# SURFACE VEHICLE RECOMMENDED PRACTICE

J1939™-16 NOV2018

Issued 2015-10
Revised 2018-11

Superseding J1939-16 OCT2015

# (R) Automatic Baud Rate Detection Process

## RATIONALE

This version was created for the following reasons:

- Addresses an issue where systems would not be able to detect the baud rate if the CAN hardware used performed differently in Listen Only Mode than described in the previous version of this document.

- Guidance for performing baud rate detection based on ECU Network Initialization.

## FOREWORD

This series of SAE Recommended Practices has been developed by the Truck and Bus Control and Communications Network Committee of the Truck and Bus Electrical and Electronics Steering Committee. The objectives of the committee are to develop information reports, recommended practices, and standards concerned with the requirements, design, and usage of devices that transmit electronic signals and control information among vehicle components. The usage of these documents is not limited to truck and bus applications; other applications may be accommodated with immediate support being provided for construction and agricultural equipment, as well as stationary power systems. These documents are intended as a guide toward standard practice and are subject to change so as to keep pace with experience and technical advances.

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## 1. SCOPE

Define a process enabling devices to detect the baud rate of a SAE J1939-11, SAE J1939-14, or SAE J1939-15 network automatically with the intent of minimizing or eliminating communication disruption between existing devices. These networks only support CBFF and CEFF Data Frames, as defined in ISO 11898-1.

## 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 J1939-11 Physical Layer, 250 Kbps, Twisted Shielded Pair

SAE J1939-14 Physical Layer, 500 Kbps

SAE J1939-15 Physical Layer, 250 Kbps, Un-Shielded Twisted Pair (UTP)

#### 2.1.2 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 11898-1 Road Vehicles - Controller Area Network (CAN) - Part 1: Data Link Layer and Physical Signaling

ISO 15765-4 Road Vehicles - Diagnostic Communication Over Controller Area Network (DoCAN) – Part 4: Requirements for Emission Related Systems

## 3. DEFINITIONS AND ABBREVIATIONS

### 3.1 Definitions

#### 3.1.1 ACK ERROR

A CAN protocol error that occurs when the transmitter fails to detect a dominant level asserted bit in the acknowledge (ACK) bit of a CAN frame.

#### 3.1.2 ACTIVE BAUD DISCOVERY MODE

This is where the ECU is operating in Baud Discovery Mode (see 3.1.4) while in Active Mode (see 3.1.3).

#### 3.1.3 ACTIVE MODE

The CAN device operating in this mode is an active participant of the network. It asserts a dominant value in the ACK bit when it successfully receives a CAN frame.

#### 3.1.4 BAUD DISCOVERY MODE

Operational mode of an ECU when it can detect the baud rate of the CAN network based on the procedures listed in this document.

#### 3.1.5 BIT-TIME MEASUREMENT

The method of determining the CAN network baud rate by measuring the time duration of a single bit.

#### 3.1.6 DATA FRAME

For the purposes of this document, data frame refers to Classical Extended Frame Format (CEFF) and Classical Base Frame Format (CBFF) data frames. Note that remote frames are excluded.

#### 3.1.7 ECU NETWORK INITIALIZATION

Action of the ECU accessing the network the first time. This could be accomplished by the traditional key switch, ignition switch, or wake-up on CAN activity. It is not intended to include recovery after errors, such as loss of communication.

#### 3.1.8 ERROR-FREE DATA FRAME

A data frame is considered to be error-free if it is received when no error bit is set and the ACK bit has been asserted. If supported by the CAN hardware, a data frame may also be considered error-free if a receiving node would have asserted the ACK bit if that node was not in Silent Mode.

#### 3.1.9 PERMANENTLY INSTALLED ECU

The classification of an ECU which is required for normal operation of the system, including, but not limited to, ECM, TCM, instrument cluster, body controller, etc. The connection point of the ECU is considered a node on an SAE J1939 network.

#### 3.1.10 SILENT BAUD DISCOVERY MODE

This is where the ECU is operating in Baud Discovery Mode (see 3.1.4) while in Silent Mode (see 3.1.8).

#### 3.1.11 SILENT MODE

The CAN device operating in this mode will not transmit messages, nor assert the ACK bit for any received CAN frame. Some CAN hardware specification documents refer to a Listen Only Mode, which might not be the same as Silent Mode. ISO 11898-1 refers to this as Bus Monitoring Mode. Regardless of the terminology used in the CAN hardware specification, it is important that the mode chosen for Baud Discovery Mode be one that does not participate in the ACK or error processes. The CAN device operating in Silent Mode is prohibited from transmitting dominant bits but is capable of receiving messages.

#### 3.1.12 TEMPORARILY INSTALLED ECU

The classification of an ECU which is not required for the normal operation of the system, including, but not limited to, service tools and datalink adapters for tools. The connection point of the ECU is considered a node on an SAE J1939 network.

### 3.2 Abbreviations

| | |
|---|---|
| ACK | Acknowledge |
| CAN | Controller Area Network |
| CBFF | Classical Base Frame Format |
| CEFF | Classical Extended Frame Format |
| ECU | Electronic Control Unit |
| ECM | Engine Control Module |
| PI-ECU | Permanently Installed ECU |

TCM Transmission Control Module

TI-ECU Temporarily Installed ECU

UML Unified Modeling Language

## 4. TECHNICAL REQUIREMENTS

### 4.1 Overview

This document describes the processes used to detect the baud rate of the SAE J1939 network segment by ECUs with the ability to adjust their CAN baud rate while in use. The specified approach provides a reliable method to detect the baud rate of that network segment without interrupting network communications.

This document describes the Silent Baud Discovery Mode for baud rate detection whereby a baud rate-adjustable ECU puts its CAN device into Silent Mode and cycles through each supported baud rate until it successfully receives an error-free data frame. The general baud rate detection behaviors are the same for all baud-rate adjustable ECUs; however, there are some minor behavior differences depending upon whether the ECU is intended as permanently installed or temporarily installed on the network.

This document also describes the Active Baud Discovery Mode for baud rate detection whereby a temporarily installed baud rate-adjustable ECU can transmit a special classical base frame format data frame “test” message so that an ECU can determine the baud rate of this network segment. There may be some networks where no periodic messages are transmitted by any of the fixed baud rate ECUs, but the temporarily installed baud rate-adjustable ECU still needs to determine the network segment baud rate. In such a scenario, a temporarily installed baud rate-adjustable ECU will never detect the network baud rate using the Silent Baud Discovery Mode detection method. In the active baud rate detection method, a baud rate-adjustable ECU puts its CAN device into Active Baud Discovery Mode and cycles through each supported baud rate as it transmits the special 11-bit “test” message until another ECU on the network asserts the ACK bit. This only works when there is one baud rate-adjustable ECU that is in Active Baud Discovery Mode at a time. Multiple baud rate-adjustable ECUs performing active baud rate detection could result in detecting an unintended baud rate if both are sending 11-bit “test” messages at the same baud rate and the CAN device in each asserts the ACK bit of the other's test message.

There is a situation where the special 11-bit “test” message transmitted by a temporarily installed baud rate-adjustable ECU in Active Baud Discovery Mode will set the baud rate of a network. This could occur in an off-vehicle programming application where the other ECU is in Silent Baud Discovery Mode. Multiple ECUs in Silent Baud Discovery Mode will not work, because each ECU’s power up time will be different and the time that the ECU remains in a supported baud rate will most likely be different. As long as there is only one ECU in Silent Baud Discovery Mode and one ECU in Active Baud Discovery Mode, then the ECU in Silent Baud Discovery Mode should detect the 11-bit “test” message and set the baud rate accordingly. When the temporarily installed baud rate-adjustable ECU in Active Baud Discovery Mode sends the next 11-bit “test” message at that baud rate, then the ECU that was in Silent Baud Discovery Mode will assert the ACK bit. At that point, the temporarily installed baud rate-adjustable ECU in Active Baud Discovery Mode will set its baud rate to that baud rate. The objective of this situation is not to determine a preselected baud rate (because a preselected network baud rate does not exist), but to establish communication between the two ECUs.

The processes in this document are intended to be performed after power is applied to the ECU and before it transmits any messages. Although these processes are not intended to be performed during the same key cycle after an ECU has determined the baud rate of the SAE J1939 network segment, nothing prevents an ECU from entering Baud Discovery Mode after a baud rate has been determined. However, this document does not specifically address those situations.

Bit-time measurement is an alternate method of baud rate detection. However, it is not considered a robust baud rate detection method and is discouraged for baud rate detection on SAE J1939 networks.

### 4.2 Baud Rate Detection ECU Classifications

There are six different baud rate detection ECU classifications. The classifications are based upon the permanence of network installation and the ability for run time baud rate adjustment. The ECU classifications are used to describe the minimum requirement on SAE J1939 network architecture for baud rate detection and describe and associate specific baud rate detection behaviors for baud rate-adjustable ECUs. Three of the ECU classifications identify fixed baud rate ECUs and three of the ECU classifications identify baud rate-adjustable ECUs.

#### 4.2.1 Permanently Installed ECU (PI-ECU) Classifications

Permanently Installed ECU is an ECU which is required for normal operation of the system and, therefore, is expected to be connected to the SAE J1939 network segment at all times. PI-ECUs are typically ECUs which are dedicated to a single vehicle or application, and a PI-ECU rarely, if ever, is connected to another different vehicle during its useful life. Some examples of permanently installed ECUs are an engine ECU, transmission ECU, instrument cluster, and body controller.

##### 4.2.1.1 Adjustable Baud Rate PI-ECU

This classification describes a permanently installed ECU that will adjust its CAN baud rate to the SAE J1939 network segment baud rate, provided that rate is supported by the ECU. This class of ECU is recommended to store the last detected baud rate in some form of persistent memory over ECU power cycles to expedite the baud rate discovery time on the next ECU network initialization event.

##### 4.2.1.2 Fixed Baud Rate PI-ECU with Periodic Message Transmits

This classification describes a permanently installed ECU that communicates on the SAE J1939 network segment using one designated baud rate. This class of ECU automatically transmits one or more periodic messages onto the SAE J1939 network. The periodic messaging by this class of ECU is the cornerstone for baud rate detection by baud rate-adjustable ECUs.

##### 4.2.1.3 Fixed Baud Rate PI-ECU with No Periodic Message Transmits

This classification describes a permanently installed ECU that communicates on the SAE J1939 network segment using one designated baud rate. This class of ECU does not automatically transmit any periodic messages onto the SAE J1939 network.

#### 4.2.2 Temporarily Installed ECU (TI-ECU) Classifications

Temporarily Installed ECU describes an ECU which is not required for normal operation of the system, but may be connected to the SAE J1939 network segment randomly and for short periods of time, as required. TI-ECUs are typically considered to be ECUs that are not dedicated to any single vehicle or application; rather, the nature of the TI-ECU involves being connected to any number of different vehicles over its useful life.

##### 4.2.2.1 Adjustable Baud Rate Only TI-ECU with Silent Baud Discovery Mode

This classification describes a temporarily installed ECU that will adjust its CAN baud rate to the SAE J1939 network segment baud rate, provided that rate is supported by the ECU. This class of ECU will only use Silent Baud Discovery Mode for detecting the SAE J1939 network segment baud rate.

##### 4.2.2.2 Adjustable Baud Rate Only TI-ECU with Active Baud Discovery Mode

This classification describes a temporarily installed ECU that will adjust its CAN baud rate to the SAE J1939 network segment baud rate, provided that rate is supported by the ECU. This class of ECU will first use Silent Baud Discovery Mode for detecting the SAE J1939 network segment baud rate. If the baud rate is not detected through the Silent Baud Discovery Mode, then this class of ECU will go into Active Baud Discovery Mode and potentially transmit CAN frames in order to detect the SAE J1939 network segment baud rate. This class of ECU should be used sparingly since the Active Baud Discovery Mode operation has the potential to interrupt network communications.

##### 4.2.2.3 Fixed Baud Rate TI-ECU

This classification describes a temporarily installed ECU that communicates on the SAE J1939 network segment using one designated baud rate. This class of ECU should only be installed on SAE J1939 networks designated with the same baud rate to avoid interrupting network communications due to baud rate differences.

## 4.3 SAE J1939 Network Architecture for Baud Rate Detection

SAE J1939 network architecture must conform to several constraints regarding the number and types of connected ECUs in order for ECUs to reliably detect the network segment baud rate. The SAE J1939 network architecture constraints are shown in the UML diagram in Figure 1. The constraints are described in this section.

a. The SAE J1939 network segment is recommended to have at least two active fixed baud rate PI-ECUs (see 4.2.1.2 and 4.2.1.3), and at least one of these fixed baud rate PI-ECUs must support periodic message transmits (see 4.2.1.2). A minimum of two active ECUs at the target baud rate allows devices in Baud Discovery Mode to observe an asserted Acknowledgement bit in the transmitted CAN frames.

b. In some instances, the network segment may only require one fixed baud rate PI-ECU that supports periodic message transmits (see 4.2.1.2). This is only feasible if the CAN hardware in at least one baud rate-adjustable ECU can detect CAN frames without observing an asserted ACK bit in the transmitted CAN frames.

c. The SAE J1939 network segment may have any number of adjustable rate PI-ECUs (see 4.2.1.1).

d. The SAE J1939 network segment may have any number of adjustable rate TI-ECUs using Silent Baud Discovery Mode (see 4.2.2.1).

e. The SAE J1939 network segment shall have no more than one adjustable baud rate TI-ECU using the Active Baud Discovery Mode to detect the baud rate (see 4.2.2.2) at the same time.

f. The SAE J1939 network segment may have any number of fixed baud rate TI-ECUs (see 4.2.2.3). The baud rate of each TI-ECU must be the same as the baud rate of the SAE J1939 network.

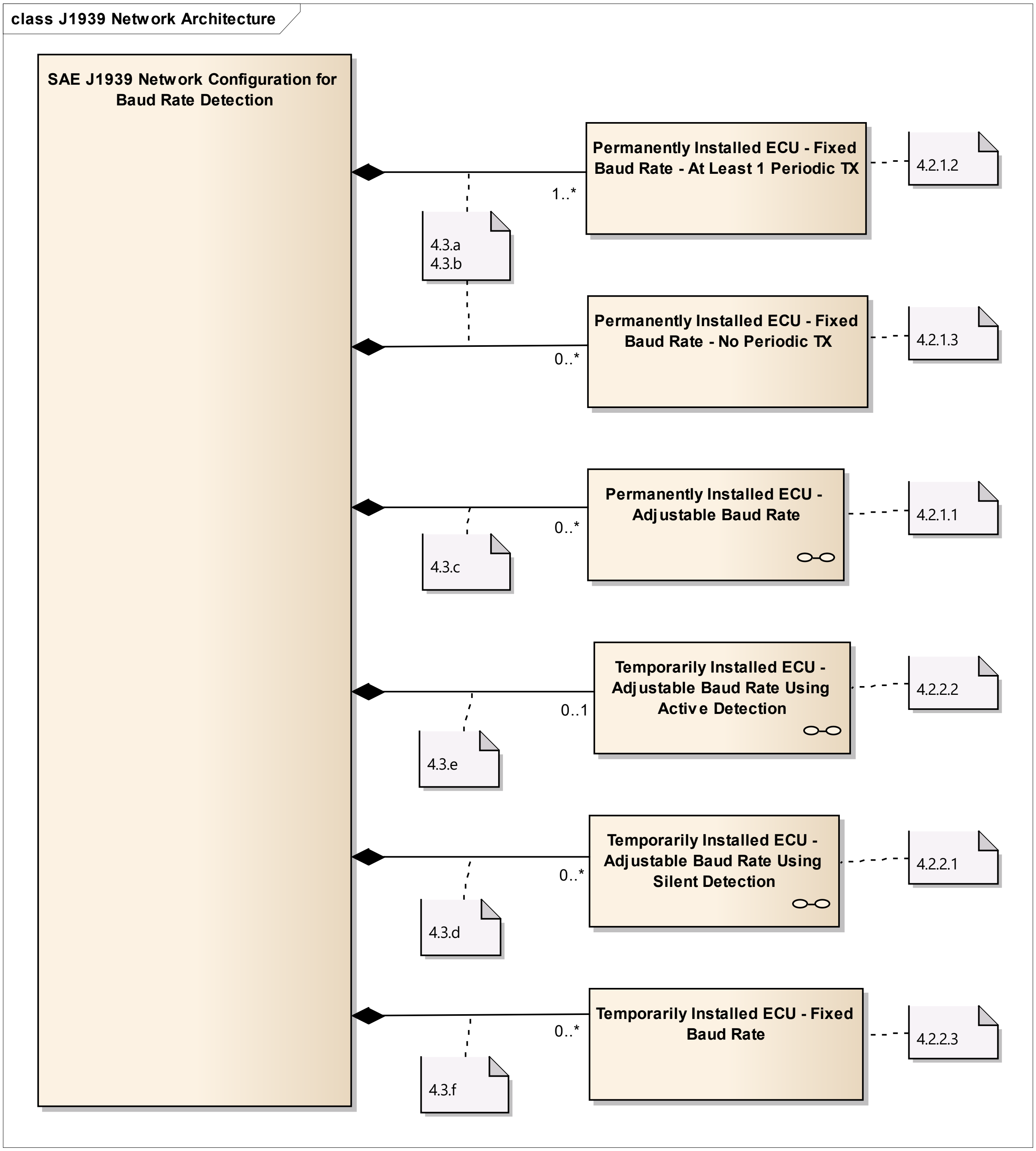


*Figure 1 - SAE J1939 network architecture for baud rate detection*

## 4.4 Baud Rate Detection Procedure General Constraints

The following set of constraints and requirements apply to all adjustable baud rate PI-ECUs and adjustable baud rate TI- ECUs which use the baud rate detection procedures.

a. Adjustable baud rate PI-ECUs and adjustable baud rate TI-ECUs shall be able to set their CAN device to Silent Mode during baud rate detection.

b. Adjustable baud rate PI-ECUs and adjustable baud rate TI-ECUs shall have a list of possible baud rates that are acceptable for the ECU to use.

c. Adjustable baud rate PI-ECUs and adjustable baud rate TI-ECUs shall be able to detect CAN errors while in Silent Mode.

## 4.5 PI-ECU Baud Rate Detection Procedure

The procedural behaviors described in this section apply to baud rate detection by a baud rate-adjustable PI-ECU. The model of baud rate detection behaviors is shown in the UML diagram in Figure 2.

A baud rate-adjustable PI-ECU shall perform the baud rate detection process on every ECU network initialization event. Typically, a PI-ECU will be installed on and remain on the same SAE J1939 network segment over its useful life, and once the PI-ECU successfully detects the baud rate of the SAE J1939 network segment, then the detected baud rate on each subsequent ECU network initialization will normally be the same. However, there are external conditions where the SAE J1939 network segment's baud rate might not be the same as detected during the last ECU network initialization, such as when the PI-ECU is physically connected to a different SAE J1939 network segment. This might be for troubleshooting or for replacement of a failed ECU, or the fixed rate PI-ECU with periodic transmits was replaced by a different fixed rate PI-ECU that uses a different baud rate.

In order to expedite the baud rate discovery time for the PI-ECU during each ECU network initialization, baud rate-adjustable PI-ECUs are recommended to maintain the last detected baud rate in some form of persistent memory over ECU power cycles and use this baud rate as the initial rate during baud rate discovery.

a. Upon network initialization, the PI-ECU will select a starting baud rate for baud rate discovery and put itself into Silent Mode (Silent Baud Discovery Mode). If the ECU has retained the last detected baud rate, then the ECU should use this baud rate as the starting rate for baud rate discovery. Otherwise, the PI-ECU should select a supported baud rate (starting with the highest rate is preferred).

b. The PI-ECU will wait until it receives an error-free data frame which was transmitted from any other network device or until it detects an error frame.

c. If the PI-ECU successfully detects an error-free data frame or detects a data frame with only an ACK bit error on the CAN bus, then it should latch on the current baud rate as the detected baud rate. The PI-ECU should end Baud Discovery Mode and begin normal communications on the SAE J1939 network.

d. If the PI-ECU detects a data frame that is not error-free or receives a CAN error frame, then the PI-ECU will continue to remain in Silent Mode and switch to the next supported baud rate (next lower rate is preferred method). If the PI-ECU reaches the end of the list of supported rates, then the PI-ECU should wrap around to the start of the list of supported baud rates.

e. The ECU repeats the procedure steps “b” to “d” until the condition in step “c” is satisfied.

f. If the PI-ECU's attempts to detect and select the baud rate were not successful for any of its supported baud rates, then the PI-ECU can either restart the Baud Discovery Mode or remain in Silent Mode such that it has no impact on network communications.

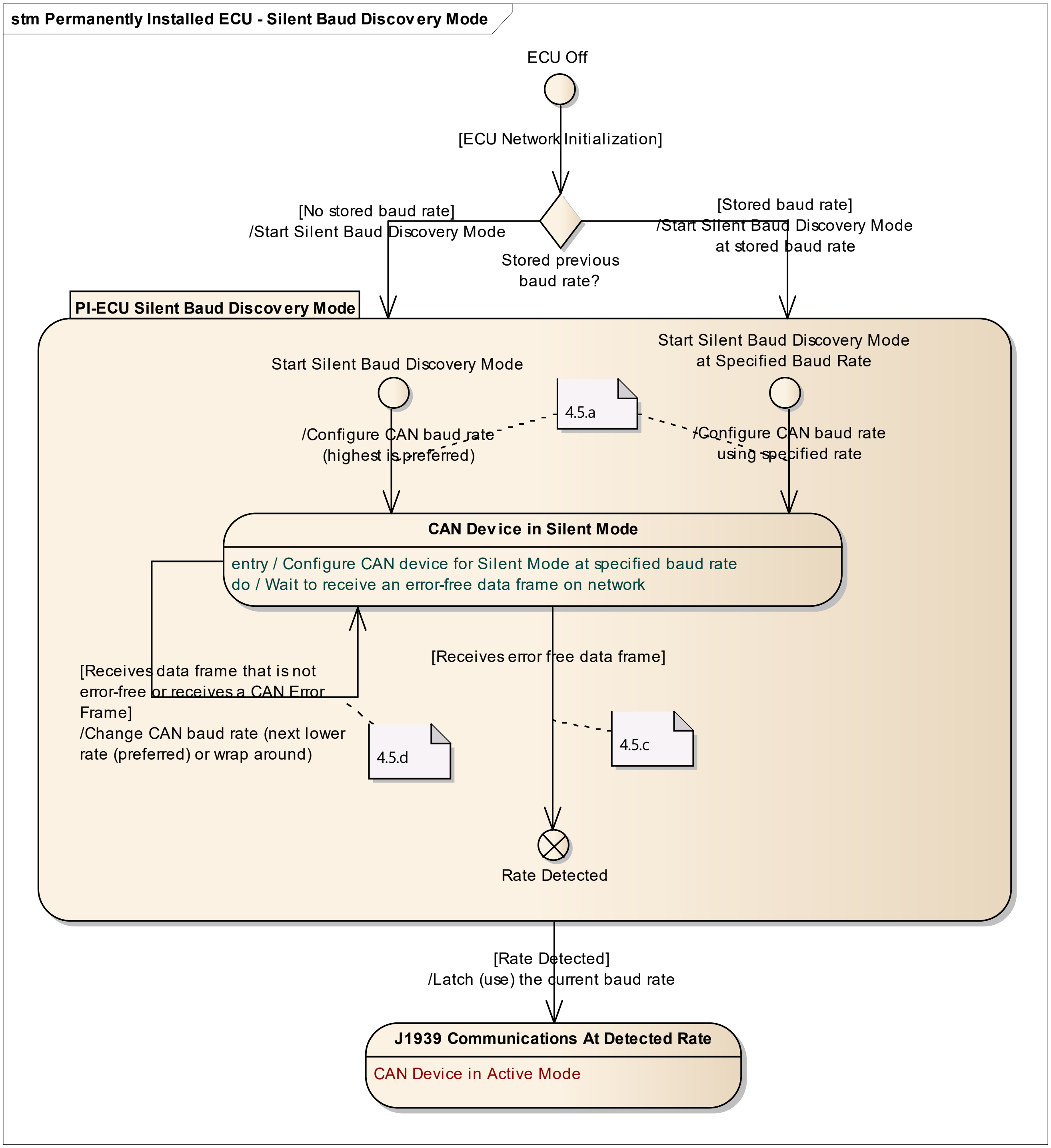


*Figure 2 - PI-ECU baud rate detection behavior model*

4.6 TI-ECU Baud Rate Detection Procedure While in Silent Baud Discovery Mode

The procedural behaviors described in this section apply to baud rate detection by a baud rate-adjustable TI-ECU that will only use the Silent Mode approach. The model of baud rate detection behaviors is shown in the UML diagram in Figure 3.

A baud rate-adjustable TI-ECU shall perform the baud rate detection process on every ECU network initialization event. This class of TI-ECU will exclusively rely upon the Silent Mode approach for detecting the baud rate of the SAE J1939 network.

a. Upon network initialization, the TI-ECU will select a starting baud rate for baud rate discovery and put itself in Silent Mode (Silent Baud Discovery Mode). The recommendation is for the TI-ECU to start with highest supported baud rate first.

b. The TI-ECU will wait until it receives an error-free data frame which was transmitted from any other network device or until it detects an error frame.

c. If the TI-ECU successfully detects an error-free data frame or detects a data frame in which the ACK bit was not asserted on the CAN bus, then it should latch on the current baud rate as the detected baud rate. The TI-ECU should end Baud Discovery Mode and begin normal communications on the SAE J1939 network.

d. If the TI-ECU detects a data frame that is not error-free or receives a CAN error frame, then the TI-ECU will continue to remain in Silent Mode and switch to the next supported baud rate (next lower baud rate is preferred method). If the TI-ECU reaches the end of the list of supported baud rates, then the TI-ECU should wrap around to the start of the list of supported baud rates.

e. The ECU repeats procedure steps “b” to “d” until the condition in step “c” is satisfied.

f. If TI-ECU’s attempts to detect and select the baud rate were not successful for any of the supported baud rates, then the TI-ECU can either restart the Baud Discovery Mode or remain in Silent Mode such that it has no impact on network communications.

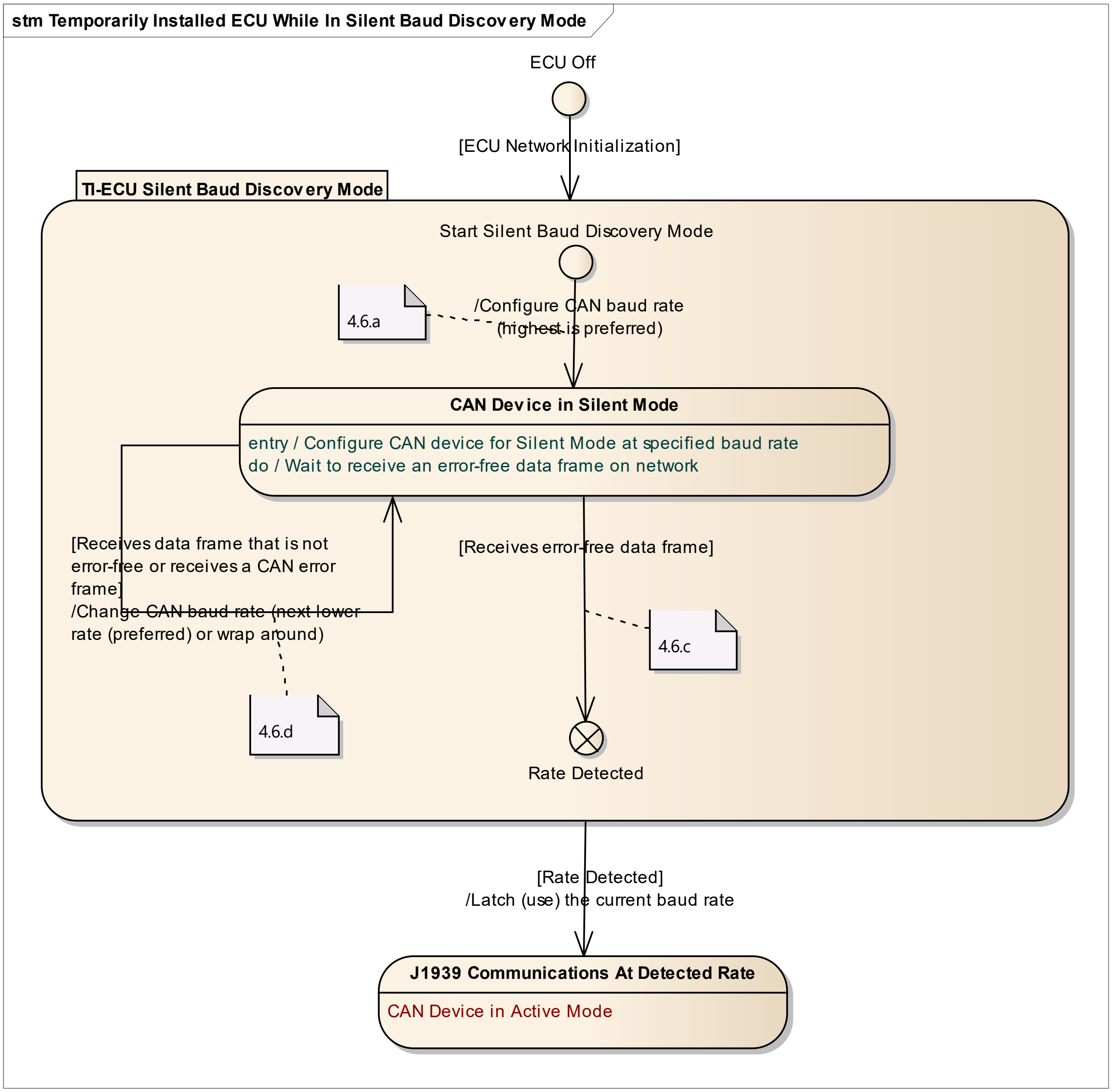


***Figure 3 - TI-ECU silent mode baud rate detection behavior model***

## 4.7 TI-ECU Baud Rate Detection Procedure While in Active Baud Discovery Mode

The procedural behaviors described in this section apply to baud rate detection by a baud rate-adjustable TI-ECU that will use the Active Baud Discovery Mode approach if unable to detect the baud rate using Silent Baud Discovery Mode approach. The model of baud rate detection behaviors is shown in the UML diagram in Figure 4. A baud rate-adjustable TI-ECU shall perform the baud rate detection process on every ECU network initialization event.

a. It is recommended that TI-ECUs attempt to detect the baud rate using Silent Baud Discovery Mode as described in 4.6 before attempting to detect the baud rate using Active Baud Discovery Mode.

b. If the TI-ECU is unable to detect the baud rate of the SAE J1939 network segment while in Silent Mode, then the TI-ECU will select a starting baud rate and put itself in Active Mode. The recommendation is for the TI-ECU to start with the highest supported baud rate first. It is up to the implementer to decide when the TI-ECU shall switch from Silent Mode to Active Mode.

c. If the TI-ECU successfully detects an error-free data frame on the CAN bus, then it will latch on the current baud rate as the detected baud rate. The TI-ECU may end Baud Discovery Mode and begin normal communications on the SAE J1939 network.

d. If the TI-ECU detects a data frame that is not error-free or receives a CAN error frame, then the TI-ECU will switch to the next supported baud rate (next lower baud rate is preferred method). If the TI-ECU reaches the end of the list of supported baud rates, then the TI-ECU should wrap around to the start of the list of supported baud rates. The purpose of this step is to accommodate situations where another TI-ECU transmits a message in order to detect the baud rate.

e. If the TI-ECU was unable to detect the baud rate of the SAE J1939 network segment as stated in step "c," then the TI-ECU will attempt to send an CBFF data frame message on the bus as specified in Table 1.

***Table 1 - Standard 11-bit message TI-ECUs use to detect the baud rate***

| **CAN ID** | **Data Bytes** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Byte 1** | **Byte 2** | **Byte 3** | **Byte 4** | **Byte 5** | **Byte 6** | **Byte 7** | **Byte 8** |
| $7DF_{16}$ | $01_{16}$ | $00_{16}$ | $20_{16}$ | $40_{16}$ | $60_{16}$ | $80_{16}$ | $A0_{16}$ | $FF_{16}$ |

NOTE: CAN ID $7DF_{16}$ is defined by ISO 15765-4 and should not have any adverse affects on other network devices.

f. If the TI-ECU successfully transmits the CBFF data frame message specified in step "e" (i.e., no error frame encountered on the bus and the ACK bit was properly asserted), then it should latch on the current baud rate as the detected baud rate. The TI-ECU should end Baud Discovery Mode and begin normal communications on the SAE J1939 network.

g. If the TI-ECU detects an ACK error, then it should try to re-transmit as recommended by ISO 11898.

h. If the TI-ECU encounters three to five consecutive CAN errors other than the ACK bit error on the CAN bus, then the TI-ECU selects the next supported baud rate (next lower rate is preferred method). If the TI-ECU reaches the end of the list of supported rates, then the TI-ECU should wrap around to the start of the list of supported baud rates.

NOTE 1: For a robust detection method, it is recommended that the TI-ECU detect and switch baud rates before any retransmission attempts (when the first error frame is detected and before the next error frame is generated).

NOTE 2: A less robust detection method would be that a device must detect the baud rate within 14 retry attempts in addition to the first attempt to prevent any receivers from transitioning to error passive. (14 retry attempts in addition to the first attempt are derived from the fact that errors count by 8, and error passive occurs at 128.)

i. The TI-ECU then repeats procedure steps "e" to "h" until the condition in step "f" is satisfied or until the TI-ECU has attempted to detect the baud rate with all of the supported baud rates. If the TI-ECU's attempts to detect and select the baud rate were not successful for any of the supported baud rates, then the TI-ECU shall stop transmitting messages and transition to Silent Mode (see step "a").

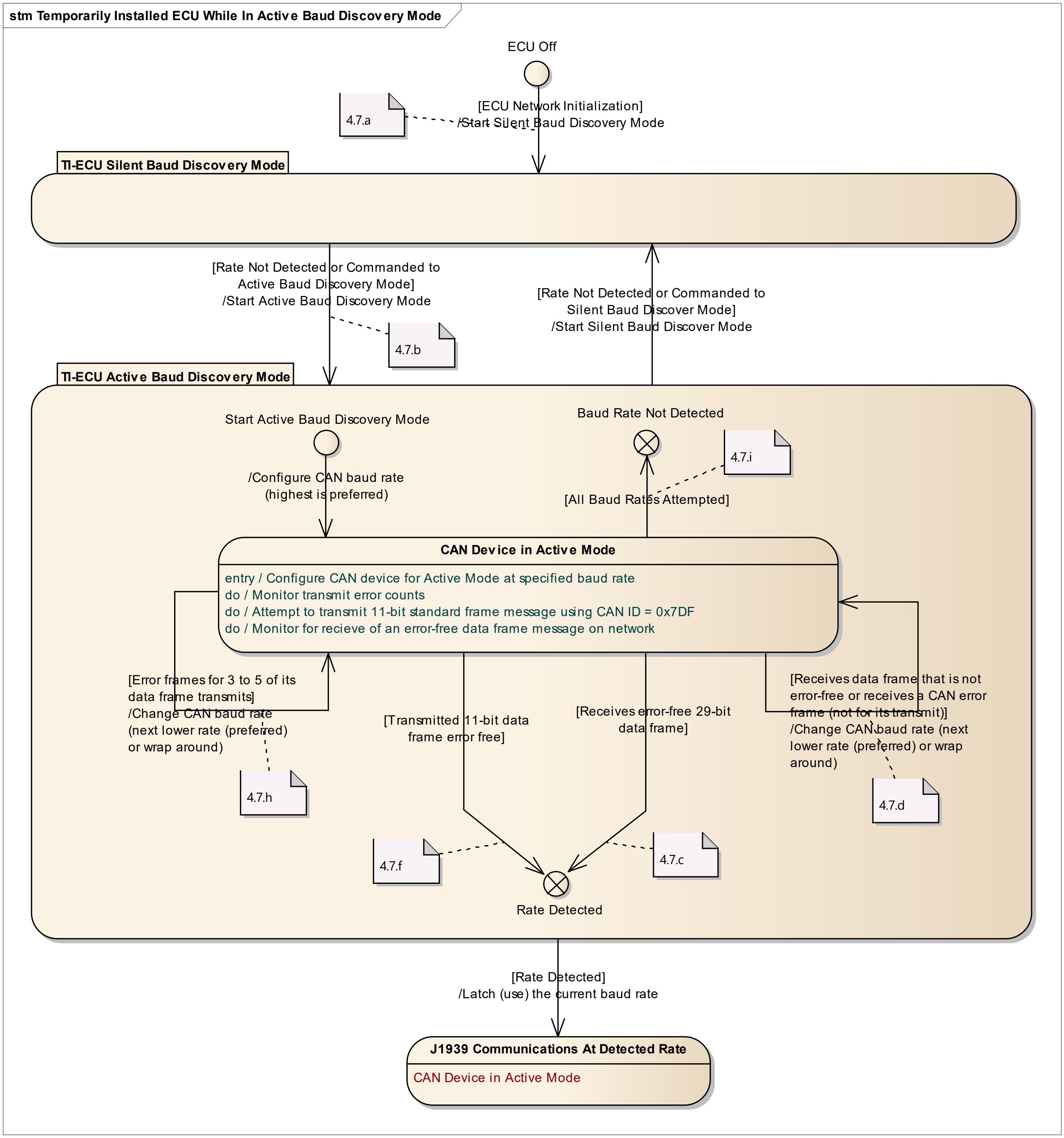


*Figure 4 - TI-ECU active baud discovery mode behavior model*

# 5. NOTES

## 5.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE TRUCK AND BUS CONTROL AND COMMUNICATIONS NETWORK COMMITTEE OF THE TRUCK AND BUS ELECTRICAL / ELECTRONIC SEERING COMMITTEE

## APPENDIX A - BAUD RATE DETECTION USE CASES

The table below specifies the expected result for different combinations of network devices that are attempting to detect the baud rate or are operating at a fixed baud rate. The column headings represent specific conditions for the ECUs on a given network. Each use case, or row in the table, represents combinations of these conditions. If a cell in the table is “Yes,” then the condition in that column header is present for that use case. If a cell in the table is “No,” then the condition in that column header is not present for that use case. If a cell in the table is “Don’t Care,” then the cell in the “Expected Result” column applies whether the condition in the column header is present or not.

***Table A1***

| **Use Case** | **One TI-ECU in Active Baud Discovery Mode (may introduce error frames with ECU(A) and/or PI-ECU(B))** | **Number of ECUs (referred to as ECU(D)) in Silent Baud Discovery Mode (could be PI-ECUs or TI-ECUs)** | **Number of ECUs Transmitting Periodic Messages (referred to as ECU(A))** | **One or more PI-ECU in Active Mode, but not Transmitting Periodic Messages (referred to as PI-ECU(B))** | **One or more PI-ECUs in Silent Mode (referred to as PI-ECU(C))** | **Expected Result** | **Comments** |
|---|---|---|---|---|---|---|---|
| 1 | No | One or more | Zero | No | Don’t Care | No Auto Baud | |
| 2 | No | One or more | Zero | Yes | Don’t Care | No Auto Baud | |
| 3 | No | One or more | One | No | Don’t Care | Timing dependent: ECU(D) in Silent Baud Discovery Mode may detect Baud Rate of ECU(A) if ECU(D) is on the network before ECU(A) goes bus off (because no other node asserted the ACK bit) | For this use case, ECU(A) can mitigate the timing issues depending on how it recovers from bus off. |
| 4 | No | One or more | Two or more | No | Don’t Care | ECU(D) in Silent Baud Discovery Mode should detect Baud Rate of ECU(A) | |
| 5 | No | One or more | One or more | Yes | Don’t Care | ECU(D) in Silent Baud Discovery Mode should detect Baud Rate of ECU(A) | |

| Use Case | One TI-ECU in Active Baud Discovery Mode (may introduce error frames with ECU(A) and/or PI-ECU(B)) | Number of ECUs (referred to as ECU(D)) in Silent Baud Discovery Mode (could be PI-ECUs or TI-ECUs) | Number of ECUs Transmitting Periodic Messages (referred to as ECU(A)) | One or more PI-ECU in Active Mode, but not Transmitting Periodic Messages (referred to as PI-ECU(B)) | One or more PI-ECUs in Silent Mode (referred to as PI-ECU(C)) | Expected Result | Comments |
|---|---|---|---|---|---|---|---|
| 6 | Yes | One | Zero | No | Don't Care | ECU(D) should set the baud rate to that of the data frame in which the ACK bit would have been asserted if the ECU(D) was not in Silent Baud Discovery Mode | |
| 7 | Yes | Two or more | No | No | Don't Care | Baud rate detection will be intermittent and depend on the duration that each ECU in Silent Baud Discovery Mode is in each supported baud rate relative to the other ECUs in Silent Baud Discovery Mode | This use case scenario should be avoided. |
| 8 | Yes | Zero | Zero | Yes | Don't Care | TI-ECU should detect Baud Rate of PI-ECU(B) | |
| 9 | Yes | One or more | Zero | Yes | No | TI-ECU and ECU(D) should detect baud rate of PI-ECU(B) | If the PI-ECU(B) is in error passive, then the TI-ECU and the ECU(D) could detect an incorrect baud rate. |

| Use Case | One TI-ECU in Active Baud Discovery Mode (may introduce error frames with ECU(A) and/or PI-ECU(B)) | Number of ECUs (referred to as ECU(D)) in Silent Baud Discovery Mode (could be PI-ECUs or TI-ECUs) | Number of ECUs Transmitting Periodic Messages (referred to as ECU(A)) | One or more PI-ECU in Active Mode, but not Transmitting Periodic Messages (referred to as PI-ECU(B)) | One or more PI-ECUs in Silent Mode (referred to as PI-ECU(C)) | Expected Result | Comments |
|---|---|---|---|---|---|---|---|
| 10 | Yes | One or more | Zero | Yes | Yes | TI-ECU and ECU(D) should detect baud rate of PI-ECU(B) | If the PI-ECU(B) is in error passive, then the TI-ECU and the ECU(D) could detect an incorrect baud rate. PI-ECU(C) might not operate properly. |
| 11 | Yes | Zero | One or more | No | Don’t care | TI-ECU should detect Baud Rate of ECU(A) | |
| 12 | Yes | One or more | One or more | No | Don’t Care | TI-ECU and ECU(D) should detect Baud Rate of ECU(A) | |
| 13 | Yes | Zero | One or more | Yes | Don’t Care | TI-ECU should detect Baud Rate of ECU(A) | |
| 14 | Yes | One or more | One or more | Yes | Don’t Care | TI-ECU and ECU(D) should detect Baud Rate of ECU(A) | |