BRITISH STANDARD

BS ISO 26021-5:2009

Road vehicles — End-of-life activation of on-board pyrotechnic devices

Part 5: Additional communication line with pulse width modulated signal

ICS 43.040.80

British Standards

National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Part 5:
Additional communication line with pulse width modulated signal

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Foreword

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 26021-5 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 26021 consists of the following parts, under the general title *Road vehicles — End-of-life activation of on-board pyrotechnic devices*:

— *Part 1: General information and use case definitions*

— *Part 2: Communication requirements*

— *Part 3: Tool requirements*

— *Part 4: Additional communication line with bidirectional communication*

— *Part 5: Additional communication line with pulse width modulated signal*

Introduction

Worldwide, nearly all new vehicles are equipped with one or more safety systems. This can include advanced protection systems based on pyrotechnic actuators. All components which contain pyrotechnic substances can be handled in the same way.

Recycling these vehicles demands a new process to ensure that the deactivation of airbags is safe and cost-efficient. Due to the harmonization of the on-board diagnostic (OBD) interface, there is a possibility of using it for on-board deployment, which is based on the same tools and processes.

Representatives of the global automobile industry agreed that automobile manufacturers

— do not support reuse as an appropriate treatment method for pyrotechnic devices,

— believe treatment of pyrotechnic devices is required before shredding, and

— support in-vehicle deployment as the preferred method.

Based on this agreement, the four big associations of automobile manufacturers (ACEA, Alliance, JAMA and KAMA) started to develop a method for the “in-vehicle deployment of pyrotechnic components in cars with the pyrotechnic device deployment tool (PDT)”. The objective is that in the future a dismantler will use only one tool without any accessories to deploy all pyrotechnic devices inside an end-of-life vehicle (ELV) by using an existing interface to the car.

Because of different requirements and safety concepts an additional communication line (ACL) is added to the basic controller area network (CAN) communication method. In this part of ISO 26021 ACL is used to mean an additional communication line with pulse width modulated signal. This direct hardware (HW) connection is used for systems with a specific safing concept, to bypass it and then enable the deployment of such systems.

Road vehicles — End-of-life activation of on-board pyrotechnic devices —

Part 5: Additional communication line with pulse width modulated signal

1 Scope

This part of ISO 26021 defines the requirements of redundancy hardware or software systems independent from the CAN line which are activated by the ACL hardware line.

It also describes the additional sequences of the deployment process, and the technical details for the direct hardware connection between pyrotechnic device deployment tool (PDT) and pyrotechnic control unit (PCU).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

SO 14230-1, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 1: Physical layer*

ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*

ISO 26021-2, *Road vehicles — End-of-life activation of on-board pyrotechnic devices — Part 2: Communication requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-1 and the following apply.

3.1
PWM
pulse width modulation
signal linked by the ACL to the independent hardware path in the PCU

NOTE The PWM signal is active during the deployment session.

4 Abbreviated terms

ACL additional communication line

GND ground signal

HW hardware

µC microcontroller

OBD on-board diagnostics

PCU pyrotechnic control unit

PDT pyrotechnic device deployment tool

5 Conventions

ISO 26021 is based on the conventions discussed in the OSI service conventions (ISO/IEC 10731) as they apply for diagnostic services.

6 Pyrotechnic device deployment via on-board diagnostic architecture

6.1 Vehicle system description

ISO 26021 is based on an envisaged diagnostic network architecture in combination with the PCU deployment architecture, as described in this subclause.

ISO 26021-2 defines the mandatory vehicle-interface of the PCU and PDT. The PCU is connected with the vehicle diagnostic connector and the communication specifications comply with ISO 15765-3 and ISO 15765-4. The PDT communicates with the PCU on CAN_H and CAN_L and enables deployment with the pulse width modulated signal.

Depending upon the vehicle-specific architecture, the mandatory link of the PCU may be connected via a gateway to the OBD connector, thus a CAN interface in the PCU for the mandatory link may not be required.

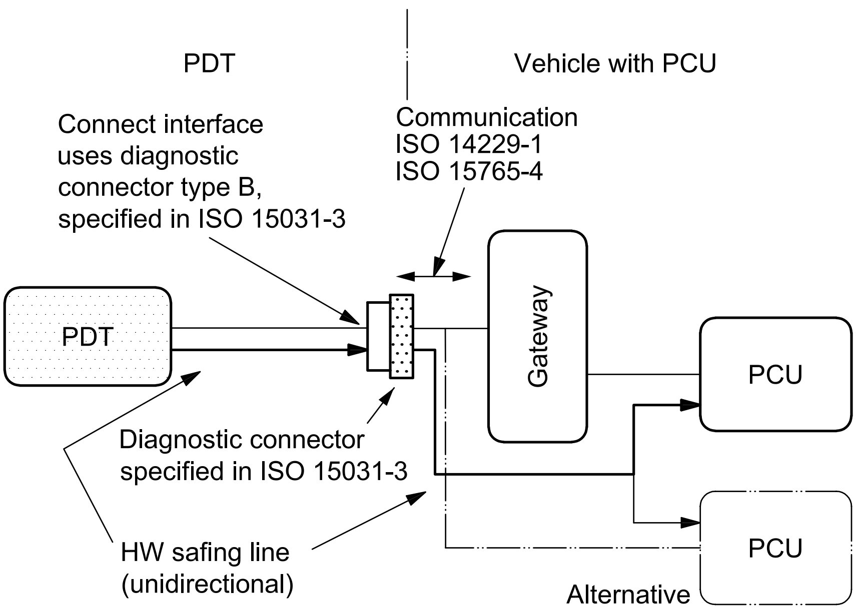


Figure 1 — Access to the vehicle via diagnostic connector

6.2 Example of in-vehicle hardware and software provision

To execute the on-board deployment via the diagnostic link, the PCU software shall have full access to the output driver stage, which controls the deployment loops. To achieve this, the safing path is controlled via the ACL line with a PWM signal.

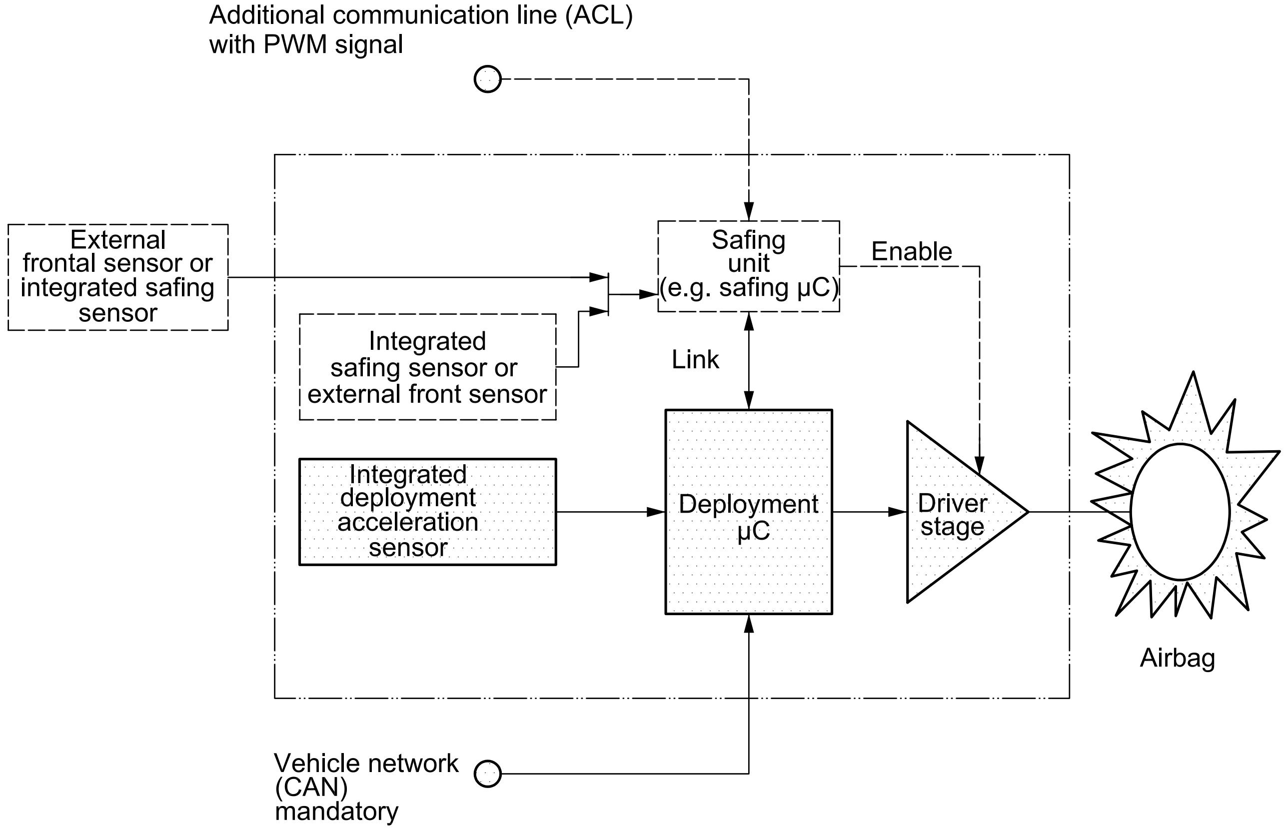


Figure 2 — Overview of hardware and software provision

6.3 Additional communication line

Depending on the hardware architecture of the PCU the additional signal is used. General requirements for the interface between deployment sequence and ACL sequence are given in Clause 7.

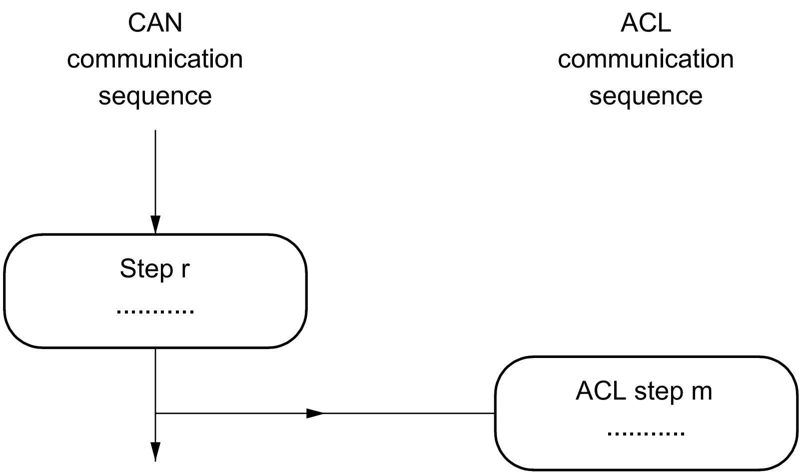


Figure 3 — Integration of ACL communication into deployment process

The standardized steps specify the diagnosis sequence. The ACL communication step *m* is the specified place to enable the hardware safing possibility.

7 ACL with PWM specification

7.1 Hardware description

The total impedance and capacitance of the ACL input circuit of the PCU shall be compliant with ISO 14230-1.

The PDT generates a PWM signal (see 7.4) that is connected over the diagnostic connector to the ACL input at the PCU. In previous systems this pin at the diagnostic connector was the L communication line.

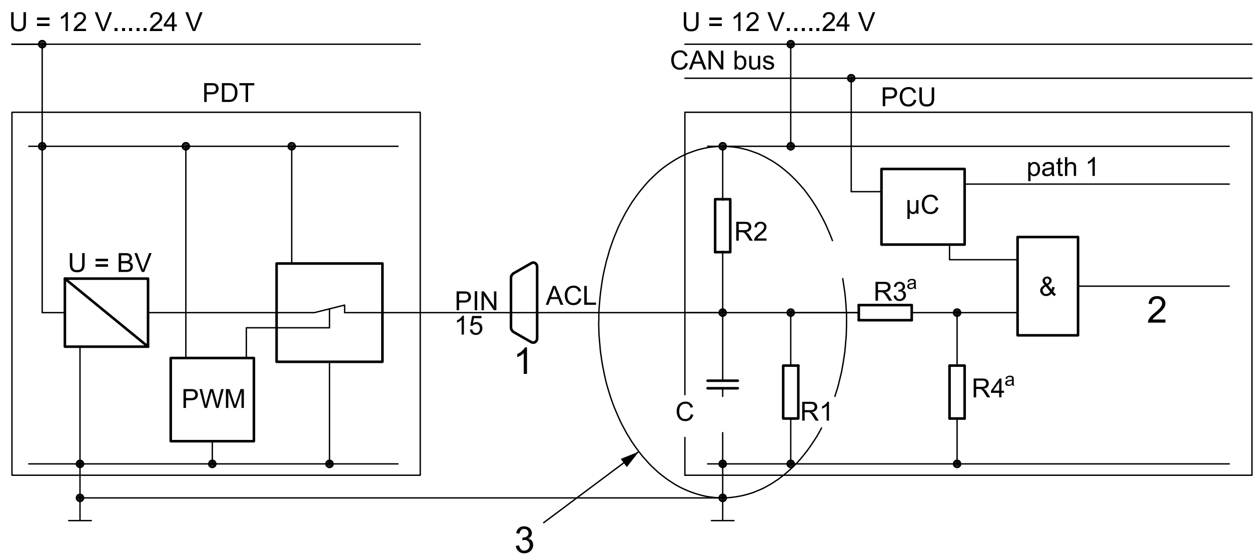
The signal level in the PCU can be adapted to the control unit's specific levels by an additional circuit (for example, voltage divider R3, R4).

The total ACL input resistance of ⩾ 50 kΩ and the input capacitance of less than 500 pF shall not be influenced by this internal circuit.

To protect against interferences by any scan tool, the ACL can optionally be AND-gated with an enable signal generated by the CAN disposal mode.

In case of AND-gate use, when the PCU is not in the disposal mode, the PWM signal will be ignored as long as there is no disposal signal detected on the CAN bus.

The output stage of the PDT has to provide up to 10 disposal devices and it has to be short-circuit-proof to GND and plus.



Key

1 OBD connector

2 redundancy path

3 K/L line in accordance with ISO 14230-1

[a] Optional.

Figure 4 — Example of a hardware interface

7.2 PCU hardware compatibility to the L line

The ACL uses on the diagnostic connector the same pin as the L communication line in older devices for the diagnostic function. The hardware of the ACL input circuit fulfils the requirements of the L line specification ISO 14230-1, so there is no influence on any scan tool in the field.

If used, an AND-gate decouples the PWM signal from the PCU in normal mode. Not until the disposal information from the CAN bus is changed to a logic signal and led to the AND-gate will the PWM signal be transferred to the redundancy path of the PCU.

This prevents the PCU from switching in the disposal mode when a signal very similar to the PWM signal appears on the ACL line.

It is possible to mix control units with L line communication and/or control units with ACL without any interference.

7.3 Allowed supply voltage

The allowed supply voltage at the PCU depends on the voltage system that is used. The supply voltage must be higher than, or equal to, the nominal voltage of the airbag system but within the allowed limits. In case of a 12 V system the supply voltage must be higher than, or equal to, 12 V.

The ground offset between the PDT and the PCU must not be greater than 0,5 V.

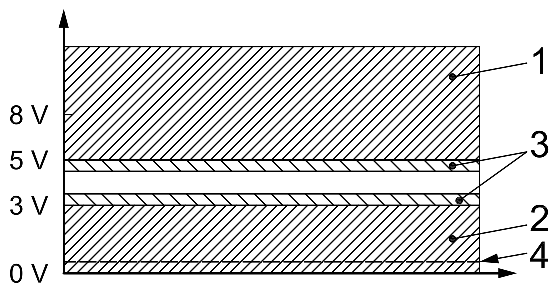
7.4 Signal description

The ACL signal is a continuous PWM voltage signal from the PDT which switches between low level and high level of the signal to be transferred.

In the PCU a voltage range from 0 V to 3 V is interpreted as low level and a voltage equal to or above 5 V is interpreted as high level (see Figure 5, parts labelled 1 and 2). The recommended tolerance range for the low level is 3 V to 3,5 V and, for the high level, is 4,5 V to 5 V. The voltage above 3 V + 0,5 V and below 5 V − 0,5 V shall not be interpreted as a valid signal by the PCU.

NOTE The recommended tolerance range of 0,5 V can vary depending on the hardware that is used, but an invalid voltage range can be introduced so there is no direct transition from high- to low-level voltage.

The signal voltage is defined as a fixed voltage, as the PCU and PDT can be provided by different supply voltages and are only connected by the GND line and the ACL.



Key

1 high level
2 low level
3 tolerance range 0,5 V
4 maximum 0,5 V offset

Figure 5 — PCU input level

The PWM signal starts with a high-level signal for 140 ms followed by a low-level signal for 60 ms. The accuracy of the transmitter timing is ± 5 %.

The receiver reads the transmitter signal with an accuracy of less than or equal to ± 10 % of the typical timing. So the detected high-level signal may vary from 126 ms to 154 ms and the detected low-level signal may vary from 54 ms to 66 ms.

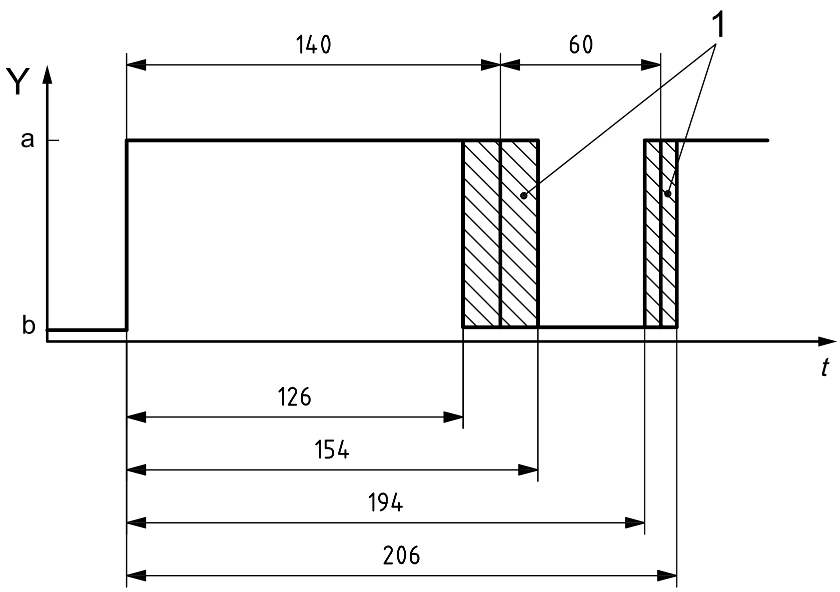
Figure 6 shows examples of the transmitter signal with ± 10 % accuracy of the receiver detection:

— typical timing of the transmitter signal [Figure 6 a)];

— − 5 % timing of the transmitter signal [Figure 6 b)];

— + 5 % timing of the transmitter signal [Figure 6 c].

Because of the ± 10 % accuracy of the receiver signal it is guaranteed that the transmitter signal is always within the receiver limits.



Key

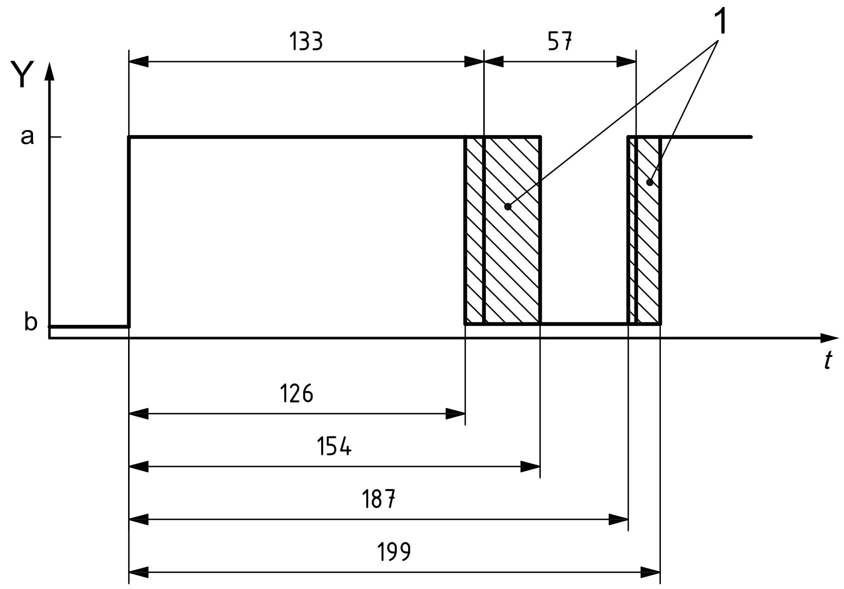
1 receiver detection range (± 10 % of typical signal)

t time in ms

Y level

a) Transmitter signal typical

Figure 6 (*continued*)



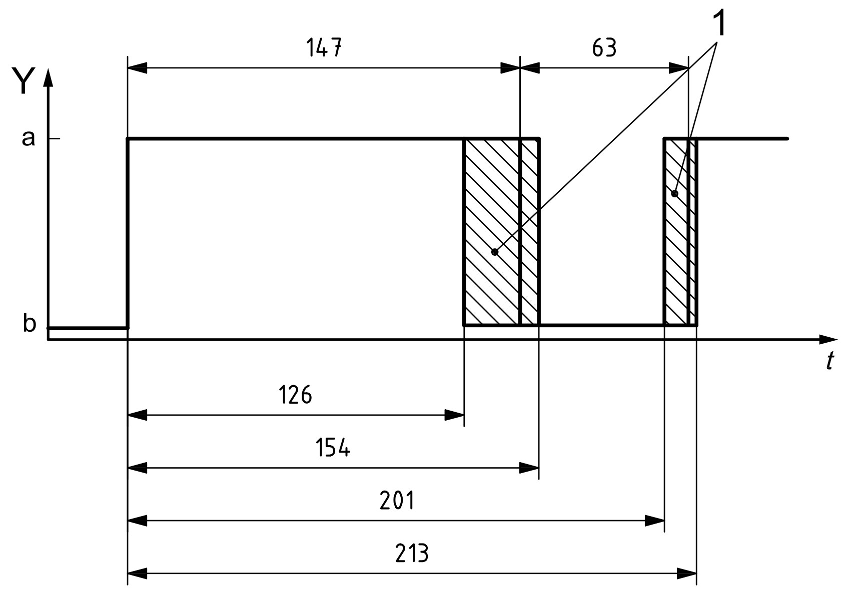
Key

1 receiver detection range (± 10 % of typical signal)

t time in ms

Y level

b) Transmitter signal – 5 %



Key

1 receiver detection range (± 10 % of typical signal)

t time in ms

Y level

c) Transmitter signal + 5 %

Figure 6 — Timing diagram

8 Deployment process with ACL line and PWM signal

8.1 General information

This section defines the general steps for the deployment process in consideration of the ACL line with the PWM signal.

8.2 Deployment process description

8.2.1 Deployment process — Overview (see Figure 7)

After the PDT detects the PCU (connector C) the PDT continues with the following steps to perform the deployment process. The main focuses in this document are the additional steps of ACL preparation and ACL steps 1 to 3.

See ISO 26021-2 for detailed information of standardized steps.

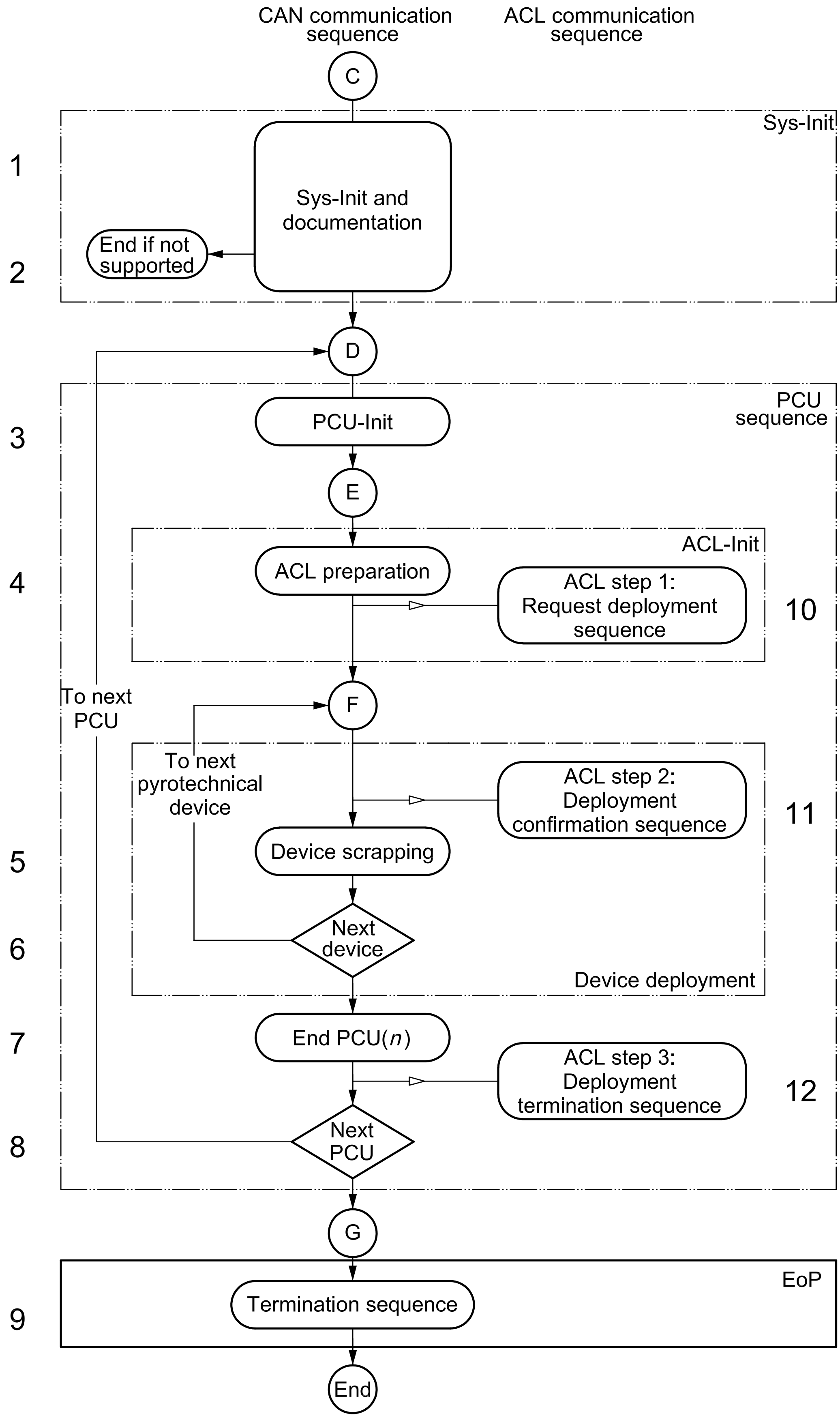


Figure 7 (*continued*)

Key

1 No additional PWM description to standard: the PDT carries out the in-vehicle configuration.

2 The PDT gets the supported deployment method ACL with PWM signal. If the version is supported the PDT shall proceed with connector (D).

3 Currently no additional ACL preparation in the CAN communication is necessary. Therefore the PDT shall proceed with (10).

4 The PDT selects the PCU and does the security handling. Together with the security access the PCU activates the optional ACL enable AND-gate. The PDT proceeds to connector (F).

5 No additional PWM description to standard: PDT read out the status and starts the device scraping session.

6 No additional PWM description to standard: the PDT checks the device loop and proceeds to connector (F) or (7).

7 The PDT ends the selection of PCU(n). Together with the end of the selection, the PCU deactivates the optional AND-gate and proceeds to (8).

8 No additional PWM description to standard: the PDT checks the next PCU loop and proceeds either to connector (E) or connector (G).

9 No additional PWM description to standard: the PDT writes the documentation to the PCU 1 and terminates the sequence.

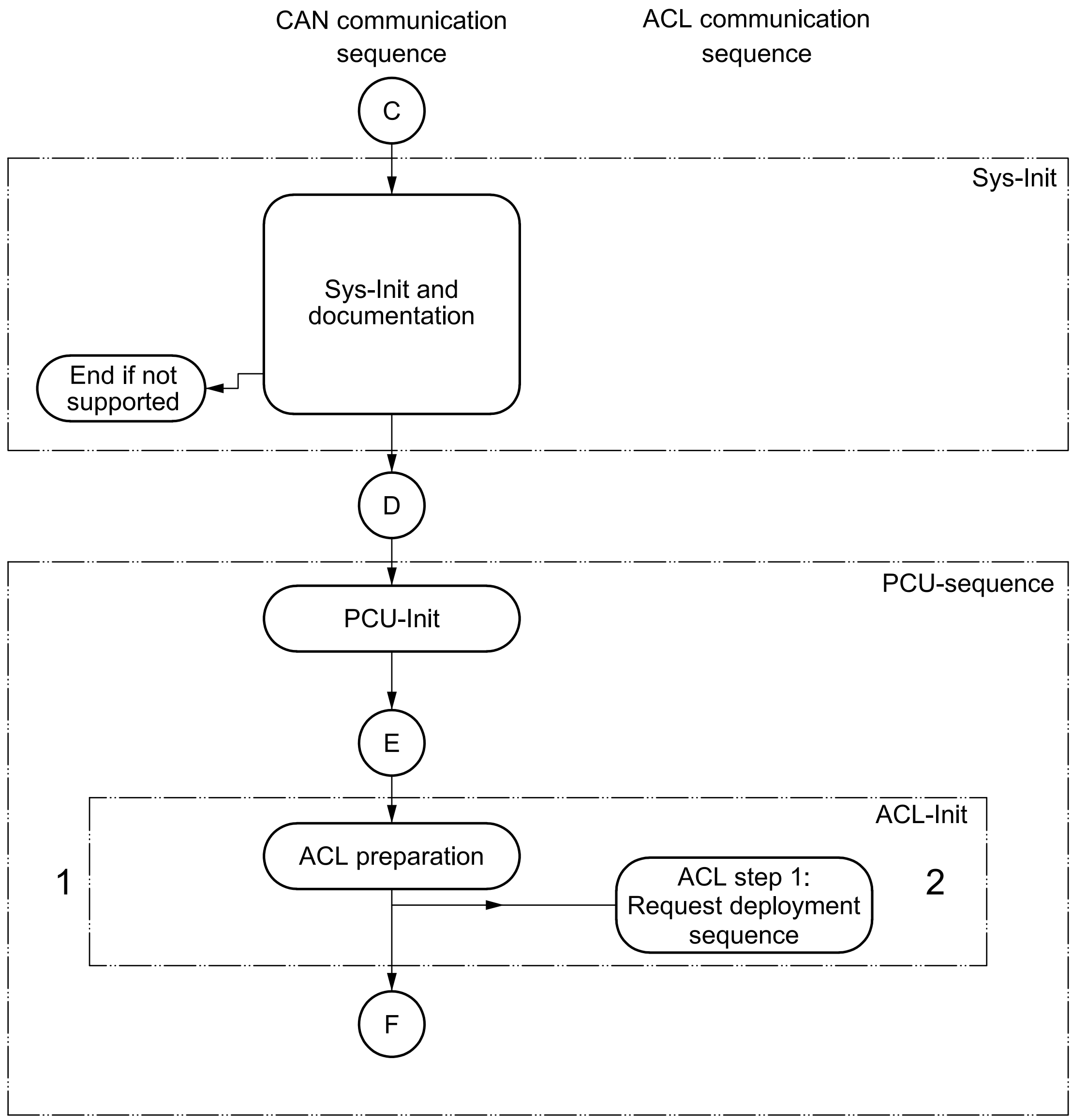
10 ACL step 1 – request deployment sequence is not necessary for ACL with PWM signal. The PDT proceeds to connector (F).

11 The PDT prepares the ACL step 2 – deployment confirmation sequence. The PDT starts the PWM signal and proceeds with (5).

12 The PDT prepares the ACL step 3 – deployment termination sequence and stops the PWM signal. The PDT proceeds to (9).

Figure 7 — Deployment process — Overview

8.2.2 Deployment process – Sys-Init and ACL-Init (see Figure 8)



The PDT does the Sys-Init and proceeds to connector (D).

1 This step is only for future use. No general ACL preparation is actually necessary in the communication sequence.

2 This step is only for future use. No general request deployment sequence is actually necessary in the communication sequence.

The PDT shall proceed to connector (E).

Figure 8 — Deployment process — ACL-Init

8.2.3 Deployment process – ACL confirmation sequence (see Figure 9)

This subclause describes the PCU-specific loop. If there are more than one PCU in a vehicle, the PDT selects the PCU(n).

The PDT shall monitor the diagnostic communication from connector (F) to the end of this security level until step 7 – end PCU(n). The PWM signal has to be switched on.

8.2.4 Advantages of PWM

The use of the ACL line with PWM signal is PCU specific. The signal should be supported by PCUs with an independent redundancy path.

The advantages of this signal are as follows:

— No communication is needed between the main firing path and the redundancy path.

— The PWM is a simple signal that also can be detected by a hardware redundancy path without any microcontroller.

— The PWM signal is optionally AND-gated by the CAN deployment signal, so there should be no interference by a signal very similar to the PWM signal, so it is possible to mix different PCUs with ACL and/or L line communication.

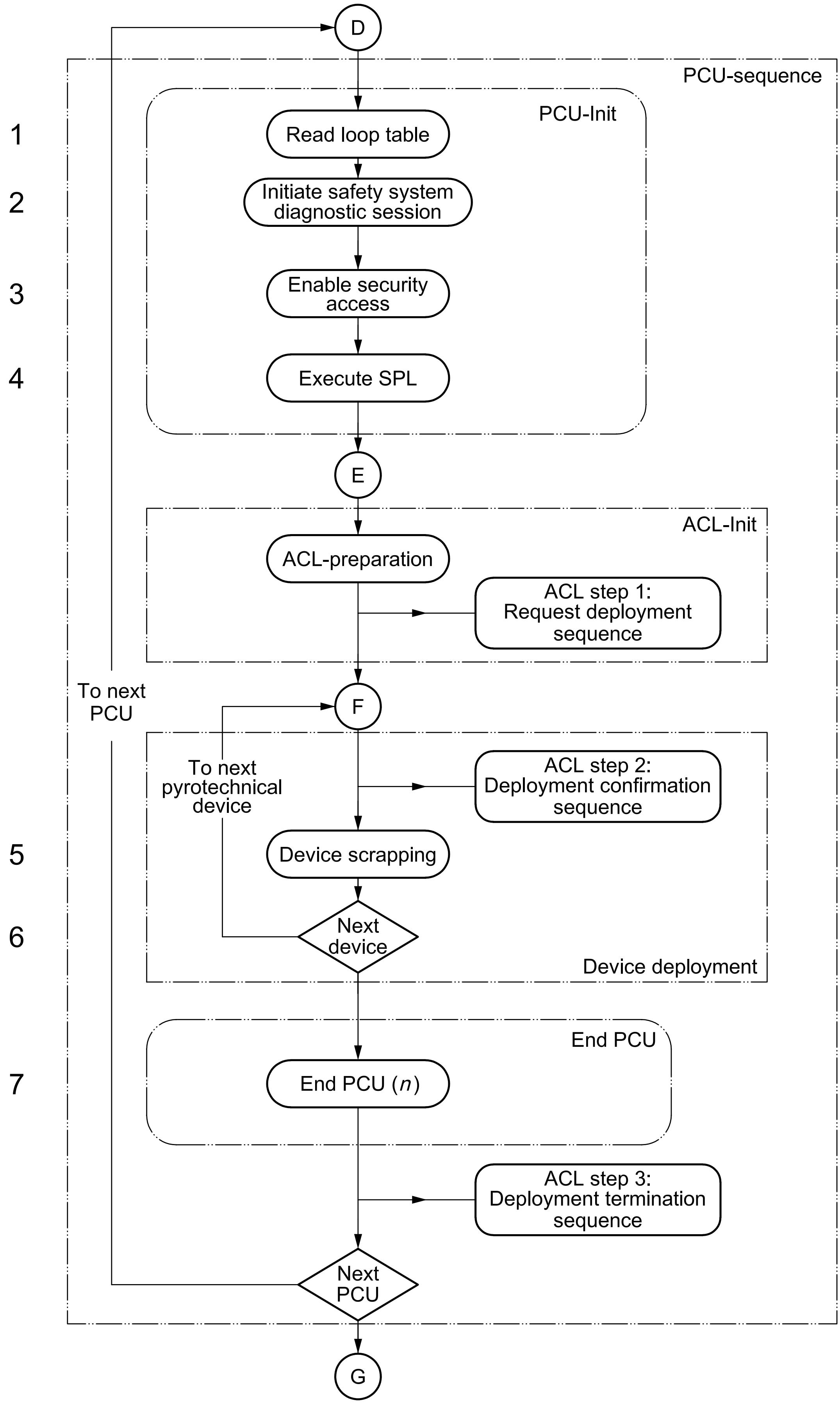


Figure 9 (*continued*)

Key

1 No change to standard: the PDT reads the number of supported pyrotechnic devices and their status.

2 No change to standard: the PDT checks whether the preconditions are met.

3 With the security access the PCU(*n*) is unlocked. Only in the deployment session with this security level is the scrapping of a deployment loop allowed. The selected PCU(*n*) activates the optional ACL enable AND-gate. The security level and the status of the optional ACL enable AND-gate shall be valid for the entire scrapping cycle of the selected PCU(*n*).

4 No change to standard: the selected PCU executes the SPL and converts the SPM format to an executable format.

5 The PDT triggers the device scrapping of the PCU. The PDT sends the PWM signal in parallel mode.

6 No change to standard: The PDT checks the number of the next device and switches either to (7) or to connecter (F).

7 The PDT sends a ResetPCU to the selected physical PCU(*n*) and ends with sending the PWM signal. The selected PCU(*n*) deactivates the optional ACL enable AND-gate either by resetting or by a timeout of normal communication.

Figure 9 — Deployment process — ACL confirmation sequence

9 Connections to the vehicle

The connection to the vehicle shall be made using the connector specified in ISO 15031-3. All data transfer between external test equipment and the vehicle shall conform to the requirements of ISO 15031-5. Contact allocation of this connector is given in Table 1.

Table 1 — Contact allocation according to ISO 15031-3

Contact	General allocation
1	Discretionary
2	Bus positive line of SAE J1850
3	Discretionary
4	Chassis ground
5	Signal ground
6	CAN_H line of ISO 15765-4
7	K line of ISO 9141-2 and ISO 14230-4
8	Discretionary
9	Discretionary
10	Bus negative line of SAE J1850
11	Discretionary
12	Discretionary
13	Discretionary
14	CAN_L line of ISO 15765-4
15	L line of ISO 9141-2 and ISO 14230-4 [in future: “Additional communication line” (option)]
16	Permanent positive voltage

NOTE Voltage range at pin 16: 9 V to 30 V, diagnostic connectors for 12 V and 24 V have different mechanical coding. Please refer to ISO 15031-3 for a detailed description of the diagnostic connector.

Bibliography

[1] ISO 9141-2, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

[2] ISO/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

[3] ISO 14230-4, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emission-related systems*

[4] ISO 15765-3, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 3: Implementation of unified diagnostic services (UDS on CAN)*

[5] ISO 15765-4, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 4: Requirements for emissions-related systems*

[6] SAE J1850, *Class B Data Communications Network Interface*

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