A

Common Circuit Examples

Section 1 – Listing by Product Name

Section 2 – Listing by Product Type

A

Notes on Circuit Examples

Note 1

In the following circuits the type of device is shown as an example to illustrate the circuit principle. For specific applications the choice of device type should be based on the suitability of its characteristics for its intended use.

Note 2

In most of the following examples showing dual channel applications, one interlock switch, is shown switching both channels (one contact set per channel). If it is foreseeable that damage to the guard (i.e. at the actuator mounting point) could allow it to be opened without operating the switch, then two separate switches may be required. The electrical principle of the circuit will remain the same as shown.

Note 3

In most cases the circuits are shown with the guard door closed and ready for motor starting by operating the normal start control.

It must be possible to start the machine only by voluntary actuation of the control provided for the purpose (see ISO 12100 and IEC 60204-1). For the purposes of these examples, the use of a conventional contactor latching circuit has been assumed. If this is not the case, then a restart interlock will be required to prevent an automatic or unintended starting of the motor when the guard is closed. A safety monitoring relay with a momentary action push button installed in the output monitoring circuit can be used to achieve this.

If the guard is designated as a Control Guard (see ISO 12100, 5.3.2.5), these requirements do not apply. The use of Control Guards is only allowed under certain conditions including:

- A Control Guard can only be used where there is no possibility of an operator or part of his body staying in or reaching into the danger zone while the guard is closed.
- The Control Guard must be the only access to the hazard area.
- The interlocking system must have the highest possible reliability. It is often advisable to use a solenoid locking switch such as the D4JL, D4GL, D4NL, TL4024 or TL4019.

Note 4

This note applies to all monitoring devices which use the technique of comparing the signal at the change of state of dual channels, safety monitoring relay units used in dual channel circuits with infrequent operation, or with more than one switching device connected.

Certain faults are only detected at a change of state of the input switching device (interlock switch or E-stop switch). If there are long periods (i.e. months as opposed to days) between switching actions, it may be possible for multiple faults to accumulate which could lead to a dangerous situation. Therefore, a regular check should be performed on the system in order to detect single faults before an accumulation occurs. This check may be manual or initiated by part of the machine's control system.

If, for example, three interlock switches are connected to the monitoring unit, certain faults will only be detected at the switch on the first guard to be opened and the switch on the last guard to be closed. This is because any switching between the first opening/last closing will not change the state of the monitoring unit input circuits. Therefore, in some applications, it may be necessary to use one monitoring device per switch.

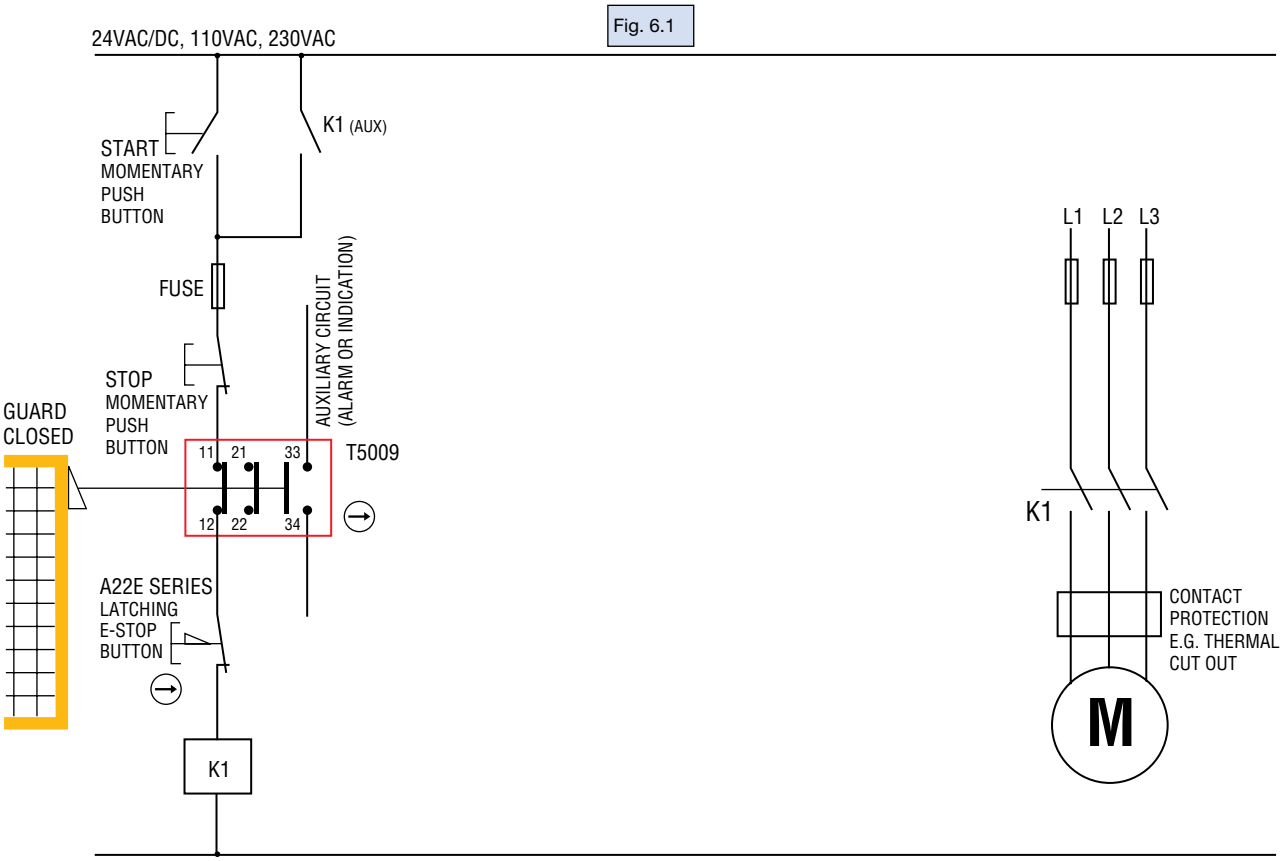
Most of the following examples show an interlock switch and an emergency stop switch combined in the circuit. When a safety monitoring relay is used for fault detection, it is important to note the following:

- All safety critical single faults, except for certain faults over the contact sets at the E-Stop, will be detected at the next opening of the guard.
- All safety critical single faults, except for certain faults over the contact sets at the interlock switch, will be detected at the next operation of the E-Stop.
- Because the E-Stop device is not likely to be operated frequently, it is recommended that its function is checked (with the guard closed) on a regular basis (start of shift or daily) to enable the safety monitoring relay to detect single faults. If the guard is rarely opened, the interlock switch should be checked in a similar manner.

Note 5

Where this symbol is used in the following example circuits, it indicates that the component or device indicated operates in the positive mode. (i.e. where two or more components are intended to move together, they are connected by direct contact or rigid links). Typical examples of this are mechanical guard interlock switches and force guided relays.

Fig. 6.1



Guard Door Interlock and E-Stop

- **Single Channel**
- **Non Monitored**

Circuit status

Circuit shown with guard door closed and ready for motor starting.

Operating principle

Opening the guard or operating the E-Stop device will cause the contactor to isolate the motor power.

Fault behavior

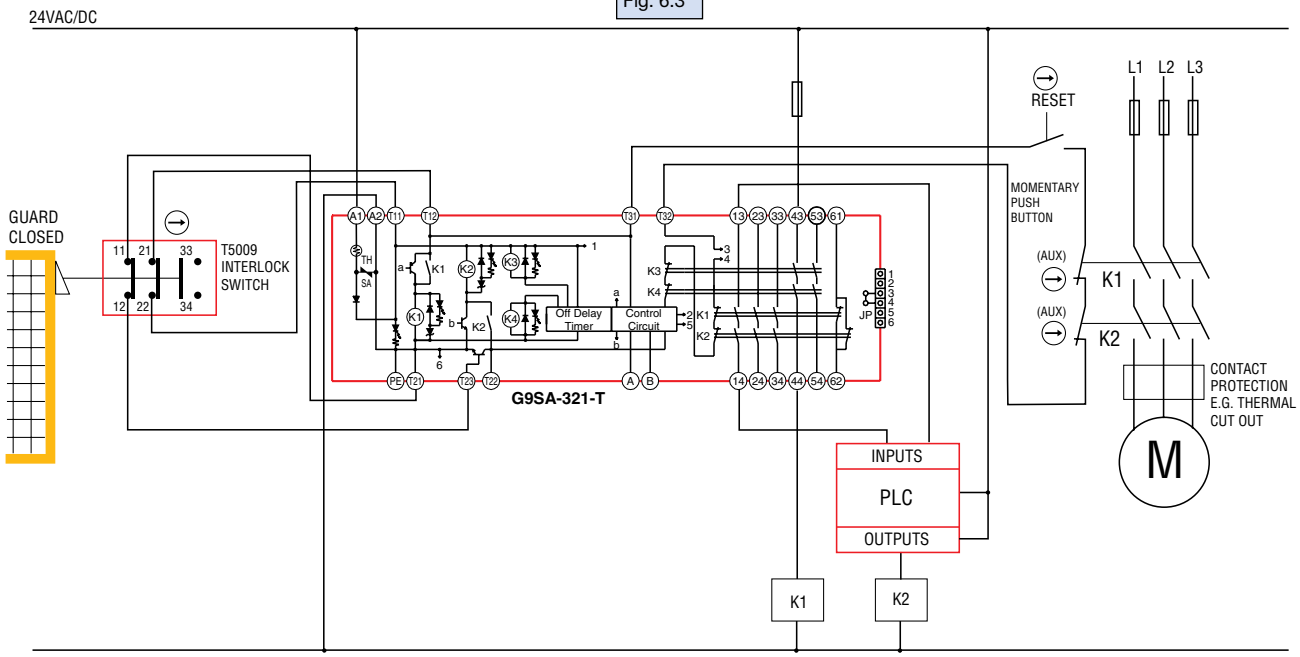
The integrity of the circuit depends on the suitability of the components (conformity with standards, tried and tested principles, etc.) and the nature of the wiring installation (use of protective conduit, short wiring runs, no movement of wiring, etc.).

Comments

This type of arrangement is widely used in applications which have low risk and where the wiring can be properly protected.

Refer to notes starting on page A32.

Fig. 6.3



PLC Control with T5009 and G9SA-321-T

- Monitored Manual Reset

Circuit status

Circuit shown with guard door closed, ready for motor starting (via signals from the PLC).

Operating principle

The G9SA-321-T immediate action outputs at 13-14 are connected to inputs at the PLC and the delayed outputs at 33, 44 are connected to the contactor K1. The relevant PLC outputs are connected to contactor K2. If the guard is opened the safety monitoring relay contacts 13-14 immediately signal the PLC to stop the motor. The PLC then has a pre-set time limit (adjustable at the G9SA-321-T) to execute its shut down sequence and switch OFF contactor K2. After this time period has elapsed, the delayed action outputs 43, 44 will switch off contactor K1, thus ensuring isolation even if there is a hardware, program or systematic fault in the PLC.

Fault detection

If either contactor K1or K2 sticks ON, the motor will stop on command but the safety monitoring relay cannot be reset (thus the fault is revealed to the operator).

Any single fault detected on the safety monitoring relay input and output circuits will result in the lock-out of the system to a safe state (OFF). All safety critical single faults will be detected at the next opening of the guard.

Comment

This system has the high integrity of hard wiring and also allows a correctly sequenced shut-down which protects the machine and program.

Refer to notes starting on page A32.

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