Speed Control Relays
SX2

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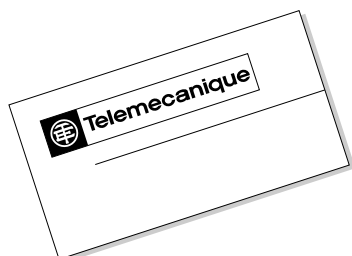
CONTENTS

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Properly applied, motion detection devices can:

- Decrease downtime
- Reduce maintenance
- Minimize product damage

As production speeds increase and more sophisticated assembly lines or conveyors are used to move products, there is a greater need to monitor and control the speed. This is particularly true since there are more motors, transmissions and belts that can fail, causing downtime.

This motion detection can be done in a number of ways, including:

- A switch or sensor and an off-delay timer (See 9050 JCK Timers, Catalog 9050CT9601)
- A self-contained motion detector (See Sensors, Catalog 9006CT9701, page 102)
- A switch or sensor and a speed control relay (described in this catalog)

Underspeed Control

Underspeed control is used to sense when a shaft or conveyor is going slower than the set speed. When the speed exceeds the set speed, the output contacts change state. They remain energized until an underspeed (slow speed) is detected, or voltage is lost to the relay, then the output contacts change state, returning to their deenergized state.

An underspeed relay can be used to detect slippage or breakage of a belt, chain, coupling, or archimedian screw. It can be used to signal the overloading of a grinder or mixer. It can also be used as part of a system to keep doors or gates from opening until moving parts on a machine or robot have stopped moving.

Overspeed Control

Overspeed control is used when a shaft or conveyor is going faster than the set speed. When the speed exceeds the set speed, the output contacts change state, and they can be used to sound an alarm or shut the machine down. They will remain energized until the speed drops below the low speed setting, then changing state.

An overspeed relay can be used to detect breakage of a belt or chain. It can also be used to sequentially start several conveyors. When the first conveyor reaches a preset speed, then the second conveyor is started, etc.
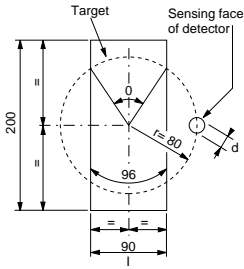
Standard Target For Rotating Shafts

A standard target covers a wide speed range and is suitable for use with most sensors. It is a rectangular piece of steel symmetrically mounted across the end of the motor shaft. The dimensions of the standard target are 7.9 in. x 3.5 in. x 0.08 in. (200 mm x 90 mm x 2 mm).

To determine the maximum and minimum shaft speed which can be detected using the SX2DV100 or SX2DV103 and this standard target, use this formula:

$N = m/n$

N = shaft speed
m = number of pulses per minute
n = number of targets (the standard target acts as two targets)

The range of the SX2DV100 and SX2DV103 is from 2.2 to 6000 pulses per minute. n = 2 if the standard target is used.

$N_{Max} = 6000 / 2 = 3000$ rpm

$N_{Min} = 2.2 / 2 = 1.1$ rpm

Calculating Pulse Duration

$$T = \frac{60 \times (l + d)}{2\pi \times N \times r}$$

l = length of target
d = diameter of sensor
N = shaft speed
r = radius from center of shaft to sensor

Using the standard target, a 18 mm sensor (for example, XS1M18PA370) and a shaft speed of 1725 rpm:

$$T = \frac{60 \times (90 + 18)}{2 \times 3.14 \times 1725 \times 80} = \frac{6480}{866,640} = 0.0075 \text{ s} = 7.5 \text{ ms}$$

The pulse durations must be:

- greater than the SX2DV limit of 2.3 ms
- greater than the sensor's ON and OFF delays

Calculating the Interval Between Pulses

$$T = \frac{60 \times ((2\pi \times r/n) - (l + d))}{2\pi \times r \times N}$$

l = length of target
d = diameter of sensor
N = shaft speed
r = radius from center of shaft to sensor
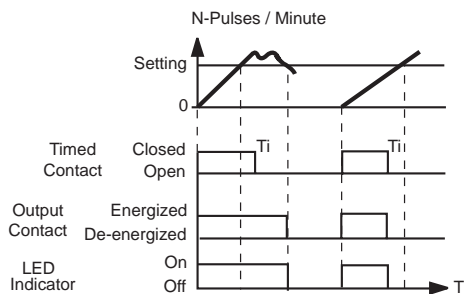n = number of targets

$$T = \frac{60 \times ((2 \times 3.14 \times 80/2) - (90 + 18))}{2 \times 3.14 \times 80 \times 1725} = \frac{8592}{866,640} = 0.0099 \text{ s} = 9.9 \text{ ms}$$

Setting and Adjustment

To facilitate setup, a selection switch and two potentiometers are on the front of the relay.

1. Select the proper speed range for the SX2DV100 or SX2DV103 relay:
    - 1 = 2.2 to 60 pulses per minute
    - 10 = 22 to 600 pulses per minute
    - 100 = 220 to 6000 pulses per minute
2. Adjust the Speed Threshold Potentiometer to the desired setting.
3. Adjust the Start-up Time Delay Potentiometer to the desired time delay.

N-Pulses / Minute

Setting

0

Timed Contact — Closed / Open — Ti — Ti

Output Contact — Energized / De-energized

LED Indicator — On / Off

T

1- Impulse input
2 - 24 VDC power supply inputs and proximity sensor connection
3 - Start-up interlocks
4 - Speed threshold potentiometer
5 - Speed range selector switch
6 - "Output relay energized" indicator
7 - Start-up delay potentiometer
8 - 110-220 VAC power supply inputs
9 - Relay outputs

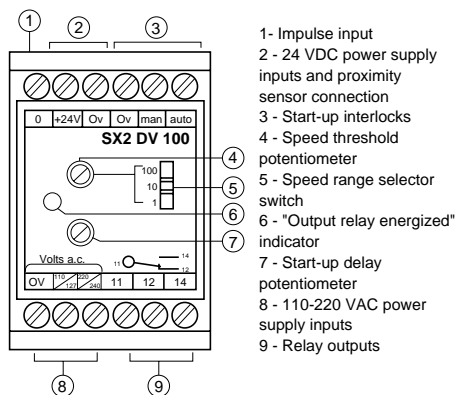SX2 DV 100

Description of Operation

The SX2DV100 and SX2DV103 relays are used to compare the number of pulses per minute that are being detected to the pulses per minute setting on the relay (using the speed threshold potentiometer and the speed range selector switch). The pulses can be detected from a rotating shaft or from items moving down a conveyor line.

As soon as power is applied to the relay power supply terminals, the timed contacts and output relay contacts close and the LED indicator comes on.

To allow time for the system to attain the preset speed, a timed contact (internal or external) is used to keep the circuit energized for a preset time period (Ti). If the system is not up to speed by Ti, the relay will shut down the system or motor.

If the preset speed is attained by the end of Ti, the output contact will remain closed. If the speed falls below the relay setting at any time after the Ti period is complete, the output contacts open, shutting down the system or motor.
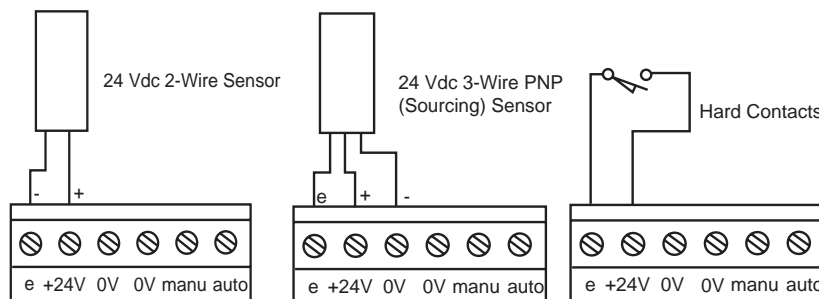
The LED indicator is illuminated while the output contact is closed.
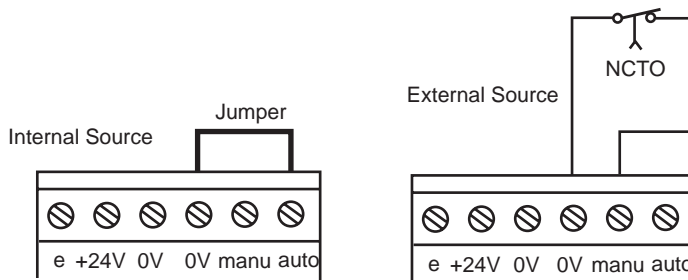
Pulse Detection

The pulses can come from a number or sources. The most common are:

- 24 Vdc, 2-wire sensors
- 24 Vdc, 3-wire, PNP (sourcing) sensors
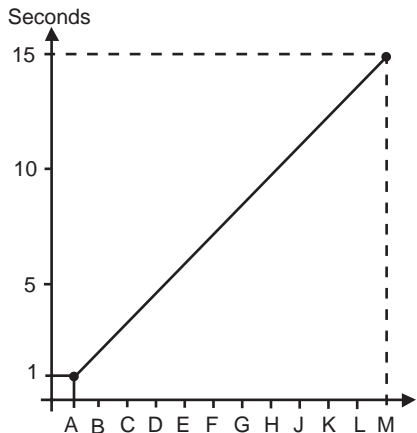- Hard contacts (limit switches, photoelectric switches, etc.)

24 Vdc 2-Wire Sensor

24 Vdc 3-Wire PNP (Sourcing) Sensor

Hard Contacts

e +24V 0V 0V manu auto | e +24V 0V 0V manu auto | e +24V 0V 0V manu auto
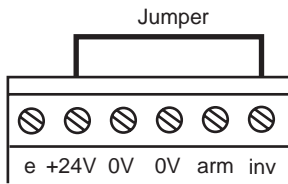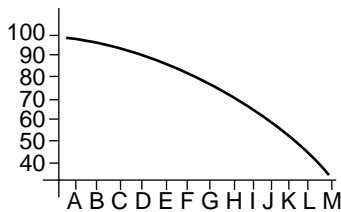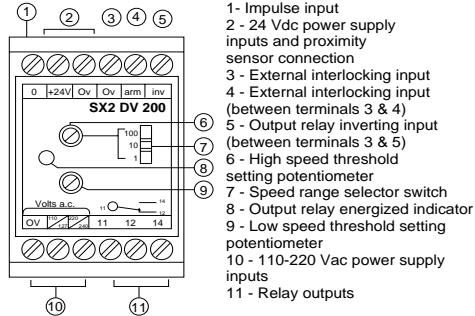
Timed Contact Source

The Ti timed contact source is either internal or external. The internal source uses the potentiometer on top of the relay to set Ti. The external source uses a normally closed contact of an on-delay timer.

Scale for Start-Up Delay Potentiometer (7)

Seconds

15

10

5

1

A B C D E F G H J K L M

Internal Source — Jumper

e +24V 0V 0V manu auto

External Source — NCTO

e +24V 0V 0V manu auto

1/98

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Setting and adjustment

1- Impulse input
2 - 24 Vdc power supply inputs and proximity sensor connection
3 - External interlocking input
4 - External interlocking input (between terminals 3 & 4)
5 - Output relay inverting input (between terminals 3 & 5)
6 - High speed threshold setting potentiometer
7 - Speed range selector switch
8 - Output relay energized indicator
9 - Low speed threshold setting potentiometer
10 - 110-220 Vac power supply inputs
11 - Relay outputs

Jumper

| e | +24V | 0V | 0V | arm | inv |

Description of Operation

The SX2DV200 and SX2DV203 relays compare the number of pulses per minute detected to the pulses per minute setting on the relay (set with the high speed threshold potentiometer, the speed range selector switch, and the low speed threshold potentiometer). The detected pulses can be from a rotating shaft or items moving down a conveyor line.

Without **inv**

Without **inv** is the most common mode of operation. There is no jumper between the **+24** terminal and the **inv** terminal. When power is applied to the relay between the **0v** terminal and either the **110/127** terminal or the **220/240** terminal, the output contact does not change state. When the detected speed reaches the high speed threshold setting, the output relay changes state (energizes). The output will remain energized until the detected speed drops below the low speed threshold setting. The low speed threshold is a percentage (100 to 30%) of the high speed threshold. the LED on top of the relay will illuminate whenever the relay is energized.
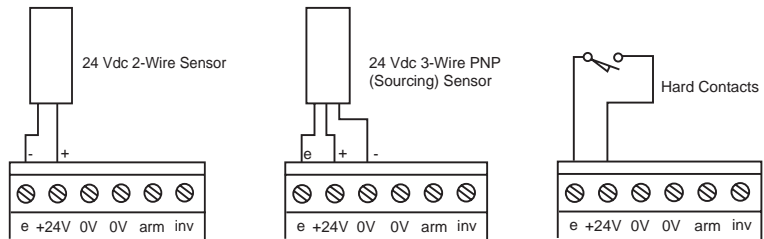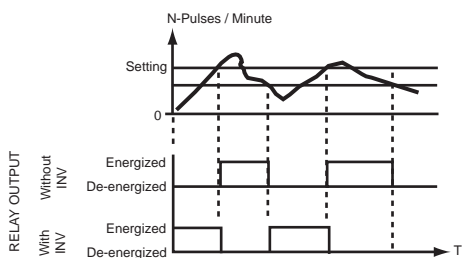
With **inv**

There is a jumper between the **+24v** terminal and the **inv** terminal. When power is applied to the relay between the **0v** terminal and either the **110/127** terminal or the **220/240** terminal, the output contact changes state. When the speed being sensed reaches the high speed threshold setting, the output relay changes state (deenergizes). The output will remain deenergized until the detected speed drops below the low speed threshold setting. The low speed threshold is a percentage (100 to 30%) of the high speed threshold. The LED on top of the relay will illuminate whenever the relay is energized.
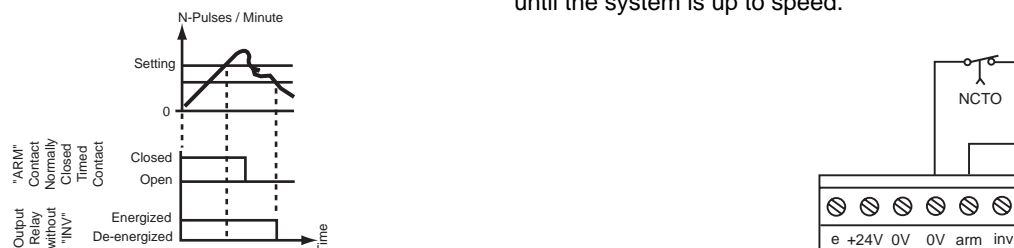
Pulse Detection

The pulses can come from a number or sources. The most common are:

- 24 Vdc, 2-wire sensors
- 24 Vdc, 3-wire, PNP (sourcing) sensors
- Hard contacts (limit switches, photoelectric switches, etc.)

24 Vdc 2-Wire Sensor

| e | +24V | 0V | 0V | arm | inv |

24 Vdc 3-Wire PNP (Sourcing) Sensor

| e | +24V | 0V | 0V | arm | inv |

Hard Contacts

| e | +24V | 0V | 0V | arm | inv |

If a normally closed timed open contact is wired between **arm** and **0v** as shown below, the output contact will energize immediately, not waiting for the speed to reach the high speed threshold. This can be used to keep the relay energized until the system is up to speed.
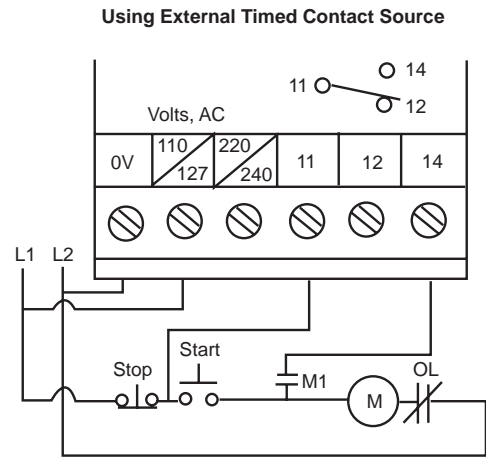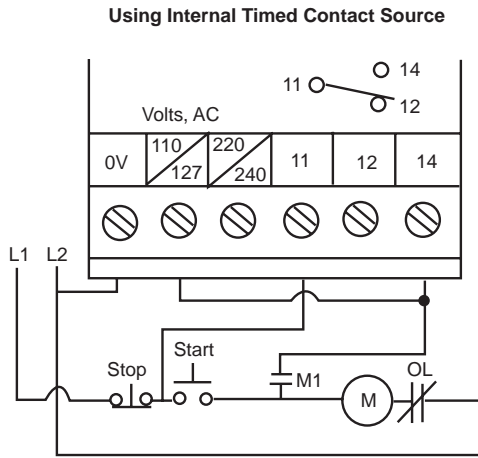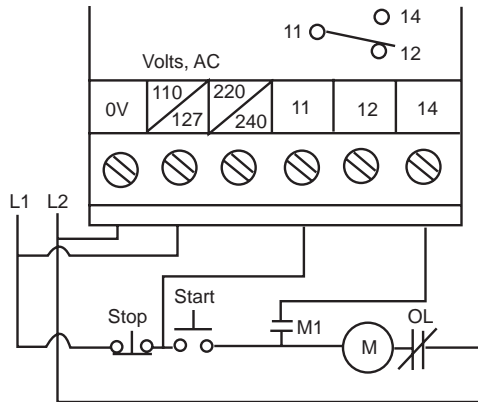
NCTO

| e | +24V | 0V | 0V | arm | inv |

SX2DV100 amd SX2DV103 Wiring Diagrams

Using Internal Timed Contact Source

Using External Timed Contact Source

SX2DV200 and SX2DV203 Wiring Diagram

Approximate Dimensions

2.63 (67)

1.73 (44)

4.37 (111)
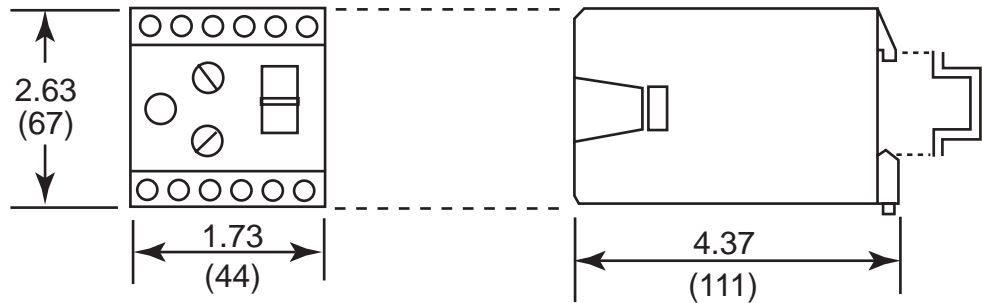
Dimensions are in inches (millimeters).
Weight: 11.3 oz (0.32 kg)

1/98 ⊓

Description	Type of Action	Threshold Range (pulses per minute)	Type of Input	Supply Voltage	Catalog Number
Underspeed	Stopping	2.2 to 6000	PNP sensor or hard contact	24 Vdc	SX2DV103
				110/220 Vac	SX2DV100
Underspeed and Overspeed Control	Stopping	3.2 to 8000	PNP sensor or hard contact	24 Vdc	SX2DV203
	Enabling			110/220 Vac	SX2DV200

Specifications

AC power supply	110 Vac (-15%, +10%) 220 Vac (-15%, +10%)
Frequency	50/60 Hz
Consumption	2 VA
DC power supply	24 Vdc (19.2 to 27.6 Vdc)
Power consumption	2 W
Related relay thermal current	5 A
Ambient temperature Operation Storage	-4 to 122 °F (-20 to +50 °C) -40 to +185 °F (-40 to +85 °C)
Housing protection	NEMA 1 (IP20)
Repeat accuracy (constant voltage)	± 1%
Thermal drift (constant voltage)	± 0.14% per °C
Voltage drift (constant temperature	± 0.5%
Input specifications	
Sensor supply	24 Vdc ±15%
Minimum input resistance	2.2 kΩ
Minimum input voltage (on)	11 V
Minimum input voltage (off)	4 V
Minimum duration of the signal	2.3 ms
Minimum interval between signals	2.3 ms
Maximum line resistance	200 Ω
Typical input current	10 mA
Maximum pulses per minute	13,000
Controllable speed range SX2DV 100/103 SX2DV 200/203	2.2 to 6000 pulses per minute 3.2 to 8000 pulses per minute
Output relay specifications	

	48 Vac	110 Vac	220 Vac	24 Vdc	48 Vdc
Voltage	48 Vac	110 Vac	220 Vac	24 Vdc	48 Vdc
Maximum current (IEC)	4 A	2 A	1 A	1 A L/R < 5 ms	0.5 A L/R < 5 ms
Maximum power	200 VA				
NEMA rating	B150				
LED	Illuminated when relay is energized				