SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2497 JUL2012

Issued 2002-10
Revised 2012-07

Superseding J2497 DEC2010

Power Line Carrier Communications for Commercial Vehicles

RATIONALE

Replaced SAE J1113 references with equivalent CISPR 25 references. Updated the Intellectual Property section and removed the contact info. Added PID and PGN information for ABS Indicator Lamp Status sections. Added missing abbreviations.

FOREWORD

This SAE Recommended Practice has been developed by the Truck and Bus Low Speed Communications Network Subcommittee of the Truck and Bus Electrical and Electronics Committee. The objectives of the subcommittee are to develop information reports, recommended practices, and standards concerned with the requirements design and usage of devices which transmit electronic signals and control information among vehicle components.

This document is intended as a guide toward standard practice and is subject to change so as to keep pace with experience and technical advances.

TABLE OF CONTENTS

1. SCOPE

This SAE Recommended Practice defines a method for implementing a bidirectional, serial communications link over the vehicle power supply line among modules containing microcomputers. This document defines those parameters of the serial link that relate primarily to hardware and software compatibility such as interface requirements, system protocol, and message format that pertain to Power Line Communications (PLC) between Tractors and Trailers.

This document defines a method of activating the trailer ABS Indicator Lamp that is located in the tractor.

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 724-776-4970 (outside USA), www.sae.org.

SAE J1587 Electronic Data Interchange Between Microcomputer Systems In Heavy-Duty Vehicle Applications

SAE J1708 Serial Data Communications Between Microcomputer Systems In Heavy-Duty Vehicle Applications

SAE J1939 Recommended Practice for a Serial Control and Communications Vehicle Network

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 ANSI Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

CISPR 25 Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers

3. ABBREVIATIONS

ABS	Antilock Brake System
AC	Alternating Current
ASK	Amplitude Shift Key modulation
CISPR	Comité International Spécial des Perturbations Radioélectriques; English: Special international committee on radio interference)
DC	Direct Current
ECU	Electronic Control Unit
FMI	Failure Mode Identifier
MID	Message Identifier
NRZ	Non Return to Zero modulation
PGN	Parameter Group Number
PID	Parameter ID
PL	Power Line
PLC	Power Line Communications
PRK	Phase Reversal Keying modulation
RF	Radio Frequency
SID	Subsystem ID
Tsd	Start Delay Time

4. INTELLECTUAL PROPERTY RIGHTS

By publication of this document, no position is taken with respect to the existence or validity of any third party patent rights in connection therewith. The SAE is not responsible for identifying patents for which a license may be required.

5. NETWORK DESCRIPTION

5.1 PLC Network

Figure 1 shows a typical PLC network. A typical network consists of Electronic Control Units (ECU) with, PLC transceivers, mounted on the tractor and trailer(s). These ECUs communicate to each other by sending Radio Frequency (RF) signals over the power line. These ECUs interface to the power line through a PLC transceiver.

The tractor PLC ECU must provide control for the Trailer ABS Indicator Lamp that is mounted in the tractor cab. This can be done by either a direct connection to the lamp, or by providing an appropriate control message (for example, by SAE J1587 or SAE J1939) to another ECU which then controls the lamp.

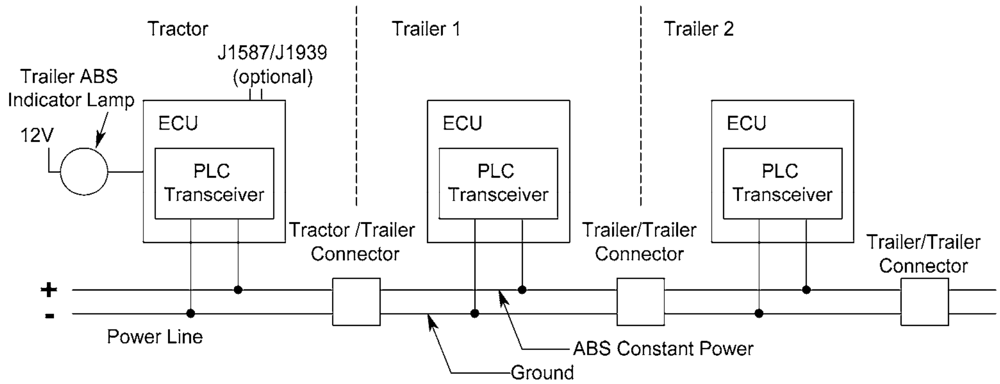


FIGURE 1 - EXAMPLE OF PLC NETWORK

5.2 PLC Transceiver

The microprocessor of an electronic module interfaces to the power line through a PLC transceiver. Refer to Figure 2. The microprocessor sends digital data (Tx) to a coding device in the PLC transceiver. This data is in the format described in SAE J1708. The coding device converts the digital data into a signal suitable for being transmitted on the power line. This signal will be described in later sections. This signal (Signal_out) is then passed through the appropriate amplifier and filters before it is coupled onto the power line. Conversely, a PLC signal (Signal_in) is taken from the power line, filtered, and decoded into digital data (Rx). This data is sent to the host microprocessor in a format defined by SAE J1708.

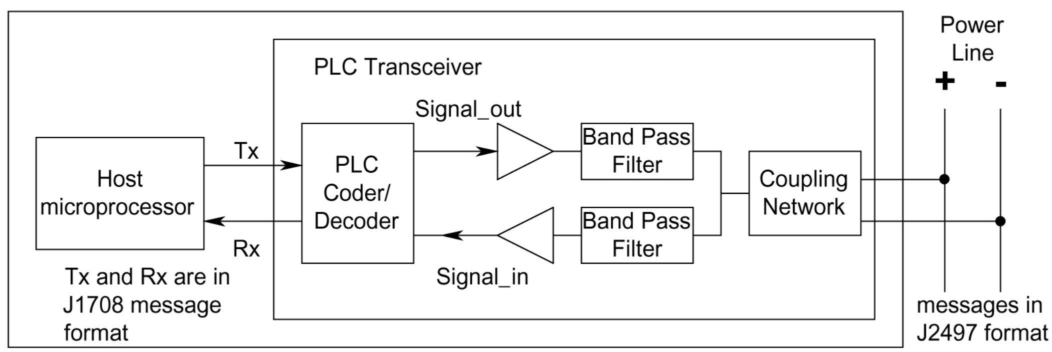


FIGURE 2 - PLC TRANSCEIVER

5.3 Coupling Examples

The PLC transceivers will interface to the power line, relative to the negative line, through the appropriate coupling network. Figure 3 illustrates two possible coupling networks. One provides capacitive coupling and the other provides transformer (inductive) coupling of the PLC signals onto the power line.

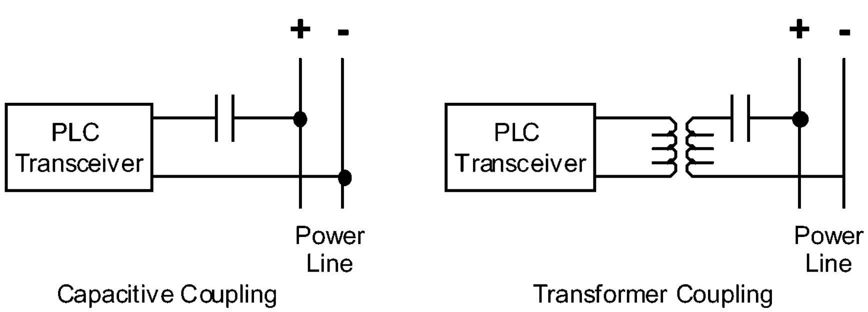


FIGURE 3 - POWER LINE COUPLING TECHNIQUES

6. POWER LINE MESSAGE

The message sent on the power line has two major parts, the preamble and the data body. Refer to Figures C1 and C2 in Appendix C for following descriptions.

6.1 Message Format Between Host Microcontroller and PLC Transceiver

The communications between the host microcontroller and the PLC transceiver follows the SAE J1708 message format. The only exception to SAE J1708 message format is the character gap between the first and second characters. The host microcontroller must wait 2 bit times after receiving the stop bit of the first character echoed back to the microcontroller before sending the second character. Refer to Figure C1 in Appendix C.

6.2 Message Format on the Power Line

The format of the message that is placed on the power line is as follows.

Message:		
Preamble:		
Initial Symbol(s)	Less than 2 symbols	
Start bit	1	Logic low, SUPERIORθ2 symbol
Data bits	8	Either Superior or Inferior symbol
Stop bit	1	Logic high, Inferior symbol
Data Body:		
Sync:	5	Logic high, SUPERIORθ1 symbol
Each data character:		
Start bit	1	Logic low, SUPERIORθ2 symbol
Data bits	8	Either superior symbol
Stop bit	1	Logic high, SUPERIORθ1 symbol
Character Gap	0 – 4	symbol times
End of message	5	Logic high, SUPERIORθ1 symbol

A symbol is the signal, encoded on the power line, that is the representation of a binary state. The symbols will be discussed in more detail in subsequent sections.

The preamble is created by the PLC transceiver and uses the first character it receives, of the message to be sent, from the host microcontroller (i.e., the MID). After the preamble, the transceiver retransmits the first data character again in the data body. The host microcontroller SHOULD NOT resend the first data character again to the PLC transceiver.

6.2.1 Preamble format

Refer to Figure C1 in Appendix C. The preamble starts with less than two complete initial SUPERIORθ2 symbols. The initial symbol(s) are followed by a start bit, 8 data bits, and 1 stop bits. The start bit is a SUPERIORθ2 symbol and the stop bit is an Inferior symbol. The data bits are either symbol.

6.2.2 Data Body Format

A sync segment follows the preamble. This sync segment consists of 5 SUPERIORθ1 symbols.

Following the sync segment is the first data character. Data characters consist of a start bit, followed by 8 data bits, and 1 stop bit. These data characters in the data body are the same characters from the SAE J1708 message sent to the PLC transceiver by the host microcontroller. The start bit is represented by a SUPERIORθ2 symbol, and a stop bit is represented by a SUPERIORθ1 symbol. The data bits can be either symbol.

The data characters are separated by character gaps of zero to four SUPERIORθ1 symbols. The character gaps are required because the bit time (symbol time) of the message on the power line is different than the bit time of the message sent between the host microprocessor and the power line transceiver.

The end of the message is terminated with five consecutive SUPERIORθ1 symbols (logic highs) after the stop bit of the last (nth) character. Refer to Figure C2 of Appendix C.

6.3 Message Encoding

The preamble and data body are encoded onto the power line using different modulation techniques.

6.3.1 Preamble Encoding

The preamble is encoded onto the power line using “Amplitude Shift Key” modulation (ASK). A logic “0” is encoded using a particular waveform. This waveform is a logic symbol known as a Superior State Phase 2 or SUPERIORθ2. The characteristic of this waveform is described in a later section. The logic “1” is encoded by the absence of any signal. This logic symbol is known as an Inferior state. These symbols are illustrated in Figure 4.

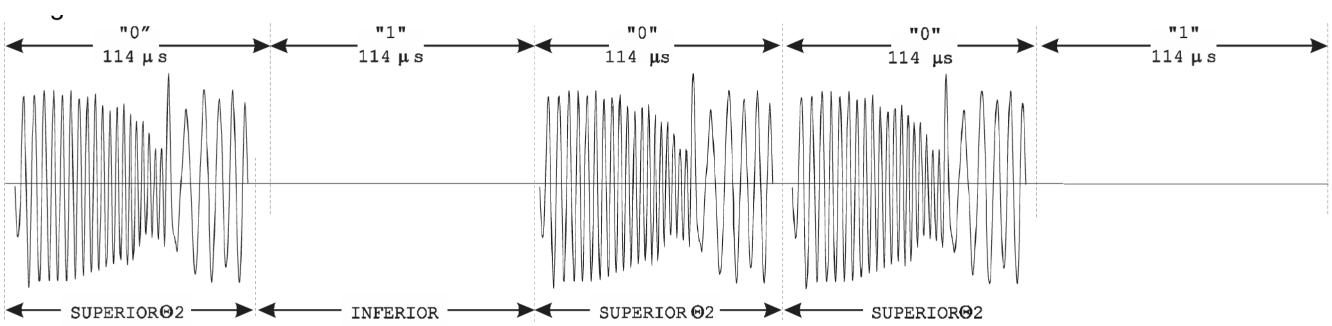


FIGURE 4 - EXAMPLE OF PREAMBLE LOGIC SYMBOL ENCODING

The bit time during the preamble is 114 μs, whereas the time of the SUPERIORθ2 symbol is 100 μs. There are 14 μs of idle time between two consecutive SUPERIORθ2 symbols. This extra idle time increases the ability to detect the preamble.

6.3.2 Data Body Encoding

The data body is encoded onto the power line using “Non Return to Zero” (NRZ) “Phase Reversal Keying” (PRK) Modulation. There are two signals used to encode binary logic symbols “1” and “0”. Both are superior state. The signal for a logic “1” symbol is known as “Superior State Phase 1” or SUPERIORθ1. The signal for a logic “0” symbol is known as “Superior State Phase 2” or SUPERIORθ2. The signal for a SUPERIORθ2 has the same function as SUPERIORθ1 except it differs in phase by 180 degrees (SUPERIORθ2 = -SUPERIORθ1). Examples of these symbols are shown in Figure 5. The SUPERIORθ2 symbol is the same symbol used in the coding of the logic “0” in the preamble. The characteristics of these waveforms are described in a later section.

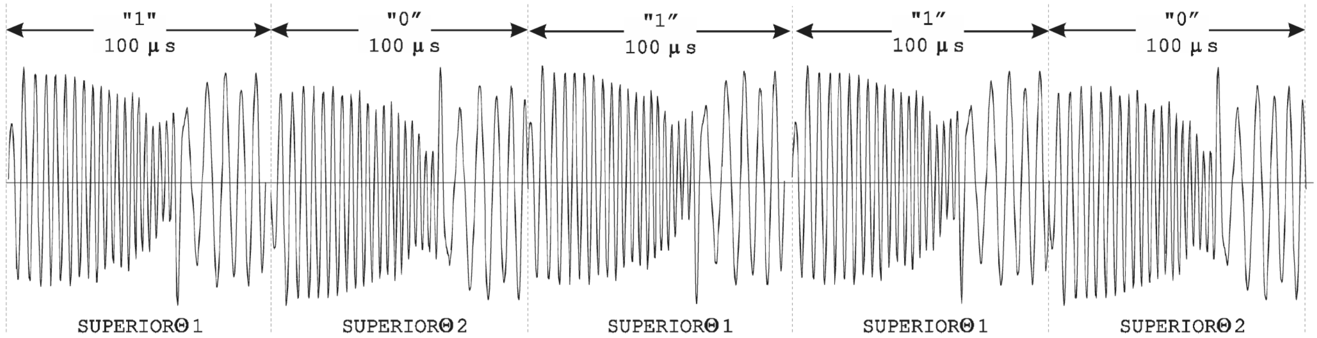


FIGURE 5 - EXAMPLE OF DATA BODY LOGIC SYMBOL ENCODING

6.4 Message Timing

Message between host microprocessor and PLC Transceiver:
Bit time is 104 µs (9600 bits per second).
Message sent on power line:
Bit time of preamble is 114 µs (8772 bits per second).
Bit time of data body is 100 µs (10 000 bits per second).
Symbol time is 100 µs.

The tolerance is ±0.5% over the operating temperature and humidity range of the PLC transceiver.

6.5 Contention Resolution

The preamble is used to resolve contention between two messages transmitted simultaneously.

The ASK encoding method provides the means of arbitration. One preamble will have signal (SUPERIORθ2) in a bit location that the contending preamble has no signal (INFERIOR). Thus, the SUPERIORθ2 symbol will overwrite the INFERIOR symbol.

Refer to Figure C1 of Appendix C. As each transceiver sends out its preamble, it observes the preamble on the power line. When one transceiver detects a SUPERIORθ2 symbol in the bit location where there should be an INFERIOR symbol, it will immediately stop transmitting and place itself in the receiver mode so as not to corrupt the preamble of the dominant message. When in the receive mode, the output of the transceiver is placed in tri-state so as not to load the line and block the incoming signal.

The received preamble is echoed back to the host microcontroller so it will know that it has lost arbitration and not to continue sending the remainder of its message.

NOTE: The delay in the first character echoed back to the host microcontroller from the PLC transceiver is considerably larger than the delay typically found in SAE J1708 communications. This is due to the PLC preamble decoding process.

7. TRANSMITTER CHARACTERISTICS

The transmitter shall be a differential driver capable of driving the specified carrier waveform on the PL network. The following sections detail the transmitter requirements for generating the SUPERIOR (either phase) and INFERIOR states on the power line network.

7.1 Waveform Generation

The AC output voltage generated during either SUPERIOR state shall be a swept sine wave. Figure 6 shows the waveform for a SUPERIOR state. The signal shall be impressed upon the DC power line voltage. The waveform can be approximately described as beginning at the 0° point at 203 kHz and linearly sweep in frequency versus time to a frequency of 400 kHz in 63 µs (19 full cycles), then linearly sweep to 100 kHz in 4 µs (1 full cycle), and then linearly sweep to 203 kHz in 33 µs (5 full cycles). The resultant waveform is thus 100 µs ± 100 ns ending at the 0 degree point after 25 cycles. The carrier may begin with either a positive or negative going phase. The shape and relative amplitude of the waveform over time is a complex function designed to reduce out-of-band radiated interference from the carrier. The exact specification for the waveform is given as a table in Appendix A.

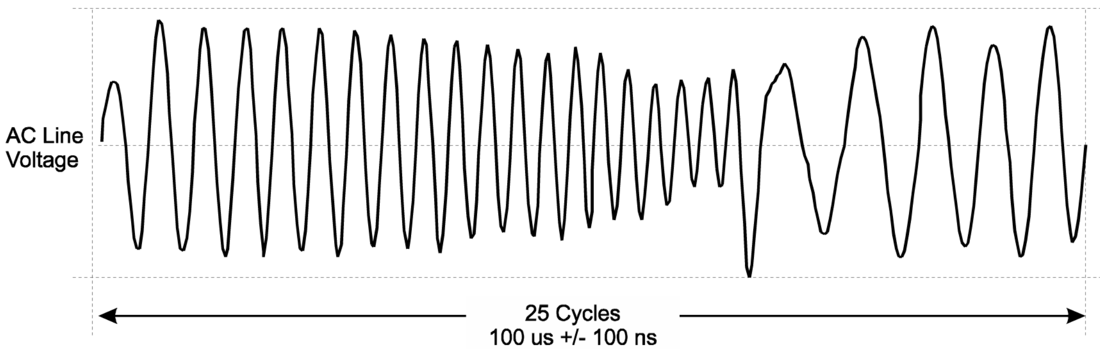


FIGURE 6 - FREQUENCY SWEPT CARRIER WAVEFORM

The only difference between the waveform of SUPERIORθ1 and SUPERIORθ2 is that they are 180 degrees out of phase (SUPERIORθ1 = - SUPERIORθ2). The phase difference depends upon the specific design and is automatically sensed by the PLC transceiver.

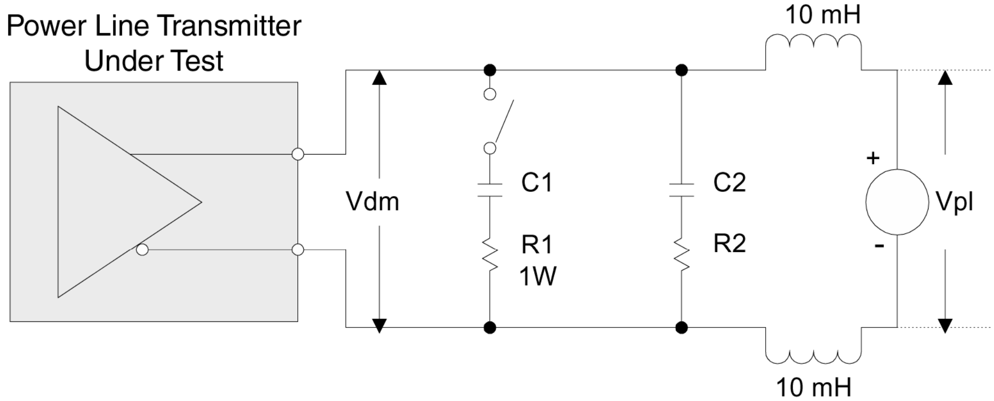
7.2 Amplitude

The amplitude of the carrier output voltage during either SUPERIOR state, into the test load shown in Figure 7 at the power line connector of the device, shall be between the minimum and maximum output levels given in the following table. The output voltage is measured between adjacent waveform peaks developing the highest differential amplitude. These output levels will be met over the load range represented by the switched load conditions of the test circuit. See Table 1.

TABLE 1 - OUTPUT VOLTAGE

Minimum	Maximum	Load Range
2.5 Vpp	7 Vpp	10 Ω - 2 kΩ

To ensure proper reception and minimum out of band interference, the normalized envelope shape of the transmitted swept carrier will match the envelope shape of the waveform of Table A1 in Appendix A to within ±10% measured while driving the test circuit of Figure 7, with the switch in the closed position.



Switch closed: Minimum network impedance from 100-400 kHz
Switch open: Maximum network impedance from 100-400 kHz

C1	R1	C2	R2	V_{PL}
5µF ESR ≤ 1 Ω	10Ω	15nF	2kΩ	12 Vdc

C1 should have equivalent series resistance less than 1 ohm.

Note: The intent is to present a nearly real load to the PLC transceiver. C1 and C2 are for AC coupling of R1 and R2 respectively. Their impedance and ESR must be much less than R1and R2 respectively within reasonable component characteristics.

FIGURE 7 - OUTPUT DRIVER TEST CIRCUIT

The 10 mH inductors must have a self resonance much greater than the PLC band (>400 kHz) and saturation and maximum current limits above DC current levels used by the PLC Transceiver or devices connected in parallel with the PLC Transceiver.

7.3 SUPERIORθ1 to SUPERIORθ2 Transition

During the output transition from the end of one SUPERIOR state to the beginning of another SUPERIOR state of the opposite phase, the waveform amplitude ±2 intervals (Table A1 in Appendix A) about the transition point may assume any value necessary to implement the phase reversal (less than the maximum waveform amplitude allowed during this interval) provided the out-of-band signal level requirements of 7.4 are met.

7.4 Conducted Emissions Limit

The PLC signal must be considered when testing for the Electro-Magnetic Compatibility. The emissions from the PLC transmitters will exceed recommended limits in the PLC frequency range. Therefore, exceptions to the limits must be made for the PLC frequency range.

The appropriate tests to consider for measuring electromagnetic emissions are defined in CISPR 25 except Section 5, Annexes B, C, D, and H.

NOTE: (Informative):

The output signal within the 100 to 400 kHz frequency range, when measured at the Artificial Network port, can exceed +105 dBuV (typically less than 120 dBuV ($1V_{RMS}$)). Thus, if the analyzer reference level is set to a value of 80 dBuV (or less) to obtain good measurement accuracy, the 105 dBuV SSC signals will create intermodulation products in the front end of the spectrum analyzer. These intermodulation products will adversely affect the readings in the band of interest, although they might be outside the sweep range of the analyzer. High pass filters should be used at the analyzer input as follows:

- To observe the PLC signal spectrum, the spectrum analyzer reference level should be set to 120 dBuV and a 10 kHz hgh pass filter should be used at the analyzer input.

- To measure out-of-band signals in higher frequency ranges, the analyzer reference level should be set to 80 dBuV and a 450 kHz, 7 to 10 pole high pass filter should be used to avoid spectrum analyzer input overload protection.

Do not rely on the spectrum analyzer's overload indicator. Intermodulation products are produced in most analyzers well before this indicator becomes active.

7.5 ECU Isolation

The PLC transceiver essentially connects in parallel to the power supply of the ECU into which the transceiver is integrated. Some component configurations in the power supply may cause attenuation and distortion, which may lead to conducted emissions exceeding the recommended limits. Examples of ECU and PLC isolation are shown in Appendix B.

8. RECEIVER CHARACTERISTICS

The PLC receiver must detect the two valid swept frequency carrier unit symbol state waveforms of SUPERIORθ1 and SUPERIORθ2. Detection is assumed to occur, for specification description purposes, by correlating the received waveform with an internal model of the waveform. This process requires that reporting of a valid medium state occur only after the complete state (100 μs) has been received.

8.1 SUPERIOR States Recognition

Unit SUPERIOR state symbol recognition (of either phase) will occur when the received swept frequency carrier signal level is ≥5.0 mV p-p and <7.0 V p-p, at the power line connector of the device, in the band from 100 to 400 kHz and the transmitted swept carrier waveform meets the relative amplitude and waveform timing requirements given in Section 7.

The received message error rate (one or more errors occurring within the message) will not exceed 0.1% (with no retries) when the swept carrier waveform is received with a signal level in the range of ≥5.0 mV p-p and <7.0 V p-p without any interfering signals or signal impairments, measured using a minimum of 1000 messages of data with a message length of five bytes. In addition, the received packet error rate will not exceed:

2% when the swept carrier waveform is received in the presence of a constant carrier interfering signal occupying any single frequency from 20 kHz to 1 MHz producing a signal-to-interfering noise ratio of 3.0 dB at the receiver terminals.

2% when the swept carrier waveform is received in the presence of broadband noise producing a signal-to-interfering noise ratio of 3.0 dB at the receiver terminal.

NOTE: (Informative):

The PLC for trucks technology is more sensitive to constant carrier interference than to broadband interference at a similar signal to noise ratio, so it is likely that designs meeting the former requirements will comply with the later. Testing with both types of interfering signals will be needed to ensure that interference will not degrade communication in the vehicle.

2% when the swept carrier waveform is received at the minimum level of 5 mV p-p, where not impaired, in the presence of a band stop filter impairment between the signal source and the receiver with a 10.0 db attenuation in the stop band, having a Q of 5, with center frequency placed at any point between 100 and 400 kHz.

9. SOFTWARE FUNCTIONS

The protocol of the messages communicated on the PLC network is that which is described in the SAE J1708.

9.1 Cab Mounted Trailer ABS Malfunction Indicator Lamp Control

The physical control of the cab mounted Trailer ABS Indicator Lamp is made by a device within the towing vehicle. An example of this device is the Tractor ABS ECU. The logical control of the cab mounted Trailer ABS Indicator Lamp is made by a device mounted on the Trailer. An example of this device is the Trailer ABS ECU.

9.1.1 Trailer Device Control Functions

The trailer mounted device performs the logical control of the cab mounted trailer ABS Indicator Lamp by sending the appropriate control message over the power line to the tractor mounted control device. The trailer device shall send either of these messages every 500 ms.

9.1.1.1 Lamp On Command

The message to command the lamp “ON” starts with message identifier (MID) 10. This message is defined in Section 10.

9.1.1.2 Lamp Off Command

The message to command the lamp “OFF” starts with message identifier (MID) 11. This message is defined in Section 10.

9.1.1.3 Power up (Bulb Check)

When power is applied and the trailer ABS device becomes active, if the lamp is not to be turned on (no faults), the trailer device has the option to send one or more initial “ON” command(s) for a bulb check. Otherwise, it shall send the “OFF” commands (Example 2.8 in Figure 8).

9.1.2 Tractor Device Control Functions

The device in the tractor, that physically controls the cab mounted Trailer ABS Indicator Lamp, shall activate the lamp as indicated in the following.

9.1.2.1 Lamp On Function

When the tractor device receives an “ON” message, from the power line, it shall turn on the Lamp for 2.5 +0.5/-0 s (Example 2.1 in Figure 8). In the event of multiple trailers sending conflicting control messages, the “ON” message has priority (Example 2.2 in Figure 8).

9.1.2.2 Lamp Off Function

When the tractor device receives an "OFF" message, over the power line, it shall turn the lamp off 2.5 +0.5/-0 s after the receipt of the last "ON" message (Examples 2.3 through 2.5 in Figure 8).

When the tractor device no longer receives "ON" or "OFF" messages, from the power line, it shall turn off the lamp 10 seconds after the receipt of the last "ON" message (Example 2.6 in Figure 8).

9.1.2.3 Power on (Bulb Check)

When the ignition becomes active and the first control message that the tractor device receives within 3 s is an "OFF", then the tractor device will turn on the lamp for 2.5 +0.5/-0 s or longer if an "ON" message is received (Examples 2.7 and 2.8 in Figure 8). If an "ON" message is received during this time, the tractor device will then control according to the preceding sections.

If no lamp control messages are received, then the tractor device will not perform a bulb check (Example 2.9 in Figure 8).

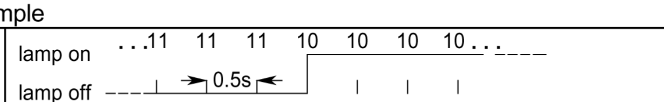
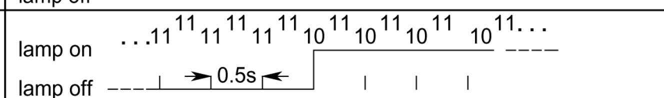
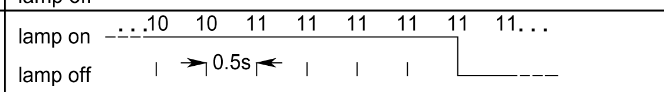
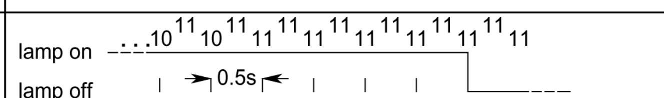
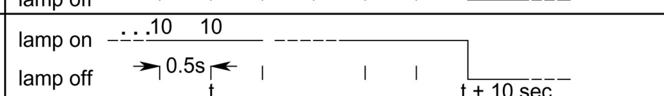
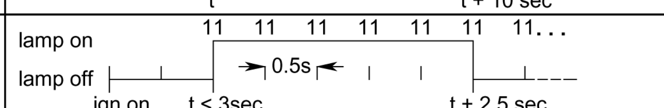
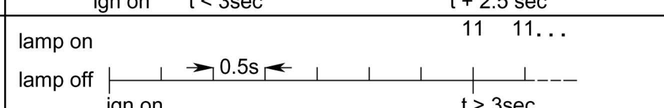
Example		Comments
2.1		Lamp on when ON message received (MID 10)
2.2		Lamp on with multiple trailers (dollies) and ON message received
2.3		Lamp off 2.5 seconds after last ON message sent. OFF messages sent.
2.4		Lamp off, multiple trailers
2.5		Lamp off with multiple trailers and ON message from one trailer no longer received.
2.6		Lamp off 10 seconds after loss of messages
2.7		Bulb check performed when OFF messages detected within 3 seconds of ignition activation.
2.8		Bulb check **NOT** performed when OFF messages are detected after 3 seconds of ignition activation.
2.9		Lamp not to be activated with no control messages available.

FIGURE 8 - CONTROL OF CAB MOUNTED TRAILER ABS INDICATOR LAMP BY TRACTOR DEVICE

9.1.3 SAE J1587 Indicator Lamp Control

The tractor PLC unit will send a message onto the SAE J1587 bus to indicate the control status of the Trailer ABS Indicator Lamp. This message is to facilitate control of a Trailer ABS Indicator lamp that is mounted in an electronic instrument panel with no dedicated control input. The Parameter Identifier (PID) for the control of this lamp is defined in SAE J1587 by PID 49 ABS Control Status.

9.1.4 SAE J1939 Indicator Lamp Control

The tractor PLC unit will send a message onto the SAE J1939 bus to indicate the control status of the Trailer ABS Indicator Lamp. This message is to facilitate control of Trailer ABS Indicator lamp that is mounted in an electronic instrument panel with no dedicated control input. The Parameter Group Number (PGN) for the control of this lamp is defined in SAE J1939 by PGN 61441 Electronic Brake Control 1 (EBC1).

10. PLC NETWORK MESSAGE FORMAT DEFINITIONS

The definitions of the PLC network messages, which are not described in the SAE J1708 and SAE J1587, are described in this section.

10.1 Trailer ABS Indicator Lamp ON (MID10)

Message Identifier (MID) 10d
- DATA = 00d
- Update rate = 500ms

The purpose of the message identifier is to command tractor mounted Trailer ABS Indicator Lamp to be ON.

10.2 Trailer ABS Indicator Lamp OFF (MID 11)

Message Identifier (MID) 11d

- DATA = 255d
- Update rate = 500 ms

The purpose of the message identifier is to command tractor mounted Trailer ABS Indicator Lamp to be OFF.

10.3 Trailer ABS Active (MID 87)

Message Identifier (MID) 87d

Format: MID / data / checksum
- Data = 255d
- Update rate = 500 ms and when ABS is first active.

State signal which indicates that the ABS in the trailer is actively controlling an ABS event. This information is used in the tractor vehicle dynamic control system for calculating trailer dynamics.

This message is to be sent on change to ABS active state and continued to be broadcast with an update rate of 500 ms while in the active state. To indicate that this message is supported by the trailer ECU, this message is transmitted, with an update rate of 500 ms, during the first 2.5 s following the application of power and vehicle motion is not detected.

11. PLC NETWORK MESSAGE FORMAT DEFINITIONS UNIQUE TO SAE J2497

Historically, communication message assignments were assumed to be identical for SAE J1587 and SAE J2497. Due to industry needs, there are reasons to apply a separate MID level for SAE J2497 as MIDs are nearly used up in SAE J1587 and there is a need for additional MIDs to support dynamic addressing in SAE J2497.

11.1 Dynamic Claim to a Unique SAE J2497 MID

11.1.1 Background

This method assumes that there is no current industry need for dynamic MID addressing for similar devices on a single SAE J1708/SAE J1587 network. It is only needed for same devices on the SAE J2497 network, resident on multiple trailers. Also, it assumes the ECU has the ability to choose from a set of pre-defined MID numbers.

For proper bus access, devices communicating on the same data bus are required to have unique message identifiers (MID) (Refer to SAE J1708, Section 6.3.3.1). Because of power line communications (PLC – SAE J2497), trailer devices of the same type (e.g., ABS ECUs) can now communicate on the same data bus (The power line). Even though SAE J1587 defines different MIDs for devices of the same type (example: Brakes MID 137, 138, 139, 246, and 247), there is no standard way of dynamically assigning these MIDs to their devices when communicating on the same power line. Manually configuring MIDs is not a reliable method because trailers are often swapped in tractor / trailer combinations.

NOTE: Today in many cases, diagnostic devices have the issue of trying to communicate with multiple MID 137 devices on the same power line when communicating with multiple trailers connected. In the future, diagnostic devices will have the option to communicate to a single ABS unit using the primary MID 137 or the newly defined set of dynamic MID addresses. SAE recommends that trailer devices communicating on the power line evolve to exclusively using the new dynamic MID assignments as soon as possible.

11.1.2 Priority of MIDs 10, 11 and 87

If the trailer device (ECU) is responsible for sending MID 10, 11 or 87, it should not attempt the dynamic MID function until after it has broadcast these higher priority MIDs at least one time.

11.1.3 Method

11.1.3.1 Power-Up MID Claim

A device powers up and waits the Tsd before sending PID 4 – Dynamic MID Claim for SAE J2497 Gateway Devices using the last claimed MID during the previous power cycle unless it has already detected another ECU using this same MID.

If the ECU does detect another ECU that starts broadcasting using the same MID, the ECU will claim the next unused (not detected) MID of the device set, reset Tsd, and then send PID 4 – Dynamic MID Claim for SAE J2497 Gateway Devices using the new MID. A “Device Set” is defined as a group of MIDs intended to allow multiple devices of the same type to operate on the same data bus (e.g., Brakes, Trailer #1, Brakes Trailer #2, etc.).

11.1.3.2 MID Infringement and Reclaim

At any time during the power cycle, if an ECU that has already claimed a MID detects another ECU that starts broadcasting using the same MID, the first unit will claim the next unused (not detected) MID of the device set, reset Tsd, and then resend PID 4 – Dynamic MID Claim for SAE J2497 Gateway Devices using the new MID. A “Device Set” is defined as a group of MIDs intended to allow multiple devices of the same type to operate on the same data bus; e.g., Brakes, Trailer #1, Brakes Trailer #2, etc.

11.1.3.3 MID Claim Examples

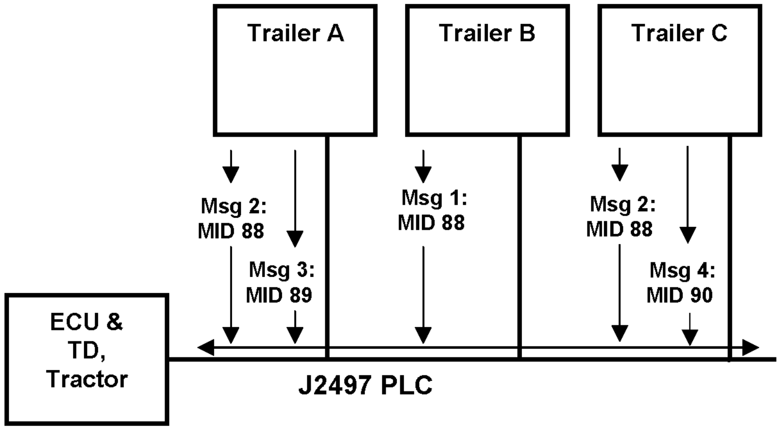


FIGURE 9 - EXAMPLE OF TRAILER DEVICE SET SUPPORTING DYNAMIC ADDRESSING

Sequence of MID Claim messages:

All three trailer ECUs are defaulted for MID 88 and receive power at the same time.

1. Trailer B initiates first and sends PID 4 using MID 88.

2. Trailers A and C see an ECU using MID88 and both units will claim the next unused (not detected) MID of the device set and reset Tsd.

3. Trailer A initiates before Trailer C and sends PID 4 using MID 89.

4. Trailers C sees an ECU using MID89 and then claims the next unused (not detected) MID of the device set, reset Tsd.

5. Trailer C initiates and sends PID 4 using MID 90.

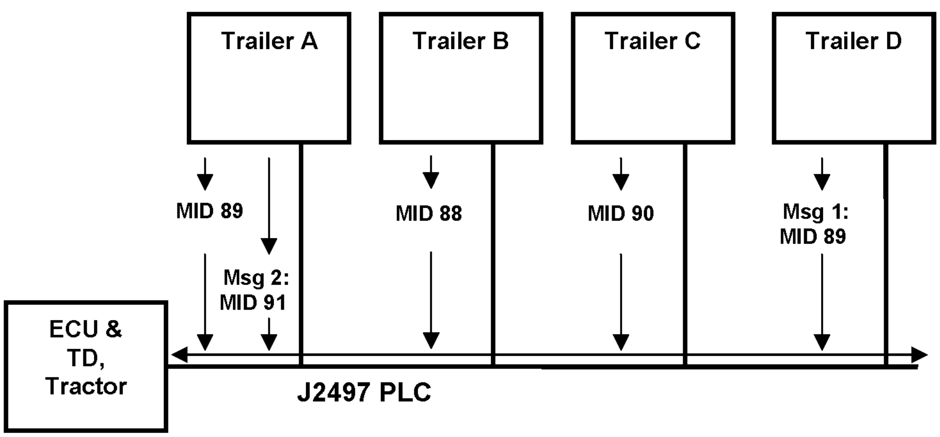


FIGURE 10 - EXAMPLE OF ADDING ECU TO TRAILER DEVICE SET SUPPORTING DYNAMIC ADDRESSING

Sequence of MID Claim messages:

1. Trailer D initiates and sends PID 4 using MID 89. (Last MID claimed during last power cycle.)

2. Trailer A sees an ECU using MID89 claims the next unused (not detected) MID of the device set, resets Tsd, then sends PID 4 using MID 91.

11.1.3.4 Trailer Device Sets without Dynamic Addressing Support

Older devices will not be using MIDs in this range and will not affect the dynamic addressing function.

11.1.4 Start Delay Time

The start delay time (Tsd) is randomly chosen to minimize the probability that two devices try to claim the same MID at power-up or after a new device is introduced to the system. The Tsd should be set to some minimal (< 1 second) non-zero delay. This will allow the bus to stabilize as quickly as possible.

Devices powering up late may be the result of a trailer being connected to an already powered train of trailers, or due to a device intermittently losing power.

11.1.5 Physical Position

MID number does not indicate physical position in a multiple trailer configurations. Using the MID to indicate physical position is not currently possible because there is no standard method to determine position. Note: it is possible for a device to claim the first dynamic MID value when it is actually not in the first trailer position due to variable conditions in the wiring systems between trailers. Devices that associate functions to MIDs need to be aware that the MID can change during power cycles.

11.1.6 MID Retention

The MID used during last power cycle should be retained in device memory. At power up, devices should begin communicating using the claimed MID from the previous power cycle and used throughout the power cycle unless another device is detected using the MID. This will reduce the resulting MID claiming actions between power cycles or during intermittent power-loss.

11.2 SAE J2497 MID Assignments

The SAE J2497 Task Force recommends that MIDs in the range of 88 to 110 be used for dynamic MID assignments. Table 2 summarizes how all MIDs should be assigned in SAE J2497.

TABLE 2 - MESSAGE ID ASSIGNMENT LIST

MID Values	MID Assignment Description
0 to 9, 12 to 86, 111 to 124, and 126 to 127	Reserved for Assignment by SAE J2497 Task Force
10, 11, and 87	PLC Network Messages As Defined in SAE J2497 Section 10
88 to 110	Available for Dynamic MID Assignment
125	PLC Identification
128 to 255	Used in SAE J2497 as Defined in SAE J1587

NOTE: MIDs in the range of 0 to 127 may also be defined in SAE J1708; however, as messages are not shared between SAE J1708/SAE J1587 and SAE J2497 networks, there is no MID definition conflict. If a message is passed from one network to another via a gateway, the MID of the original message should be interpreted according to the network where it was used as the message header.

11.3 Parameter Identification Assignments

Parameter identification characters (PIDs) for use in SAE J2497 are defined in SAE J1587.

11.4 Subsystem Identification Assignments

Subsystem identification numbers (SIDs) for use in SAE J2497 are defined in SAE J1587.

11.5 Failure Mode Identifier Assignments

Failure mode identifiers (FMIs) for use in SAE J2497 are defined in SAE J1587.

12. NOTES

12.1 Marginal Indicia

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 LOW SPEED COMMUNICATIONS NETWORK COMMITTEE

APPENDIX A - SUPERIOR STATE WAVEFORM

A.1 The specification for the waveform during SUPERIOR State is given as a table, below, describing the relative amplitude of the waveform over 360 evenly spaced intervals (over the 100 µs frequency sweep period). The values shown in the table for each point are relative to a maximum of ±0.5 about a 0.0 reference level. The values for the waveform of the opposite phase will be identical except for having the opposite sign.

TABLE A1 - DIGITIZED 100 MS WAVEFORM—360 INTERVALS (361 POINTS)

i	value	i	value	I	Value	I	value	I	value	i	value	I	value
0	0.0000	52	0.4001	104	0.2039	156	-0.2319	208	-0.2202	260	-0.1932	312	-0.1875
1	0.0816	53	0.4082	105	0.3419	157	-0.3436	209	-0.1164	261	-0.2437	313	-0.2684
2	0.1328	54	0.3351	106	0.3867	158	-0.3534	210	0.0251	262	-0.2930	314	-0.3319
3	0.1827	55	0.1916	107	0.3435	159	-0.2372	211	0.1559	263	-0.3328	315	-0.3758
4	0.2149	56	0.0225	108	0.1955	160	-0.0465	212	0.2239	264	-0.3436	316	-0.3865
5	0.2149	57	-0.1517	109	0.0135	161	0.1443	213	0.1887	265	-0.3322	317	-0.3758
6	0.2041	58	-0.3040	110	-0.1777	162	0.2879	214	0.0855	266	-0.2899	318	-0.3192
7	0.1585	59	-0.4053	111	-0.3300	163	0.3224	215	-0.0369	267	-0.2362	319	-0.2377
8	0.0784	60	-0.4295	112	-0.3968	164	0.2392	216	-0.1417	268	-0.1844	320	-0.1300
9	-0.0246	61	-0.3560	113	-0.3592	165	0.0663	217	-0.1717	269	-0.1244	321	-0.0099
10	-0.1479	62	-0.2197	114	-0.2226	166	-0.1424	218	-0.1099	270	-0.0644	322	0.1101
11	-0.2628	63	-0.0397	115	-0.0333	167	-0.2973	219	-0.0006	271	-0.0214	323	0.2087
12	-0.3550	64	0.1511	116	0.1679	168	-0.3643	220	0.1301	272	0.0450	324	0.2857
13	-0.3973	65	0.3067	117	0.3104	169	-0.2894	221	0.2072	273	0.1182	325	0.3330
14	-0.3973	66	0.4053	118	0.3760	170	-0.1157	222	0.2285	274	0.1903	326	0.3542
15	-0.3257	67	0.4140	119	0.3520	171	0.0871	223	0.1508	275	0.2680	327	0.3437
16	-0.2056	68	0.3428	120	0.1970	172	0.2640	224	0.0235	276	0.3330	328	0.3099
17	-0.0533	69	0.2091	121	-0.0002	173	0.3424	225	-0.1019	277	0.3760	329	0.2498
18	0.1161	70	0.0251	122	-0.2097	174	0.2908	226	-0.1727	278	0.3836	330	0.1469
19	0.2619	71	-0.1636	123	-0.3590	175	0.1266	227	-0.1645	279	0.3652	331	0.0447
20	0.3736	72	-0.3028	124	-0.4078	176	-0.0813	228	-0.0615	280	0.3330	332	-0.0806
21	0.4404	73	-0.3971	125	-0.3412	177	-0.2519	229	0.0706	281	0.2849	333	-0.2061
22	0.4301	74	-0.4018	126	-0.1846	178	-0.3221	230	0.1922	282	0.2142	334	-0.3261
23	0.3652	75	-0.3310	127	0.0255	179	-0.2640	231	0.2578	283	0.1541	335	-0.3847
24	0.2442	76	-0.1904	128	0.2122	180	-0.1073	232	0.2122	284	0.0834	336	-0.4295
25	0.0997	77	-0.0173	129	0.3430	181	0.0898	233	0.0815	285	0.0126	337	-0.4197
26	-0.0529	78	0.1690	130	0.3652	182	0.2509	234	-0.1116	286	-0.0842	338	-0.3646
27	-0.2115	79	0.3120	131	0.2746	183	0.3223	235	-0.3090	287	-0.1826	339	-0.2791
28	-0.3218	80	0.4082	132	0.1053	184	0.2717	236	-0.4610	288	-0.2641	340	-0.1586
29	-0.3973	81	0.3867	133	-0.1035	185	0.1194	237	-0.5000	289	-0.3436	341	-0.0362
30	-0.4008	82	0.2915	134	-0.2753	186	-0.0765	238	-0.4600	290	-0.3949	342	0.0839
31	-0.3596	83	0.1316	135	-0.3597	187	-0.2281	239	-0.3383	291	-0.4295	343	0.2039
32	-0.2610	84	-0.0686	136	-0.3426	188	-0.2899	240	-0.1861	292	-0.4295	344	0.2962
33	-0.1148	85	-0.2594	137	-0.2216	189	-0.2405	241	-0.0338	293	-0.4022	345	0.3670
34	0.0648	86	-0.3827	138	-0.0450	190	-0.0906	242	0.0862	294	-0.3514	346	0.4108
35	0.2065	87	-0.4295	139	0.1366	191	0.0855	243	0.1612	295	-0.2821	347	0.4189
36	0.3373	88	-0.3796	140	0.2936	192	0.2163	244	0.1827	296	-0.2006	348	0.3781
37	0.4082	89	-0.2444	141	0.3545	193	0.2578	245	0.2041	297	-0.1202	349	0.3059
38	0.4082	90	-0.0536	142	0.3048	194	0.1963	246	0.2134	298	-0.0269	350	0.1803
39	0.3334	91	0.1479	143	0.1651	195	0.0377	247	0.2363	299	0.0753	351	0.0312
40	0.1922	92	0.3134	144	-0.0235	196	-0.1379	248	0.2471	300	0.1648	352	-0.1211
41	0.0277	93	0.4032	145	-0.1992	197	-0.2578	249	0.2714	301	0.2606	353	-0.2349
42	-0.1524	94	0.3829	146	-0.3111	198	-0.2899	250	0.2793	302	0.3421	354	-0.3321
43	-0.2968	95	0.2805	147	-0.3328	199	-0.2106	251	0.2599	303	0.3960	355	-0.3752
44	-0.3963	96	0.0953	148	-0.2436	200	-0.0608	252	0.2213	304	0.4189	356	-0.3474
45	-0.4295	97	-0.0992	149	-0.0753	201	0.0939	253	0.1613	305	0.4082	357	-0.2874
46	-0.3944	98	-0.2729	150	0.1111	202	0.1929	254	0.1013	306	0.3738	358	-0.1970
47	-0.2861	99	-0.3790	151	0.2669	203	0.2041	255	0.0413	307	0.3008	359	-0.0985
48	-0.1417	100	-0.3865	152	0.3385	204	0.1154	256	-0.0161	308	0.2068	360	0.0000
49	0.0277	101	-0.3174	153	0.2986	205	-0.0262	257	-0.0536	309	0.0975		
50	0.1922	102	-0.1589	154	0.1497	206	-0.1610	258	-0.0858	310	0.0096		
51	0.3230	103	0.0283	155	-0.0441	207	-0.2362	259	-0.1400	311	-0.0981		

APPENDIX B - ECU ISOLATION

B.1 There may be an incompatibility between Electronic Control Units (ECUs) and the PLC signal. Components in an ECU can cause severe attenuation and distortion of the PLC signal, causing poor signal transmission reliability and undesirable emissions outside of the PLC band (100 to 400 KHz). Further, the PLC signal may cause undesirable interference with ECUs. The following is a suggestion for isolating the PLC transceiver output from incompatible components in ECUs.

Incompatible ECU components can be isolated using an inductor of appropriate value. This is illustrated as inductor, L, in Figure B1. The inductor must be chosen to offer sufficient isolating impedance.

Examples of incompatible components are large value capacitors, junction devices such as diodes, or microprocessors. Large value capacitors, such as those found in power supplies (C_S1 and CS_2) attenuate the PLC signal. Reverse blocking diodes (Din) may distort the PLC signal.

Components such as high frequency bypass capacitor (Cin) may not have to be isolated provided their shunting impedance is considerably higher than the power line input impedance.

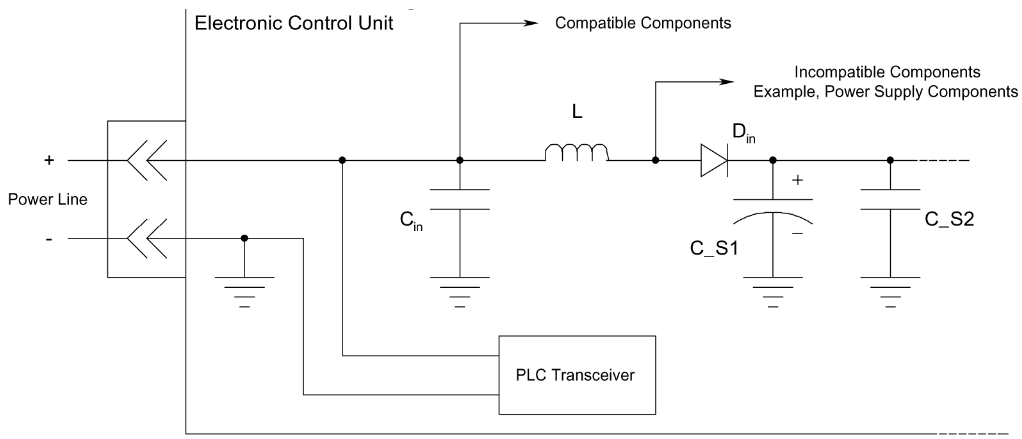


FIGURE B1 - PLC AND ECU ISOLATION

APPENDIX C - TIMING DIAGRAMS

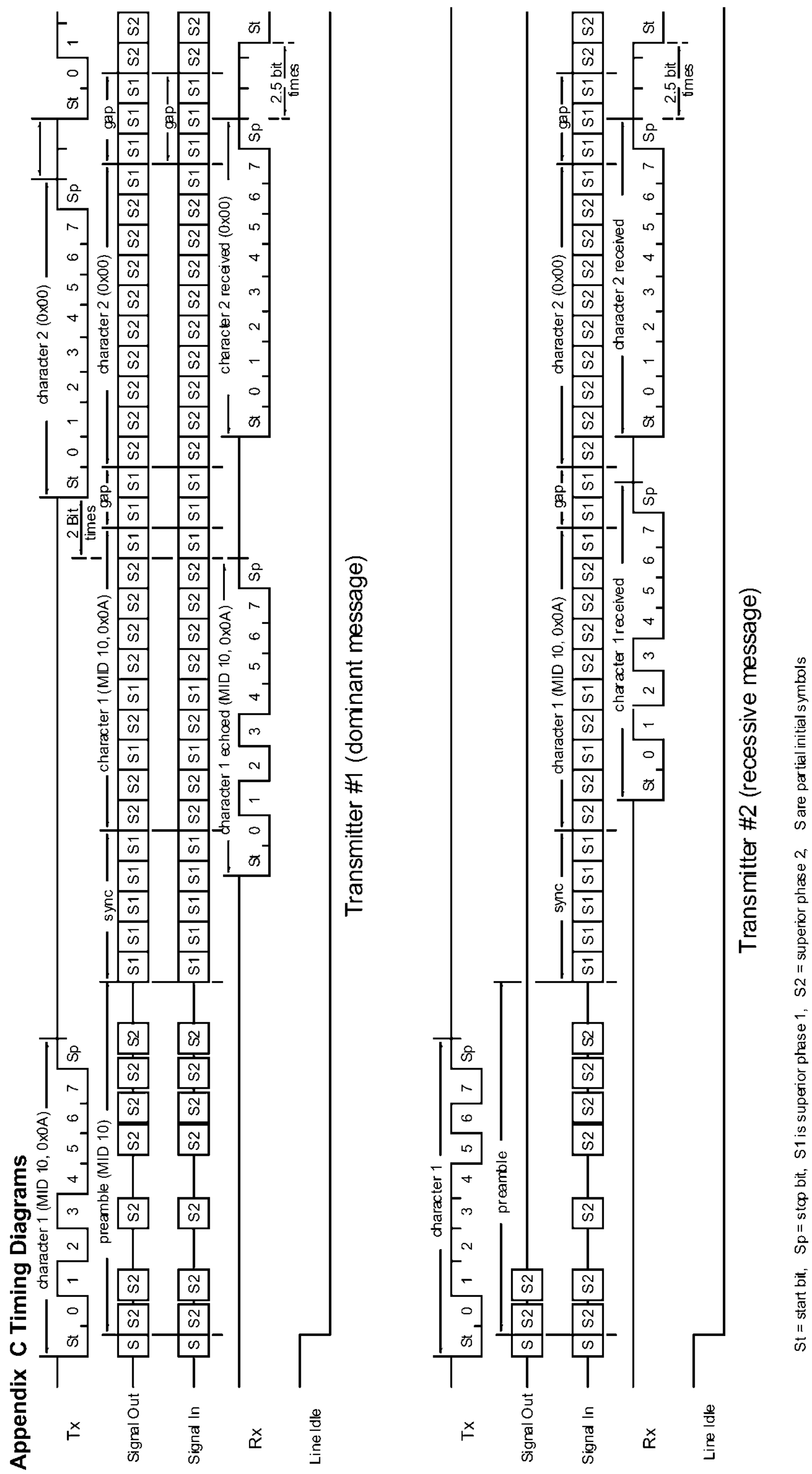


FIGURE C1 - START OF MESSAGE TRANSMISSION TIMING AND CONTENTION ARBITRATION

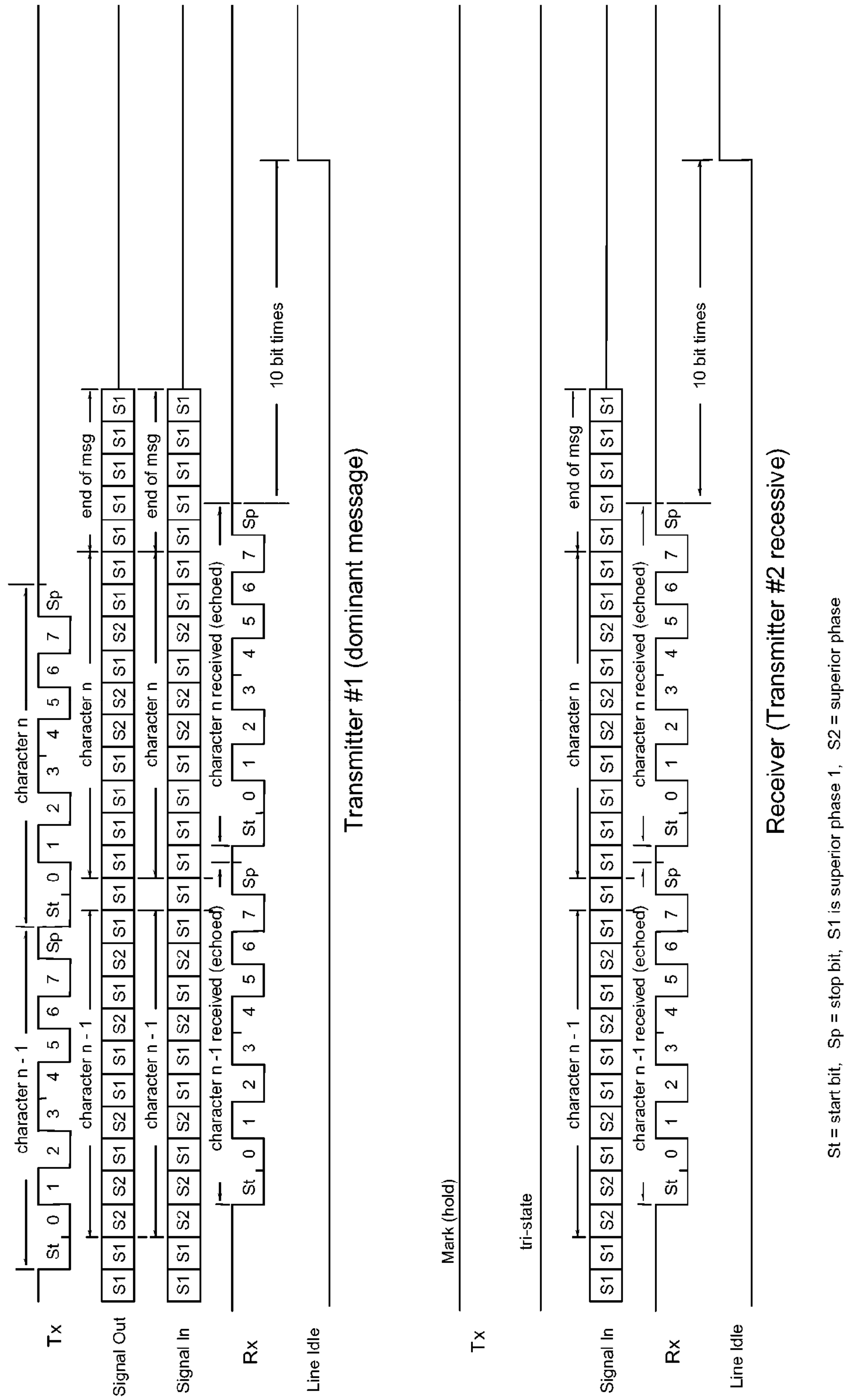


FIGURE C2 - END OF MESSAGE TIMING