Operating Principle

The XPSVN zero speed safety relay is used for zero speed detection of electric motors. Its primary use is in systems employing one or more of the following:

- Directional controls for reversing motors
- Electrical locking of machinery doors and guards with safety interlocking devices. An example would be to energize the solenoid of an XCSE solenoid safety interlock device (locking without power).
- Electrical braking systems that lock the system after it comes to zero speed.
- DC injection brakes.

When coasting to a stop, electric motors generate a residual voltage in their windings, resulting from residual magnetism, and this decreases proportionally to the decrease in motor speed. This residual voltage is monitored by the XPSVN safety relay to detect the motor's zero speed. The wiring between the motor windings and the safety relay are also monitored, to identify a wire break (fault) differently from a zero speed detection. Therefore, a broken or loose wire will not be interpreted as a zero speed condition of the motor.

The XPSVN safety relay is designed for zero speed detection in all types of electrical machinery using AC or DC, single phase or three phase power, which can be controlled by electric motor controls such as adjustable frequency controllers, control components to start under low load (i.e.: low voltage), and brakes which inject direct current (DC) into the windings.

The XPSVN is not compatible with Wound Rotor Motors. These motors are typically used in high HP (1000+) low speed applications, where the additional windings (required for these types of motors) pay for themselves. If power is removed from stator, but rotor is left energized, then transformer coupling between the two could create a small voltage across the stator. This could make the XPSVN think the motor is still turning, which means the safety outputs would never energize or change state. These motors do not have residual magnetism in the rotor that can act as a source of flux for generator effect, in which case the XPSVN may think the motor is at zero speed, and could energize the safety outputs while the motor is still running. Wound Rotor motors are not in common use today, and very rare.

The XPVN is not designed to detect locked rotor conditions. Here the motor still has voltage applied to it, but in essence has zero speed. Generally, a locked rotor condition is not a safe state for machinery nor the operators. The XPSVN will sense voltage applied to the windings, and will not indicate the motor's "apparent" zero speed. The outputs of the XPSVN will not change state, the gates or guards will not be unlocked, and operators will not be allowed access to the unsafe area.

Two potentiometers, mounted on the face of the module, allow independent adjustment of the switching threshold for each input circuit. This allows adjustment for different types of motors and application requirements. It should be noted that "Zero speed" may not indicate absolute zero speed. This device detects speeds below user adjustable values as set by these potentiometers.

To assist in diagnostics, XPSVN modules incorporate 4 LED indicators and 2 solid state outputs to provide information on the status of the zero speed detection circuit.

Technical Data

Module Type		**XPSVN**
Power Supply		
Voltage	**V**	24 Vac/dc, 115/230 Vac
Voltage limits		-15 to +10% (24 Vdc)
		-15 to +15% (115 Vdc)
		-15 to +10% (230 Vdc)
Frequency	**Hz**	50/60
Power Consumption		
24 V	**W**	< 4
115 V/230 V	**VA**	< 8
Module Fuse Protection		≤ 4 A external fuse for 115 and 230 V versions ≤ 500 mA external fuse for 24 V versions
Inputs		
Maximum voltage between terminals Z1, Z2, Z3	**V**	500
Detection threshold	**V**	0.01 to 0.1 (adjustable)
Outputs		
Voltage Reference		Relay hard contacts
No. and nature of safety circuits		1 N.O. (13-14), 1 N.C. (21-22)
No. and nature of additional circuits		2 solid state
AC-15 Breaking capacity	**VA**	C300: inrush 1800, sealed 180
DC-13 Breaking capacity		24 V/1.5 A - L/R=50 ms (contact 13-14) 24 V/1.2 A - L/R=50 ms (contact 21-22)
Breaking capacity of solid state outputs		24 V/20 mA, 48 V / 10 mA
Max thermal current (Ithe)	**A**	2.5
Output fuse protection	**A**	4 A fuse; per IEC 60947-5-1, DIN VDE 0660 part 200
Minimum current	**mA**	10
Minimum voltage	**V**	17
Electrical Life		See page 156
Rated Insulation Voltage (Ui)	**V**	300 (Pollution degree 2 per IEC 60947-5-1, DIN VDE 0110 parts 1 and 2)
Rated Impulse Withstand Voltage (Uimp)	**kV**	4 (Overvoltage category III, per IEC 60947-5-1, DIN VDE 0110 parts 1 and 2)
LED Display		4
Operating Temperature		+14 °F to +130 °F (-10 °C to +55 °C)
Storage Temperature		-13 °F to +185 °F (-25 °C to +85 °C)
Degree of Protection per IEC 60529		
Terminals		IP20
Housing		IP50
Connection Type		Captive screw-clamp terminals. Maximum wire size: 1-12 AWG (1 x 4 mm^2) without cable end, 2-14 AWG (2 x 2.5 mm^2) with cable end.
Recommended Terminal Clamp Torque		7.0 in.lbs. (0.8 Nm)

XPSVN

File E164353
CCN NKCR

File LR44087
Class 3211 03

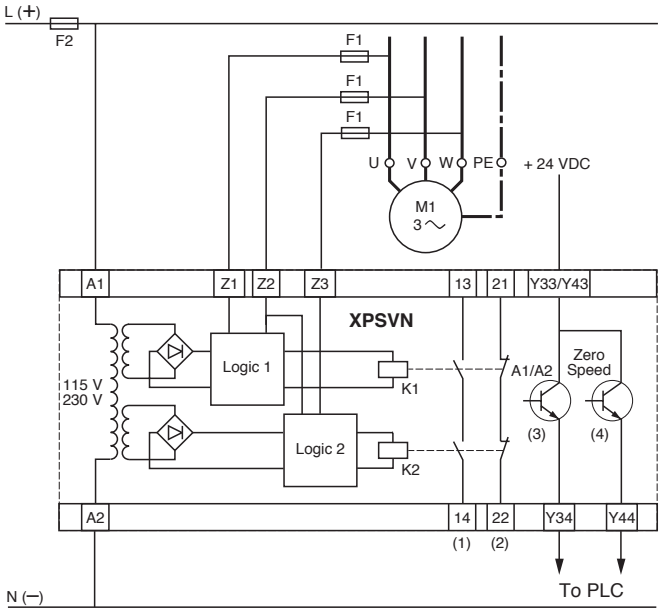
Ordering Information

Description	No. of Safety Circuits	Solid State Outputs for PLC	Power Supply	Catalog Number	Weight oz. (kg)
Safety modules for zero speed detection	2	2	24 Vdc	**XPSVN1142**	18 (0.500)
			115 Vac	**XPSVN3442**	21 (0.600)
			230 Vac	**XPSVN3742**	21 (0.600)

Suitable for use in circuits through Category 4 per EN 954-1
See page 258 for dimensions.

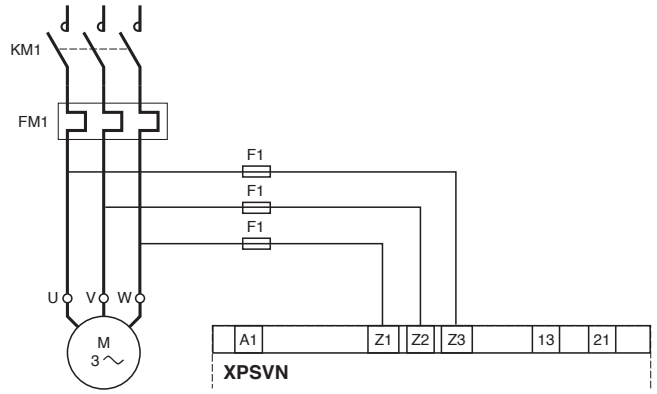
Wiring Diagrams and Connections

XPSVN with 3-Phase AC Motor



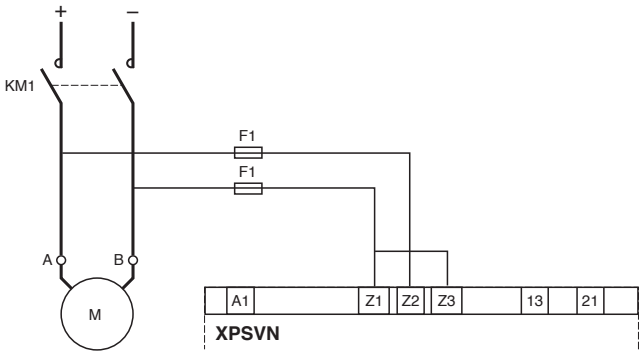
(1) Contacts are open when motor is running, closed when motor is stopped.
(2) Contacts are closed when motor is running, open when motor is stopped.
(3) Internal electronic fuse status (Y33/Y43-Y34)
(4) Zero speed (Y33/Y43-Y44)
F1 = 2 A

XPSVN with 3-Phase AC Motor



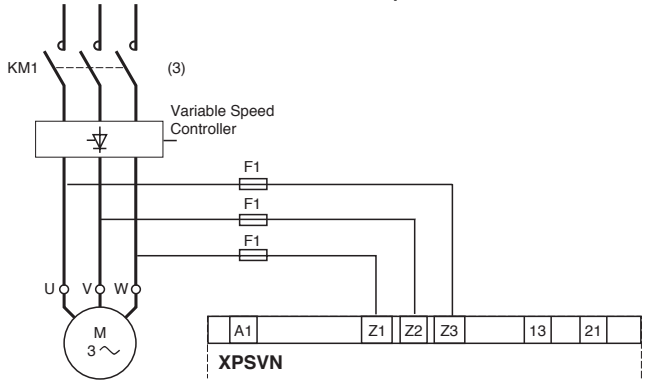
F1 = 2 A

XPSVN with DC Motor



F1 = 2 A

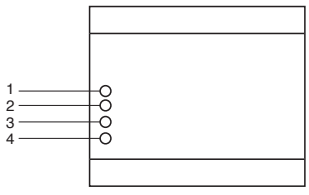
XPSVN with 3-Phase AC Motor and Variable Speed Controller



F1 = 2 A

(3) Use an output from the variable speed controller to open KM1 under normal stopping conditions.

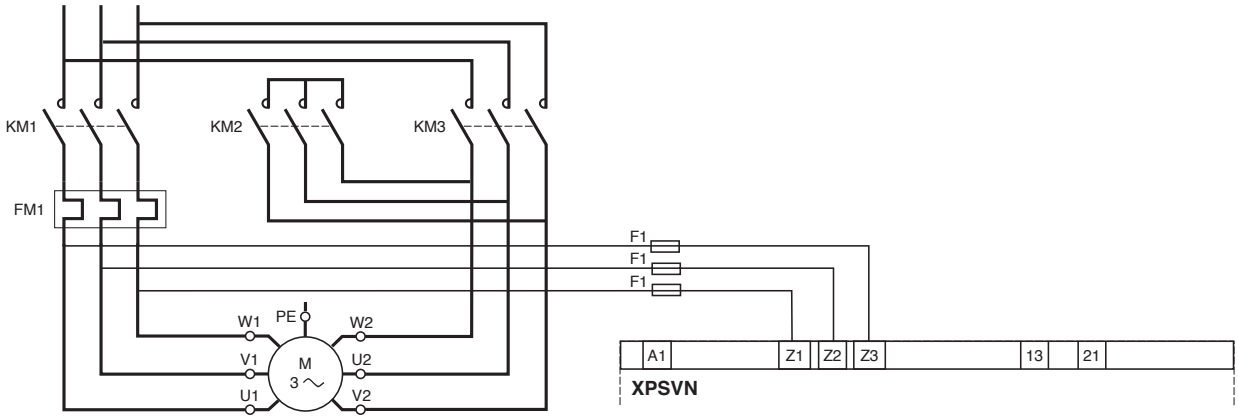
LED Signals



1 A1-A2 supply voltage
2 Stop detected by channel 1
3 Stop detected by channel 2
4 Stop detected by both channels within time window

Wiring Diagrams and Connections

XPSVN with 3-Phase AC Motor and Star Delta Starting

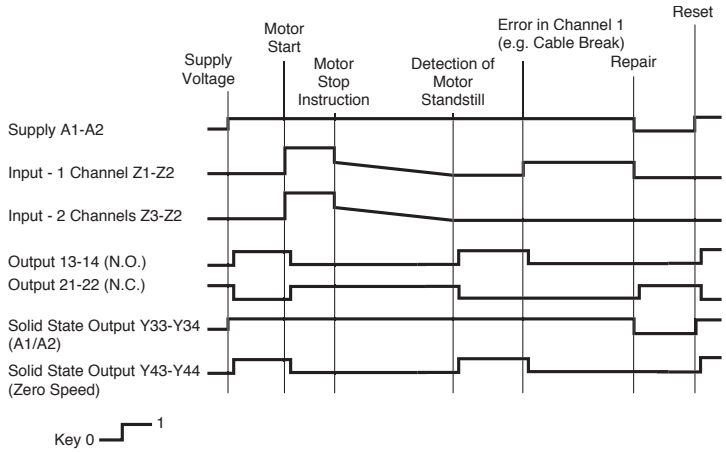


KM1: High speed rotation
KM2: Low speed rotation
KM3: Star

F1 = 2 A

The star contactor (KM3) must be closed after the motor is de-energised, in order to allow detection of zero speed.

XPSVN Functional Diagram

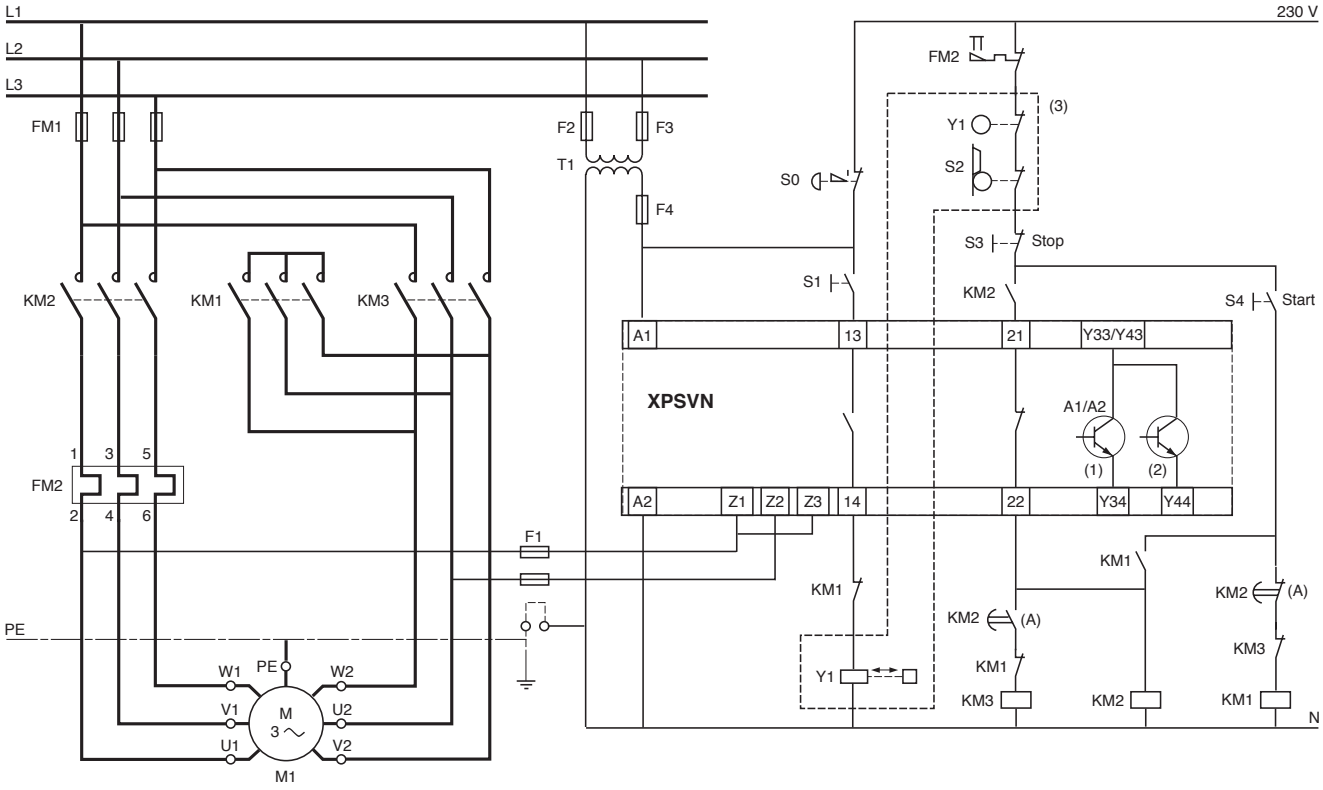


The voltages at terminals Z1, Z2 and Z3 are indicated solely for the purpose of schematic diagram representation.

Wiring Diagrams and Connections

XPSVN

Example of a safety circuit connecting an XPSVN, star delta motor starter, and XCSE safety interlock switch.



S0: Emergency stop button

S1: Push button (N.O.) to unlock guard

S3: Stop button: (N.C.)

S4: Start button (N.O.)

FM2: Overload relay and related N.C. contact

KM2: Time delay auxiliary contacts (A)

(1) Internal electronic fuse status (Y33/Y43-Y34)

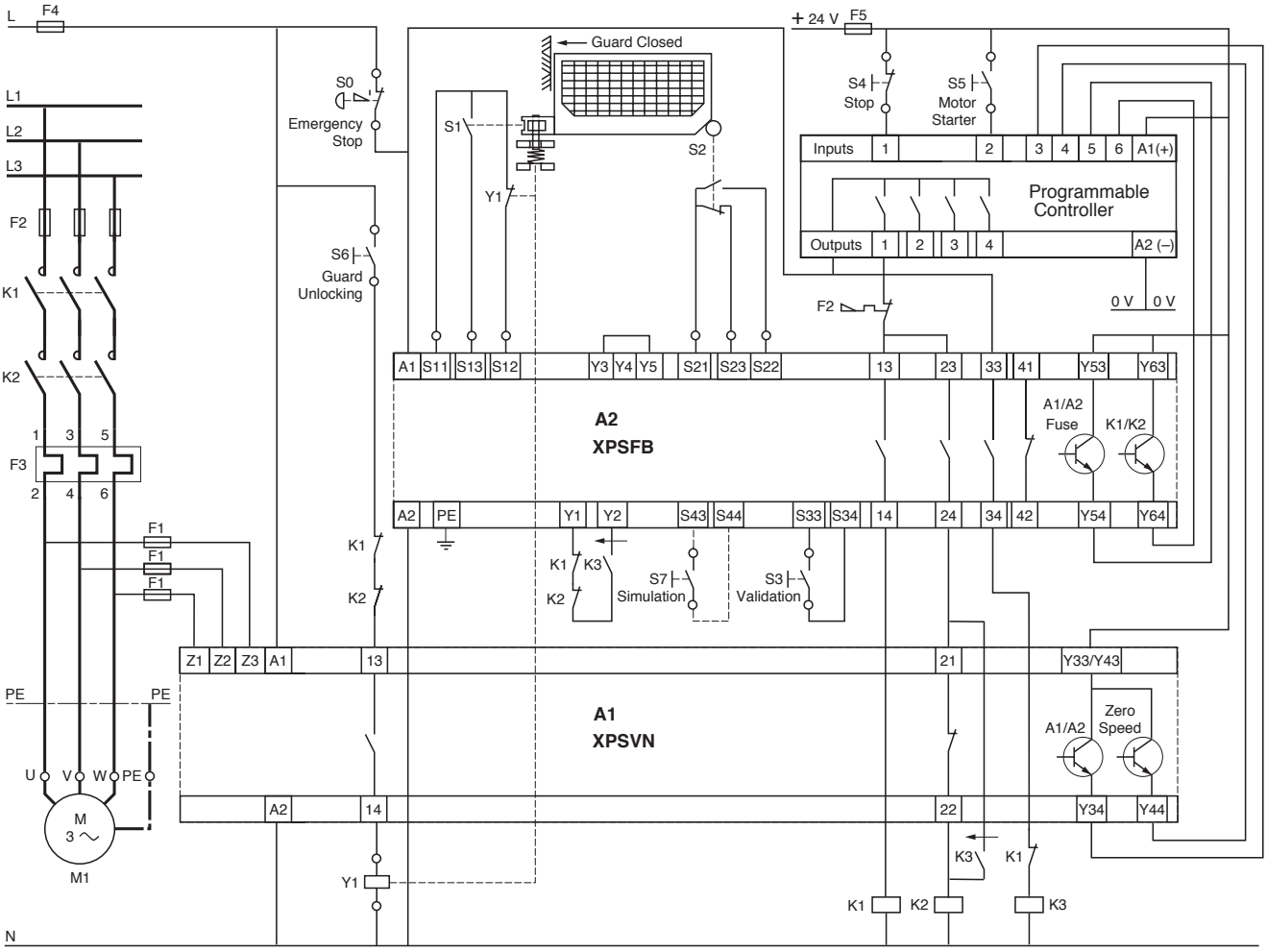
(2) Zero speed (Y33/Y43-Y44)

(3) Area defined by dashed lines indicate a XCSE or XCSL safety interlock switch. Components include:
Y1: Solenoid coil and related N.C. contact
S2: N.C. safety contacts

Wiring Diagrams and Connections

XPSVN

Example of a safety circuit connecting an XPSVN, XPSFB, XCSE safety interlock switch, a limit switch, a motor starter, a Programmable Controller, and a 3-phase AC motor.



S1 + Y1: Safety Interlock Switch with Solenoid Locking without Power Type XCS-E, or XCSL

K3: Pulse on De-energisation Relay Type XPSTSW