



SURFACE VEHICLE STANDARD	J2221™	MAY2019
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(R) Standardized Symbols for Electrical Circuit Diagrams		

RATIONALE

Industry adoption of this symbol convention will aid in the understanding of electrical circuits by engineers, OEM suppliers, service technicians and the industry generally. Standardization will mitigate misinterpretation within the industry.

This surface vehicle standard applies to medium and heavy-duty commercial vehicles.

The benefits of standardization are:

- The symbols can be used universally.
- Communication of electrical information is enhanced.
- The symbols are supported by text annotations for identification and operating notes.
- The symbols can display clearly on electronic display monitors and can be printed legibly.

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1. SCOPE

This SAE Recommended Practice identifies graphic symbols used in electrical circuit diagrams. The symbols aid troubleshooting electrical systems.

2. REFERENCES

Additional standards available for reference:

International Electrotechnical Commission (IEC) 60617-Graphical Symbols for Diagrams

American National Standards Institute (ANSI) Y32.2

3. DEFINITIONS

3.1 CLEAN GROUND

A low impedance ground point isolated to reduce transient noise from the electrical circuit.

3.2 ELECTRICAL CIRCUIT

An electrical circuit includes all of the components and connecting cables, starting from the electrical energy source, going through the functional component(s) and the return route.

3.3 ELECTRICAL CIRCUIT DIAGRAM

A drawing using standardized symbols to depict the relationship and interconnections of components and conductors of an electrical circuit.

3.4 FUNCTIONAL NAME

A name of a component or device that describes the action or purpose of the component or device.

3.4.1 Example -- GROUND

An electrical conductor with a relative zero potential used as the return for an electrical circuit(s).

3.5 SEPARABLE

Used to describe a terminal or connector which can be separated, disjoined or disconnected.

3.6 SYMBOL

The graphic depiction of a device.

3.7 SYMBOL CHARACTER

A fundamental element used to construct a symbol.

4. DESCRIPTION OF SYMBOLS AND SYMBOL CONSTRUCTION

This document uses a building-block approach to construct symbols. Fundamental symbol characters are assembled to form symbols that depict physical components. Components are shown installed on a fully operable machine in a quiescent state: engine and key off, shifter in neutral, and engine cold. The following example shows how symbol characters can be combined to depict an actual vehicle device.

EXAMPLE: A single-pole relay or contactor consists of three main elements, a separate symbol character can depict each (see Figure 1):



FIGURE 1 - FUNDAMENTAL SYMBOL CHARACTERS ASSEMBLED TO FORM SYMBOLS THAT DEPICTS A PHYSICAL COMPONENT

Symbols and symbol characters can be positioned and oriented in the attitude that best conveys circuit information. The symbol characters are usually positioned in a cause-and-effect sequence (left-to-right or top-to-bottom) to convey functional inter-relationships (see Figure 2):

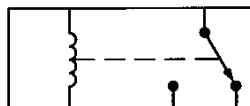


FIGURE 2 - ORIENTATION OF SYMBOL CHARACTERS

A relay for vehicle applications is protected by an integral enclosure, which is graphically depicted by a rectangular box symbol character. Adding the enclosure symbol character results in the following symbol (see Figure 3):

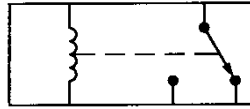


FIGURE 3 - ENCLOSURE WITH SYMBOL CHARACTERS

A vehicle relay includes terminals for connection to related circuit wiring. Symbol characters can be added to depict plug-in or threaded terminals. An enhanced relay symbol results (see Figure 4):

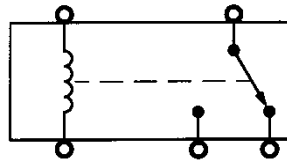


FIGURE 4 - SYMBOL CHARACTER WITH TERMINALS

To depict a relay with an integral transient-suppression resistor, the resistor symbol character can be added, with the result (see Figure 5):

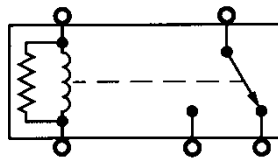


FIGURE 5 - SYMBOL CHARACTER WITH ADDITION OF INTEGRAL-TRANSIENT SUPPRESSION RESISTOR

5. SYMBOL LABELS

Symbols may include labels to depict identification information, including:

- Functional Name
- Rating
- Terminal markings
- Operating notes

If the actual vehicle uses symbols to identify devices or terminals, those identifying symbols should be included with the device symbol on the electrical circuit diagram.

For example, labels for a relay can be depicted as follows (see Figure 6):

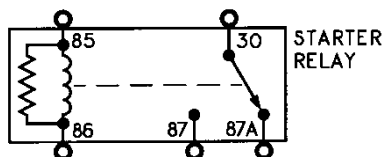


FIGURE 6 - SYMBOL CHARACTER WITH TERMINAL IDENTIFICATION