

## Applications de protection et schémas de câblage

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## Sélection des applications

Page	SIL CL	PL	Cat.*	Cat. d'arrêt	Barrière immatérielle	Tapis	Scrutateur laser	Interrupteur à broche	Sans contact	Gâche de sécurité	Arrêt d'urgence	Commande par câble
					Guard-Shield						800F	Lifeline
Dispositif d'entrée												
5	3	e	4	0	•						•	
6	2	d	3	0							•	•
7	2	d	4	0				Trojan 5	SensaGuard			
8	2	d	3	0	•							
9	3	e	4	0	•	•			Sipha		•	
10	2	d	3	0				Elf Trojan 15			•	
11	3	e	4	0	•	•			Sipha		•	
12	2	d	3	0				MT-GD2				
13	3	e	3/4	0/1						TLS-GD2	•	
14	3	e	4	0	•						•	
15	2	d	3	0				Cadet 3 Trojan 5 MT-GD2				
16	2	d	3	0				Trojan 5				
17	2	d	3	1							•	
18	2	d	3	0				Trojan 15				
19	3	e	3/4	0							•	
20	3	e	3/4	1							•	
21	3	e	4	0							•	
22	3	e	4	0	•		•		SensaGuard	440G-MT	•	
23	3	e	3/4	0/1	•		•		SensaGuard	440G-MT	•	
24	3	e	3/4	0/1	•	•			SensaGuard	440G-MT	•	
25	3	e	3/4	0/1	•		•		SensaGuard	440G-MT	•	
26	3	e	4	0/1	•					440G-MT		
27	3	e	4	0							•	
28	3	e	4	1								
29	2	d	3	1						TLS3-GD2	•	
30	2	d	3	0	•							
31	3	e	4	0	•							
32	3	e	4	0	•							
33	3	e	4	0								
34	3	e	4	0	•					TLS3-GD2		
35	3	e	4	1							•	
36	3	e	4	0/1							•	
37	2	d	3	1		•						
38	3	e	4	0	•							
39	3	e	4	0	•							
40	3	e	4	0	•							

\* Ces caractéristiques sont des directives générales qui sont susceptibles de convenir dans la plupart des cas. Les caractéristiques de performance de sécurité sont appliquées aux fonctions de sécurité. Les caractéristiques de sécurité doivent être appliquées à partir d'un dispositif d'entrée via un dispositif logique sur un dispositif de sortie. Nombre d'exemples d'application contiennent plusieurs dispositifs et peuvent avoir plusieurs fonctions de sécurité. Par conséquent, une analyse détaillée de l'application et une complète mise en œuvre de la norme sont requises et peuvent conduire à des caractéristiques différentes des recommandations fournies.

Poignée de sécurité										Variateur	Mouvement	
Poignée	Automate standard	Série 100	Spécialisé	Série 200	Série 300	GuardPLC	SmartGuard	Guard I/O	Contacteurs	Drive-Guard	Guard-Motion	
Dispositif d'entrée		Logique							Dispositifs de sortie			Page
		MSR127							100S			5
		MSR127							100S			6
	•	MSR127							100S			7
		MSR126	MSR35H						100S			8
				•					700S			9
	•	MSR127							100S			10
					•				100S-700S			11
•		MSR127	MSR178							•		12
		MSR138							700S			13
					•				100S			14
		MSR127								•		15
	•	MSR127			•					•		16
								CompactBlock		•		17
		MSR126							Flex I/O			18
		MSR138							100S		•	19
		MSR138									•	20
								CompactBlock	100S		•	21
						1600			100S			22
						1800			100S-700S			23
							•		100S			24
								CompactBlock	100S-700S			25
								CompactBlock	100S-700S			26
		MSR142							Vanne			27
•		MSR138	MSR178						100S			28
•			MSR57							•		29
				MSR211					100S			30
			MSR22LM						100S			31
									100S			32
					•				100S			33
		MSR138							100S			34
		MSR144							100S-700S			35
		MSR210		MSR230/ MSR238					100S			36
			Mat Manager						100S			37
			MSR41						100S			38
			MSR42						100S			39
			MSR42						100S			40

**Remarque 1**

Dans les circuits suivants, le type de dispositif Allen-Bradley/Guardmaster est pris en exemple pour illustrer le principe du circuit. Pour des applications spécifiques, le choix du type de dispositif doit être basé sur l'adéquation de ses caractéristiques à l'utilisation prévue.

**Remarque 2**

Dans la plupart des exemples suivants montrant des applications à double voie, un interrupteur de sécurité est montré commutant les deux voies (un jeu de contacts par voie). S'il est prévisible que des dégâts survenus sur le dispositif de protection (p. ex., au niveau de la fixation de l'actionneur) puissent avoir pour conséquence qu'il soit ouvert sans que l'interrupteur ne soit actionné, alors deux interrupteurs séparés peuvent être requis. Le principe électrique du circuit reste identique.

**Remarque 3**

Dans la plupart des cas, les circuits sont illustrés avec la barrière de protection fermée et prête pour le démarrage du moteur par activation de la commande de démarrage normale.

Il doit être possible de démarrer la machine uniquement par activation volontaire de la commande (voir ISO 12100-2 4.11.8). Ces exemples s'appuient sur l'utilisation d'un circuit de verrouillage à contacteur conventionnel. Si ce n'est pas le cas, un dispositif de verrouillage du redémarrage est requis afin d'empêcher le démarrage automatique ou involontaire du moteur lorsque la barrière de protection est fermée. Par exemple, un relais de sécurité Minotaur avec un bouton-poussoir momentané installé dans le circuit de surveillance de sortie peut être utilisé dans ce but.

Si la protection est reconnue comme protection de contrôle (voir ISO 12100-2 5.3.2.5), ces exigences ne s'appliquent pas mais l'utilisation de protections de contrôle n'est autorisée que dans certaines conditions, notamment :

- une protection de contrôle peut être utilisée uniquement lorsqu'il n'est pas possible qu'un opérateur ou une partie seulement du corps de l'opérateur reste ou pénètre dans la zone dangereuse lorsque la barrière est fermée ;
- la protection de contrôle doit être le seul moyen d'accès à la zone dangereuse ;
- le système de verrouillage doit présenter une fiabilité aussi élevée que possible. Il est souvent recommandé d'utiliser un dispositif de verrouillage à électroaimant, comme le Guardmaster Atlas ou TLS-GD2.

**Remarque 4**

Relais de surveillance de sécurité utilisés dans les circuits à double voie avec fonctionnement peu fréquent ou avec plus d'un commutateur connecté. Cette remarque concerne tous les dispositifs de surveillance qui utilisent la technique consistant à comparer le signal au moment du changement d'état des deux voies.

Certains défauts sont détectés uniquement lors du changement d'état du dispositif de commutation d'entrée (interrupteur de sécurité ou arrêt d'urgence). S'il existe de longues périodes (p. ex., des mois plutôt que des jours) entre les actions de déclenchement, il est possible que plusieurs défauts s'accumulent, ce qui peut conduire à une situation dangereuse. Il faut donc vérifier régulièrement le système afin de détecter les défauts individuels avant qu'ils ne s'accumulent. Cette vérification peut être manuelle ou initiée par une partie du système de commande machine.

Si par exemple 3 interrupteurs de sécurité sont raccordés à l'unité de surveillance, certains défauts sont détectés uniquement au niveau de l'interrupteur de la première barrière de protection devant être ouverte et de l'interrupteur sur la dernière barrière devant être fermée. Cela est dû au fait que toute commutation entre la première ouverture/la dernière fermeture ne change pas l'état des circuits d'entrée de surveillance. Par conséquent, dans certaines applications il peut être nécessaire d'utiliser un dispositif de surveillance par interrupteur.

La plupart des exemples suivants montrent un interrupteur de sécurité et un arrêt d'urgence combinés dans le circuit. Lorsqu'un relais de surveillance (p. ex. Guardmaster Minotaur) est utilisé pour la détection des défauts, il est important de prendre en considération les points suivants :

- tous les défauts individuels critiques pour la sécurité, sauf certains défauts des jeux de contacts sur l'arrêt d'urgence, sont détectés lors de l'ouverture suivante de la protection ;
- tous les défauts individuels critiques pour la sécurité, sauf certains défauts des jeux de contacts sur l'interrupteur de sécurité, sont détectés lors du déclenchement suivant de l'arrêt d'urgence ;
- étant donné que le dispositif d'arrêt d'urgence a peu de chance d'être déclenché fréquemment, il est recommandé de vérifier son fonctionnement (avec la protection fermée) à intervalles réguliers (début de la période de travail ou quotidiennement) afin de permettre au Minotaur de détecter les défauts individuels. Si la protection est rarement ouverte, l'interrupteur de sécurité doit être vérifié de façon similaire.

**Remarque 5**

- ⤵ Ce symbole indique que le composant ou le dispositif associé possède la fonction d'ouverture directe (sécurité positive). En cas de défaut, l'ouverture des contacts soudés est forcée par le mouvement de la barrière de protection.
- ⊗ Ce symbole indique des contacts à couplage mécanique ; si un contact se trouve soudé en position fermée, tous les autres contacts dépendant (auxiliaires) restent en position, c.-à-d. qu'il ne peuvent pas changer d'état.

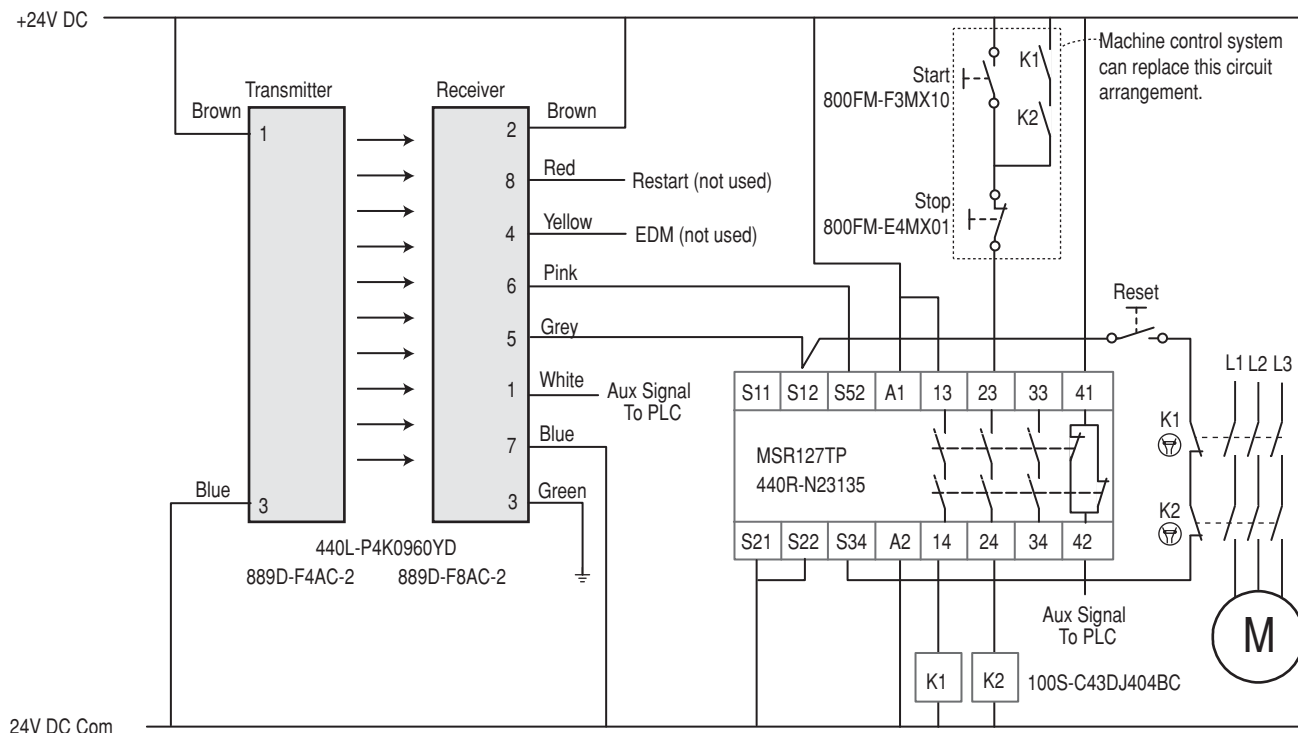
**Information générale concernant la sécurité****IMPORTANT**

Cet exemple d'application est destiné aux utilisateurs qualifiés et présuppose que vous êtes formé et expérimenté dans la configuration du système de sécurité.  
Contactez Rockwell Automation pour en savoir plus sur nos services d'évaluation des risques liés à la sécurité.

**ATTENTION**

Une évaluation de risque doit être exécutée pour s'assurer que toutes les combinaisons de tâche et de risque ont été identifiées et prises en compte. L'évaluation de risque peut entraîner l'utilisation de circuits supplémentaires pour réduire le risque à un niveau tolérable. Les circuits de sécurité doivent prendre en considération des calculs de distance de sécurité qui ne font pas partie du sujet de ce document.

Pour d'autres informations importantes destinées à l'utilisateur et recommandations de sécurité, voir pages G-2 et G-3 dans la section Généralités de ce catalogue.



### Circuit Status

The light curtain is configured with the factory default settings (Guard only mode) and is unobstructed. The outputs of the safety relay are open. The motor is off and ready to run.

### Operating Principle

**STARTING:** Press the Reset button to close the outputs of the MSR127. Press the Start button to energize contactors K1 and K2. The motor starts with the two normally open contacts of K1 and K2 holding the circuit energized.

**STOPPING:** Obstructing the light curtain de-energizes the safety outputs of the MSR127, which in turn drops out K1 and K2. The contactors disconnect the motor from its power source, and the motor coasts to a stop. Clearing the obstruction in the light curtain does not cause the motor to energize (the Reset and Start buttons must be pressed). The motor can also be turned off by pressing the stop button.

### Fault Detection

Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR127 checks the signals from the light curtain. If OK, the MSR127 then checks the status of the K1 and K2 contactors. If either K1 or K2 fails in the actuated state, the other contactor will disconnect the motor. The MSR127 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

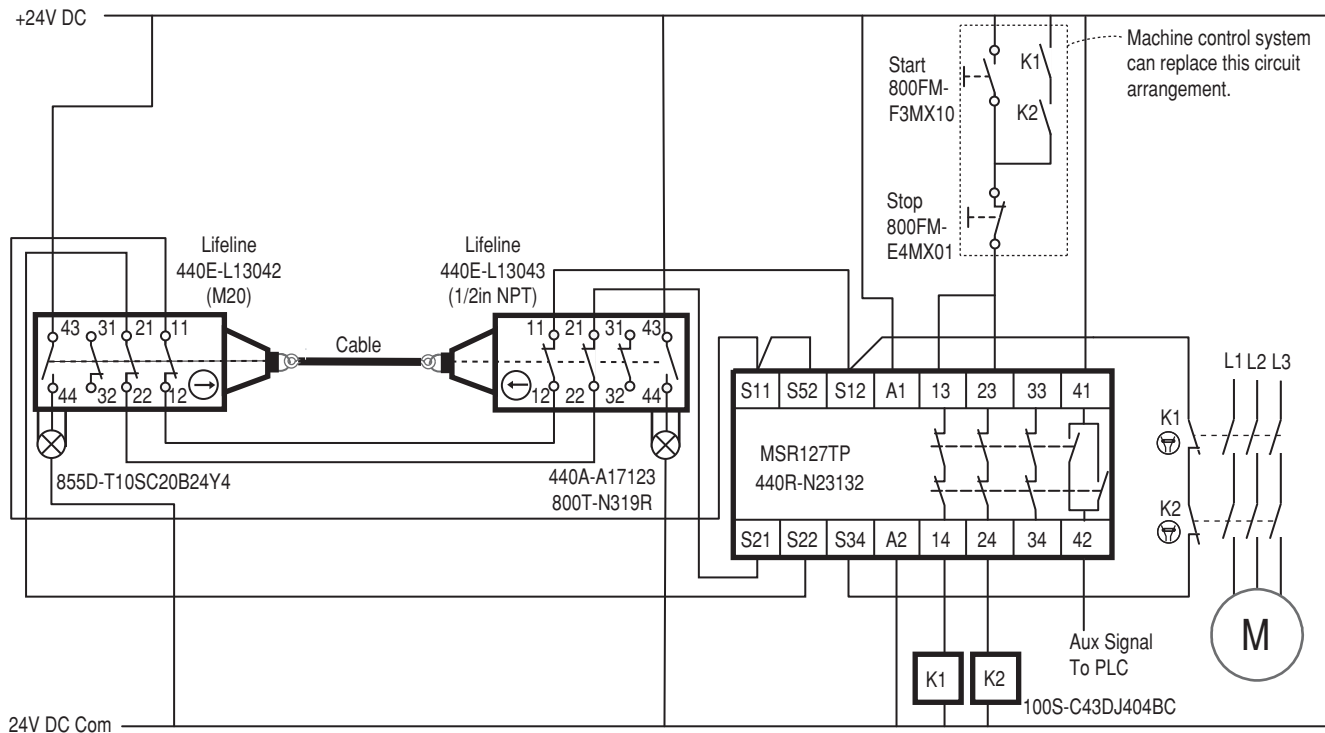
Contactors K1 and K2 are controlled by the safety system. Contactor K2 is controlled by both the machine control system and the safety system. This increases the probability of performance of the safety function because K1 is significantly less likely to weld at the same time as K2 due to the diversity of expected wear out times.

### Ratings

The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLE per ISO 13849-1:2006. This circuit executes a Category 0 stop.

## Commande par câble

Lifeline, 800F, MSR127, 100S



### Circuit Status

Both Lifeline cable pull switches are taut and reset; their contacts are closed. The MSR127 safety relay is energized, as its inputs and monitoring circuits are satisfied. The motor is off and ready to run.

### Operating Principle

Two cable pull switches are used to protect an area over 10 meters in length. Auxiliary lights provide indication as to which switch has been actuated to stop the motor. The difference between the two switches is the conduit thread and is shown for example purposes.

**STARTING:** Press the Start button to energize contactors K1 and K2. The motor starts and the two normally open contacts of K1 and K2 close to hold the circuit energized across the Start button.

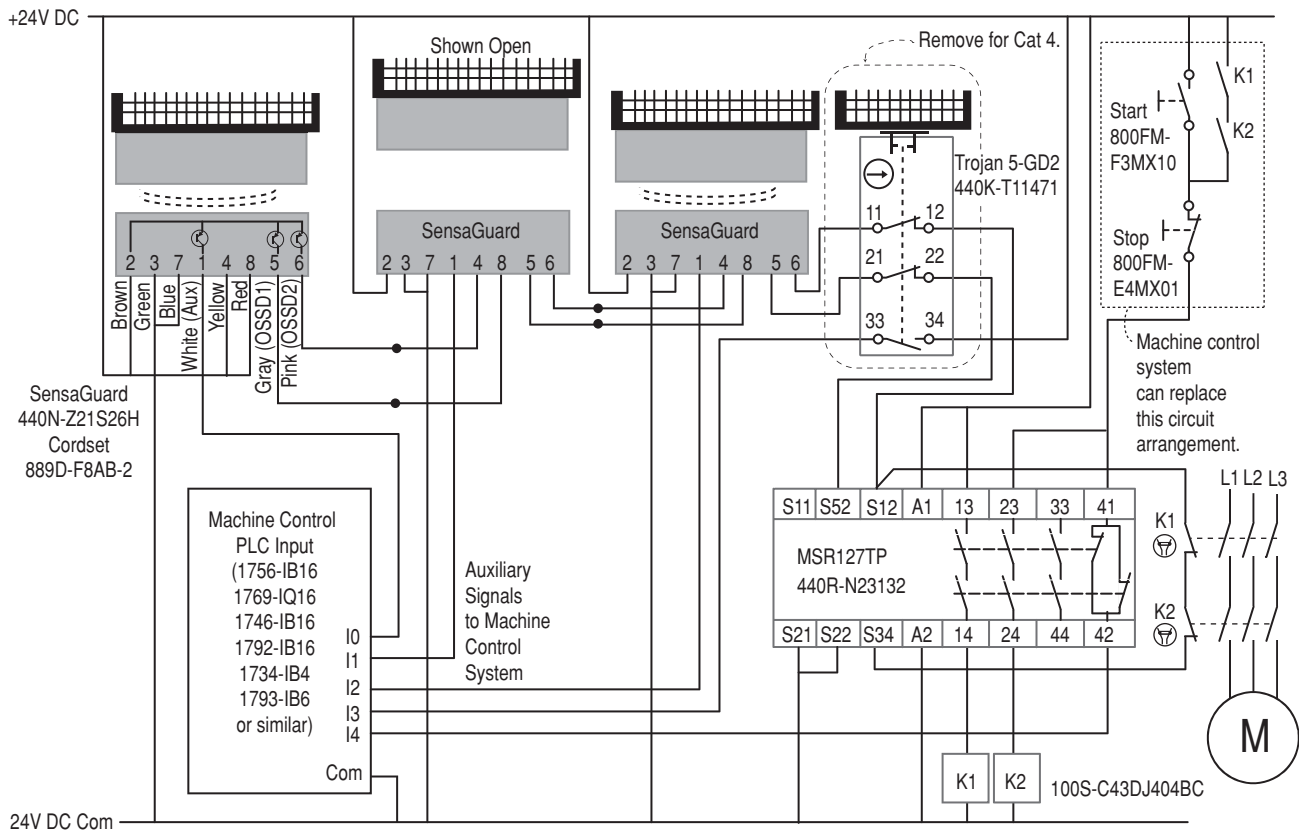
**STOPPING:** Pull the Lifeline cable or press the e-stop button on the Lifeline switch to de-energize the outputs of the MSR127 and turn off the motor. To restart the motor, make sure the area is clear of hazards, pull out the e-stop button (if pressed) and rotate the reset knob on the Lifeline 4 to the Run position. Then press the Start button to start the motor. As an alternative, the motor can be stopped by pressing the Stop pushbutton. It can then be restarted by pressing the Start pushbutton.

### Fault Detection

Upon successful completion of internal checks on power up, the MSR127 checks its input circuits. With both Lifeline switches reset, the MSR127 checks the output contactors through the S12/S34 circuit. If the contactors are off, the MSR127 energizes its outputs and turns on the contactors which turn on the motor. A short or open circuit fault in the Lifeline cable pull switches will be detected by the MSR127. If either the K1 or K2 faults in the energized state, the motor will be stopped by the other contactor and the fault will be detected by the MSR127 on the next attempt to restart. An internal fault in the MSR127 will be detected by itself. Depending on the type of fault, the result will be de-energization of the K1 and K2 contactors or prevention of re-start.

### Ratings

The safety function initiated by the Lifeline cable pull switches meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. The series connection of the Lifeline cable switches limits the circuit to SIL CL2 and Category 3. This circuit executes a Category 0 stop.



### Circuit Status

The first, third and fourth gates are closed. The second gate is open. The MSR127 safety relay S12 and S52 inputs are open due to the open gate, and therefore, the MSR127 safety outputs are open. The machine control PLC has a 24V auxiliary signal at terminal I1 from the second gate because the gate is open. The 1st, 3rd and 4th auxiliary signals are off, as their gates are closed. The PLC also has an auxiliary signal from the MSR127 indicating that the safety system is not ready. The motor is off.

### Operating Principle

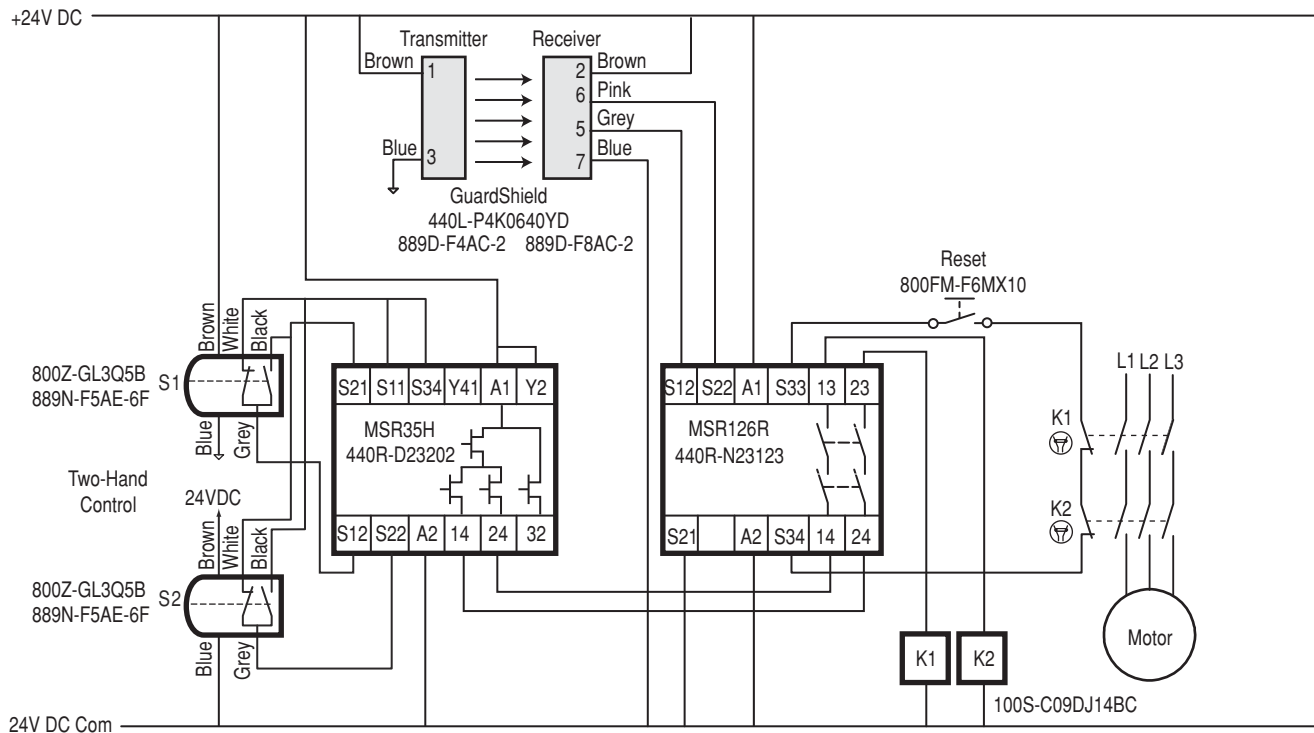
**STARTING:** Closing the second gate satisfies the input of the MSR127. The MSR127 verifies that both K1 and K2 contactors are off and energizes its safety outputs. Pressing the start button energizes the motor. The Stop/Start circuit is not part of the safety system and can be replaced by the machine control system (e.g., a PLC). **STOPPING:** Press the Stop button to turn the motor off, without affecting the status of the safety system. Opening any of the gates will cause the safety system to stop the motor.

### Fault Detection

Upon successful completion of internal checks on power up, the SensaGuard interlocks check for 24V at pins 4 and 8. If the actuator is within range, the SensaGuard will activate its OSSD outputs. The OSSD outputs perform continuous checking for short circuits to 24V, ground and crossfaults. Upon detection of a fault, the OSSD outputs turn off. The MSR127 also performs internal checks on power-up. It then checks for input signals. If okay, the MSR127 checks the S12/S34 monitoring circuit to determine whether both contactors are off. If one of the contactors gets stuck on, the other contactor will de-energize the motor, and the MSR127 will detect the fault at the next attempt to start the motor. The contactors have mechanically linked auxiliary contacts to help ensure fault detection of the contactors. Contactors K1 and K2 are controlled by the safety system. Contactor K2 is controlled by both the machine control system and the safety system. This increases the probability of performance of the safety function because K1 is significantly less likely to weld at the same time as K2 due to the diversity of expected wear out times.

### Ratings

The safety function initiated by the Lifeline cable pull switches meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. When a device with two mechanically operated contacts is connected in series with the SensaGuard, the maximum rating is Category 3. If the Trojan 5 GD2 were removed from the circuit, the safety performance meets the requirements of Category 4. The SensaGuard interlocks are designed to meet Category 4 when connected in series. The MSR127 is rated to Category 4. The design and connection of the contactors meets category 4. This example circuit performs a Stop Category 0 function (coast to stop).



### Circuit Status

The operator's hands are not on the two 800Z palm buttons. The outputs of the MSR35H are off. The light curtain is configured with the factory default settings (Guard only mode) and is unobstructed. The outputs of the MSR126R safety relay are off. The motor is off and ready to run.

The light curtain is protecting one portion of the machine. An operator, using two-hand control is accessing a different portion of the machine and has full view of his or her area.

### Operating Principle

**STARTING:** Press the Reset button to energize the output of the MSR126. The operator places both hands on the 800Z buttons simultaneously (within 0.5 s). The outputs of the MSR35H (terminals 14, 24) energize the 100S contactors, which start the motor.

**STOPPING:** Removing one or both hands from the 800Z palm buttons causes the outputs of the MSR35H to turn off, which drops out K1 and K2 and stops the motor. Obstructing the light curtain de-energizes the safety outputs of the MSR126R, which in turn drops out K1 and K2 and turns the motor off. Clearing the light curtain does not restart the motor, even if the operator has their hands on the palm buttons. The reset button must be pressed after the light curtain is cleared.

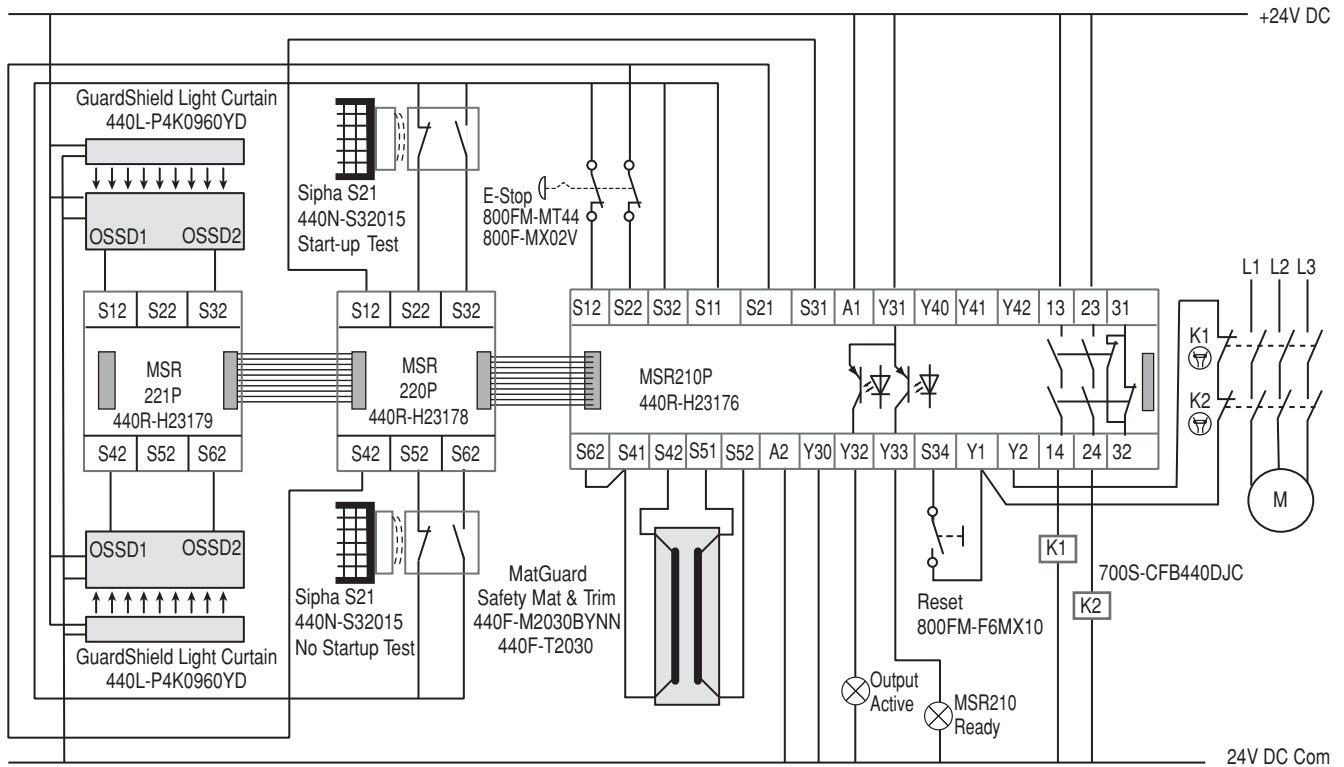
### Fault Detection

Upon power up, the 800Z, GuardShield, MSR35H and MSR126 perform internal checks. After passing internal checks, the MSR35H waits for a change of state of its inputs. Faults (opens and shorts) at the inputs will be detected by the MSR35H and prevent the outputs from being energized. The GuardShield light curtain also performs checks on its OSSD output signals for crossfaults, shorts and opens. The MSR126 looks for dual signals at its inputs. It then checks the status of the contactors. If one contactor fails in the actuated state, the other contactor will stop the motor. The MSR126 will detect if one of the contactors are stuck in the energized position, and prevents restart.

### Ratings

The safety function initiated by the light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure, which can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety function initiated by the 800Z palm buttons meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.





### Circuit Status

The light curtains are unobstructed. The safety gates are closed. The e-stop is reset and the safety mat is unoccupied. The MSR210 outputs are off. The motor is ready to run.

### Operating Principle

The MSR200 is chosen as the safety relay for its modularity and ability to handle diverse devices, and to allow each device to be connected to individual inputs. The MSR200 has communication modules (not shown) to allow individual status information to be transmitted to the machine control system.

**STARTING:** Press the reset button to energize the outputs of the MSR210 and turn the motor on.

**STOPPING:** Activating any one of the safety devices (light curtain, e-stop, safety mat, or gate) de-energizes the MSR210 outputs and the motor coasts to a stop. If a safety device is activated, the motor cannot start.

### Fault Detection

Upon successful completion of internal checks on power up, the MSR210P checks the input circuits. Shorts from the inputs to power, to ground or to other inputs will be detected immediately by the MSR210P and will prevent energization or will de-energize all of its outputs. If one of the 700S safety control relays (K1 or K2) fails in an actuated state, the motor will be able to stop by the 2nd relay (K2 or K1). This type of fault will be detected by the MSR210P on the next attempt to restart, and the MSR210P will not energize its outputs when the reset button is pressed. Upon power-up, one of the safety gates must be opened and closed to confirm proper operation.

Since the noncontact sensor uses a N.O. contact, a broken wire may exist prior to usage. A startup test confirms the operation of the N.O. contact. For Start-up test, connect terminal S12 or S42 to terminal S31. If startup test is not desired, connect S12 or S42 to S21. With the start-up test, the gates must be opened and closed to confirm operation of both the N.O. and N.C. contacts. After successful completion of the start-up test, the reset button must be pressed momentarily to energize the outputs of the MSR210P.

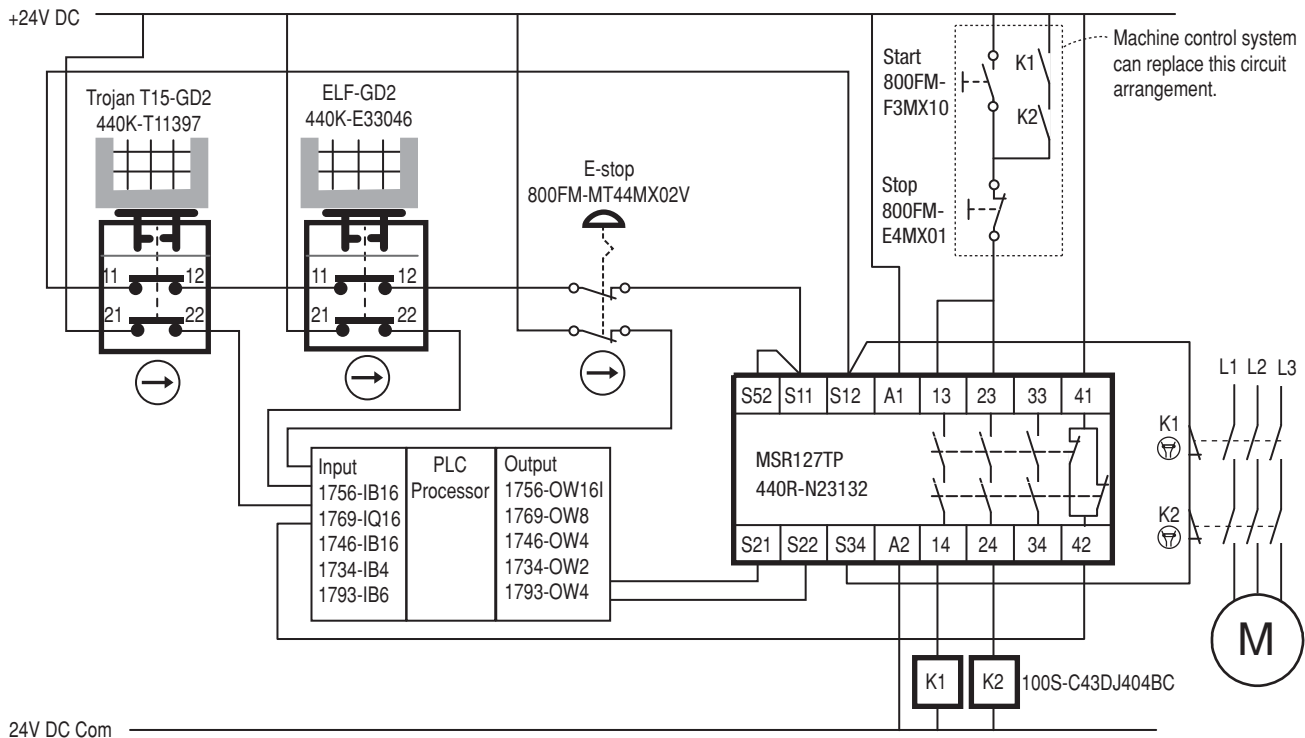
### Ratings

The safety functions initiated by the GuardShield light curtains, Sipa non-contact interlocks, and the 800F e-stop button meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety functions initiated by the safety mat are limited to SIL CL 2 and Category 3, PLd. This example circuit performs a Stop Category 0 function (coast to stop).

# Applications de protection et schémas de câblage

## Interrupteurs de sécurité – Accès multiple

### Trojan T15, Elf-GD2, 800F, MSR127, 100S



#### Circuit Status

Circuit shown with the safety gates closed and e-stop released. The safety relay is de-energized. The motor is off.

#### Operating Principle

With 2 N.C. + 1 N.O. interlocks, a potential exists for the gate to be slightly open which results in the auxiliary contact being closed and the safety being open. The machine cannot start and the PLC does not know which gate is open. By sending the second safety channel through the PLC, the machine control system knows which door is open, when the safety system is off due to a gate that may be slightly open. The infinite simultaneity feature of safety relays like the MSR127 allow enough time for the PLC to process all the gates and close the second channel of the safety relay without creating a lockout condition.

When a safety gate is opened, the interlock opens Ch1 directly to the safety relay and opens Ch2 which is connected to the input of a PLC. The PLC must then open Ch2 of the safety relay. The logic in the PLC must open the Ch2 signal if any one or more of the safety gates are open and must only close the Ch2 circuit when all of the safety gates and e-stop are closed. The PLC can also use the information on the inputs on PanelView or similar device. The auxiliary signal (41/42) from the MSR127 must be an input to the PLC. This PLC program must only close its output when all the safety inputs are closed and the auxiliary signal from the MSR127 is closed. This allows the PLC to indirectly confirm that its own output is working properly.

**STARTING:** Channel 1 input (S11/S12) of the MSR127 is satisfied. Using isolated relay contacts in its output module, the PLC closes the second safety channel (21/22 of the MSR127). The safety outputs of the MSR127 close. Press the Start button to start the motor.

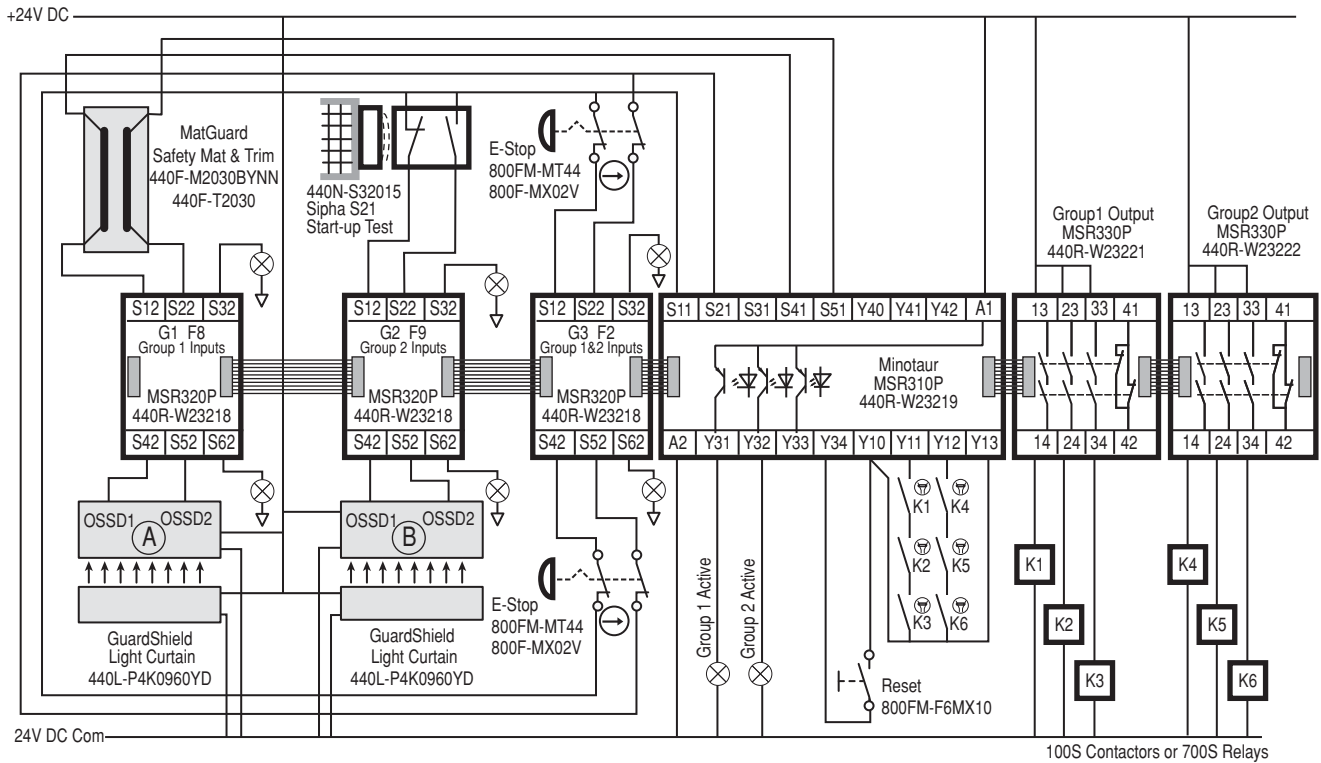
**STOPPING:** Opening any one of the safety gates or pressing the e-stop causes the motor to turn off. Closing the gate or releasing the e-stop does not cause the motor to start due to the start-stop interlocking circuit. To restart the motor, close the safety gate or release the e-stop. Then press the start button.

#### Fault Detection

If the PLC fails with its output closed, the safety relay will detect the difference between the safety gate and the PLC and stop the motor. A single fault (open or short) across one of the interlocks will be detected by the safety relay and the motor will be turned off. The motor will remain off until the fault is corrected or power is cycled. If either contactor K1 or K2 sticks ON—the motor will stop on command due to the other contactor, but the MSR127 cannot be reset (thus the fault is revealed to the operator). A single fault detected on the MSR127 input circuits will result in the lock-out of the system to a safe state (OFF) at the next operation of the safety gate or e-stop device.

#### Ratings

The safety function initiated by the Trojan T15 safety gate interlocks and the 800F e-stop meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0.



### Circuit Status

The light curtains are unobstructed. The safety gate is closed. The e-stops are reset, and the safety mat is unoccupied. The MSR330P outputs are off. K1-K6 are ready to be energized.

### Operating Principle

The MSR300 is chosen as the safety relay for its zoning capability. The two e-stops operate globally—turning off both sets of outputs for Groups 1 and 2. The light curtain A and safety mat control the outputs of Group 1. The light curtain B and safety gate control the outputs of Group 2. With no connections to Y40-Y42, all outputs have monitored manual reset.

**STARTING:** Press the reset button to energize all MSR330P outputs.

**STOPPING:** Obstructing the light curtain A or stepping on the safety mat turns off the Group 1 outputs while leaving the Group 2 outputs energized. The reset button must be pressed to re-energize the Group 1 outputs after light curtain A and safety mat are cleared. Obstructing the light curtain B or opening the safety gate turns off the Group 2 outputs. The reset button must be pressed to re-energize the Group 2 outputs after light curtain B is cleared and the safety gate is closed. Pressing either e-stop de-energizes both Group 1 and Group 2 outputs. The e-stop must be released and the reset button must be pressed to re-energize the Group 1 and 2 outputs.

### Fault Detection

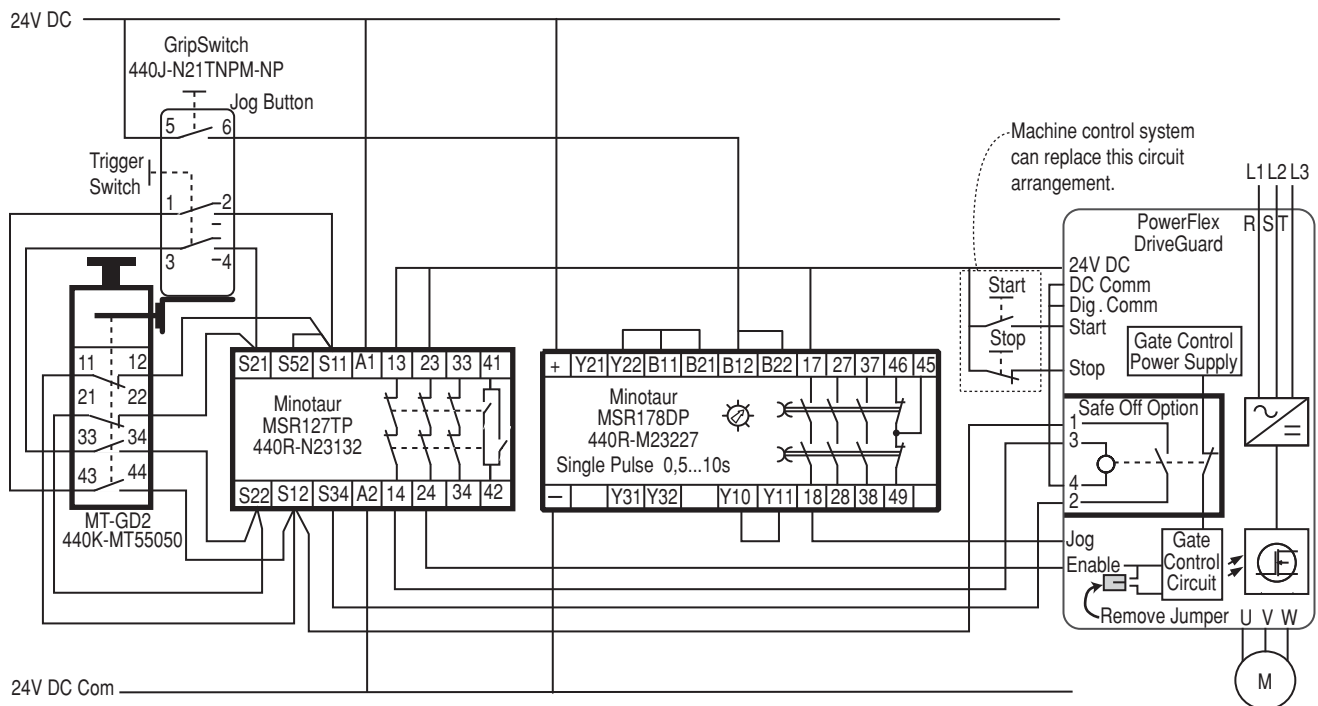
Upon successful completion of internal checks on power up, the MSR310P checks the input circuits. Shorts from the inputs to power, ground or other inputs will be detected immediately and will prevent energization or will de-energize the MSR330P outputs. If one of the 100S or 700S output devices (K1-K6) is stuck in an actuated state, the MSR310P will prevent startup because the Y11 or Y12 feedback loop will remain open.

### Ratings

The rating assumes that two contactors are connected in series to power a hazard (not shown). The safety function initiated by the GuardShield light curtains, Sipa interlocks and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. The safety function initiated by MatGuard safety mats meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

**Poignée de sécurité & variateur – Marche par à-coup de sécurité**

440G-MT, GripSwitch, MSR127, MSR178, PowerFlex DriveGuard

**Circuit Status**

The 440J GripSwitch is held by the MT-GD2. The MSR127 safety outputs are closed. The PowerFlex Enable and Safe-off option are energized. The MSR178 safety outputs are de-energized. The motor is ready to run.

**Operating Principle**

The MSR178 is chosen for its ability to perform timing functions. In this case, the MSR178 is set up to jog the PowerFlex drive with a single pulse having a duration set between 0.5 to 10 s (no jumpers from Y10 to Y31 or Y32 and fine adjustment made by potentiometer on front of MSR178). While in the MT-GD2 holder, the GripSwitch is disabled, and the drive can be controlled by the machine control system (not shown).

**STARTING:** Close the three-position trigger switch to the mid-position. Remove the enabling switch from the MT-GD2 holder. Press and hold the Jog button on the GripSwitch to initiate the operation of the MSR178. The MSR178 closes its safety outputs for the set duration.

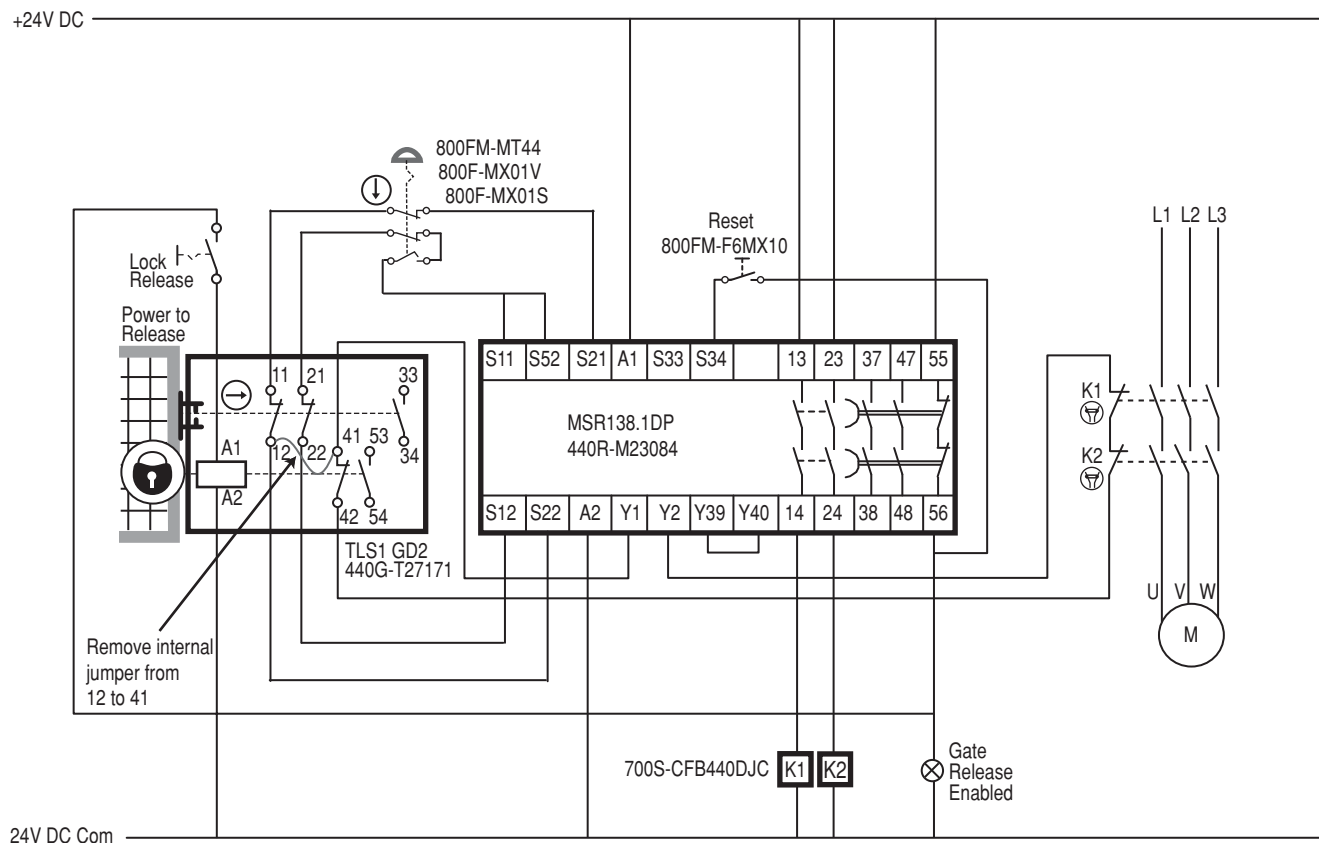
**STOPPING:** The jog function stops after the set time expires. To restart, momentarily release the jog button and then re-close it to repeat the jog. Releasing or squeezing the three-position switch opens the outputs of the MSR127, and the PowerFlex drive executes a coast to stop.

**Fault Detection**

Upon successful completion of internal checks by the MSR127, MSR178 and the PowerFlex drive, the drive awaits the closure of the MSR127 safety outputs. If the MSR127 fails, the drive will not energize the motor and the fault will be detected by non-operation of the motor. The MSR127 uses dual channel to detect faults to power, ground and cross channel faults on the GripSwitch or the MT-GD2. A short across the jog switch will be detected as a subsequent jog attempt will be prevented by the MSR178. A fault in the Safe-Off option of the drive will be detected by the MSR127 on the next attempt to restart the drive. Internal faults in the MSR127 will result in non-operation of the motor. Internal faults of the MSR178 will result in non-operation of the jog function.

**Ratings**

The safety function initiated by GripSwitch enabling device meets the safety performance requirements of SIL CL 2 per IEC62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO13849-1:2006. This circuit executes a Category 0 stop.



### Circuit Status

The e-stop is reset and the safety gate is closed. The outputs of the safety relay are open and the motor is off.

### Operating Principle

**STARTING:** Press the Reset button to energize the outputs of the MSR138. The immediate outputs of the MSR138 energize the 700S control relays and start the motor.  
**STOPPING:** When the e-stop is pressed, the immediate outputs of the MSR138 open and the motor coasts to stop. After the time delay of the MSR138 expires, the delayed N.C. output closes and provides voltage to the Lock Release button. Press the Lock Release button to power the solenoid and open the Gate.

Closing the Gate or resetting the e-stop does not re-energize the 700S safety control relays. Press the reset to re-energize the 700S control relays.

### Fault Detection

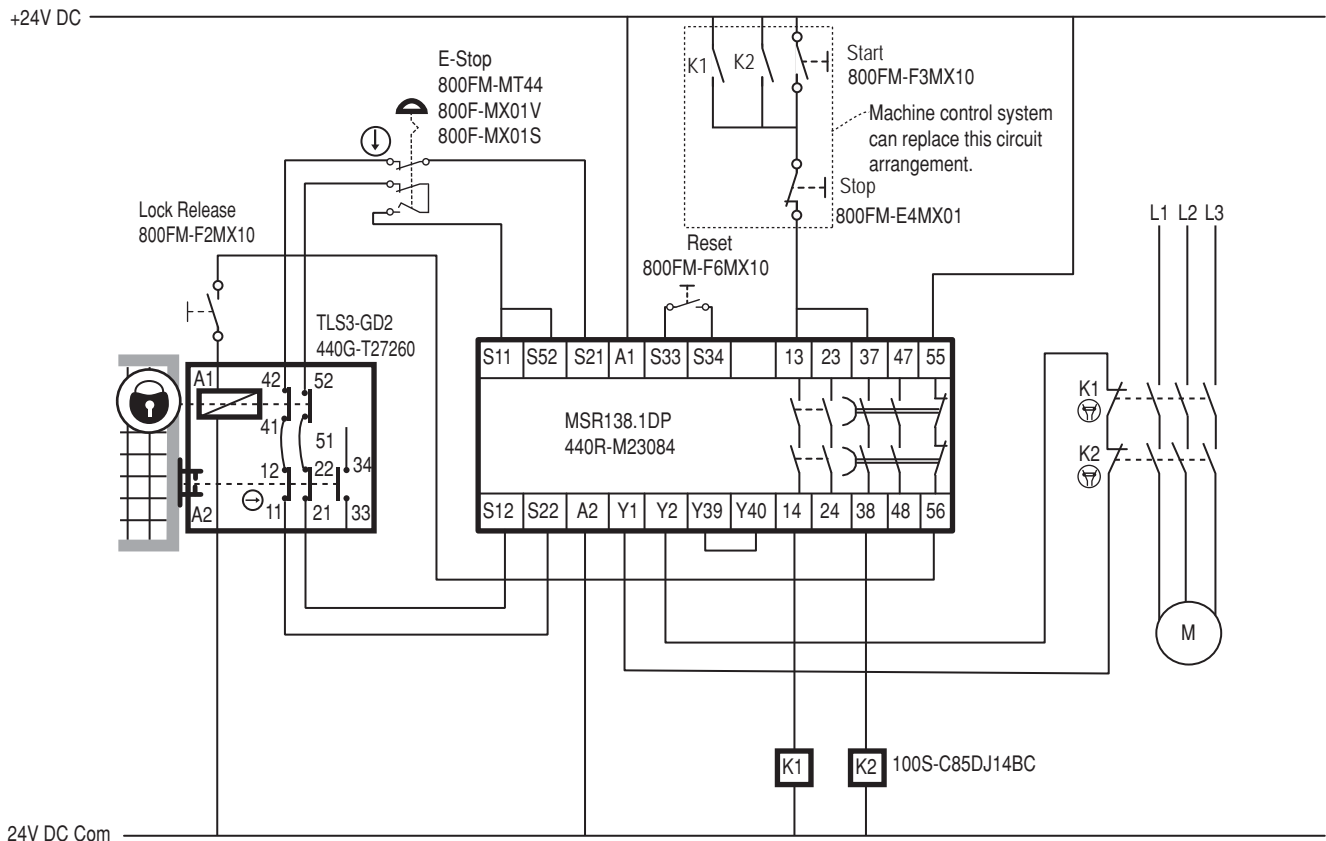
Upon power-up, the MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop and the TLS1 GD2. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are okay, the output energizes. The Reset button is linked to the delayed N.C. output in order to supply +24V for reset only when delay time has lapsed. If any of the MSR138 contacts faults to the ON state, the motor is stopped by the redundant outputs. The fault will be detected by the S56/S34 monitoring circuit on the next attempt to re-start. If the Gate is not interlocked by the TLS1 solenoid or one of the 700S control relays faults to the ON state, the MSR138 will detect the fault in the Y1/Y2 circuit on the next attempt to start. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

### Ratings

The safety function initiated by TLS1-GD2 guard locking interlock and the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

# Interrupteur de sécurité – Gâche de sécurité avec temporisation

TLS3-GD2, 800F, MSR138, 100S



## Circuit Status

The e-stop is reset and the safety gate is closed. The outputs of the safety relay are open, and the motor is off.

## Operating Principle

The guard locking interlock and delayed outputs of the safety relay keep the guard closed and locked during the rundown time of the motor.

**STARTING:** Press the reset button to energize both the immediate and delayed outputs of the MSR138. Press the start button to energize contactors K1 and K2, which start the motor.

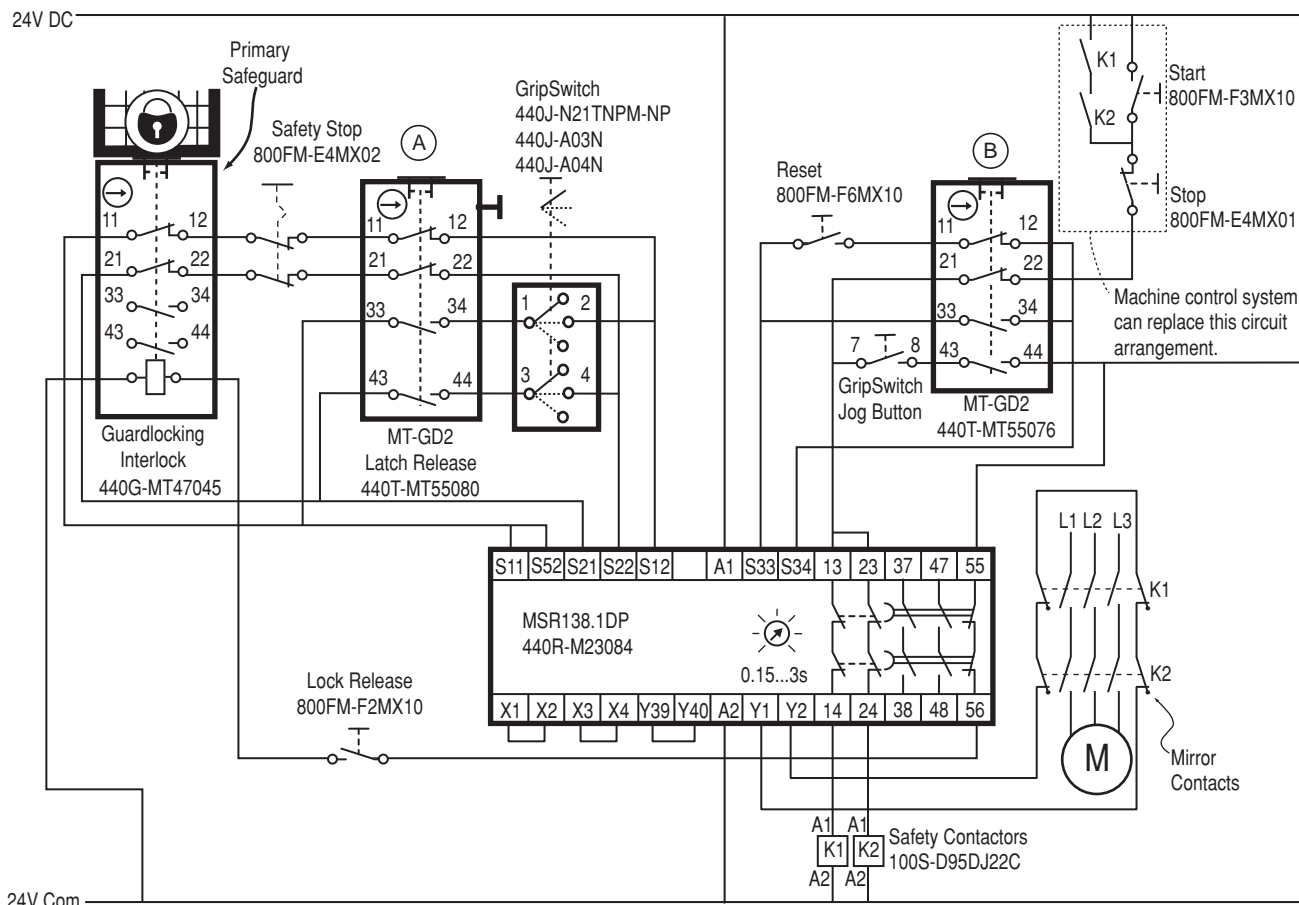
**STOPPING:** Press the e-stop to initiate a stop command. The immediate outputs of the MSR138 de-energize and the MSR138 timing cycle starts. Contactor K1 drops out and the motor begins a coast to stop. After the time delay of the MSR138 expires, the N.C. output closes and provides voltage to the lock release button. Press the lock release button to power the solenoid and open the gate. After the time delay, the normally open safety contact opens, dropping out K2.

## Fault Detection

Upon power-up, the MSR138 performs internal checks. The MSR138 then looks for dual signals from the e-stop and the TLS3 GD2. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If any of the MSR138 contacts faults to the ON state, the motor is stopped by the redundant outputs. The fault will be detected by internal crosschecking in the MSR138. With K1 on the immediate output of the MSR138, it performs the primary breaking of the motor circuit. If K1 fails due to welded contacts, the K2 will break the motor circuit. The failure of K1 will be detected by the Y1/Y2 monitoring circuit on the next attempt to restart the motor. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

## Ratings

The safety function initiated by the TLS3-GD2 guard locking interlock and the 800F e-stop button meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



## Circuit Status

The 440J GripSwitch is held by two MT-GD2 tongue interlocks by its mounting plate accessories. The safety gate is closed and the 440G-MT guard locking interlock is locked. The MSR138DP safety outputs are open. Contactors K1 and K2 are de-energized. The motor is off and the application ready to run.

## Operating Principle

The GripSwitch enabling device is used to access the hazardous area while the motor is running. The access is of the full body type. With the safety gate unlocked, the operator walks into the hazardous area with the GripSwitch. Before accessing the hazard area, the motor must be stopped. After entering the hazard area, the motor can be restarted with the GripSwitch. One MT-GD2 interlock is used to bypass the gate interlock safety circuit. The other MT-GD2 is used to reset the safety system and prevent the starting of the motor from outside the cell, when the GripSwitch is used.

**STOPPING:** Press the Safety Stop. The immediate outputs of the MSR138.1DP open and the motor initiates a coast to stop. After the time expires on the MSR138.1DP, the delayed outputs change state. The contacts across 55 and 56 close and the safety gate can be unlocked. Press the lock release button to momentarily power the solenoid of the 440G-MT and open the gate.

**STARTING:** Remove the enabling switch from the MT-GD2 holders. Squeeze the GripSwitch trigger to the middle position. The MSR138.1DP resets and closes its safety outputs and the motor is ready to run. Press the jog button on the GripSwitch to momentarily turn on the motor.

**STOPPING DURING ENABLING:** Release the jog switch to stop the motor. Releasing or applying further pressure to the trigger switch on the GripSwitch will stop the motor.

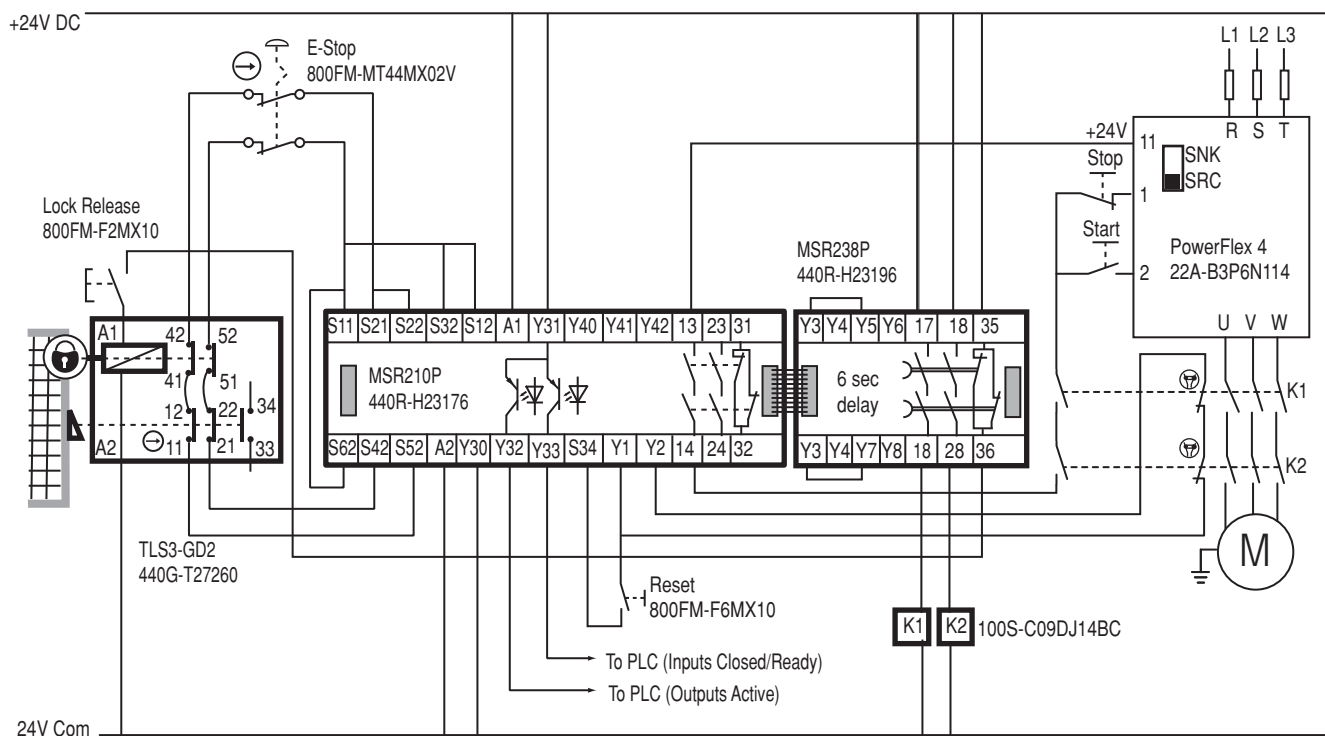
## Fault Detection

Upon successful completion of internal checks on power-up, the MSR138.1DP checks the gate and GripSwitch circuit. If both circuits have been closed, the MSR138.1DP checks the reset circuit. Upon closure of the reset button, the MSR138.1DP checks the status of the contactors. Due to the size of the 100S-D contactors, mirrored contacts (on either side of the unit) are used to safely reflect the status of the armature. If all mirrored contacts are closed, then the MSR138.1DP energizes its outputs. If one contactor welds in the closed state, the second contactor will shut off the motor and the fault will be detected by the MSR138.1DP, upon the next attempt to start the motor. Single channel faults on the input devices (GripSwitch, Interlocks and Stop switch) will be detected by the MSR138.1DP either on or before a demand is placed on the safety system (depending on the nature of the fault).

## Ratings

The safety function initiated by the MT-GD2 guard locking interlock and the GripSwitch button meets the safety performance requirements of SIL CL 2 per IEC62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLD per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).





### Circuit Status

The guard door is closed and locked (mechanical lock, power to release). The e-stop is released. K1 and K2 are off. The drive is powered, but not enabled. The motor is off.

### Operating Principle

Access to the hazard is prevented (i.e., locked) by the guard locking TLS3-GD2 while the motor is running and for a fixed duration (controlled by the MSR238) after the e-stop command is initiated.

**STARTING:** Momentarily press the reset button. The contacts in the MSR210P and MSR238P close. K1 and K2 energize and connect the motor to the drive and also connects 24V to the start button. This ensures that the motor is connected to the drive, before the start button becomes effective. The PowerFlex 4 drive is allowed to start. Start the motor by momentarily pressing the start switch. The motor can be stopped by momentarily pressing the stop switch. The start and stop switches can be replaced by more elaborate control devices (like a PLC).

**STOPPING:** Press the e-stop. The MSR210P opens its immediate output (13-14) and begins the timing sequence in the MSR238. The PowerFlex 4 also begins its programmed deceleration as the stop signal is opened. After six seconds, the MSR238 times out and contacts 17-18 and 27-28 open. K1 and K2 de-energize and disconnect the motor from the drive. Contacts 35-36 close and provide power to the release button of the TLS3-GD2. Press and hold the release button to open the gate.

Closing the gate or releasing the e-stop will not cause the motor to turn on. Two separate and deliberate actions are needed: 1) momentarily press the reset button to activate the safety relay and then 2) momentarily close the start switch to turn the motor on. In this application, the user must ensure that the time delay of the MSR238P provides sufficient time for the hazards, driven by the motor, to stop. Ramping to stop or dynamic braking are recommended to speed up the braking process. The time delay of the MSR238P should be set longer than the stopping time of the PowerFlex 4 or the motor will coast to its final stop. The PowerFlex 4 will not be able to start while the K1 and K2 contactors are de-energized.

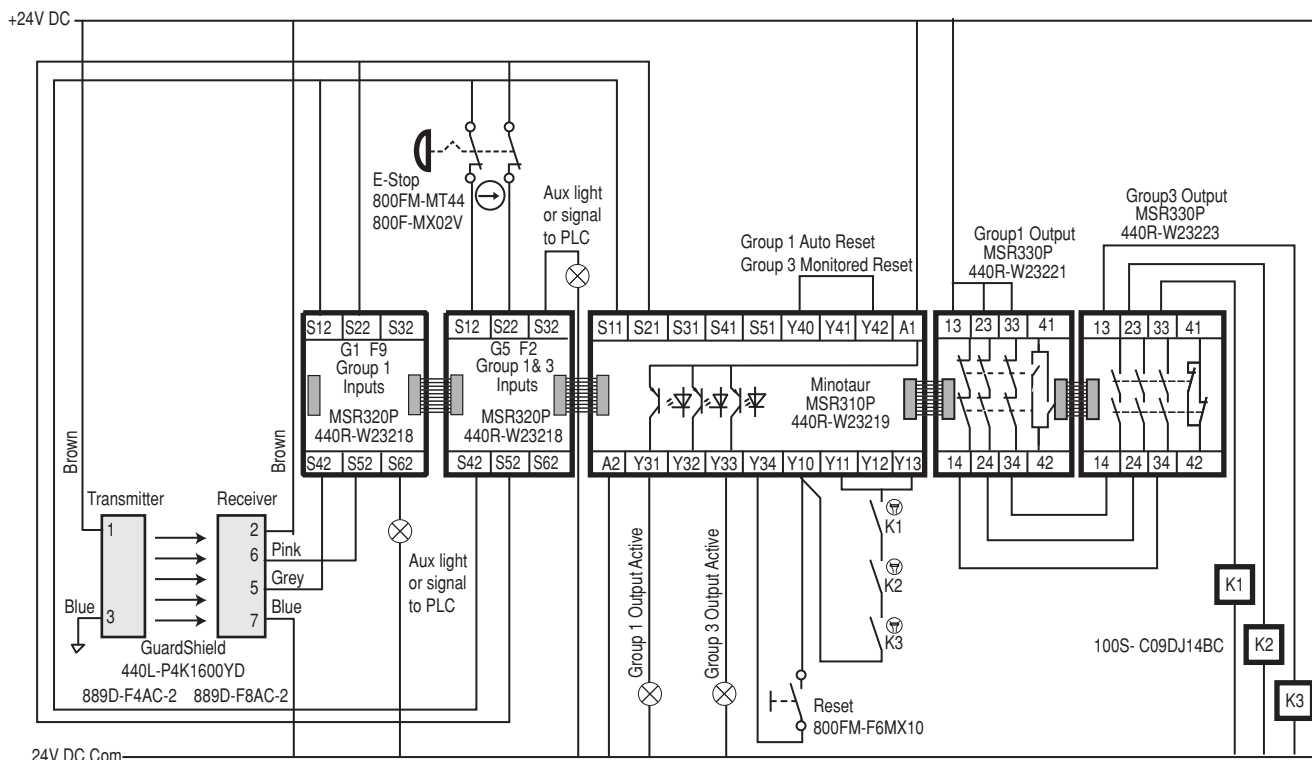
### Fault Detection

If the drive output faults to an energized state, the motor can be turned off by pressing the e-stop. If K1 welds in an energized state, the motor can be stopped by K2. If either K1 or K2 welds closed, the MSR210P will not be able to start due to the feedback loop (Y1-Y2) being open. A short across the interlock or e-stop will be detected by the MSR210P. The MSR210P will also detect if the reset is held or stuck in the closed position, and will prevent the motor from starting.

### Ratings

The safety function initiated by the TLS3-GD2 guard locking interlock and the 800F e-stop button meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 1 function (brake and then remove power to motor).





### Circuit Status

The light curtain is set at the factory default setting (guard only) and is unobstructed. The e-stop is reset. The Group 1 MSR330P safety outputs (13/14, 23/24, 33/34) are on. The Group 3 MSR330P safety outputs are off. K1-K3 are off and ready to be energized.

### Operating Principle

Since the safety outputs of the two MSR330P modules are connected in series, both the light curtain and e-stop will control (turn on and off) the K1-K3 loads. The light curtain is set to automatic reset mode. The e-stop stop operates in monitored reset mode. The jumper from Y40 to Y42 sets the Group 1 output to automatic reset and the Group 3 output to monitored reset. The MSR310P must have the monitoring circuit connected to both Y11 and Y13 to allow both the Group 1 and Group 3 outputs to energize.

**STARTING:** Press the reset button to energize the Group 3 outputs, which energize the loads K1-K3.

**STOPPING:** Obstructing the light curtain turns off the Group 1 safety outputs and de-energizes K1-K3. Clearing the light curtain automatically re-energizes K1-K3. This arrangement is known as presence sensing device initiation, and additional precautions (e.g., limited to partial body access, part sensing, limited speed) may be necessary to ensure safe operation of the machine. Pressing the e-stop turns off both the Group 1 and Group 3 safety outputs and de-energizes K1-K3. Resetting the e-stop re-energizes the Group 1 outputs, but the Group 3 outputs remain off. The Reset button must be pressed to turn on the Group 3 outputs and energize the loads K1-K3.

### Fault Detection

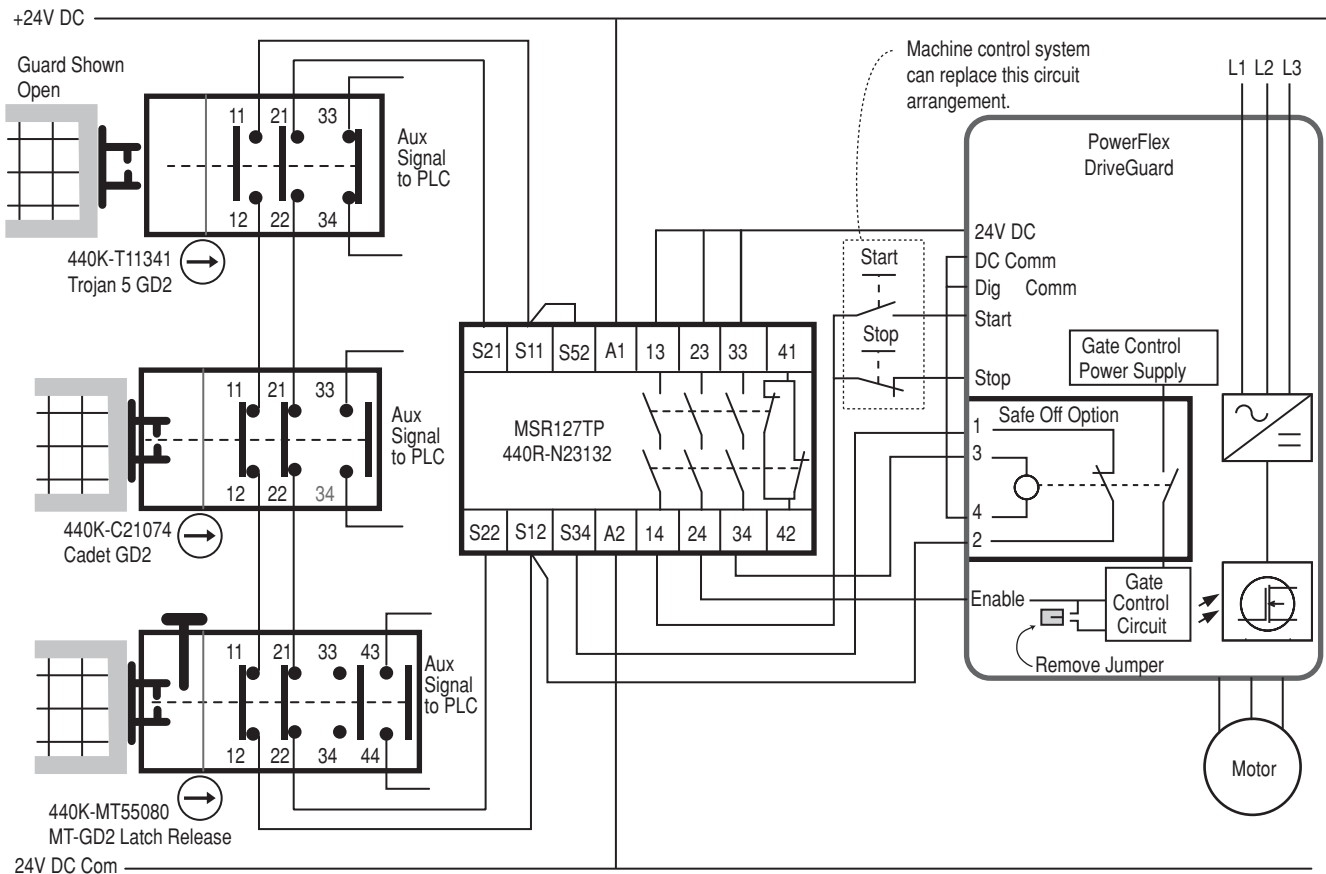
Upon successful completion of internal checks on power up, the GuardShield energizes its outputs. Cross-channel shorts and shorts to ground or power are detected by the GuardShield. The MSR310P also performs internal checks, and then scans the input circuits. The MSR310P uses pulse testing from S11 and S21 to detect shorts from the inputs to power, ground or other inputs. These faults will be detected immediately and will prevent energizing or will de-energize the MSR330P outputs. If one of the 100S output devices (K1-K3) is stuck in an actuated state, the MSR310P will prevent start-up because the Y10/Y11/Y13 feedback loop will remain open.

### Ratings

When two contactors are connected in series to power a hazard (not shown), the safety functions initiated by GuardShield light curtains and the 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.

## Variateur – Accès multiple

Trojan 5 GD2, Cadet GD2, MT-GD2, MSR127, PowerFlex DriveGuard



### Circuit Status

One of the gates is open. The safety outputs of the MSR127 are de-energized. The PowerFlex with DriveGuard is de-energized and not enabled. The motor is off.

### Operating Principle

**STARTING:** When the last gate closes, the safety outputs of the MSR127 close and apply power to the drive enable circuit, Safe-Off option, Start and Stop buttons. Pressing the Start and Stop buttons turns the motor on and off. The motor is controlled by parameters set within the PowerFlex drive.

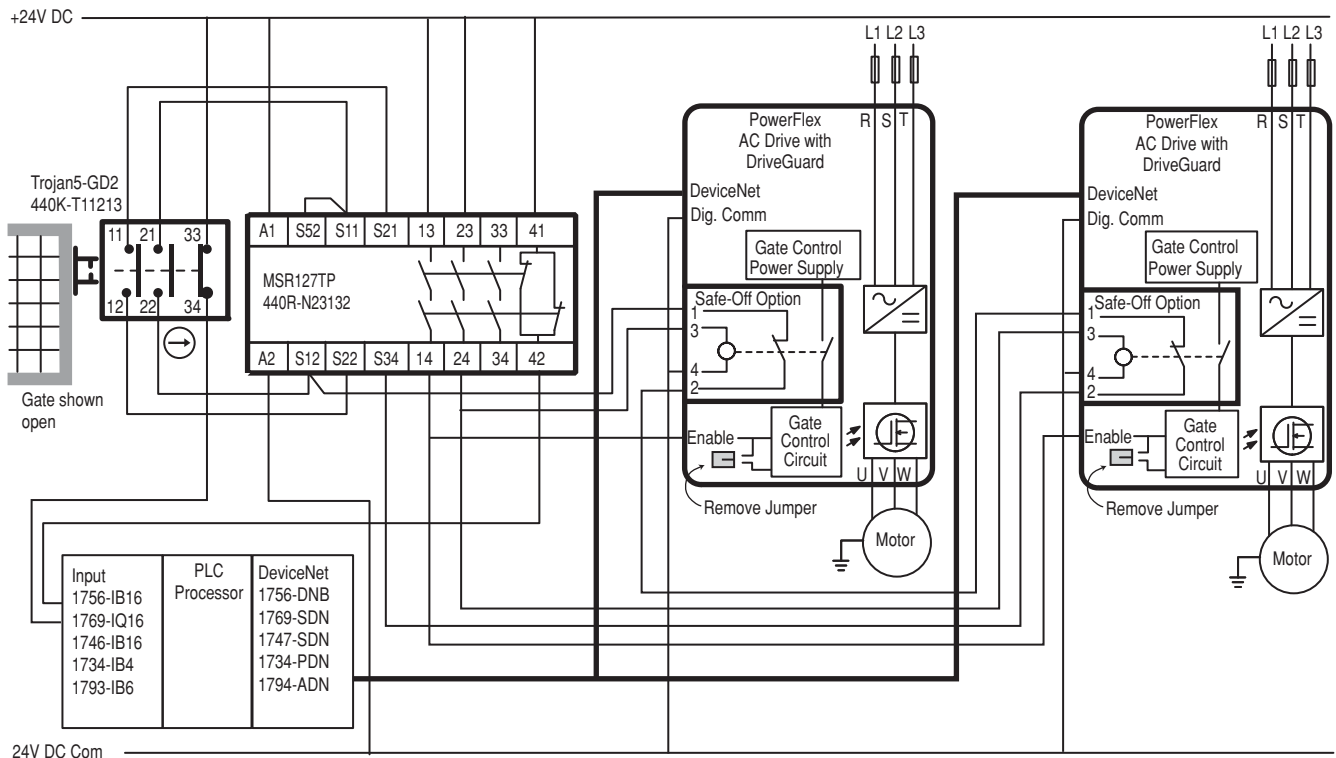
**STOPPING:** Opening any of the guard doors causes the MSR127 safety outputs to de-energize. This removes power to the PowerFlex enable, Safe-Off, Start, and Stop circuits. The motor performs a coast to stop.

### Fault Detection

Upon power-up the PowerFlex drive and MSR127 perform internal checks. The MSR127 then looks for dual signals from the gate interlocks. With the gates closed, the MSR127 checks the wiring of the drive Safe-Off option. If closed, then the MSR127 energizes its outputs and the motor can be started. A single open circuit fault at the gate interlocks will be detected immediately, and the motor will coast to a stop. A crossfault (channel 1 to channel 2) at the gate interlocks will be detected immediately. A short across one gate interlock contact will be detected when an attempt to re-start is made. This type of short can be masked by opening and closing another gate interlock and may result in a loss of the safety function due to an accumulation of contact shorts. The MSR127 is rated for Category 4 and will not lose the safety function due to an accumulation of faults. The PowerFlex 70 DriveGuard is rated at Category 3, as it will perform the safety function in the presence of a single internal fault.

### Ratings

The safety function initiated by gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.



### Circuit Status

The safety gate is open. The MSR127TP safety outputs (13/14, 23/24, 33/34) are open. The Enable and Safe-Off Option on both PowerFlex drives are off. Auxiliary signals from the Trojan 5 GD2 (33/34) and the MSR127 (41/42) inform the PLC that the safety system is OFF. The motors of both drives are off.

This circuit is intended to show that multiple drives can be connected in parallel. The number of drives that can be connected in parallel is dependent on: the load (the safe-off option plus the enable of each drive), appropriate de-rating to prevent early wear out of the MSR127TP contacts, the application requirements (e.g., zoning) and the risk assessment (e.g., some drives may require separate safety systems).

### Operating Principle

**STARTING:** Upon closing the gate, the Trojan 5 GD2 closes the safety inputs of the MSR127TP (S11/S12 and S21/S22) and opens the signal to the PLC. The safety outputs of the MSR127TP close and enable both PowerFlex drives. The auxiliary signal of the MSR127TP opens. The PLC compares the gate and safety relay auxiliary signals. When both signals are open, the PLC knows that the safety system is ready. The PLC can now start and control the drives over the DeviceNet network. The PLC must ensure that the drives are not started upon the closing of the gate; a separate, intentional action must initiate the motor movement (this is not shown in the diagram).

**STOPPING:** Normal stopping is performed by the PLC. If the gate is opened, the input signals to the MSR127TP open. The MSR127TP opens its safety outputs which disable all the drives connected to them via the Safe-Off option. The drives perform an immediate coast to stop.

### Fault Detection

Upon power-up, the MSR127TP performs internal checks. The MSR127TP then looks for dual signals from the Trojan5-GD2. If only one signal is present, or a crossfault exists, the MSR127TP assumes a fault is present and does not energize its safety outputs. With the gate closed, the MSR127TP checks the S12/S34 monitoring circuit. If the Safe-Off options are de-energized, the MSR127TP assumes the drives are off and are ready to be enabled. The MSR127TP energizes its safety outputs. If the monitoring circuit remains open, the MSR127TP will assume a fault is present and not allow its safety outputs to energize. Single point failures related to the tongue interlock are excluded if actuator speed, alignment and mechanical stops meet installation instruction requirements, and a periodic proof test confirms proper operation.

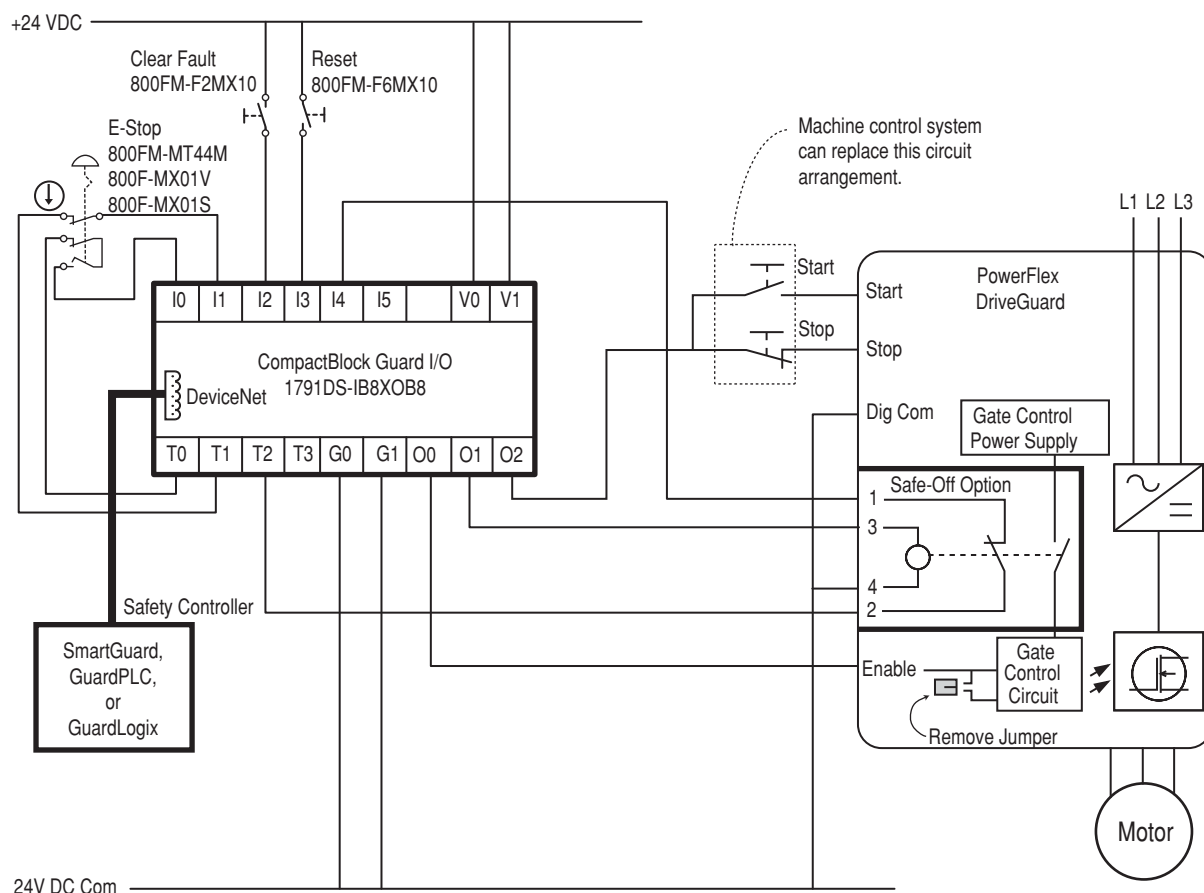
### Ratings

The safety function initiated by the Trojan 5-GD2 gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

# Applications de protection et schémas de câblage

## Variateur & E/S de sécurité – Architecture Intégrée

### 800F, CompactBlock Guard I/O, PowerFlex DriveGuard



#### Circuit Status

The e-stop is reset. The outputs of the CompactBlock Guard I/O are off. The PowerFlex output is off. The motor is off.

#### Operating Principle

**STARTING:** Press and release the reset button to energize the outputs of the 1791DS. This action energizes the Safe-Off option which connects the Gate Control Power Supply to the Gate Control Circuit. It also provides the Enable signal which allows the Gate Control Circuit to turn the output drive transistor on and off. Output O2 applies power to the Start and Stop controls, which can then be used to control the drive for production operations.

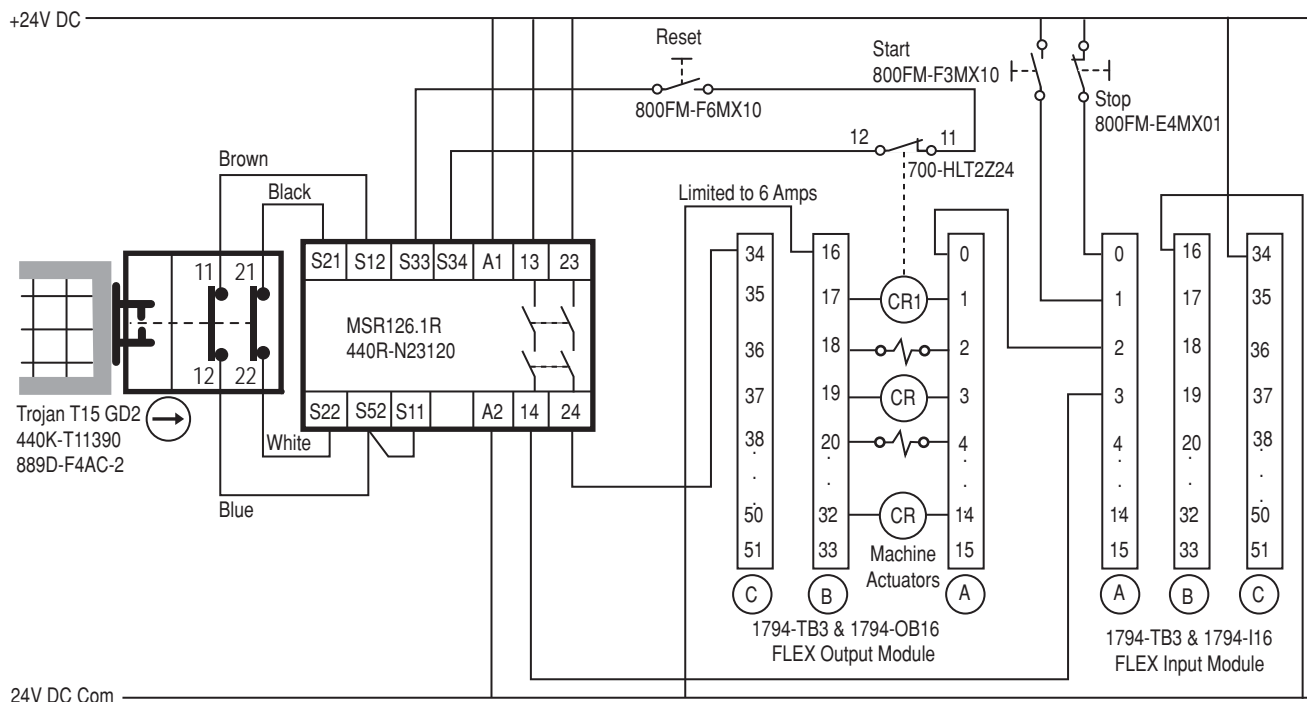
**STOPPING:** When the e-stop is pressed, the O2 output sends a stop command to the drive, which executes its pre-programmed stopping routine. After a short delay (programmed in the safety controller), the O0 and O1 outputs turn off. This disables the drive. The normally closed contact in the Safe-Off option closes and sends a signal back to terminal I4 to inform the safety system that the drive is ready for restart.

#### Fault Detection

Upon power-up, the PowerFlex drive and 1791DS perform internal checks. The 1791DS then looks for dual signals from the e-stop. The pulsed outputs T0 and T1 are used to help check for open and short circuit fault conditions in the e-stop circuit. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the 1791DS checks the monitoring circuit (terminal I4) when the reset button is pressed. If these checks are OK, the outputs energize. If the O2 output of the 1791DS faults to the ON state, the motor is stopped by the O0 and O1 outputs, and the fault will be detected on the next attempt to re-start by the self-checking in the 1791DS. If the drive control faults to an ON state, the motor will stop because the power to the drive control circuit will be removed by the Safe-Off option.

#### Ratings

The safety function initiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop, by the program in the safety controller.



### Circuit Status

The safety gate is closed. The outputs of the MSR126.1R safety relay are open and the machine actuators are off. Control Relay CR1 is de-energized and its 11/12 contact is closed.

### Operating Principle

The MSR126.1R is chosen for this application because its thermal (non-switching) current carrying capacity is 6 A in one circuit. The Flex output module performs the normal switching of the machine actuators during the manufacturing process. The safety system enables the machine functions by providing power to the FLEX Output Module. One of the Flex outputs must drive an electro-mechanical output whose normally closed contact is in the monitoring loop of the safety relay. The machine logic must energize this output while the machine is running, as it is used by the MSR126.1R to confirm that power is removed from the output module, before restarting.

**STARTING:** Press the reset button to energize the output contacts 13/14 of the MSR126.1R. This connects the 24V supply to terminal C34 of Flex 1794-OB16 output module and also sends a signal to the A3 terminal of the 1794-IB16. The logic system is informed that the gate is closed and the machine is ready to run. Press the Start button to start the machine process.

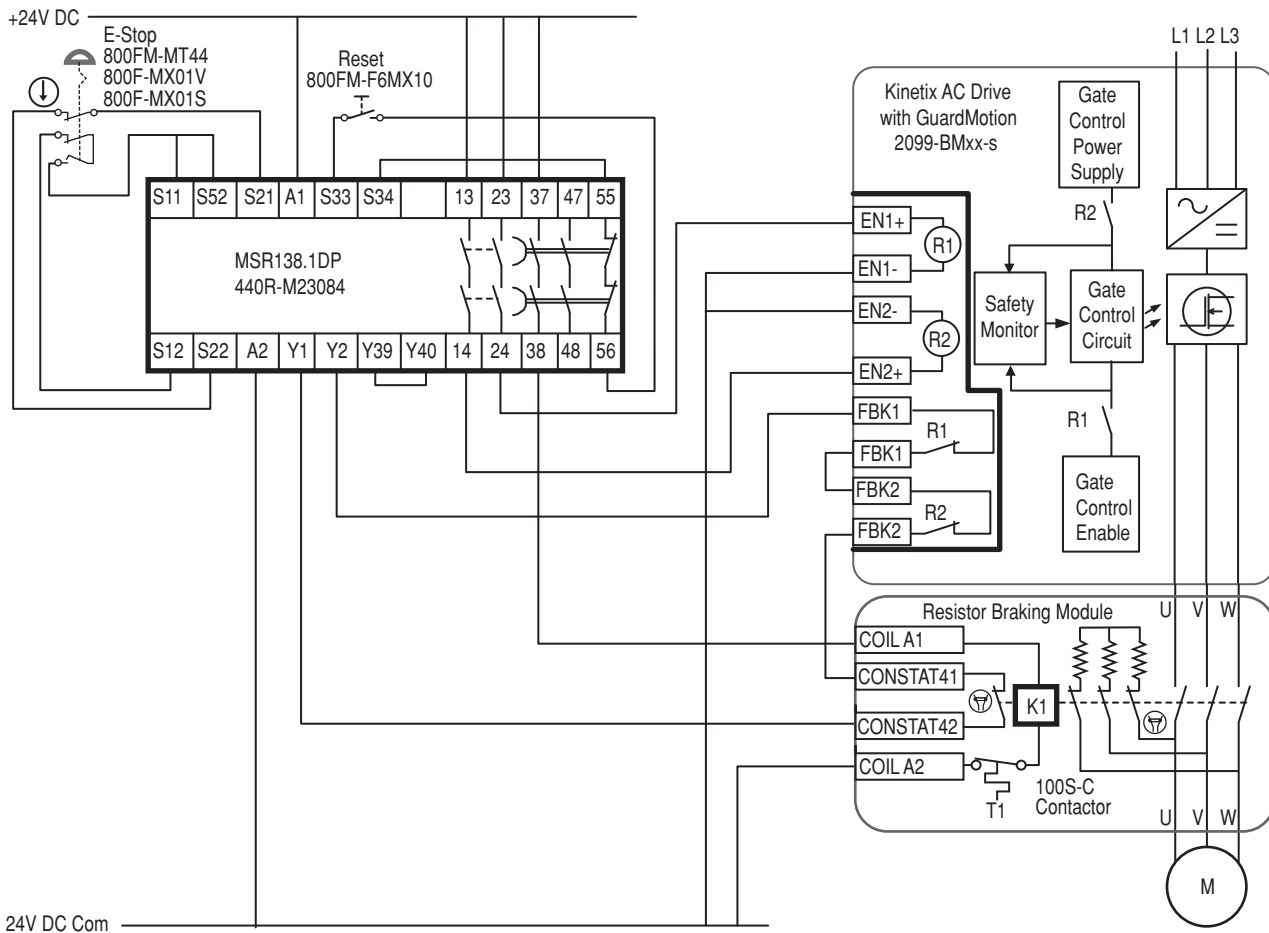
**STOPPING:** Press the Stop button to stop the machine. Then, open the gate to access the machine. While the gate is open, the machine actuators cannot operate because power is removed from the output module. If the gate is inadvertently opened while the machine is running, power will be removed from output module and the machine actuators will be de-energized.

### Fault Detection

Upon successful completion internal checks on power up, the MSR126.1R checks the input circuits. With the gates closed, the MSR126.1R checks the dual circuits and then waits for the reset signal. A single fault, a short from 24V to terminal 14 of the MSR126.1R, may lead to the loss of the safety function. With the MSR126.1R and Flex system mounted in the same cabinet and with proper validation, this fault may be excluded. If not mounted in the same cabinet, a signal from the output (A0) should be fed back into the input module (A2). The logic can perform a comparison of input A2 and A3, and turn the machine off if these signals are not in agreement. If CR1 is not de-energized when the gate is closed, the MSR126.1R will not close its outputs.

### Ratings

The safety function initiated by the Trojan T15-GD2 gate interlocks meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.



### Circuit Status

The e-stop is reset. The outputs of the safety relay are open, and the motor is off.

### Operating Principle

**STARTING:** Press and release the reset button to energize the outputs of the MSR138. This action energizes the 100S contactor in the resistor braking module, which connects the motor to the drive and enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.

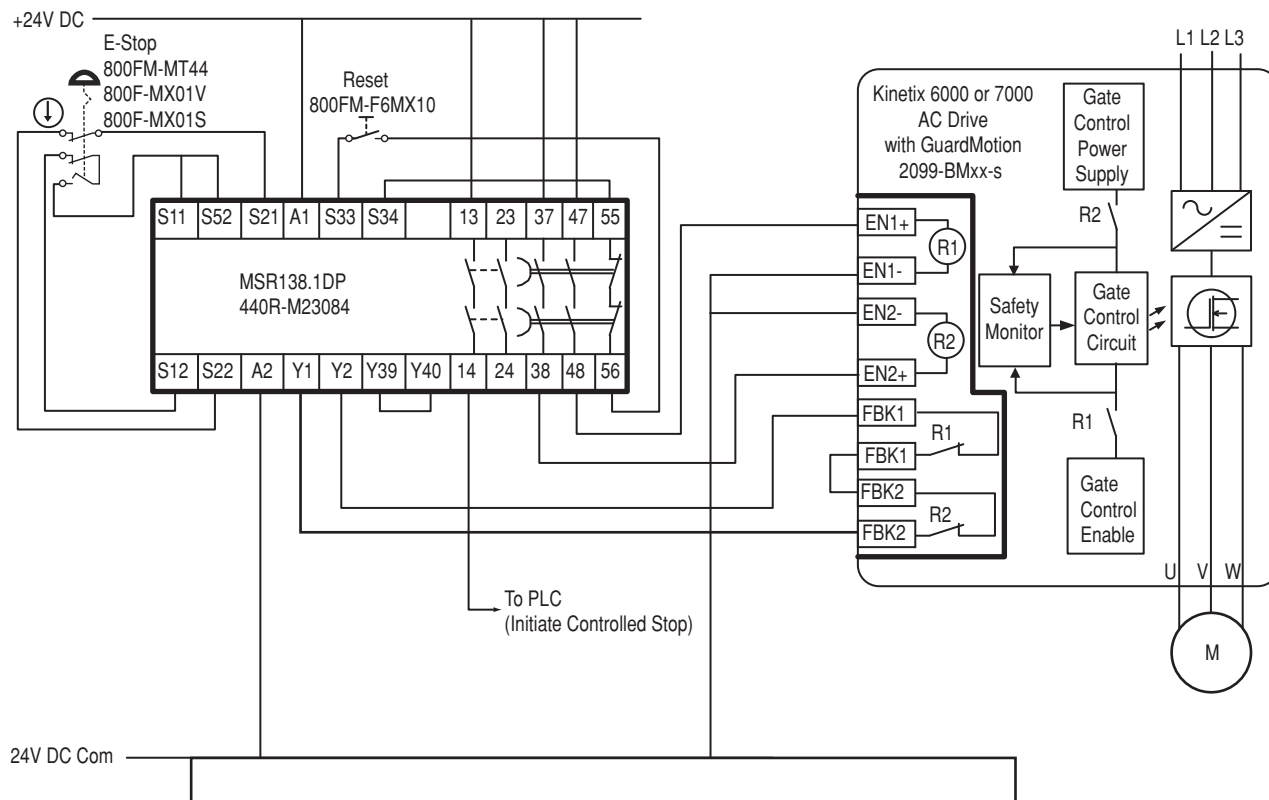
**STOPPING:** When the e-stop is pressed, the immediate outputs of the MSR138 open and disable the drive. The motor begins to coast to a stop. After the time delay of the MSR138 expires, the delayed outputs open and drop out the 100S contactor in the Resistor Braking Module. This disconnects the motor from the drive and engages the braking resistors, which rapidly stop the motor.

### Fault Detection

Upon power-up, the Kinetix drive and MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If the delayed outputs of the MSR138 fault to the ON state, the motor is stopped by the MSR138 immediate outputs. The fault will be detected by the Y1/Y2 monitoring circuit on the next attempt to re-start because K1 will remain energized. If the drive faults to an ON state, the motor will stop because it will be disconnected by K1. This fault will be detected by the Y1/Y2 monitoring circuit on the next attempt to re-start because the Kinetix feedback circuit will remain off. If K1 gets stuck or welded closed, the motor will stop by the drive and the fault will be detected by the Y1/Y2 monitoring circuit of the MSR138 on the next attempt to re-start.

### Ratings

The safety function initiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop.



### Circuit Status

The e-stop is reset. The outputs of the safety relay are open, and the motor is off.

### Operating Principle

**STARTING:** Press and release the reset button to energize the outputs of the MSR138. This action enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.

**STOPPING:** When the e-stop is pressed, the immediate outputs of the MSR138 open and sends a signal to the machine control PLC to initiate a controlled stop. After the time delay of the MSR138 expires, the delayed outputs open and drop out the GuardMotion feature which disables the drive.

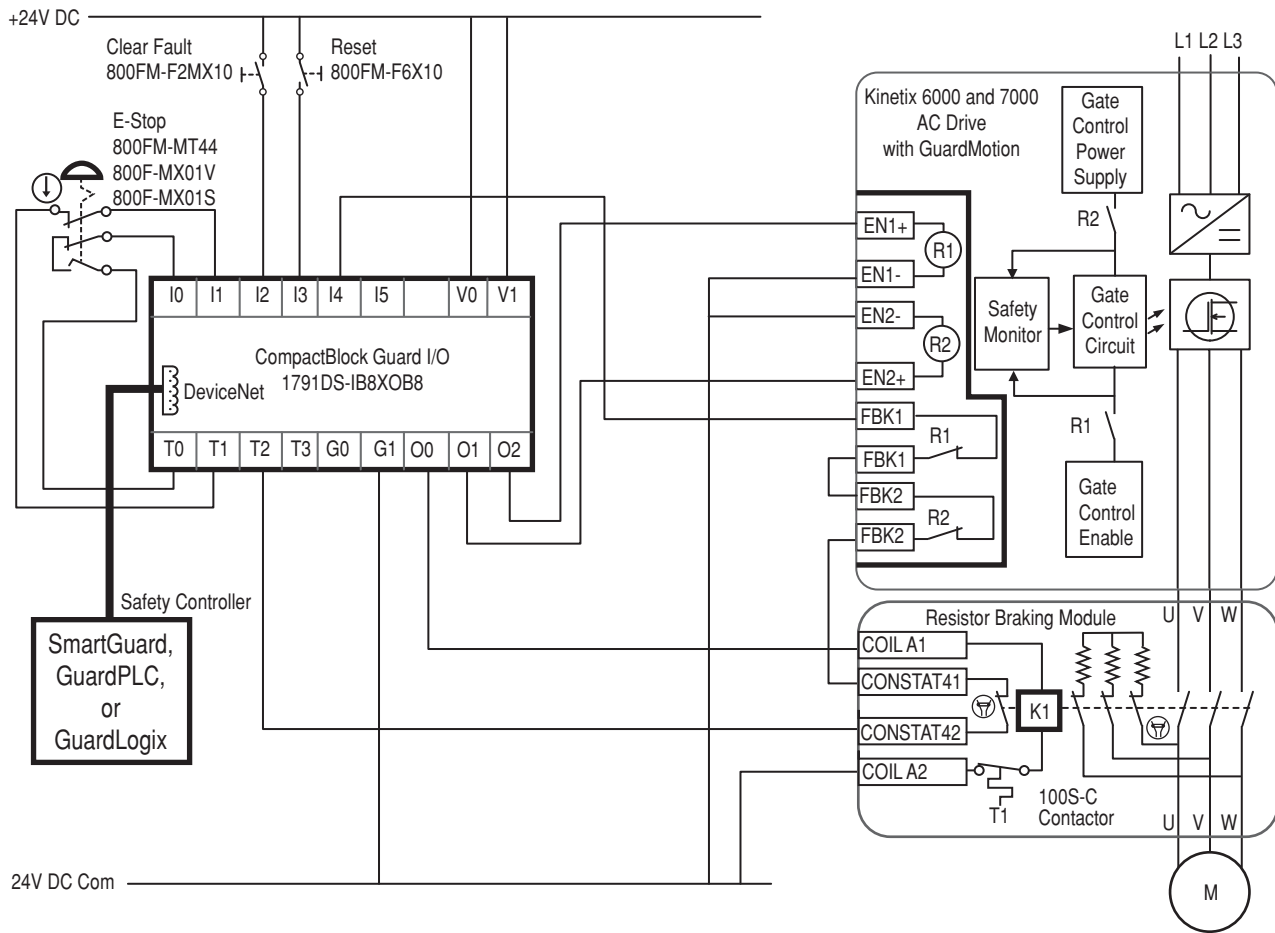
### Fault Detection

Upon power-up, the Kinetix drive and MSR138 perform internal checks. The MSR138 then looks for dual signals from the e-stop. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the MSR138 checks the Y1/Y2 monitoring circuit when the reset button is pressed. If these checks are OK, the output energizes. If the delayed outputs of the MSR138 fault to the ON state, the motor is stopped by the MSR138 immediate outputs. The fault will be detected by the S33/S34 monitoring circuit on the next attempt to re-start. If one of the safe-off relays faults to the ON state, the MSR138 will detect the fault in the Y1/Y2 circuit on the next attempt to start the drive.

### Ratings

The safety function initiated by the 800F e-stop meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 1 stop.



**Circuit Status**

The e-stop is reset. The outputs of the CompactBlock Guard I/O are off. The Kinetix outputs are off. The Resistor Braking Module is off. The motor is off.

**Operating Principle**

**STARTING:** Press and release the reset button to energize the outputs of the CompactBlock Guard I/O. This action energizes the 100S contactor in the resistor braking module, which connects the motor to the drive and enables the operation of the Kinetix drive. When the Kinetix drive is enabled, an internal signal is sent back to its controller (not shown) to inform it that the drive is enabled. The motor is then controlled by its controller.

**STOPPING:** When the e-stop is pressed, the O1 and O2 outputs of the 1791DS open and disable the drive. The motor begins to coast to a stop. After a short delay (determined by a risk assessment or stop time measurement and programmed in the safety controller), the O0 output turns off and drops out the 100S contactor in the resistor braking module. This disconnects the motor from the drive and engages the braking resistors, which rapidly stop the motor.

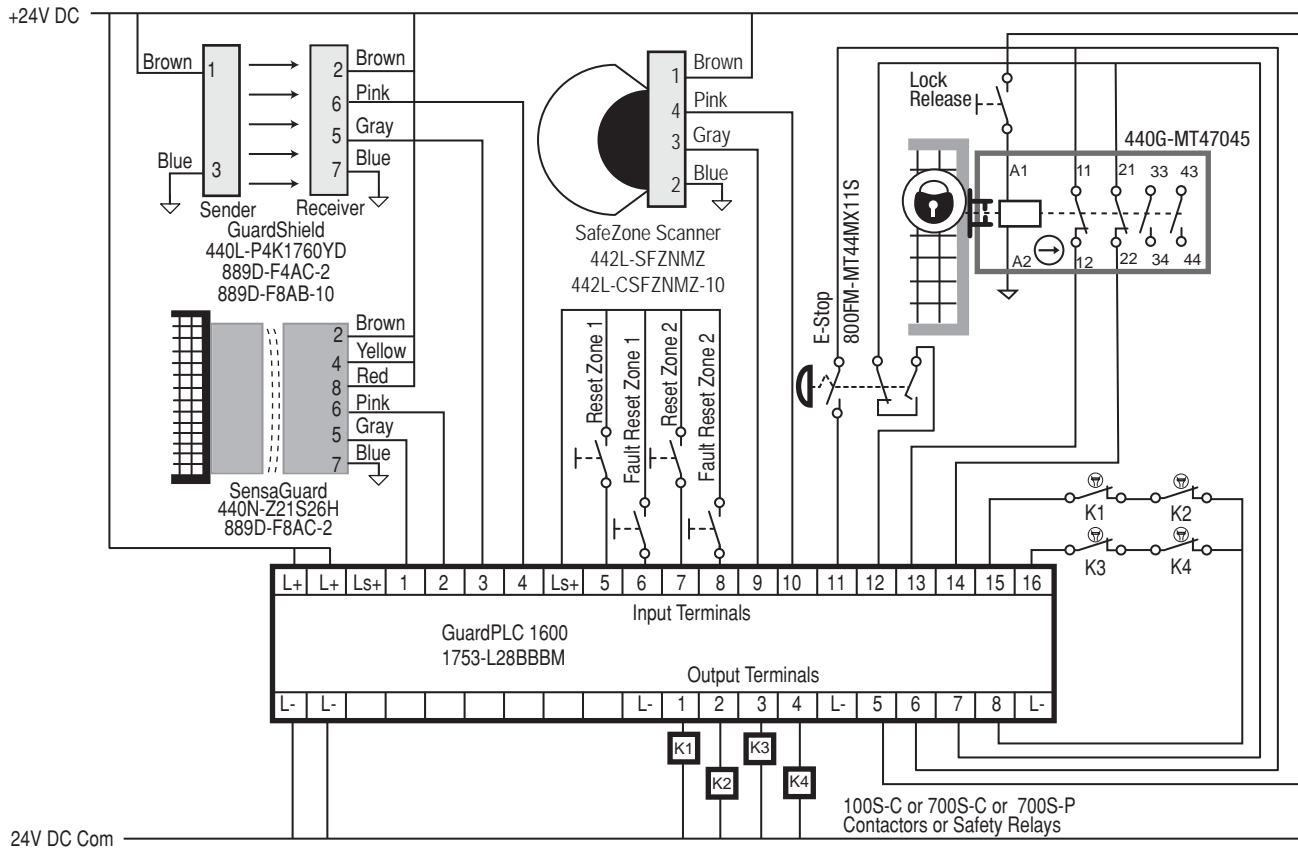
**Fault Detection**

Upon power-up, the Kinetix drive and 1791DS perform internal checks. The 1791DS then looks for dual signals from the e-stop. The pulsed outputs T0 and T1 are used to help check for open and short circuit fault conditions in the e-stop circuit. The e-stop has a self-monitoring contact, which opens if the contact block falls off the control panel. With the e-stop signals made, the 1791DS checks the monitoring circuit when the reset button is pressed. If these checks are OK, the outputs energize. If the O0 output of the 1791DS faults to the ON state, the motor is stopped by the O1 and O2 outputs. The fault will be detected by the safety controller on the next attempt to re-start because K1 will remain energized. If the drive faults to an ON state, the motor will still be able to stop because it will be disconnected by K1. This fault will be detected on the next attempt to re-start because the Kinetix feedback circuit will remain off. If K1 gets stuck or welded closed, it will still be possible to stop the motor by the drive, and the fault will be detected by the safety controller on the next attempt to re-start.

**Ratings**

The safety function initiated by the 800F e-stop meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. This circuit executes a Category 0 stop. To achieve a Category 1 stop, the machine control system must be notified of the e-stop command through DeviceNet, command the Kinetix to execute a stop, and delay the outputs O0, O1, and O2 until the stop condition is completed.





### Circuit Status

The GuardPLC is programmed to control two zones without a DIO connection. The GuardShield and SensaGuard are associated with Zone 1 and contactors K1 and K2. The SafeZone Laser Scanner and 440G-MT are associated with Zone 2 and contactors K3 and K4. The SafeZone, located behind the locked safety gate, is used to detect someone in the hazard area. The E-Stop applies to both zones. The two safety gates are closed, the light curtain and zone scanner are clear and the e-stop is released. Both zones are ready to be activated.

### Operating Principle

**STARTING:** Press the reset button for each zone to energize the safety outputs of the GuardPLC. The safety contactors K1 through K4 become energized and allow the zones to operate. The GuardPLC signals the machine control system over an Ethernet/IP connection that the zones are ready to run. The machine control system (not shown) controls the zones.

**STOPPING:** Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1 and K2 contactors. Clearing the light curtain or closing the gate will not cause the contactors to re-energize. The Zone 1 Reset button must be pressed to restart Zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The GuardPLC energizes Output 5 to provide voltage for the 440G-MT guard locking solenoid. Pressing the Gate Release button allows the gate to be opened. Closing the gate or resetting the e-stop does not re-energize the K1-K4 contactors. The respective Zone Reset buttons must be pressed after the input devices are cleared.

### Fault Detection

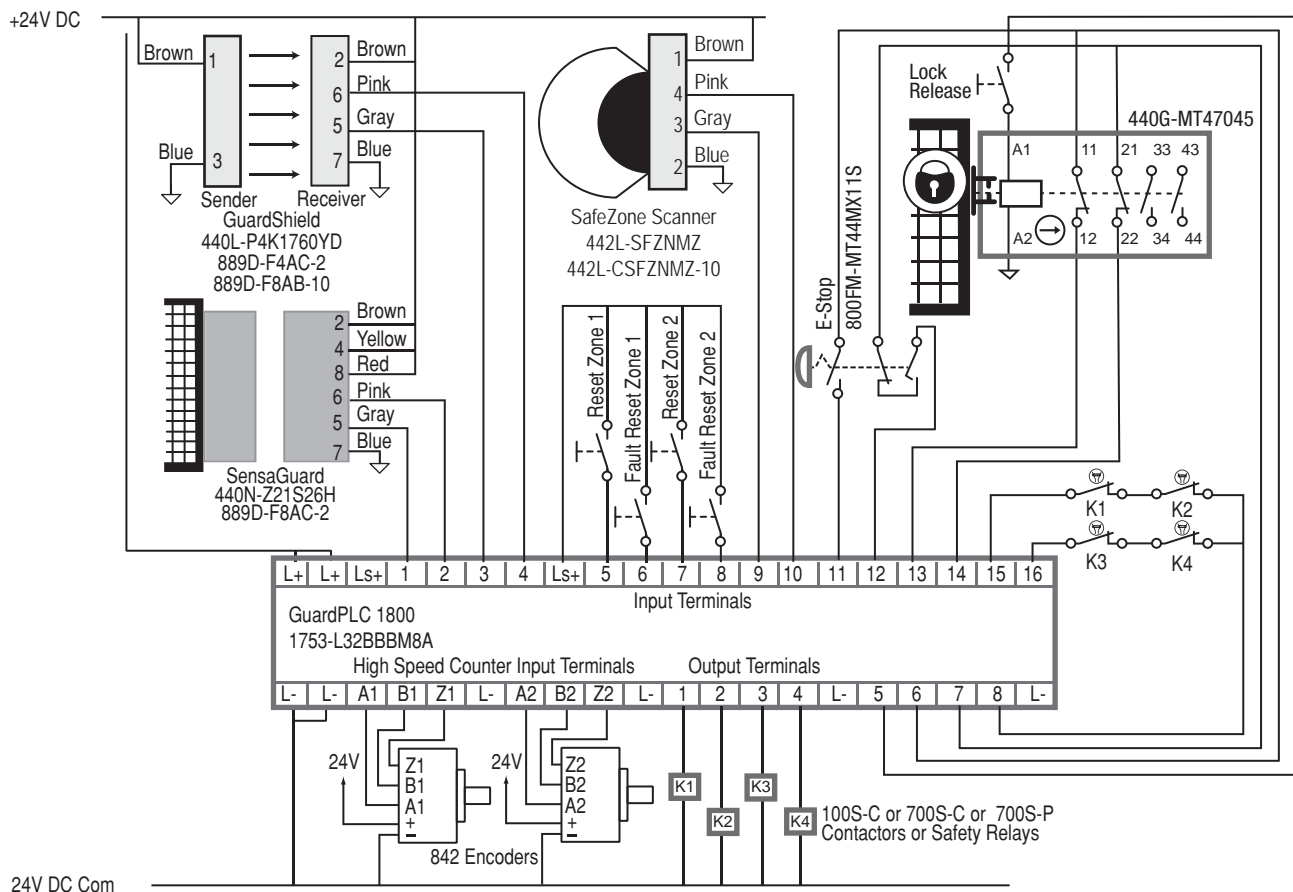
Upon successful completion of internal checks on power up, the GuardPLC checks the input devices. Outputs 6 and 7 are configured as pulse test sources and are used by the GuardPLC to help check for open and short-circuit fault conditions of the E-Stop and 440G-MT interlock. If a fault is detected, the GuardPLC will not energize the respective outputs. The GuardPLC checks the status of the K1-K4 contactors. If the contactors are energized, stuck or welded closed, the GuardPLC will detect this due to the open circuit to Inputs 15 or 16, and will not energize the respective zone. Output 8 is configured as a pulse test source to help detect wiring faults on these contactor feedback circuits. The programmable safety function blocks associated with each device performs self checking. If a fault occurs, the respective Fault Reset button must be pressed, after the fault is cleared. Then, the Reset button must be pressed and released for the machine to restart.

### Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function initiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

## Automate de sécurité – Deux zones avec codeurs

GuardShield, SensaGuard, SafeZone, 800F, 440G-MT, 842 Encoders, GuardPLC 1800, 100S, 700S



### Circuit Status

The GuardPLC is programmed to control two zones. The GuardShield and SensaGuard control Zone 1 with contactors K1 and K2. The SafeZone Laser Scanner and 440G-MT control Zone 2 with contactors K3 and K4. The SafeZone, located behind the locked safety gate, is used to detect someone in the hazard area. The E-Stop applies to both zones. The dual encoders monitor the machine for zero speed and safe speed. The safety gates are closed; the light curtain and zone scanner are clear; the machine is at zero speed; and the e-stop is released. Both zones are ready to be activated.

### Operating Principle

**STARTING:** Press the reset button for each zone to energize the safety outputs of the GuardPLC. The safety contactors K1 through K4 become energized and allow the zones to operate. The GuardPLC signals the machine control system over an Ethernet/IP connection that the zones are ready to run. The machine control system (not shown) controls the zones.

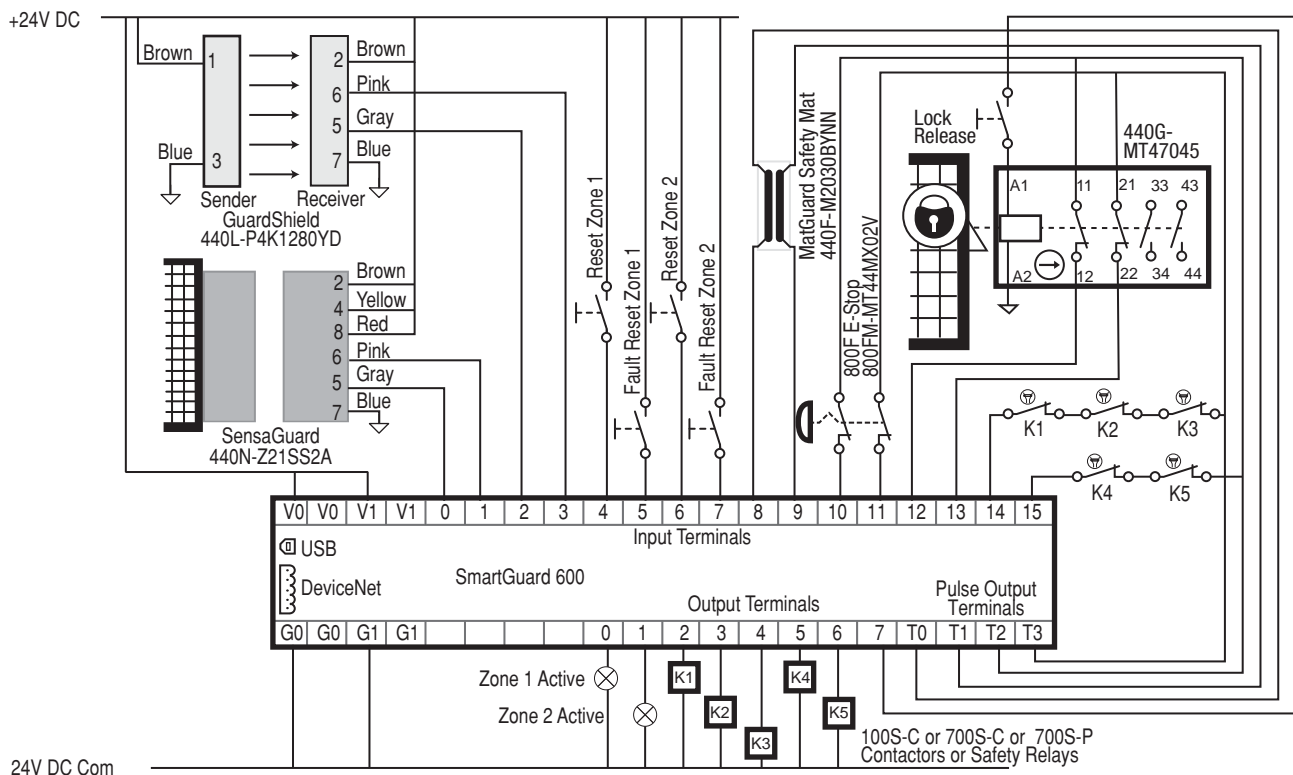
**STOPPING:** Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1 and K2 contactors. Clearing the light curtain or closing the gate will not cause the contactors to re-energize. The Zone 1 Reset button must be pressed to restart Zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The GuardPLC energizes Output 5 to provide voltage for the 440G-MT guard locking solenoid. Pressing the Lock Release button allows the gate to be opened. Closing the gate or resetting the e-stop does not re-energize the K1-K4 contactors. The respective Zone Reset buttons must be pressed after the input devices are cleared.

### Fault Detection

Upon successful completion of internal checks on power up, the GuardPLC checks the input devices. Outputs 6 and 7 are configured as pulse test sources and are used by the GuardPLC to help check for open and short-circuit fault conditions of the E-Stop and 440G-MT interlock. If a fault is detected, the GuardPLC will not energize the respective outputs. The GuardPLC checks the status of the K1-K4 contactors. If the contactors are energized, stuck or welded closed, the GuardPLC will detect this due to the open circuit to Inputs 15 or 16, and will not energize the respective zone. Output 8 is configured as a pulse test source to help detect wiring faults on these contactor feedback circuits. The programmable safety function blocks associated with each device performs self checking. If a fault occurs, the respective Fault Reset button must be pressed, after the fault is cleared.

### Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function initiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.

**Circuit Status**

The SmartGuard is programmed to control two zones without a DeviceNet connection. The GuardShield and SensaGuard control zone 1 with contactors K1, K2 and K3. The MatGuard and the 440G-MT control zone 2 with contactors K4 and K5. The MatGuard, located behind the locked safety gate, is used to detect someone in the hazard area. The e-stop applies to both zones. The two safety gates are closed, the light curtain and safety mat are clear and the e-stop is released. Both zones are ready to be activated.

**Safety Mat Principles**

Outputs T0 and T1 are configured as standard diverse outputs to source the 24V for the safety mat circuits. When a demand is placed on the mat, the circuits short together and both inputs (IN8 and IN9) are HI. Software detects the non-diversity and de-energizes zone 2. In this application, stepping on the mat cannot be differentiated from an actual channel to channel short between the mat circuits. Due to this, stepping on the mat must stop the hazard, and a manual reset is required to restart after each demand on the mat.

**Operating Principle**

**STARTING:** Press the reset button for each zone to energize the safety outputs of the SmartGuard. Two indicators are illuminated to show the zones are active. The safety contactors K1 through K5 become energized and allow the zones to operate. Spare contacts (not shown) on the K1-K5 devices signal the machine control system that the zones are ready to run. The machine control system (not shown) controls the zones.

**STOPPING:** Obstructing the light curtain or opening the SensaGuard gate will de-energize the K1-K3 contactors. Clearing the light curtain or closing the gate will not cause the contactors to energize. The zone 1 Reset button must be pressed to restart zone 1. The e-stop acts as a global stop. When pressed, both zones are de-energized. The guard locking gate is associated with the e-stop. After pressing the e-stop, the SmartGuard energizes output 7 which provides voltage for the guard locking solenoid. Press the Lock Release push button to power the solenoid and open the gate. Closing the gate or resetting the e-stop does not re-energize the K1-K5 contactors. The respective zone reset buttons must be pressed after the input devices are cleared.

**Fault Detection**

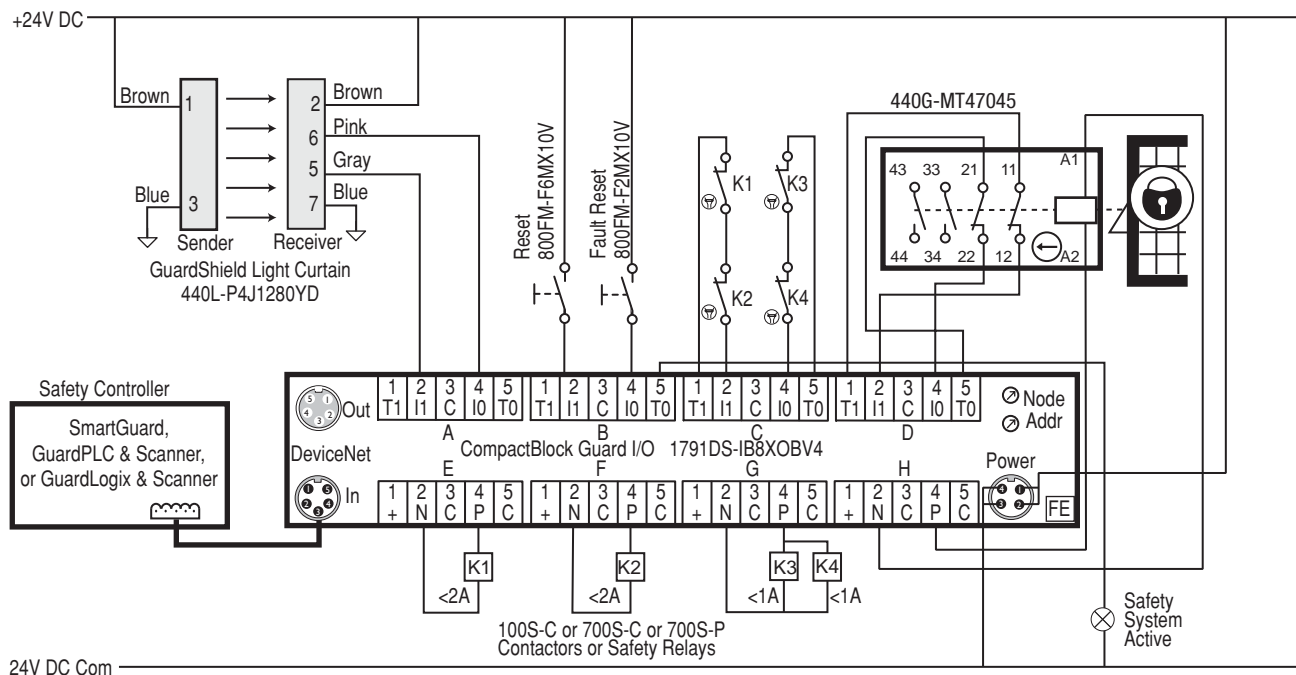
Upon successful completion of internal checks on power up, the SmartGuard checks the input devices. The pulsed outputs T2-T3 are used by the SmartGuard to help check for open and short-circuit fault conditions. If a fault is detected, the SmartGuard will not energize the respective outputs. When the zone reset buttons are pressed, the SmartGuard checks the status of the K1-K5 contactors. If the contactors are energized, stuck or welded closed, the SmartGuard will detect this due to the open circuit to Inputs 14 or 15, and will not energize the respective zone. The programmable safety function blocks associated with each device performs self-checking. If a fault occurs, the respective fault reset button must be pressed, after the fault is cleared.

**Ratings**

The ratings assume that two contactors are connected in series to power the hazards. The safety function initiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the MatGuard safety mat and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.



The ratings assume that two contactors are connected in series to power the hazards. The safety function initiated by the SensaGuard interlock, GuardShield light curtains, and 800F e-stop meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the SafeZone scanner and 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop.



## Circuit Status

The light curtain is cleared, and the 440G-MT guard locking switch is closed and locked. The contactors K1-K4 are off. The safety system is ready to be energized.

## Operating Principle

The 1791DS-IB8XOBV4 has bi-polar outputs, which allows the module to switch both the positive and negative side of the load device (e.g. contactors and solenoids) and to check for faults on both the positive and negative side of the load.

**STARTING:** Press the reset button to energize the contactors K1-K4. The safety controller verifies that the monitoring circuits at terminals in the "C" connector are closed. The safety contactors K1 through K4 become energized and allow the machine to run. The Safety System Active indicator is turned on by the safety controller. The safety controller signals the machine control system that the safety system is ready to run. The machine control system (not shown) controls the machine.

**STOPPING:** Obstructing the light curtain de-energizes contactors K1-K4. The contactors may also be de-energized by the safety controller due to other safety demands (like a system level e-stop). When the contactors K1-K4 are de-energized, the solenoid of the 440G-MT can be energized and allow the gate to be opened. While the gate is open, the program in the safety controller must not allow the contactors to re-energize. Closing the gate or clearing the light curtain do not re-energize the contactors. Press the reset button to re-energize the contactors.

## Fault Detection

Upon successful completion of internal checks on power up, the safety controller checks the input devices. Test outputs T0 and T1 in the "D" connector are configured as pulse test sources and are used by the safety controller to help check for open and short-circuit fault conditions of the 440G-MT gateswitch. If a fault is detected, the safety controller will not energize the K1-K4 contactors. The safety controller checks the status of the K1-K4 contactors. The safety controller will detect contactors that are energized, stuck or welded closed by the open circuits at inputs I0 and I1 and will not energize the respective zone. The contactors and the 440G-MT solenoid are switched on both the positive and negative side, so shorts to either the supply voltage or to ground will be detected. After clearing a fault, press the Fault Reset button to reset the module. Press the Reset button to allow the contactors to be energized.

## Programming

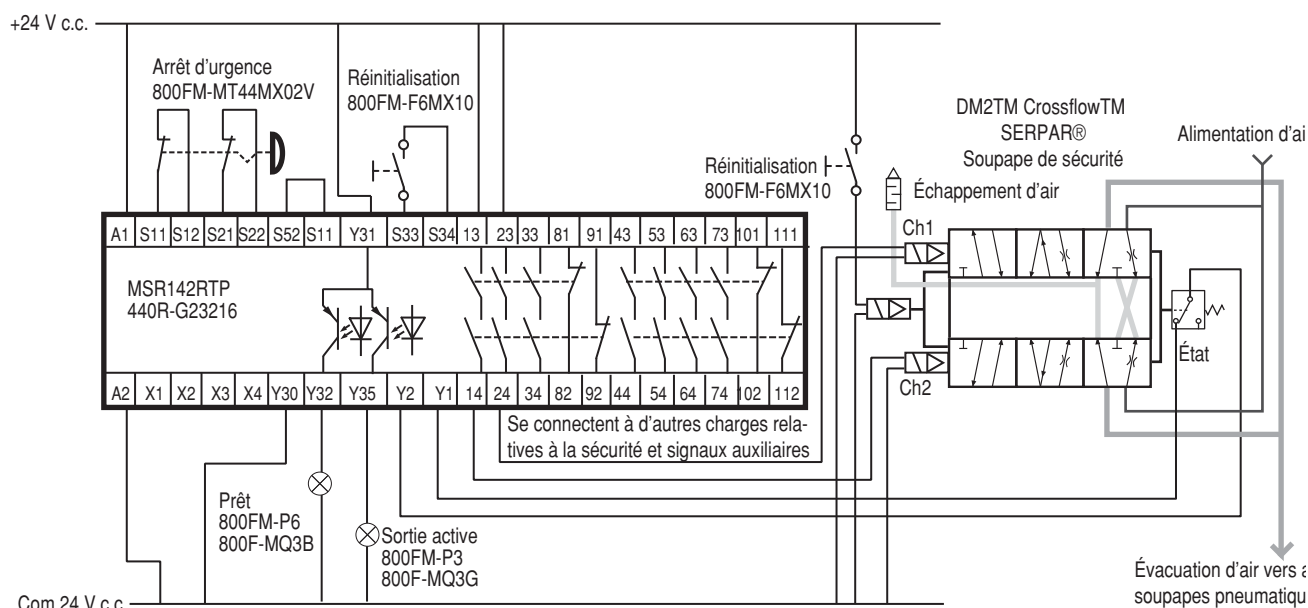
The safety outputs of the 1791DS-IB8XOBV4 are configured in firmware as four (4) dual channel pairs. Both outputs in the pair must be complementary or a fault occurs. Outputs T0 and T1 in the "D" connector must be configured as pulse outputs. Test outputs T0 in the "B" connector must be configured in software as 'standard outputs' to drive the Safety System Active indicators.

## Ratings

The ratings assume that two contactors are connected in series to power the hazards. The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has a Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1:2006. The safety functions initiated by the 440G-MT interlock meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and have a Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1:2006. This circuit executes a Category 0 stop. If only one contactor is used to power a hazard, the safety function can meet SIL CL 2, Category 2 structure and PLd.

# Vanne de sécurité & Arrêt d'urgence – Ventilation de la source d'air

800F, MSR142, Pneumatic Safety Valve



## Etat circuit

Le bouton d'arrêt d'urgence est relâché, les sorties de relais de sécurité MSR142 sont arrêtées et la soupape pneumatique est fermée.

## Principe de fonctionnement

**DÉMARRAGE :** Presser le bouton de réinitialisation pour mettre sous tension les contacts de sortie du relais de sécurité. Les deux solénoïdes dans la soupape sont activées et permettent à l'air de circuler de l'alimentation d'air à l'évacuation d'air.

**ARRÊT :** Une pression du bouton d'arrêt d'urgence désactive les sorties de sécurité du MSR142, qui à son tour arrête les solénoïdes de la soupape de sécurité. La soupape ferme l'alimentation d'air et relâche la pression d'air vers l'échappement d'air. Relâcher le bouton d'arrêt d'urgence ne fait pas se remettre en marche la soupape.

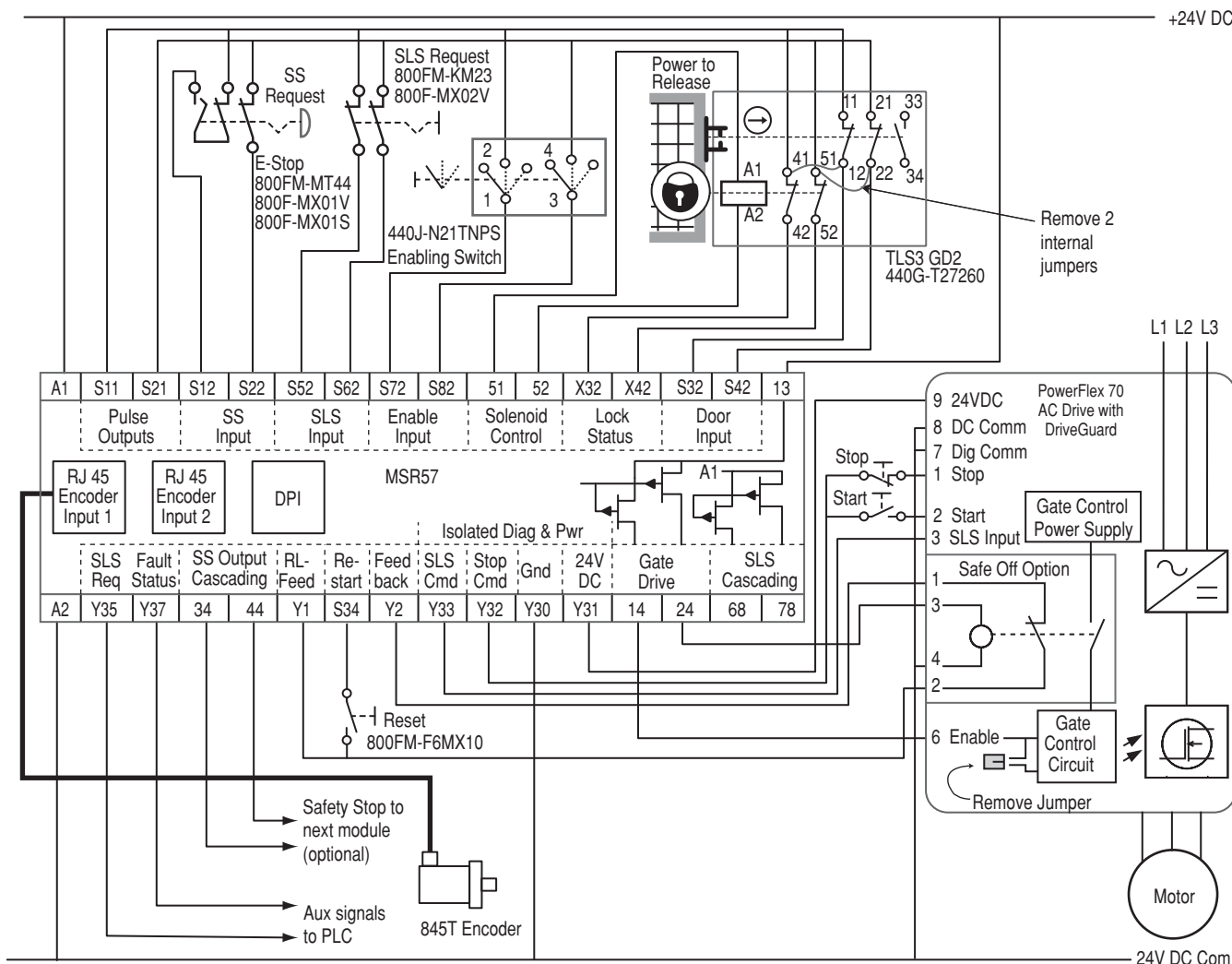
## Détection de défaut

Après achèvement réussi de vérifications internes lors de la mise en marche, le MSR142 vérifie l'état de l'arrêt d'urgence. Si un circuit ouvert ou court-circuit est détecté, le MSR142 n'activera pas ses sorties. Si les deux circuits d'entrée sont correctement fermés, le MSR142 vérifie l'état de la soupape de sécurité. Si les deux solénoïdes de la soupape de sécurité sont activées, le contact d'état sera ouvert, et le MSR142 n'activera pas ses sorties. Si les deux solénoïdes sont désactivées, le contact d'état sera fermé et le MSR142 allumera sa DEL Prêt. Une pression du bouton de réinitialisation active les sorties de sécurité du MSR142 et ouvre la soupape de sécurité.

La soupape de sécurité exécute ses propres vérifications internes. Si l'une des soupapes reste actionnée, est bloquée ou se déplace trop lentement, le flux d'air vers l'évacuation d'air sera réorienté vers l'échappement. Pour annuler la condition de défaillance, les deux soupapes doivent être désactivées et le bouton de réinitialisation de soupape doit être poussé.

## Caractéristiques nominales





### Circuit Status

The safe stop (SS) request e-stop button is released. The safe limited speed (SLS) request button is released. The enabling switch is released. The guard locking interlock is closed and locked. The safety outputs (Gate Drive) of the MSR57 are off. The motor is off.

### Operating Principle

The MSR57 performs the safe limited speed function. It provides a signal to the drive to initiate the slow speed. The MSR57 accepts encoder signals to monitor the speed. When the speed is within the safe speed limit, the guard locking device is allowed to open. If the speed exceeds the limit, a safe shutdown is initiated.

**STARTING:** Press the reset button to energize outputs of the MSR57. Then press the start button to turn on the motor. The motor will execute its programmed function.

**SAFE LIMITED SPEED:** Turn the key operated selector switch to the SLS position and remove the key. The MSR57 sends a command to the drive to go to its configured safe limited speed. When the motor reaches and stays at the limited speed, the guard locking door becomes unlocked. Grip the enabling switch to the middle position and enter the hazard area. Exit the hazard area while holding the GripSwitch. Switch the SLS request to run. Then press the reset button to allow the drive to rotate the motor at high speeds. The GripSwitch can then be released.

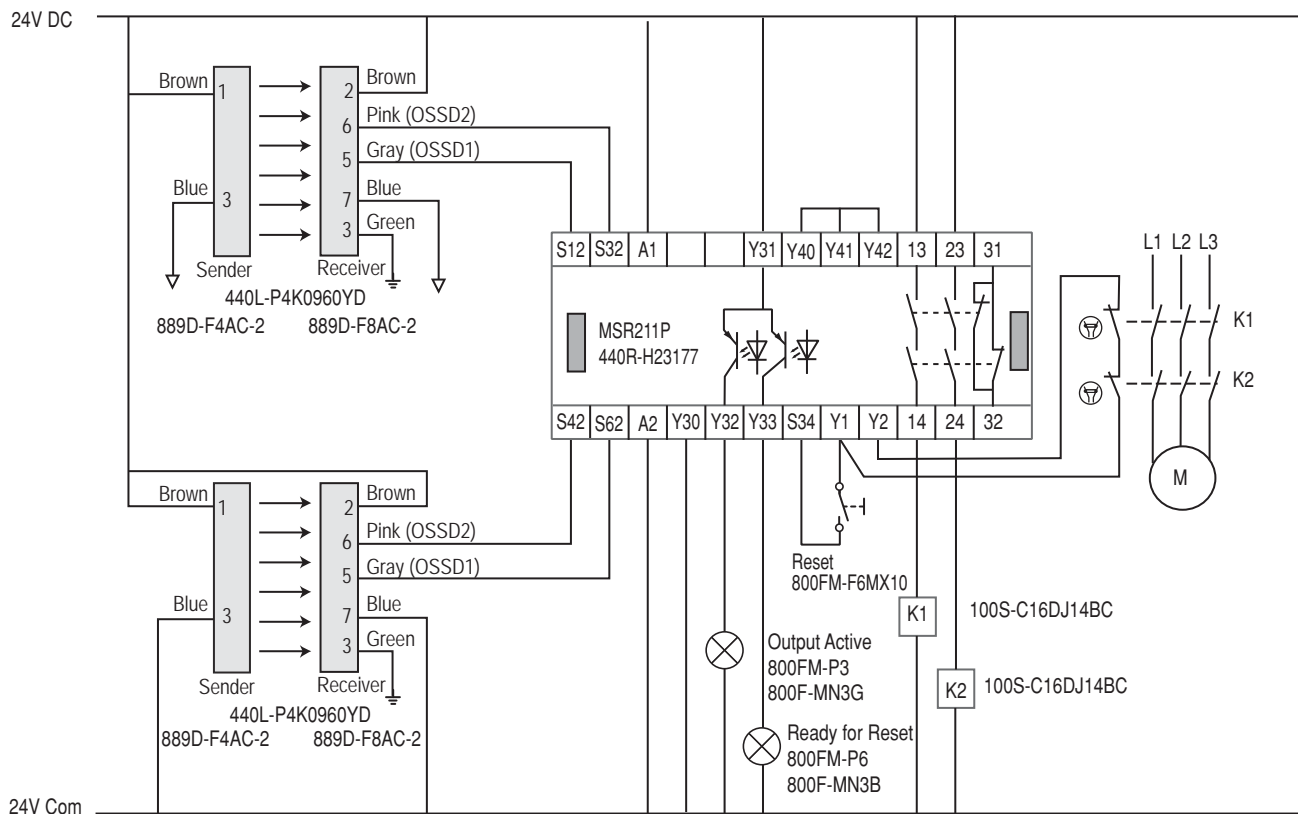
**STOPPING:** The e-stop can be pressed at any time to initiate a stop. If the speed exceeds the limit or the GripSwitch is released, a safe-off stop is initiated.

### Fault Detection

Upon power-up the MSR57 and PowerFlex 70 perform internal checks. The MSR57 generates continuous test pulses to check for short circuit at the input devices. Dual channel inputs and outputs provide single fault tolerance.

### Ratings

The safety functions initiated by the 800F e-stop and TLS3-GD2 guardlocking device meet the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLD per ISO 13849-1: 2006. This example circuit performs a Stop Category 1 function (brake and then remove power to motor).



### Circuit Status

Both light curtains are clear. The MSR211P output contacts are de-energized. The motor is off and ready to run.

### Operating Principle

The MSR211P accepts two light curtains and functions as an alternative to a cascaded arrangement of light curtains.

STARTING: Press the reset button to energize the outputs of the MSR211P, which turns the motor on.

STOPPING: Obstructing either light curtain causes the motor to stop.

### Fault Detection

Upon successful completion of internal checks on power-up, the MSR211 checks the input signals from the GuardShield light curtains. If all four signals from the light curtains are present and no shorts exist, the MSR211P checks for the reset button. With the jumper from Y40 to Y42, the MSR211P checks to make sure the reset button is not held closed. When the reset button is pressed, the MSR211P checks the status of the two contactors. If the circuit on Y1/Y2 is closed, the MSR211 energizes its output. With the jumper from Y40 to Y41, the MSR211P confirms that both contactors are energized within 300 ms.

### Ratings

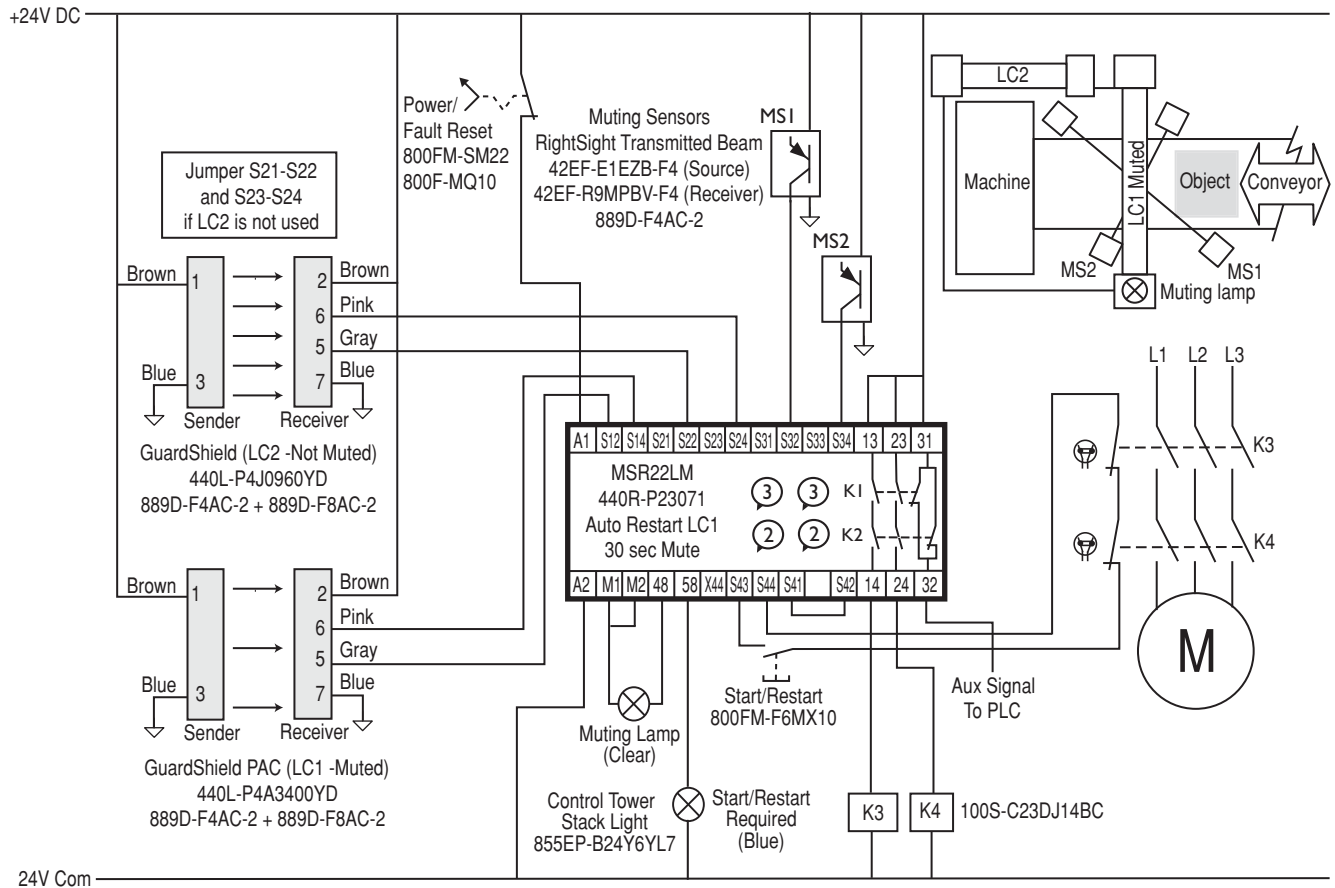
The safety functions initiated by the two GuardShield light curtains meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



# Applications de protection et schémas de câblage

## Barrière immatérielle – Inhibition avec deux détecteurs

### GuardShield, RightSight, 800F, Control Tower, MSR22LM, 100S



#### Circuit Status

The light curtain is clear. The muting sensors are clear. The outputs of the safety relay are de-energized, and the motor is off.

#### Operating Principle

The MSR22LM is designed for automated conveyor applications, where an object moves through a light curtain into or out of a hazardous area. With two sensor muting, the object can move in both directions.

**STARTING:** Upon initial power-up, the start/restart button must be pressed to energize the outputs of the MSR22LM and start the motor.

**MUTING:** The object must block the sensor MS1 and then MS2 prior to passing through the light curtain. After passing through the light curtain, the object must clear MS2 and then MS1 for the motor to continue running during the muting operation.

**STOPPING:** Obstructing the light curtain without blocking sensors MS1 and MS2 de-energizes the MSR22LM safety outputs. After clearing the light curtain, press the start/restart button to re-energize the safety outputs of the MSR22LM.

#### Fault Detection

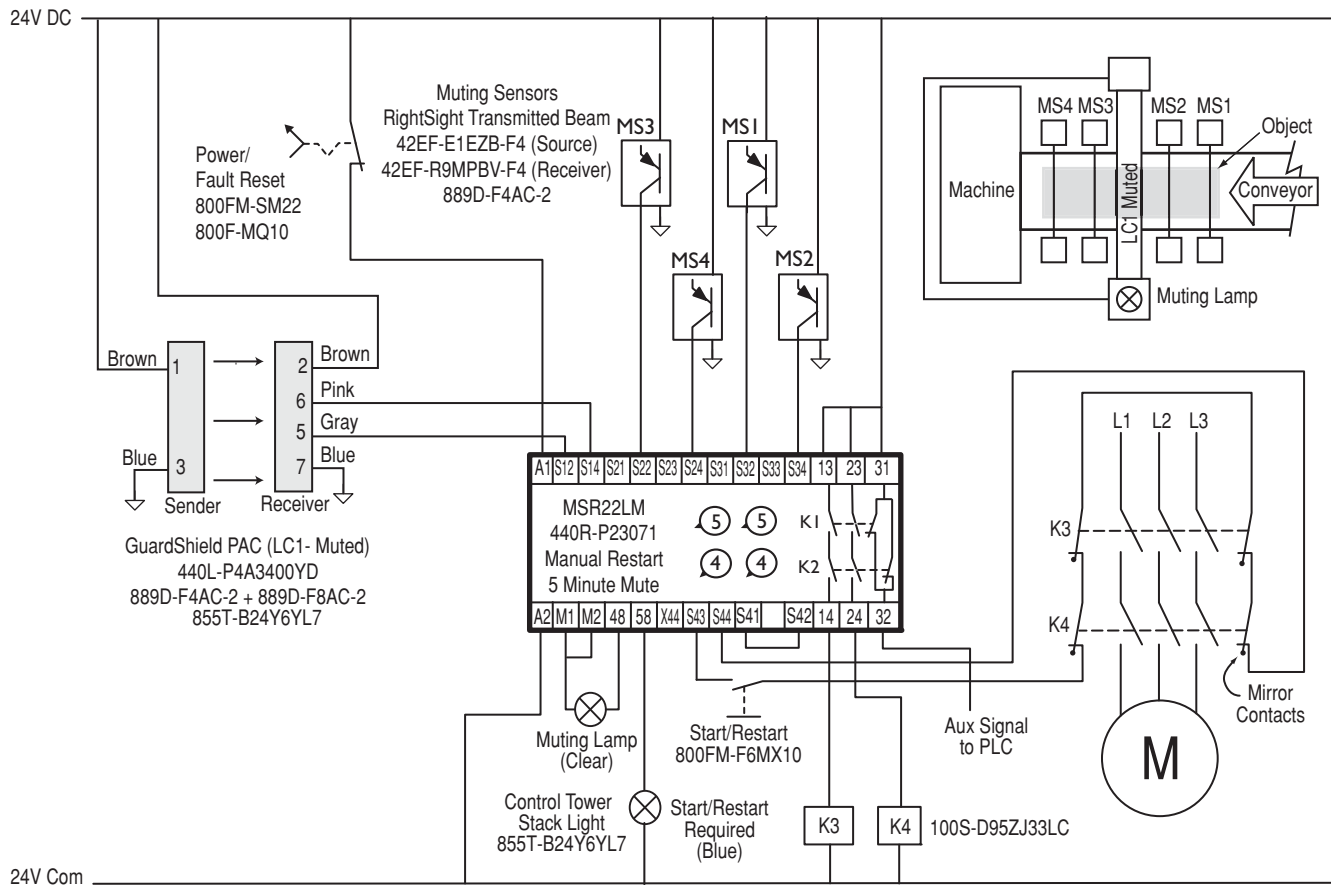
Upon power-up, the GuardShield and MSR22LM perform internal checks. If OK and clear, the GuardShield outputs turn on. The MSR22LM checks the muting inputs. If OK, the MSR22LM checks the light curtain for dual channel signals. If OK, the muting lamp blinks continuously and the start/restart required lamp turns on to indicate that the MSR22LM is ready to start. While running, an incorrect sequence of the muting sensors and light curtain operation or excessive time to move the object through the light curtain will de-energize the safety outputs of the MSR22LM. The run LEDs or the muting lamp blink at certain rates to indicate the type of fault that has occurred. The start/restart button can be held down for three seconds to manually move material through the conveyor. The motor will then run for 12 seconds. Some faults can be cleared by removing the object from the sensors. The start/restart required indicator will turn on when the MSR22LM is ready to go. Other faults may have to be cleared by cycling the power to the MSR22LM. The MSR22LM monitors the 100S contactors through mechanically linked contacts connected in series. If one contactor welds closed, the second contactor will stop the motor, and the MSR22LM will detect the fault at the next attempt to start the motor.

#### Ratings

The safety functions initiated by the two GuardShield light curtains meet the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).

## Barrière immatérielle – Inhibition avec quatre détecteurs

GuardShield, RightSight, 800F, Control Tower, MSR22LM, 100S



## Circuit Status

The light curtain is cleared. The muting sensors are cleared. The outputs of the safety relay are de-energized, and the motor is off.

## Operating Principle

The MSR22LM is designed for automated conveyor applications, where an object moves through a light curtain into or out of a hazardous area. With four sensor muting, the object can only move in one direction.

**STARTING:** Upon initial power-up, the start/restart button must be pressed to energize the outputs of the MSR22LM and start the motor.

**MUTING:** The object must block the sensors MS1 and MS2 prior to passing through the light curtain. The object must be large enough to block all four sensors, for the motor to continue running during the muting operation.

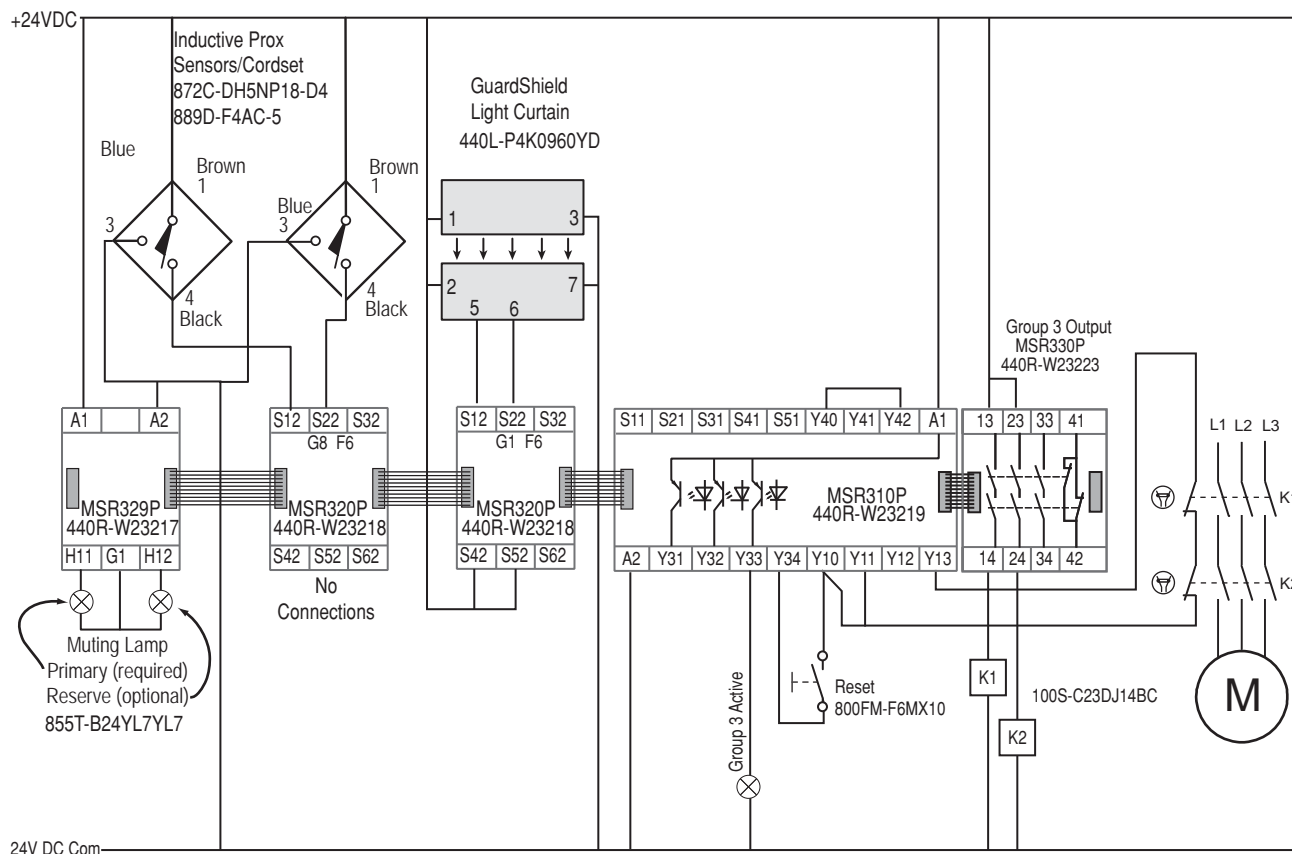
**STOPPING:** Obstructing the light curtain without blocking sensors MS1 and MS2 de-energizes the MSR22LM safety outputs. After clearing the light curtain, press the start/restart button to re-energize the safety outputs of the MSR22LM.

## Fault Detection

Upon power-up, the GuardShield and MSR22LM perform internal checks. If OK and clear, the GuardShield outputs turn on. The MSR22LM checks the muting inputs. If OK, the MSR22LM checks the light curtain for dual channel signals. If OK, the muting lamp blinks continuously and the start/restart required lamp turns on to indicate that the MSR22LM is ready to start. While running, an incorrect sequence of the muting sensors and light curtain operation or excessive time to move the object through the light curtain will de-energize the safety outputs of the MSR22LM. The run LEDs or the muting lamp blink at certain rates to indicate the type of fault that has occurred. The start/restart button can be held down for three seconds to manually move material through the conveyor. The motor will then run for 12 seconds. Some faults can be cleared by removing the object from the sensors. The start/restart required button will turn on when the MSR22LM is ready to go. Other faults may have to be cleared by cycling the power to the MSR22LM. The MSR22LM monitors the 100S-D contactors through the mechanically linked "mirrored" contacts connected in series. If one contactor welds closed, the second contactor will stop the motor, and the MSR22LM will detect the fault at the next attempt to start the motor.

## Ratings

The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLe per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



### Circuit Status

The light curtain is clear. The inductive proximity sensors are clear. The MSR330P outputs are de-energized. The motor is off.

### Operating Principle

The MSR300 is configured for a muting function. When both proximity sensors detect appropriate targets, the light curtain function is muted. The proximity sensors operate as a pair and do not have to operate in a specific sequence. The application must be an automatic process where the muting function is temporary. A muting lamp indicates when the muting function is active. The muting lamp is monitored. If the muting lamp burns out, the MSR300 will continue to function if a reserve lamp is present; otherwise the output stay off until the primary muting lamp is replaced.

**STARTING:** Press the reset button to energize all MSR330P outputs. The contactors K1 and K2 energize and the motor is turned on.

**STOPPING:** Obstructing the light curtain when the proximity sensors are not active will cause the MSR310P to de-energize and stop the motor.

### Fault Detection

Upon successful completion of internal checks on power up, the MSR310P checks the input circuits. Shorts from the inputs to power, ground or other inputs will be detected immediately and will prevent energizing or will de-energize the MSR330P outputs. If one of the 100S output devices (K1 or K2) is stuck in an actuated state, the MSR310P will prevent startup because the Y10/Y13 feedback loop will remain open. The proximity sensors must be located in a way that prevents easy bypassing with spare targets.

### Ratings

The safety function initiated by the GuardShield light curtain meets the safety performance requirements of SIL CL 3 per IEC 62061:2005 and has Category 4 structure that can be used in systems requiring Performance Levels up to PLE per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



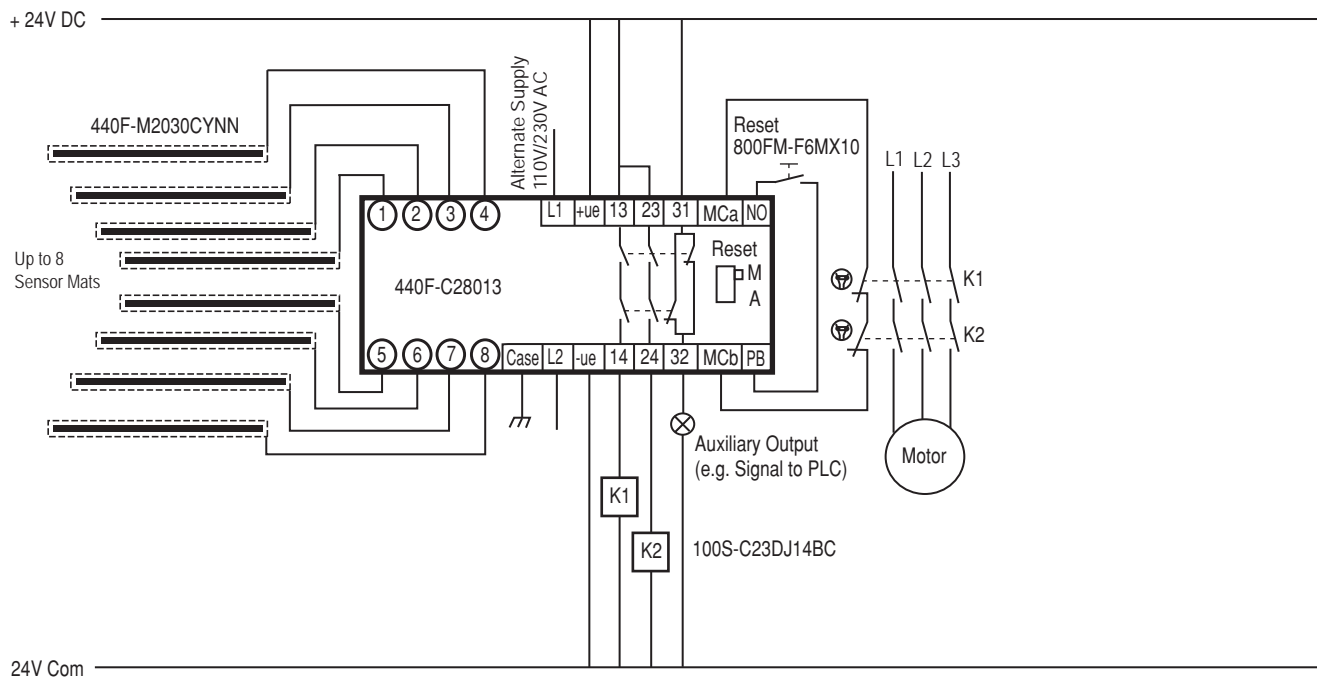
The e-stop is reset. The safety outputs of the MSR144, MSR230 and MSR238 are de-energized. The motor is off.

The MSR144 was chosen for its ability to expand its outputs with a combination of MSR230 and MSR238 modules. Up to five modules can be added to one MSR144. Ribbon cables on the front of the relay extend control of the MSR144 to MSR230 and MSR238. Without jumpers to X1/X2 and X3/X4, the MSR144 is set to monitored manual reset.

**STOPPING:** When an e-stop is pressed, the safety outputs of the MSR144 and MSR230 immediately turn off and de-energize K1-K6. Four seconds later, the safety outputs of the MSR238 turn off and de-energize K7 and K8.

Upon power-up, the MSR144 performs internal checks. The checks also include verification that the MSR230 and MSR238 modules are in the off state. The MSR144 then looks for dual signals from the e-stop circuit. A crossfault on the e-stop circuit will be detected by the MSR144. With the e-stop signals made, closing the reset button places a voltage to the Y2 terminal. The external devices (K1 through K8) are checked to confirm they are off. A fault in K1 through K8 will cause their normally closed contacts to remain open, and this fault will be detected by the MSR144.

The safety function initiated by the series connection of 800F e-stop buttons meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. The Category 3 rating requires the redundant usage of K1-K8 to de-energize the machine actuators, and the contactors must be monitored by the safety system. This example circuit performs a Stop Category 0 function (coast to stop).



### Circuit Status

There is no presence on the safety mats. The safety outputs of the Mat Manager are de-energized. The motor is off.

### Operating Principle

The Mat Manager monitors up to eight mats, which are individually connected to the Mat Manager by M12 connectors. LEDs on the front of the Mat Manager indicate which mat is actuated as well as providing status LED for power and safety outputs.

STARTING: Press the reset button to energize the outputs of the Mat Manager.

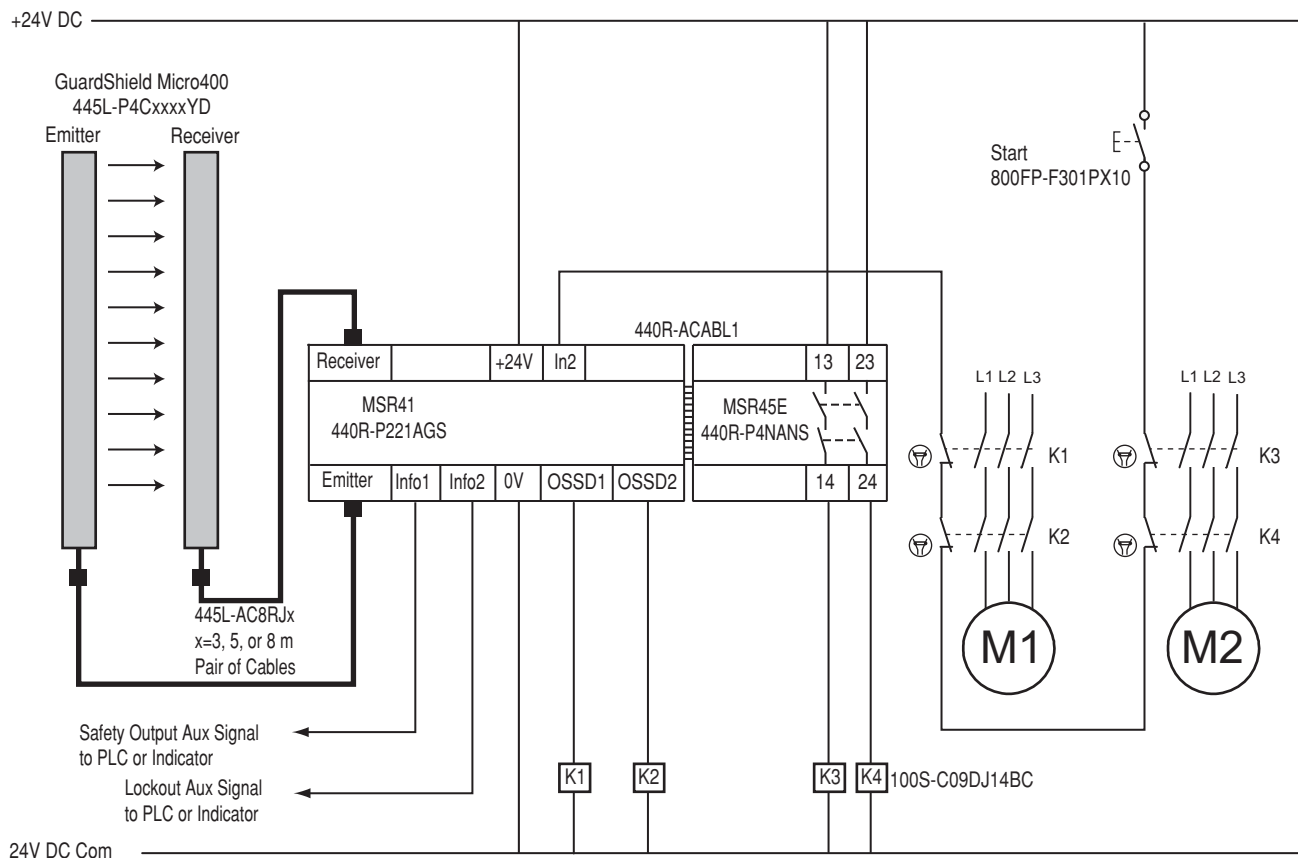
STOPPING: Stepping on any of the safety mats will turn off the safety outputs of the Mat Manager and de-energize the K1 and K2 contactors.

### Fault Detection

Upon power-up, the Mat Manager performs internal checks. The Mat Manager then looks for current flowing through each of the safety mats. A short or open circuit on any of the safety mats will be detected by the Mat Manager. With the safety mat signals made, the Mat Manager checks the reset button. With monitored manual reset selected, a short circuit or stuck pushbutton will be detected by the Mat Manager. Pressing the reset button, the Mat Manager checks the K1 and K2 contactors. A stuck or welded contactor will be detected by an open normally closed contact.

### Ratings

The safety function initiated by the MatGuard safety mat meets the safety performance requirements of SIL CL 2 per IEC 62061:2005 and has Category 3 structure that can be used in systems requiring Performance Levels up to PLd per ISO 13849-1: 2006. This example circuit performs a Stop Category 0 function (coast to stop).



### Circuit Status

The light curtain is clear. K1, K2, K3 and K4 are off. The motors are off and ready to run.

### Operating Principle

**STARTING:** Momentarily press the Start button. The OSSD safety outputs and the safety contacts 13/14 and 23/24 close. The contactors K1-K4 energize, and the motors M1 and M2 start.

**STOPPING:** Breaking the light curtain causes the OSSD safety outputs and the safety contacts 13/14 and 23/24 to open. The contactors K1-K4 drop out and the motors coast to a stop.

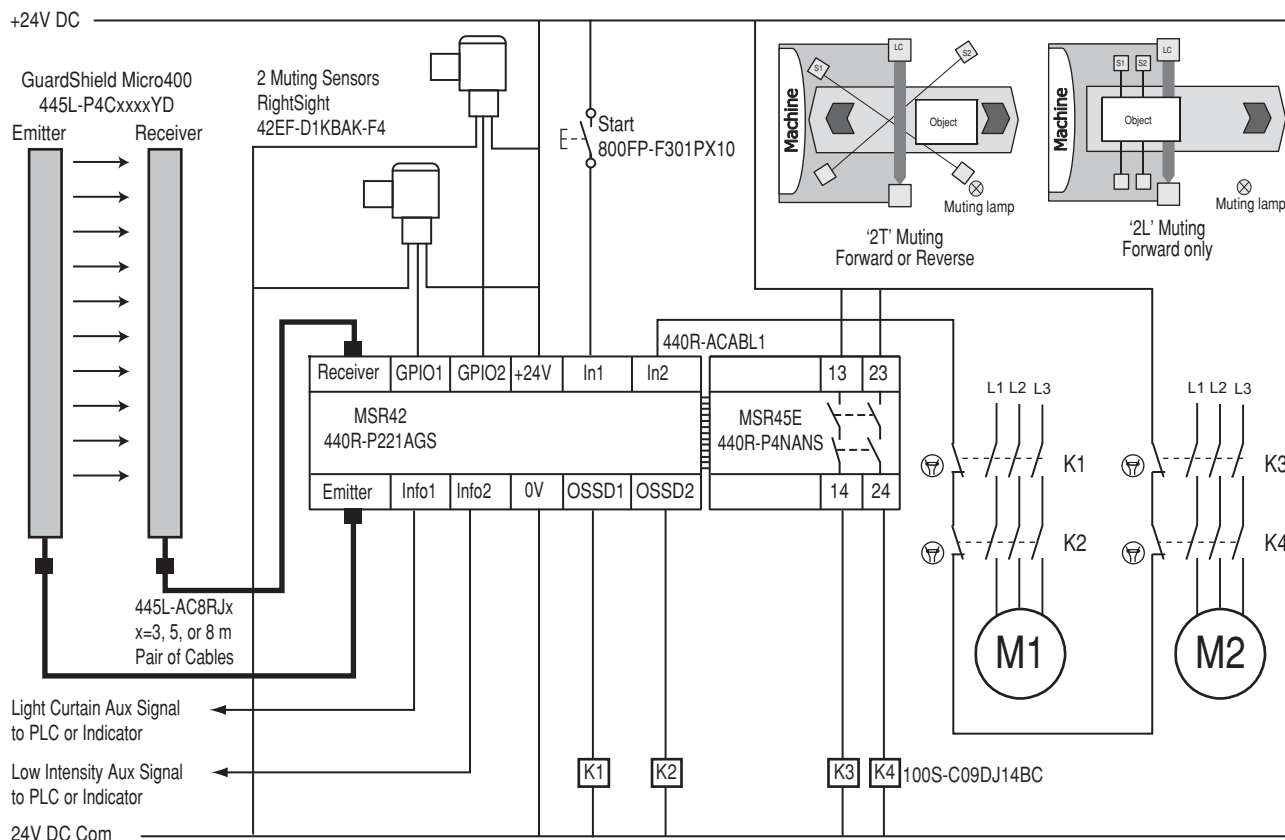
Removing the object from the light curtain will not cause the motor to run. The operator must momentarily close the Start switch to turn the motor on.

### Fault Detection

Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR41 checks the signals from the light curtain. If it's okay, the MSR41 then checks the status of the K1-K4 contactors. If one of the pair of contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR41 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

### Ratings

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.



### Circuit Status

The light curtain and muting sensors are clear. K1, K2, K3 and K4 are off. The motors are off and ready to run.

### Operating Principle

**STARTING:** Momentarily press the Start button. The OSSD safety outputs turn on and the safety contacts 13/14 and 23/24 close. The contactors K1-K4 energize, and the motors M1 and M2 start.

**MUTING:** The MSR42 must be configured for two sensor L-type or T-type sensing. When the object passes by the sensors in the proper sequence, the light curtain becomes muted. The muting process is complete when the object passes by both sensors, and the light curtain becomes active again.

**STOPPING:** Breaking the light curtain causes the OSSD safety outputs and the safety contacts 13/14 and 23/24 to open. The contactors K1-K4 drop out and the motors coast to a stop.

### Fault Detection

Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR42 checks the signals from the light curtain. If it's okay, the MSR42 then checks the status of the four sensors and the K1 and K2 contactors. If a sensor is shorted in the ON state, the MSR42 will not allow the OSSD outputs to turn ON. If one of the contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR42 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

### Ratings

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.



The light curtain and muting sensors are clear. K1 and K2 are off. The motor is off and ready to run.

STARTING: Momentarily press the Start button. The OSSD safety outputs turn on. The contactors K1-K2 energize, and the motor M1 starts.

MUTING: The MSR42 must be configured for four sensor T-type sensing, with appropriate time settings. When the object passes by the sensors in the proper sequence, the light curtain becomes muted. The muting process is complete when the object passes by all the sensors and the light curtain becomes active again.

STOPPING: Violating the muting timing constraints and breaking the light curtain causes the OSSD outputs to turn off. The contactors K1-K2 drop out and the motors coast to a stop. If the object stops in the light curtain, the Start button can be used to temporarily override the muting function and energize the OSSD outputs.

Upon successful completion of internal checks on power up, the GuardShield light curtain energizes its outputs with no objects present. The GuardShield light curtain outputs turn on. If a crossfault is detected, the GuardShield light curtain goes to a lockout state with its outputs off. After successful completion of internal checks, the MSR42 checks the signals from the light curtain. If it's okay, the MSR42 then checks the status of the four sensors and the K1 and K2 contactors. If a sensor is shorted in the ON state, the MSR42 will not allow the OSSD outputs to turn ON. If one of the contactors fails in the actuated state, the other contactor will disconnect the motor. The MSR42 will detect the faulted contactor and will not allow the motor to restart until the fault is corrected.

This circuit can meet the safety performance requirements of PLe per ISO13849-1: 2006 and SIL CL3 per IEC62061:2005. This circuit executes a Category 0 stop.