



SURFACE VEHICLE INFORMATION REPORT

J2836™/4

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Use Cases for Diagnostic Communication for Plug-in Electric Vehicles

RATIONALE

The use cases described herein identify the diagnostic requirements and interactions to charge or discharge plug-in electric vehicles (PEVs). Some of these identified setting DTCs where later analysis has shown that this is not desired. Updates to the faults and clarification of the actions for faults will be included in this V2 update.

SAE J2836/4 has been reaffirmed to comply with the SAE Five-Year Review policy.

A reaffirmed status is given to technical reports that have been reviewed by the technical committee and deemed to be current with no need for immediate revision. No changes have been made to this document as a result of this review.

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1. SCOPE

This SAE Surface Vehicle Technical Information Report, SAE J2836/4, establishes diagnostic use cases between plug-in electric vehicles (PEV) and the electric vehicle supply equipment (EVSE). As PEVs are deployed and include both plug-in hybrid electric (PHEV) and battery electric (BEV) vehicle variations, failures of the charging session between the EVSE and PEV may include diagnostics particular to the vehicle variations. This document describes the general information required for diagnostics and SAE J2847/4 will include the detail messages to provide accurate information to the customer and/or service personnel to identify the source of the issue and assist in resolution. Existing vehicle diagnostics can also be added and included during this charging session regarding issues that have occurred or are imminent to the EVSE or PEV, to assist in resolution of these items.

1.1 Purpose

This document provides the general information which must be supported by SAE Recommended Practice SAE J2847/4.

1.2 Background

SAE J1772 identifies control pilot and proximity circuits for PEV charging. These circuits have included resistors in certain locations that allow analogue diagnostics for (1) open circuits, (2) shorts to ground, and (3) short to 12 V (or 16 V). Four points on the control pilot and five on the proximity circuit have been evaluated for these three failure conditions and this document summarizes the resulting effect and whether it is detectable or not. Additional versions of this document are intended to include more information regarding from Interoperability testing to SAE J2953.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1772 SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler

SAE J2953/1 Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)

SAE J2953/2 Test Procedures for the Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1715 Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology

SAE J2012 Diagnostic Trouble Code Definitions

2.2.2 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 61851-1 Electric Vehicle Conductive Charging System Part 1: General Requirements

IEC 62196-1 Plugs, Socket-Outlets, Vehicles Connectors and Vehicle Inlets - Conductive Charging of Electric Vehicles

3. DEFINITIONS

3.1 CHARGER

An electrical device that converts alternating current energy to regulated direct current for replenishing the energy of a rechargeable energy storage device (i.e., battery) and may also provide energy for operating other vehicle electrical systems.

3.2 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

This is the generic term used to describe the device that is physically connected and provides energy to the vehicle. EVSEs may take several physical forms, and their logical function may likewise differ substantially. Physical forms include a mobile cord set used for 120 VAC charging, a fixed or wall-mounted 240 VAC charger, or an off-board DC charger. An EVSE may also support reverse power flow (discharging).

3.3 ENERGY PORTAL

Energy portal is any charging point for a PEV. At a minimum, the energy portal is a 120 V, 15 A outlet for AC L1, but can also be a 208/240 V electric vehicle supply equipment (EVSE) outlet for AC L2 connected to the premises circuit. More information on AC L1 and AC L2 is described in SAE J1772.

3.4 ENERGY TRANSFER STRATEGY

A strategy that accounts for all of the electrical energy needs of an EV and the present status of all on-board equipment, including the EV storage battery. It determines the rate that energy is to be transferred to the EV and how the ETS shall be operated to accomplish this.

3.5 HOME AREA NETWORK (HAN)

A HAN is an energy related network, contained within a premises used for communicating with devices within the premises. HANs do not necessarily require connectivity outside the premises, but may be connected to one or more external communication networks (e.g., utility AMI, internet, cell phone network, etc.) using gateways, bridges, and interfaces.

3.6 INTEROPERABILITY

The condition where components of a system, relative to each other, are able to work together to perform the intended operation of the total system. Information interoperability is the capability of two or more networks, systems, devices, applications, or components to share and readily use information securely and effectively with little or no inconvenience for the user. As an example, a 10 mm box-end hand wrench and a 10 mm socket wrench are interoperable, relative to a 10 mm hex-head bolt. The wrench and the bolt are both parts of a fastening system. The fact that the system performs as required with either wrench establishes the interoperability of the wrenches and the bolt.

3.7 PLUG-IN ELECTRIC VEHICLE (PEV)

This is the generic term used to describe any vehicle that plugs in to receive electrical energy. This includes many different classifications of vehicles, such as battery electric vehicle (BEV), plug-in hybrid electric vehicle (PHEV), extended-range electric vehicle (E-REV), and so on.

4. TECHNICAL REQUIREMENTS

4.1 Basic Diagnostics

SAE J1772 identifies the function and levels for the control pilot and detection circuit.

4.1.1 Control Pilot and Proximity Detection Circuit

SAE J1772 includes resistors in both the control pilot and proximity detection circuits for state changes and diagnostics. Certain failures however are still not detectable and indicators are included on the vehicle and EVSE that provide additional status to customers for some of these non-detectable failures. The type of indicator and specific location for these is not identified, but are required on both the EVSE and the PEV.

An indicator on the EVSE assists the customer that the EVSE has power from the grid.

An indicator on the vehicle advises the customer that the EVSE is connected to the vehicle, and the proper states have occurred for the charge cycle to commence.

- The control pilot functions that are identified in SAE J1772 are as follows:

State A - Not connected.

1. EVSE provides 12 V on pilot circuit.
2. EVSE connector is engaged with vehicle inlet to proceed to State B.

State B - Connected, but not ready to accept energy.

3. Vehicle resistor R3 drops the 12 to 9 V and wakes up vehicle electronics.
4. The EVSE detects the pilot circuit drop to 9 V and starts the PWM generator, unless an EVSE scheduled charge is programmed. In that case, the pilot stays at "B1" or no PWM until the scheduled charge expires, then start the PWM for state "B2."

State C - Vehicle ready to accept energy.

5. The vehicle reads a valid PWM value identifying available line current (ALC) and closes S2.
6. EVSE senses the pilot PWM drop from 9 to 6 V or 3 V (vehicle ready to accept charge), closes switches supplying 120 V or 240 V power to the vehicle.
7. Vehicle charger starts the charging session at AC L1 or L2.

State A within this document, however, is not actually State A for this control pilot analysis.

State A is defined as "not connected" that means the cord is on the wall (EVSE) or in the trunk. This state does not require diagnostics.

This evaluation is therefore identifying State A as the "start of connecting" and "proceeding into State B" (e.g., the vehicle is powering up, and the EVSE is starting the PWM generator).

State B is evaluated as "connected, but not ready to accept energy."

This means the vehicle is awake, the EVSE has started the PWM generator, then the fault occurred.

State C is evaluated as "vehicle ready to accept energy."

This means the vehicle has closed S2, the EVSE has closed the contactors.

4.1.2 Control Pilot Detectable Failures

The control pilot circuit can fail due to shorts, both high and low and opens at four locations. Figure 1 identifies the schematic for this and the points for diagnostics, P1 through P4. This also includes the Optional measurement point on the pilot before the diode and values are included in Tables 1 through 3. In the case with monitor requirement after the diode only; without the optional measuring device before the diode (SAE J1772, Figure 1), detections will be indeterminate in most cases and does not set DTC. The pilot diode in this evaluation is a standard 1N4148 with the standard 0.7 V drop. Any other diode used by the vehicle would result in a variation of “after diode” measurements.

Tables 1, 2, and 3 identify the conditions due to open circuits, short to ground and short high, respectively, at locations P1 through P4.

Figure 1 also includes the position for the detection circuit that can also fail due to shorts, both high and low and opens at five locations identified as D1 through D5.

Tables 4, 5, and 6 identify the conditions due to open circuits, short to ground and short high, respectively, at locations D1 through D5.

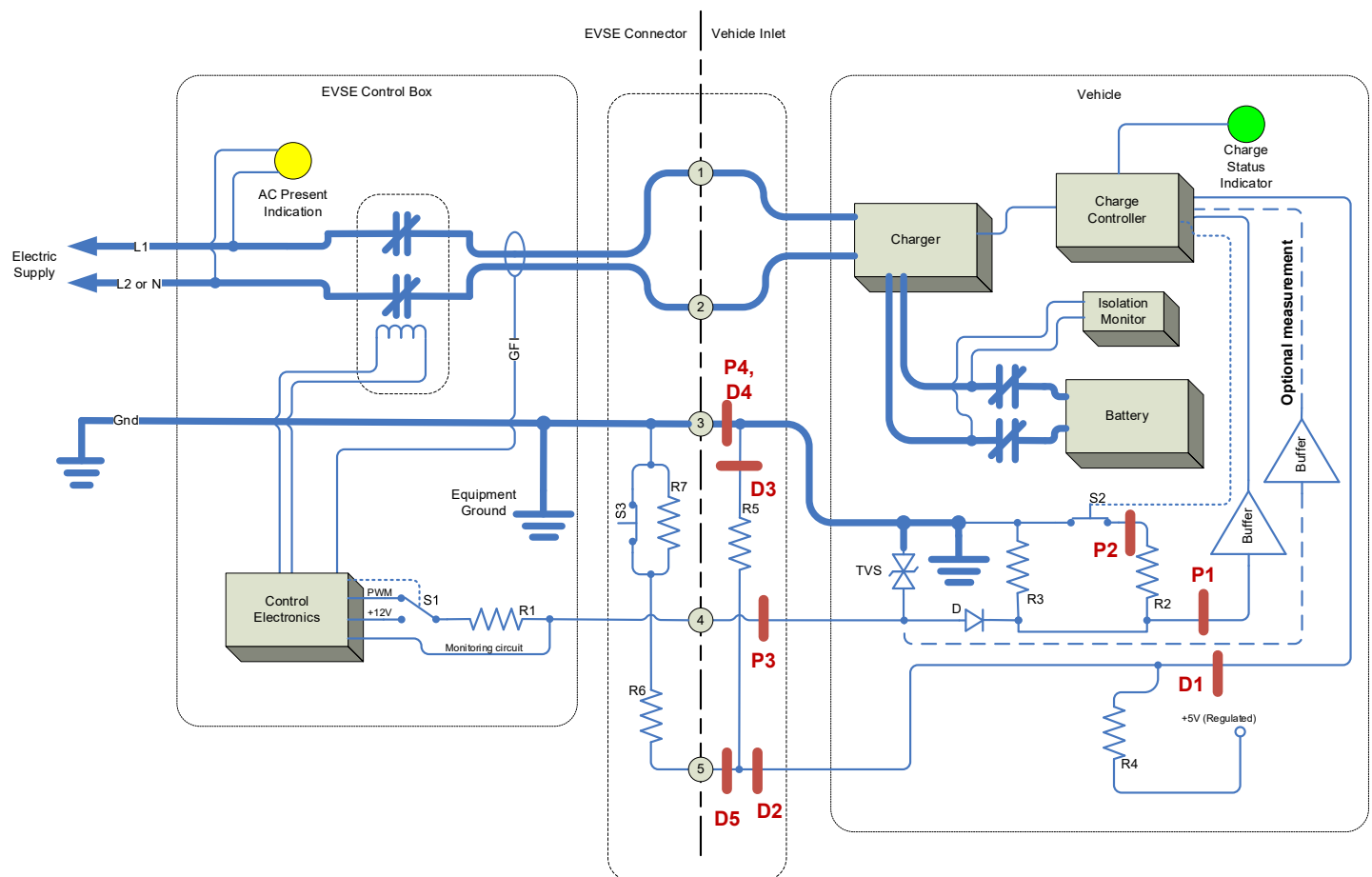


Figure 1 - Control pilot and detection circuit schematic and failure detection points

Table 1 shows the open circuit conditions for the control pilot. The monitoring requirement, shown in Figure 1, is after the diode but measurement at both before and after is included below.

Table 1 Summary:

- 0 = undetectable
- 1 = Fault or disconnected (State A) – unclear