Other forms of safety interlock switch include magnetic, RF tag, optical, or inductive.

Safety light curtain

See safety light screen.

Safety light screen

A safeguarding device comprising an LED array emitter and receiver element which creates a sensing field or plane. When an individual or object interrupts this sensing field, the light screen detects the interruption and initiates a stop command. Also known as Active Opto-electronic Protective Device -AOPD, Presence Sensing Safeguarding Device, safety light curtain, light devices and optical guards.

Safety mat

A safeguarding device consisting of a sensing surface and a control. The sensing surface is capable of detecting the presence of individual(s) on its surface.

Safety module

A device that performs a specific safety function(s) and consists of monitored, multiple, mechanically-linked relays, or monitored solid-state safety outputs. Commonly confused with a single, discrete mechanically-linked "safety" relay. Also known as Safety Interface Module or Safety Relay Modules.

Safety relay

An electromechanical relay with force-guided contacts which allow the monitoring of a safety device's circuit to check relay status. See also force-guided contacts.

Safety stop

Removal of power to the Machine Primary Control Elements that allow for an orderly cessation of motion for safeguarding purposes. Also known as a Protective Stop.

Safety Stop Interface (SSI)

An interface which provides the means to integrate external devices to effect a stop command. It consists of two input channels (A&B), which are compatible with devices that have two Normally Open hard contacts or relay outputs.

Secondary Switching Device (SSD)

An output which, in a lock-out condition, performs a back-up safety function by going to the OFF-state and initiating an appropriate machine control action.

Self-checking circuitry

A circuit with the capability to verify that all of its own critical safety circuit components, along with their redundant backups, are operating properly.

Separation distance

The calculated distance between a hazard and its associated safeguard. See Safety distance.

Simultaneity

Concurrent events, actions, or actuations occurring within a specific time frame. This time frame is 0.5 second in a Two-Hand Control or Two-Hand Trip applications per ANSI B11.19, ANSI/RIA R15.06 and ISO 13851 (Note: ISO 13851 defines this as synchronous actuation).

Solenoid

A coil equipped with a movable iron core that will produce linear motion as a result of current passing through the coil (the iron core is pulled into the center of the coil). When current is removed, a spring returns the iron core to the original position.

Secondary Switching Device (SSD)

Abbreviation for Secondary Switching Device. An output which, in a lock-out condition, performs a back-up safety function by going to the OFF-state and initiating an appropriate machine control action.

Safety Stop Interface (SSI)

Abbreviation for Safety Stop Interface. An interface which provides the means to integrate external devices to effect a stop command. It consists of two input channels (A&B), which are compatible with devices that have two normally open hard contacts or relay outputs.

Standards

A specification, criterion or benchmark that is widely used, accepted or is sanctioned and codified by a standards agency. Safety standards are minimum requirements for product and machine design, manufacture, use and evaluation.

Supplemental guarding/safeguarding

Additional means used to prevent or hinder personnel from accessing the guarded hazard by augmenting the primary means of safeguarding.

T**Trip condition**

The response of a safety or safeguarding device in which an ON-state is achieved when the safeguard is cleared, re-closed, or re-armed, without operator intervention.

Trip initiate

The resetting, reclosing, or clearing of a safeguard causing the initiation of machine motion or operation. Trip Initiate is not allowed as a means to initiate a machine cycle per NFPA 79 and ISO 60204-1, and is commonly confused with PSDI.

Two-hand control device

An actuating control that requires concurrent actuation of both of the operator's hands to initiate and control machine motion during the hazardous portion of the machine cycle.

Two-hand trip

An actuating control that requires concurrent actuation of both of the operator's hands to initiate the machine cycle. Typically used on full revolution clutch or single-stroke machines.

Type 2 light screen

A set of design, construction and testing requirements for light screens described by IEC 61496. The "types" perform differently in the presence of faults and under influences from environmental conditions. Type 2 requirements are less stringent than those for Type 3 or Type 4

Type 4 safety light screen

A set of design, construction and testing requirements for light screens described by IEC 61496. The "types" perform differently in the presence of faults and under influences from environmental conditions. Type 4 requirements are the most stringent.

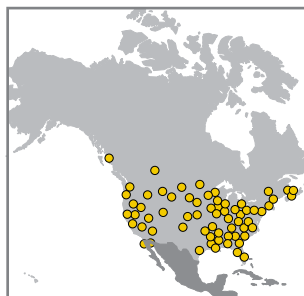
U**Uncontrolled stop**

The stopping of machine motion by removing power to the machine actuators, all brakes and/or other mechanical stopping devices being activated.

Universal Safety Stop Interface (USSII)

Abbreviation for Universal Safety Stop Interface. An interface that provides a means to integrate external devices to effect a stop command. It consists of two input channels (A&B), which are compatible with Banner solid-state OSSD outputs with "handshake" verification (two-wire hookup), or with devices that have two normally open hard contacts or relay outputs (four-wire hookup).

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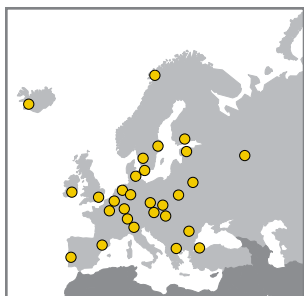
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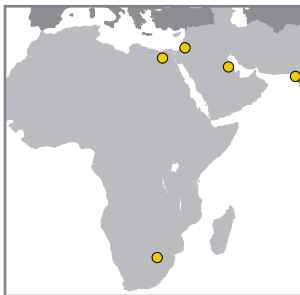
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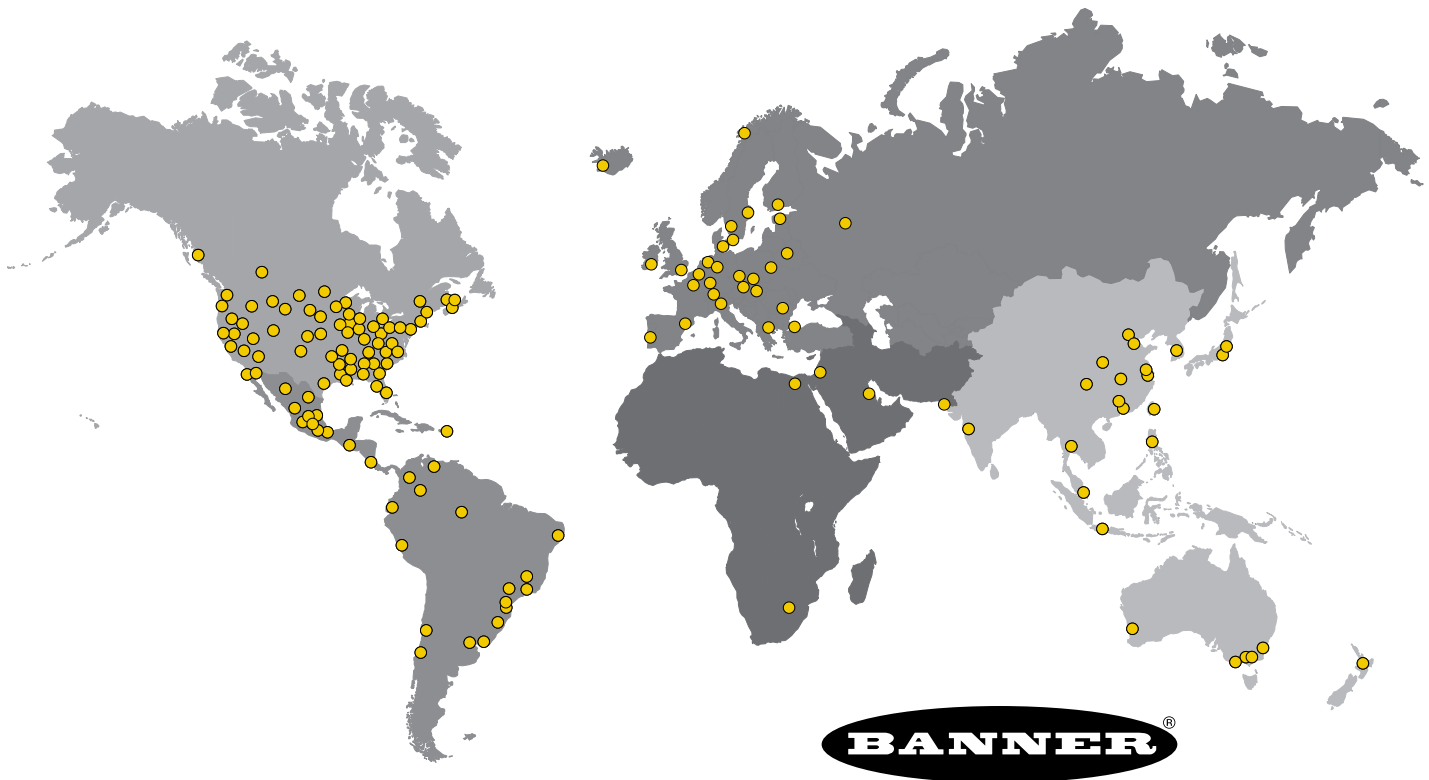
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MSK2T824C2Y	45949	w.o.	MSKB2424C3Y	45666	w.o.	MSKT424C1Y	45800	w.o.

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MSKT424C2Y	45812	w.o.	MSXLDKT2024C1Y	48189	w.o.	MSXLE4024	52643	w.o.
MSKT424C3	43324	w.o.	MSXLDKT2024C2	52701	w.o.	MSXLE4024Y	48143	w.o.
MSKT424C3Y	45824	w.o.	MSXLDKT2024C2Y	48201	w.o.	MSXLE424	52625	w.o.
MSKT4424C1	43310	w.o.	MSXLDKT2024C3Y	48213	w.o.	MSXLE424Y	48125	w.o.
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MSKT4424C2Y	45822	w.o.	MSXLDKT2024LC2Y	48516	w.o.	MSXLE4824	52647	w.o.
MSKT4424C3	43334	w.o.	MSXLDKT2024LC3Y	48528	w.o.	MSXLE4824Y	48147	w.o.
MSKT4424C3Y	45834	w.o.	MSXLDKT2424C1Y	48190	w.o.	MSXLE824	52627	w.o.
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MSM12A	43164	194	MSXLDKT2824C3Y	48215	w.o.	MSXLHDE8412Y	68972	w.o.
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MSM20A	43166	194	MSXLDKT2824LC2Y	48518	w.o.	MSXLHDE8412Y	68976	w.o.
MSM24A	43167	194	MSXLDKT2824LC3	52895	w.o.	MSXLHDE8412Y	49925	w.o.
MSM28A	43168	194	MSXLDKT2824LC3Y	48530	w.o.	MSXLK2D1224C1Y	49937	w.o.
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MSM36A	43170	194	MSXLDKT3224C1Y	48192	w.o.	MSXLK2D1224C3Y	49949	w.o.
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MSM44A	43172	194	MSXLDKT3224C2Y	48204	w.o.	MSXLK2D1224C3Y	49926	w.o.
MSM48A	43173	194	MSXLDKT3224C3Y	48216	w.o.	MSXLK2D1224C3Y	52808	w.o.
MSM4A	43162	194	MSXLDKT3224LC1Y	48507	w.o.	MSXLK2D1224C3Y	49938	w.o.
MSM8A	43163	194	MSXLDKT3224LC2Y	48519	w.o.	MSXLK2D1224C3Y	49950	w.o.
MSMA-PSC-2	62867	w.o.	MSXLDKT3224LC3Y	48531	w.o.	MSXLK2D1224C3Y	52797	w.o.
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MSMB-4	48954	w.o.	MSXLDKT3624C3Y	48217	w.o.	MSXLK2D1224C3Y	49928	w.o.
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MSR4424Y	47671	w.o.	MSXLDKT4424C1Y	48195	w.o.	MSXLK2D1224C3Y	49945	w.o.
MSR4824	37467	w.o.	MSXLDKT4424C2	52707	w.o.	MSXLK2D1224C3Y	49957	w.o.
MSR4824Y	47673	w.o.	MSXLDKT4424C2Y	48207	w.o.	MSXLK2D1224C3Y	49934	w.o.
MSR824	37447	w.o.	MSXLDKT4424C3Y	48219	w.o.	MSXLK2D1224C3Y	49946	w.o.
MSR824Y	47653	w.o.	MSXLDKT4424LC1Y	48510	w.o.	MSXLK2D1224C3Y	49958	w.o.
MSS12	44310	w.o.	MSXLDKT4424LC2Y	48522	w.o.	MSXLK2D1224C3Y	49924	w.o.
MSS16	44311	w.o.	MSXLDKT4424LC3Y	48534	w.o.	MSXLK2D1224C3Y	49936	w.o.
MSS20	44312	w.o.	MSXLDKT4824C1Y	48196	w.o.	MSXLK2D1224C3Y	52818	w.o.
MSS24	44313	w.o.	MSXLDKT4824C2	52708	w.o.	MSXLK2D1224C3Y	49948	w.o.
MSS28	44314	w.o.	MSXLDKT4824C2Y	48208	w.o.	MSXLK2T2024C1Y	49963	w.o.
MSS32	44315	w.o.	MSXLDKT4824C3Y	48220	w.o.	MSXLK2T2024C1Y	49966	w.o.
MSS36	44316	w.o.	MSXLDKT4824LC1Y	48511	w.o.	MSXLK2T2024C1Y	49967	w.o.
MSS4	44308	w.o.	MSXLDKT4824LC2	52888	w.o.	MSXLK2T2024C1Y	49979	w.o.
MSS40	44317	w.o.	MSXLDKT4824LC2Y	48523	w.o.	MSXLK2T2024C1Y	49991	w.o.
MSS44	44318	w.o.	MSXLDKT4824LC3Y	48535	w.o.	MSXLK2T2024C1Y	52841	w.o.
MSS48	44319	w.o.	MSXLDKT824C1Y	48186	w.o.	MSXLK2T2024C1Y	52852	w.o.
MSS8	44309	w.o.	MSXLDKT824C2	52698	w.o.	MSXLK2T2024C1Y	49982	w.o.
MSVM-1	48955	w.o.	MSXLDKT824C2Y	48198	w.o.	MSXLK2T2024C1Y	52651	w.o.
MSVM-2	46149	w.o.	MSXLDKT824C3Y	48210	w.o.	MSXLK2T2024C1Y	48151	w.o.
MSVM-4	48956	w.o.	MSXLDKT824LC1	52866	w.o.	MSXLK2T2024C1Y	52663	w.o.
MSXLDKT1224C1	52687	w.o.	MSXLDKT824LC1Y	48501	w.o.	MSXLK2T2024C1Y	48163	w.o.
MSXLDKT1224C1Y	48187	w.o.	MSXLDKT824LC2	52878	w.o.	MSXLK2T2024C1Y	52675	w.o.
MSXLDKT1224C2	52699	w.o.	MSXLDKT824LC2Y	48513	w.o.	MSXLK2T2024C1Y	48175	w.o.
MSXLDKT1224C2Y	48199	w.o.	MSXLDKT824LC3Y	48525	w.o.	MSXLK2T2024C1Y	52652	w.o.
MSXLDKT1224C3Y	48211	w.o.	MSXLE1224	52629	w.o.	MSXLK2T2024C1Y	48152	w.o.
MSXLDKT1224LC1Y	48502	w.o.	MSXLE1224Y	48129	w.o.	MSXLK2T2024C1Y	52664	w.o.
MSXLDKT1224LC2Y	48514	w.o.	MSXLE1624	52631	w.o.	MSXLK2T2024C1Y	48164	w.o.
MSXLDKT1224LC3	52891	w.o.	MSXLE1624Y	48131	w.o.	MSXLK2T2024C1Y	52676	w.o.
MSXLDKT1224LC3Y	48526	w.o.	MSXLE2024	52633	w.o.	MSXLK2T2024C1Y	48176	w.o.
MSXLDKT1624C1Y	48188	w.o.	MSXLE2024Y	48133	w.o.	MSXLK2T2024C1Y	52653	w.o.
MSXLDKT1624C2	52700	w.o.	MSXLE2424	52635	w.o.	MSXLK2T2024C1Y	48153	w.o.
MSXLDKT1624C2Y	48200	w.o.	MSXLE2424Y	48135	w.o.	MSXLK2T2024C1Y	52665	w.o.
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MSXLDKT1624C3Y	48212	w.o.	MSXLE2824Y	48137	w.o.	MSXLK2T2024C1Y	52677	w.o.
MSXLDKT1624LC1Y	48503	w.o.	MSXLE3224	52639	w.o.	MSXLK2T2024C1Y	48177	w.o.
MSXLDKT1624LC2Y	48515	w.o.	MSXLE3224Y	48139	w.o.	MSXLK2T2024C1Y	52654	w.o.
MSXLDKT1624LC3Y	48527	w.o.	MSXLE3624	52641	w.o.	MSXLK2T2024C1Y	48154	w.o.

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MSXLKA2424C3Y	48178	w.o.	MSXLR4424	52646	w.o.	OTC-1-GN	30979	119
MSXLKA2824C1	52655	w.o.	MSXLR4424Y	48146	w.o.	OTC-1-RD	30977	119
MSXLKA2824C1Y	48155	w.o.	MSXLR4824	52648	w.o.	OTC-1-YW	30978	119
MSXLKA2824C2	52667	w.o.	MSXLR4824Y	48148	w.o.	PFC-2-25	02613	69
MSXLKA2824C2Y	48167	w.o.	MSXLR824	52628	w.o.	PGAB-1	30699	w.o.
MSXLKA2824C3	52679	w.o.	MSXLR824Y	48128	w.o.	PGAB-2	30698	w.o.
MSXLKA2824C3Y	48179	w.o.	MS-XPE-32	63440	w.o.	PGA-PSA-1	30697	w.o.
MSXLKA3224C1	52656	w.o.	MS-XPE-43	64218	w.o.	PGA-PSB-1	30696	w.o.
MSXLKA3224C1Y	48156	w.o.	MUSAB-1	43833	w.o.	PGA-TBA1-1	34069	w.o.
MSXLKA3224C2	52668	w.o.	MUSA-MH-1	43831	w.o.	PGA-TBA2-1	34070	w.o.
MSXLKA3224C2Y	48168	w.o.	MUSA-PS-1	43832	w.o.	PGCA-1A	34052	w.o.
MSXLKA3224C3	52680	w.o.	MUSA-TA-1	43834	w.o.	PGCA-2A	34053	w.o.
MSXLKA3224C3Y	48180	w.o.	MUSC-1	41200	w.o.	PGCB-1A	34054	w.o.
MSXLKA3624C1	52657	w.o.	MUSC-1T3	64127	w.o.	PGCB-2A	34055	w.o.
MSXLKA3624C1Y	48157	w.o.	MUSF-RM-1	80942	w.o.	PGCB-2A	34055	w.o.
MSXLKA3624C2	52669	w.o.	OTBA5	27986	w.o.	PIU4100U	26937	68
MSXLKA3624C2Y	48169	w.o.	OTBA5 W/G	35098	w.o.	PIU4100UXP	71565	68
MSXLKA3624C3	52681	w.o.	OTBA5 W/R	35058	w.o.	PIU4100UXT	71570	68
MSXLKA3624C3Y	48181	w.o.	OTBA5 W/Y	35078	w.o.	PIU41600U	31003	68
MSXLKA4024C1	52658	w.o.	OTBA5L	32167	w.o.	PIU41600UXP	71569	68
MSXLKA4024C1Y	48158	w.o.	OTBA5L W/G	35100	w.o.	PIU41600UXT	71574	68
MSXLKA4024C2	52670	w.o.	OTBA5L W/R	35060	w.o.	PIU4200U	39996	68
MSXLKA4024C2Y	48170	w.o.	OTBA5L W/Y	35080	w.o.	PIU4200UXP	71566	68
MSXLKA4024C3	52682	w.o.	OTBA5LQD	32255	w.o.	PIU4200UXT	71571	68
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MSXLKA424C2Y	48161	w.o.	OTBA5QD W/G	35099	w.o.	PIU4330UXP	71567	68
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MSXLKA4424C1Y	48159	w.o.	OTBB5 W/G	35102	w.o.	PIU4500UXT	71573	68
MSXLKA4424C2	52671	w.o.	OTBB5 W/R	35062	w.o.	PIU460U	26230	68
MSXLKA4424C2Y	48171	w.o.	OTBB5 W/Y	35082	w.o.	PIU460UXP	70721	68
MSXLKA4424C3	52683	w.o.	OTBB5L	32254	w.o.	PIU460UXT	68619	68
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MSXLKA4824C1	52660	w.o.	OTBB5L W/R	35064	w.o.	PWS4100P	70417	68
MSXLKA4824C1Y	48160	w.o.	OTBB5L W/Y	35084	w.o.	PWS410P	70411	68
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MSXLKA4824C2Y	48172	w.o.	OTBB5LQD W/G	35105	w.o.	PWS4120P	02828	68
MSXLKA4824C3	52684	w.o.	OTBB5LQD W/R	35065	w.o.	PWS4130P	02829	68
MSXLKA4824C3Y	48184	w.o.	OTBB5LQD W/Y	35085	w.o.	PWS4140P	02830	68
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MSXLKA824C1Y	48150	w.o.	OTBB5QD W/G	35103	w.o.	PWS415P	02816	68
MSXLKA824C2	52662	w.o.	OTBB5QD W/R	35063	w.o.	PWS4200P	02832	68
MSXLKA824C2Y	48162	w.o.	OTBB5QD W/Y	35083	w.o.	PWS420P	02817	68
MSXLKA824C3	52674	w.o.	OTBVN6	28591	w.o.	PWS4250P	02833	68
MSXLKA824C3Y	48174	w.o.	OTBVN6 W/G	35110	w.o.	PWS425P	02818	68
MSXLB1224C1Y	49853	w.o.	OTBVN6 W/R	35070	w.o.	PWS4300P	70420	68
MSXLB1224C2Y	49865	w.o.	OTBVN6 W/Y	35090	w.o.	PWS430P	02819	68
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MSXLB2024C1Y	49855	w.o.	OTBVN6L W/G	35112	w.o.	PWS43P	02813	68
MSXLB2024C2Y	49867	w.o.	OTBVN6L W/R	35072	w.o.	PWS440P	02821	68
MSXLB2424C1	52726	w.o.	OTBVN6L W/Y	35092	w.o.	PWS445P	02822	68
MSXLB2424C2Y	49868	w.o.	OTBVN6LQD	35057	w.o.	PWS450P	70414	68
MSXLB2824C1Y	49857	w.o.	OTBVN6LQD W/G	35113	w.o.	PWS45P	02814	68
MSXLB3224C2Y	49870	w.o.	OTBVN6LQD W/R	35073	w.o.	PWS460P	02823	68
MSXLB3224C3	52752	w.o.	OTBVN6LQD W/Y	35093	w.o.	PWS470P	02824	68
MSXLB3624C2	52741	w.o.	OTBVN6LQDH	67222	w.o.	PWS47P	02815	68
MSXLKT1224C1Y	49889	w.o.	OTBVN6QD	28585	w.o.	PWS480P	02825	68
MSXLKT1224C2	52771	w.o.	OTBVN6QD W/G	35111	w.o.	PWS490P	02826	68
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MSXLKT1624C3Y	49914	w.o.	OTBVN6QD W/Y	35091	w.o.	PWXP410P	70412	68
MSXLKT2024C2Y	49903	w.o.	OTBVP6	28589	w.o.	PWXP4110P	02848	68
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MSXLKT424C2Y	49899	w.o.	OTBVP6QD	28590	w.o.	PWXP43P	02834	68
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MSXLR3624	52642	w.o.	OTBVR81LQD W/Y	35089	w.o.	PWXT4140P	02872	68
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PWXT4250P	02875	68	RP-QM90F-100L	62064	160	SFI-M12SS06UXT	72285	65
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SLPP14-270P88	83724	32	SLSC14-450Q8	72400	25	SLSCP30-600P88	73985	26
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SLPP14-970P88	83729	32	SLSC30-1200Q8	72412	26	SLSCR14-1350P8	73933	25
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SLSCR14-450Q8	72418	25	SLSE30-2100Q8	82068	25	SLSP14-1050Q85	71234	24
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SLSCR14-600Q8	72419	25	SLSE30-2250Q5	83842	25	SLSP14-1200P88	73955	24
SLSCR14-750P8	73929	25	SLSE30-2250Q8	79018	25	SLSP14-1200Q85	71235	24
SLSCR14-750Q8	72420	25	SLSE30-2400P8	83843	25	SLSP14-1200Q88	72386	24
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SLSCR14-900Q8	72421	25	SLSE30-2400Q8	82069	25	SLSP14-1350Q85	73367	24
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SLSCR30-1050Q8	72429	26	SLSE30-300Q5	71237	24	SLSP14-1500P88	73957	24
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SLSCR30-1350P8	73944	26	SLSE30-450Q5	71238	24	SLSP14-150P88	73948	24
SLSCR30-1350Q8	72431	26	SLSE30-450Q8	72369	24	SLSP14-150Q85	71228	24
SLSCR30-1500P8	73945	26	SLSE30-600P8	73871	24	SLSP14-150Q88	72379	24
SLSCR30-1500Q8	72432	26	SLSE30-600Q5	71239	24	SLSP14-1650P88	73958	24
SLSCR30-1650P8	73946	26	SLSE30-600Q8	72370	24	SLSP14-1650Q85	73369	24
SLSCR30-1650Q8	72433	26	SLSE30-750P8	73872	24	SLSP14-1650Q88	73373	24
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SLSCR30-900Q8	72428	26	SLSK14-450Q88-1RE15	73477	27	SLSP30-1050Q85	71266	25
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SLSE14-1050Q5	71218	24	SLSK14-450Q88-5RE25	79185	27	SLSP30-1200P88	73967	25
SLSE14-1050Q8	72365	24	SLSK14-600Q85-2R15E25	81431	27	SLSP30-1200Q85	71267	25
SLSE14-1200P8	73863	24	SLSK14-600Q88-2RE25	79510	27	SLSP30-1200Q88	72394	25
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SLSE14-1350P8	73864	24	SLSK14-600Q88-RE15	78089	27	SLSP30-1350Q88	72395	25
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SLSE14-1350Q8	73359	24	SLSK14-750Q88-1RE25	77329	27	SLSP30-1500Q85	71269	25
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SLSE14-1650Q5	73357	24	SLSK30-1200P88-2RE25	78575	27	SLSP30-1800P88	73971	25
SLSE14-1650Q8	73361	24	SLSK30-1200Q85-RE25	72252	27	SLSP30-1800Q85	71271	25
SLSE14-1800Q5	73358	24	SLSK30-1200Q88-1R25E15	79427	27	SLSP30-1800Q88	72398	25
SLSE14-1800Q8	73362	24	SLSK30-1200Q88-2R25E15	81097	27	SLSP30-1950P88	83845	25
SLSE14-300P8	73857	24	SLSK30-1200Q88-2RE25	78438	27	SLSP30-1950Q85	83846	25
SLSE14-300Q5	71213	24	SLSK30-1350Q85-RE25	72253	27	SLSP30-1950Q88	82074	25
SLSE14-300Q8	72360	24	SLSK30-1350Q88-1RE15	81229	27	SLSP30-2100P88	83847	25
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SLSE14-450Q8	72361	24	SLSK30-1350Q88-RE25	77911	27	SLSP30-2250P88	83849	25
SLSE14-600P8	73859	24	SLSK30-1500Q85-RE25	72254	27	SLSP30-2250Q85	83850	25
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SLSE14-900Q8	72364	24	SLSK30-1650Q88-1RE15	78556	27	SLSP30-450P88	73962	24
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SLSR30-1800P8	73903	25	SSM-475-S	63474	196	USCD-2L2	67171	w.o.
SLSR30-1800Q8	71259	25	SSM-550	61895	195	USCD-2T2	51224	w.o.
SLSR30-1950P8	83853	25	SSM-550-S	63475	196	USCD-2T3	65998	w.o.
SLSR30-1950Q8	82070	25	SSM-675	61896	195	USCD-2T3E	62812	w.o.
SLSR30-2100P8	83854	25	SSM-675-S	63476	196	USCMB-1	51651	176
SLSR30-2100Q8	82071	25	SSM-825	61897	195	USCMB-2	54976	176
SLSR30-2250P8	83855	25	SSM-825-S	63477	196	USCT-2T2	63491	w.o.
SLSR30-2250Q8	82072	25	SSM-875	71615	195	USCT-2T3	68396	w.o.
SLSR30-2400P8	83856	25	SSM-875-S	71622	196	USDAB-1	50002	w.o.
SLSR30-2400Q8	82073	25	SSM-975	61898	195	USDAB-1D	52245	w.o.
SLSR30-300P8	73893	24	SSM-975-S	63478	196	USDAB-1E	62092	w.o.
SLSR30-300Q8	71249	24	SSM-FM-11A10	10179	104	USDAB-2	50003	w.o.
SLSR30-450P8	73894	24	SSM-FM-11A20	10180	104	USDAB-2D	52246	w.o.
SLSR30-450Q8	71250	24	SS-XPE-32	71932	203	USDAL-1	55624	w.o.
SLSR30-600P8	73895	24	SS-XPE-43	71933	203	USDAL-1D	55625	w.o.
SLSR30-600Q8	71251	24	STBA-RB1-MB1	77858	175	USDAL-2	55626	w.o.
SLSR30-750P8	73896	24	STBA-RB1-MB2	77859	175	USDAL-2D	55627	w.o.
SLSR30-750Q8	71252	24	STBA-RB1-MB3	77860	175	USDA-RM-1	50001	w.o.
SLSR30-900P8	73897	24	STBA-RB1-S1	77861	199	USDA-RM-2	55707	w.o.
SLSR30-900Q8	71253	24	STBA-RB1-S2	77862	199	USDINT-1L2	54176	w.o.
SMA-MBK-1	61933	172	STBA-RB2-MB2	83345	122	USDINT-1L2D	54177	w.o.
SMB12MM	27635	172	STBA-RB2-MB3	83346	122	USDINT-1L4	55597	w.o.
SMB1812SF	52520	172	STBA-RB2-S1	83347	199	USDINT-1L4D	55598	w.o.
SMB30A	32723	173	STBA-RB2-S2	83348	199	USDINT-1T2	48536	w.o.
SMB30MM	27162	173	STBVP6	64179	118	USDINT-1T2D	48772	w.o.
SMB30SC	52521	173	STBVP6L	64182	w.o.	USDINT-1T2E	52440	w.o.
SMBAMS30P	73135	173	STBVP6LQ	64183	w.o.	USDINT-1T4	55589	w.o.
SMBAMS30RA	73137	174	STBVP6LQ5	64184	w.o.	USDINT-1T4D	55590	w.o.
SMBAMSBRA	73138	174	STBVP6Q	64180	118	USDINT-2L2	54178	w.o.
SMBR55F01	67104	174	STBVP6Q5	64181	118	USDINT-2L2D	54179	w.o.
SMBR55F02	02903	174	STBVP6-RB1	77805	121	USDINT-2L4	55599	w.o.
SMBR55FRA	58809	175	STBVP6-RB1E02	77806	121	USDINT-2L4D	55600	w.o.
SM-GA-5A	66093	92	STBVP6-RB1Q8	78265	121	USDINT-2T2	49785	w.o.
SM-HA-5A	66094	92	STBVP6-RB2	83343	121	USDINT-2T2D	49786	w.o.
SPE1	61864	45	STBVP6-RB2E02	83344	121	USDINT-2T4	55591	w.o.
SPE1Q3	70147	45	STBVP6-RB2Q8	83348	121	USDINT-2T4D	55592	w.o.
SPE1Q5	71983	45	STBVR81	64190	118	USDK2T1224C4YP2	49663	w.o.
SPE1Q8E	75812	45	STBVR81L	64193	w.o.	USDK2T1224C5Y	57021	w.o.
SPK1Q83-2RE15	78353	47	STBVR81LQ	64194	w.o.	USDK2T1224C5YP2	49675	w.o.
SPK1Q88E-1RE25	77372	47	STBVR81LQ6	64195	w.o.	USDK2T1224Y1	42538	w.o.
SPKA-AG12-1	73179	198	STBVR81Q	64191	118	USDK2T1624C4YP2	49664	w.o.
SPKA-AG30-1	73180	198	STBVR81Q6	64192	118	USDK2T1624C5Y	57022	w.o.
SPP1	61866	45	STBVR81-RB1	80685	w.o.	USDK2T1624C5YP2	49676	w.o.
SPP1Q83	74925	45	STP07	69985	185	USDK2T1624Y1	42539	w.o.
SPP1Q88E	76208	45	STP-1	43835	w.o.	USDK2T2024C4YP2	49665	w.o.
SPR1	61865	45	STP-10	62026	w.o.	USDK2T2024C5Y	57023	w.o.
SPR1Q8	70148	45	STP-11	66046	w.o.	USDK2T2024C5YP2	49677	w.o.
SPR1Q8E	75811	45	STP-12	46914	w.o.	USDK2T2024Y1	42540	w.o.
SPXLE1	62747	45	STP-13	71929	28	USDK2T2412C5Y	57031	w.o.
SPXLE1Q3	71094	45	STP-14	71930	28	USDK2T24244C4YP2	46796	w.o.
SPXLE1Q5	74371	45	STP-15	71931	28	USDK2T24244C4YP2	49666	w.o.
SPXLE1Q8E	77326	45	STP-16	82850	36	USDK2T2424C5Y	57024	w.o.
SPXLP1	62748	45	STP-17	82851	36	USDK2T2424C5YP2	49678	w.o.
SPXLP1Q85	74367	45	STP-18	82852	36	USDK2T2424Y1	42541	w.o.
SPXLP1Q88E	77325	45	STP-2	43957	w.o.	USDK2T2824C4YP2	49667	w.o.
SSA-EBM-02E	69705	155	STP25	69986	185	USDK2T2824C5Y	57025	w.o.
SSA-EBM-02L	69699	154	STP-3	43958	28	USDK2T2824C5YP2	49679	w.o.
SSA-EBM-11E	69706	155	STP-4	43836	w.o.	USDK2T2824L5YP2	79086	w.o.
SSA-EBM-11L	69700	154	STP-5	43837	w.o.	USDK2T2824Y1	42542	w.o.
SSA-EBM-12E	69707	155	STP50	77974	185	USDK2T3212C4YP2	54505	w.o.
SSA-EBM-12L	69701	154	STP-6	43838	w.o.	USDK2T3212C5Y	57032	w.o.
SSA-EBP-02E	69708	155	STP-7	48981	w.o.	USDK2T3212C5YP2	54509	w.o.
SSA-EBP-02L	69702	155	STP75	77976	185	USDK2T3212Y1	54473	w.o.
SSA-EBP-11E	69709	155	STP-8	49126	w.o.	USDK2T3224C4YP2	49668	w.o.
SSA-EBP-11L	69703	155	STP-9	50694	w.o.	USDK2T3224C5Y	57026	w.o.
SSA-EBP-12E	69710	155	STPX07	69987	185	USDK2T3224C5YP2	49680	w.o.
SSA-EBP-12L	69704	155	STPX25	69988	185	USDK2T3224Y1	42543	w.o.
SSA-ML-A	70494	193	STPX50	77971	185	USDK2T3624C4YP2	49669	w.o.
SSA-ML-W	62095	193	STPX75	75320	185	USDK2T3624C5Y	57027	w.o.

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USDKT24012YI	54474	w.o.	USDKT1624C4YP2	49628	w.o.	USDKTD3624C4YP2	49705	w.o.
USDKT24024C4YP2	49670	w.o.	USDKT1624C5Y	57003	w.o.	USDKTD3624C5Y	57046	w.o.
USDKT24024C5Y	57028	w.o.	USDKT1624C5YP2	49640	w.o.	USDKTD3624C5YP2	49717	w.o.
USDKT24024C5YP2	49682	w.o.	USDKT1624YI	42527	w.o.	USDKTD3624YI	42556	w.o.
USDKT24024YI	42545	w.o.	USDKT2024C4YP2	49629	w.o.	USDKTD4012C5Y	57052	w.o.
USDKT2424C4YP2	49661	w.o.	USDKT2024C5Y	57004	w.o.	USDKTD4024C4YP2	49706	w.o.
USDKT2424C5Y	57019	w.o.	USDKT2024C5YP2	49641	w.o.	USDKTD4024C5Y	57047	w.o.
USDKT2424C5YP2	49673	w.o.	USDKT2024YI	42528	w.o.	USDKTD4024C5YP2	49718	w.o.
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USDKT24812C5YP2	54511	w.o.	USDKT2424YI	42529	w.o.	USDKTD4424C5YP2	49719	w.o.
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USDKT26412C4YP2	51710	w.o.	USDKT3224C5Y	57007	w.o.	USDKTD50612YI	51742	w.o.
USDKT26412C5Y	57036	w.o.	USDKT3224C5YP2	49644	w.o.	USDKTD6412C5Y	57055	w.o.
USDKT26412C5YP2	51713	w.o.	USDKT3224YI	42531	w.o.	USDKTD7212C5Y	57056	w.o.
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USDKT2712YI	51723	w.o.	USDKT4012C5Y	57014	w.o.	USE1224Y	55138	w.o.
USDKT2824C4YP2	49662	w.o.	USDKT4012C5YP2	54498	w.o.	USE1224YI	42504	w.o.
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USDKT2D2024YI	42564	w.o.	USDKT4812C5YP2	54499	w.o.	USE2824YI	42512	w.o.
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USDKT2D3624C4YP2	49741	w.o.	USDKT71212C4YP2	51702	w.o.	USE4024YI	42518	w.o.
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USDKT2D424C4YP2	49733	w.o.	USDKTD1224C5YP2	49711	w.o.	USE4812Y	55165	w.o.
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USDKT2D4424YI	42570	w.o.	USDKTD2024C5Y	57042	w.o.	USE5612YI	51314	w.o.
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USK2D1624C5Y	57098	w.o.	USKD3212C5Y	57089	w.o.	USR424YP2	49602	w.o.
USK2D1624C5YP2	51564	w.o.	USKD3212C5YP2	54545	w.o.	USR4424Y	55156	w.o.
USK2D1624Y1	51871	w.o.	USKD3212Y1	54485	w.o.	USR4424Y1	42521	w.o.
USK2D2024C4YP2	51550	w.o.	USKD3224C4Y	70407	w.o.	USR4424YP2	49622	w.o.
USK2D2024C5Y	57099	w.o.	USKD3224C4YP2	51508	w.o.	USR4812Y	55166	w.o.
USK2D2024C5YP2	51565	w.o.	USKD3224C5Y	57083	w.o.	USR4812Y1	54467	w.o.
USK2D2024LC4Y	77550	w.o.	USKD3224C5YP2	51523	w.o.	USR4812YP2	54459	w.o.
USK2D2024Y1	51872	w.o.	USKD3224Y1	51860	w.o.	USR4824Y	55158	w.o.
USK2D24123C5Y	81665	w.o.	USKD3624C4YP2	51509	w.o.	USR4824Y1	42523	w.o.
USK2D2412C5Y	57107	w.o.	USKD3624C5Y	57084	w.o.	USR4824YP2	49624	w.o.
USK2D2412C5YP2	54556	w.o.	USKD3624C5YP2	51524	w.o.	USR5612Y	55168	w.o.
USK2D2412Y1	54488	w.o.	USKD3624Y1	51861	w.o.	USR5612Y1	51315	w.o.
USK2D2424C4YP2	51551	w.o.	USKD40123C5YP2	77121	w.o.	USR5612YP2	51309	w.o.
USK2D2424C5Y	57100	w.o.	USKD4012C4YP2	54542	w.o.	USR6412Y	55170	w.o.
USK2D2424C5YP2	51566	w.o.	USKD4012C5Y	57090	w.o.	USR6412Y1	51317	w.o.
USK2D2424Y1	51873	w.o.	USKD4012C5YP2	54546	w.o.	USR6412YP2	51311	w.o.
USK2D2824C4YP2	51552	w.o.	USKD4012Y1	54486	w.o.	USR7212Y	55172	w.o.
USK2D2824C5Y	57101	w.o.	USKD4024C4YP2	51510	w.o.	USR7212Y1	51319	w.o.
USK2D2824C5YP2	51567	w.o.	USKD4024C5Y	57085	w.o.	USR7212YP2	51313	w.o.
USK2D2824Y1	51874	w.o.	USKD4024C5YP2	51525	w.o.	USR824Y	55137	w.o.
USK2D3212C5Y	57108	w.o.	USKD4024Y1	51862	w.o.	USR824Y1	42503	w.o.
USK2D3212Y1	54489	w.o.	USKD424C4YP2	51501	w.o.	USR824YP2	49604	w.o.
USK2D3224C4YP2	51553	w.o.	USKD424C5Y	57076	w.o.	USS12	55118	w.o.
USK2D3224C5Y	57102	w.o.	USKD424C5YP2	51516	w.o.	USS16	55119	w.o.
USK2D3224C5YP2	51568	w.o.	USKD424Y1	51853	w.o.	USS20	55120	w.o.
USK2D3224Y1	51875	w.o.	USKD4424C4YP2	51511	w.o.	USS24	55121	w.o.
USK2D36243C5Y	78406	w.o.	USKD4424C5Y	57086	w.o.	USS28	55122	w.o.
USK2D3624C4YP2	51554	w.o.	USKD4424C5YP2	51526	w.o.	USS32	55123	w.o.
USK2D3624C5Y	57103	w.o.	USKD4424Y1	51863	w.o.	USS36	55124	w.o.
USK2D3624C5YP2	51569	w.o.	USKD48123C5Y	79925	w.o.	USS4	55116	w.o.
USK2D3624Y1	51876	w.o.	USKD4812C4YP2	54543	w.o.	USS40	55125	w.o.
USK2D4012C5Y	57109	w.o.	USKD4812C5Y	57091	w.o.	USS44	55126	w.o.
USK2D4012C5YP2	54558	w.o.	USKD4812C5YP2	54547	w.o.	USS48	55127	w.o.
USK2D4024C4YP2	51555	w.o.	USKD4812Y1	54487	w.o.	USS56	55128	w.o.
USK2D4024C5Y	57104	w.o.	USKD4824C4YP2	51512	w.o.	USS64	55129	w.o.
USK2D4024C5YP2	51570	w.o.	USKD4824C5Y	57087	w.o.	USS72	55130	w.o.
USK2D4024Y1	51877	w.o.	USKD4824C5YP2	51527	w.o.	USS8	55117	w.o.
USK2D424C4YP2	51546	w.o.	USKD4824Y1	51864	w.o.	US-XPE-32	63438	w.o.
USK2D424C5Y	57095	w.o.	USKD5612C4YP2	51513	w.o.	US-XPE-43	64214	w.o.
USK2D424C5YP2	51561	w.o.	USKD5612C5Y	57092	w.o.	UTB-3100C	69275	186
USK2D424Y1	51868	w.o.	USKD5612C5YP2	51528	w.o.	UTB-3250C	69276	186
USK2D4424C4YP2	51556	w.o.	USKD5612Y1	51865	w.o.	UTB-325C	69273	186
USK2D4424C5Y	57105	w.o.	USKD6412C4YP2	51514	w.o.	UTB-350C	69274	186
USK2D4424C5YP2	51571	w.o.	USKD6412C5Y	57093	w.o.	UTB-5100C	69279	186
USK2D4424Y1	51878	w.o.	USKD6412C5YP2	51529	w.o.	UTB-5250C	69280	186
USK2D4812C5Y	57110	w.o.	USKD6412Y1	51866	w.o.	UTB-525C	69277	186
USK2D4824C4YP2	51557	w.o.	USKD7212C4YP2	51515	w.o.	UTB-550C	69278	186
USK2D4824C5Y	57106	w.o.	USKD7212C5Y	57094	w.o.	UTB-8100C	69287	186
USK2D4824C5YP2	51572	w.o.	USKD7212C5YP2	51530	w.o.	UTB-8250C	69288	186
USK2D4824Y1	51879	w.o.	USKD7212Y1	51867	w.o.	UTB-825C	69285	186
USK2D5612C4YP2	51558	w.o.	USKD8243C4YP2	79757	w.o.	UTB-850C	69286	186
USK2D5612C5Y	57111	w.o.	USKD824C4YP2	51502	w.o.			
USK2D5612C5YP2	51573	w.o.	USKD824C5Y	57077	w.o.			
USK2D5612Y1	51880	w.o.	USKD824C5YP2	51517	w.o.			
USK2D6412C4YP2	51559	w.o.	USKD824Y1	51854	w.o.			
USK2D6412C5Y	57112	w.o.	USMAB-1	64734	w.o.			
USK2D6412C5YP2	51574	w.o.	USMAL-1	60643	w.o.			
USK2D6412Y1	51881	w.o.	USMA-PSC-1	60642	w.o.			
USK2D7212C4YP2	51560	w.o.	USMB-1	50000	176			
USK2D7212C5Y	57113	w.o.	USMB-4	55668	w.o.			
USK2D7212C5YP2	51575	w.o.	USMB-5	55669	w.o.			
USK2D7212Y1	51882	w.o.	USMB-6	57140	176			
USK2D824C4YP2	51547	w.o.	USMB-8	75115	176			
USK2D824C5Y	57096	w.o.	USR1224Y	55139	w.o.			
USK2D824C5YP2	51562	w.o.	USR1224Y1	42505	w.o.			
USK2D824LC4Y	77551	w.o.	USR1224YP2	49606	w.o.			
USK2D824Y1	51869	w.o.	USR1624Y	55141	w.o.			
USK2T12243C5YP2	80426	w.o.	USR1624Y1	42507	w.o.			
USK2T3624C4Y	81277	w.o.	USR1624YP2	49608	w.o.			
USK2T40243C5Y	77601	w.o.	USR2024Y	55144	w.o.			
USK2T56123C5YP2	80530	w.o.	USR2024Y1	42509	w.o.			
USKCM4824LY1	79538	w.o.	USR2024YP2	49610	w.o.			
USKD1224C4YP2	51503	w.o.	USR2412Y	55160	w.o.			
USKD1224C5Y	57078	w.o.	USR2412Y1	54461	w.o.			
USKD1224C5YP2	51518	w.o.	USR2412YP2	54453	w.o.			
USKD1224Y1	51855	w.o.	USR2424Y	55146	w.o.			
USKD1624C4YP2	51504	w.o.	USR2424Y1	42511	w.o.			
USKD1624C5Y	57079	w.o.	USR2424YP2	49612	w.o.			
USKD1624C5YP2	51519	w.o.	USR2824Y	55148	w.o.			
USKD1624Y1	51856	w.o.	USR2824Y1	42513	w.o.			
USKD20243C4Y	76999	w.o.	USR2824YP2	49614	w.o.			
USKD2024C4YP2	51505	w.o.	USR3212Y	55162	w.o.			
USKD2024C5Y	57080	w.o.	USR3212Y1	54463	w.o.			
USKD2024C5YP2	51520	w.o.	USR3212YP2	54455	w.o.			
USKD2024Y1	51857	w.o.	USR3224Y	55150	w.o.			
USKD2412C4YP2	54540	w.o.	USR3224Y1	42515	w.o.			
USKD2412C5Y	57088	w.o.	USR3224YP2	49616	w.o.			
USKD2412C5YP2	54544	w.o.	USR3624Y	55152	w.o.			
USKD2412Y1	54484	w.o.	USR3624Y1	42517	w.o.			
USKD2424C4YP2	51506	w.o.	USR3624YP2	49618	w.o.			
USKD2424C5Y	57081	w.o.	USR4012Y	55164	w.o.			
USKD2424C5YP2	51521	w.o.	USR4012Y1	54465	w.o.			
USKD2424Y1	51858	w.o.	USR4012YP2	54457	w.o.			
USKD2824C4YP2	51507	w.o.	USR4024Y	55154	w.o.			
USKD2824C5Y	57082	w.o.	USR4024Y1	42519	w.o.			

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