

GWY-300
(CAN Gateway)

USER'S MANUAL

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Renu Electronics Pvt. Ltd.
Survey No. 2/6,
Baner Road,
Pune-411045

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This manual is designed to provide the necessary information for trouble-free installation and operation of your new Gateway product. However, if you need assistance, please call Renu Electronics Pvt. Ltd. at 91-20-27292840 or visit our web site at www.renuelectronics.com

MANUAL REVISION

If you contact us in reference to this manual, please include the following document number

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Revision : Revision 2

| Revision Number | Date | Description |
|-----------------|------------|--|
| Preliminary | 29/11/2005 | |
| Revision 0 | 19/01/2006 | Seven Segment Display is replaced with LED and hence corresponding changes are done. |
| Revision 1 | 08/02/2007 | Chapter 6: Diagnostic section is added Appendix: PGN information updated. Troubleshooting section is also added. |
| Revision 2 | 12/12/2011 | System Requirement for Gateway setup software revised. |

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For Rectified Products: Any product that will be replaced will have Warranty for 6 months or upto Original Product Warranty period whichever is greater.

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IMPORTANT

Gateway Products are intended to be Protocol Converters/Data Sharer devices that can also take control actions on request of device being connected. It is assumed that user is well acquainted with the PLC / Inverters / Controllers being used.

Any Mechanical or Electrical Modification to this Unit will void all Warranties.

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INTRODUCTION

In this chapter. . . .

- ◆ Purpose of this manual
- ◆ Introduction To Gateway
- ◆ GWY-300-B Specifications



INTRODUCTION

1.1 Purpose of this manual

Thank you for purchasing GWY-300-B Product from Renu Electronics Pvt. Ltd..

The intention of this User Manual is to provide a guide for Safe installation, Configuration and operation of GWY-300-B. **Functionality of all the Gateway models is same.** Read this User manual thoroughly before installing and operating GWY-300-B,

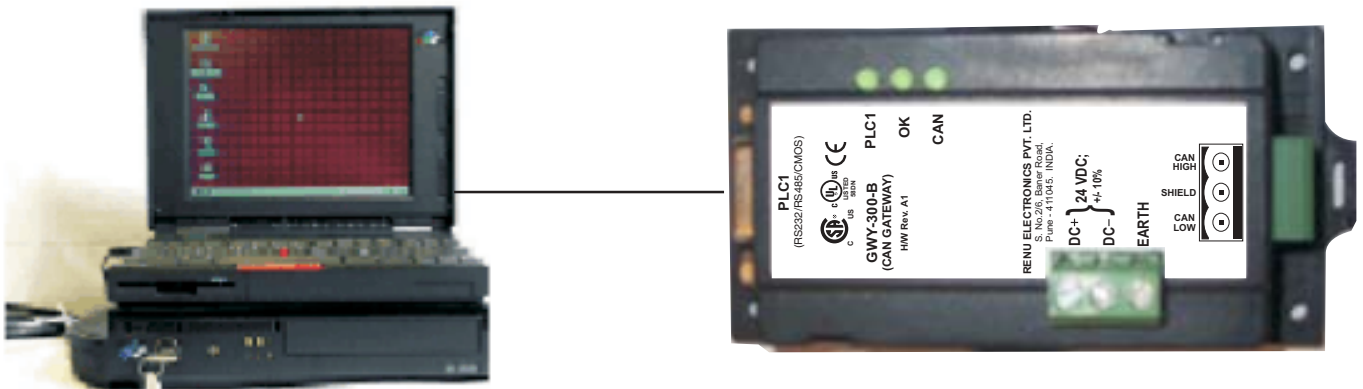
This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information in this document may not cover all the details or variations in hardware or software. Features described herein may not be present in all hardwares. Renu Electronics Pvt. Ltd. reserves the right to update information in this publication without prior notice.

1.2 Introduction to Gateway

Gateway is a Protocol Converter / Data sharer for devices like PLCs, inverters (Adjustable Speed Drives), and other Controllers. Gateway has two serial ports that connect with two different devices. These devices share data through Gateway. Gateway communicates with a device to get the information required by the device connected on the other port. The device that requires data is called Destination Device and the device that provides data is called Source Device. Information could be,

- value of a PLC register.
- status of a PLC coil.
- Command from Source Device to Destination Device to perform any action at the destination end.

Configuration Of Gateway

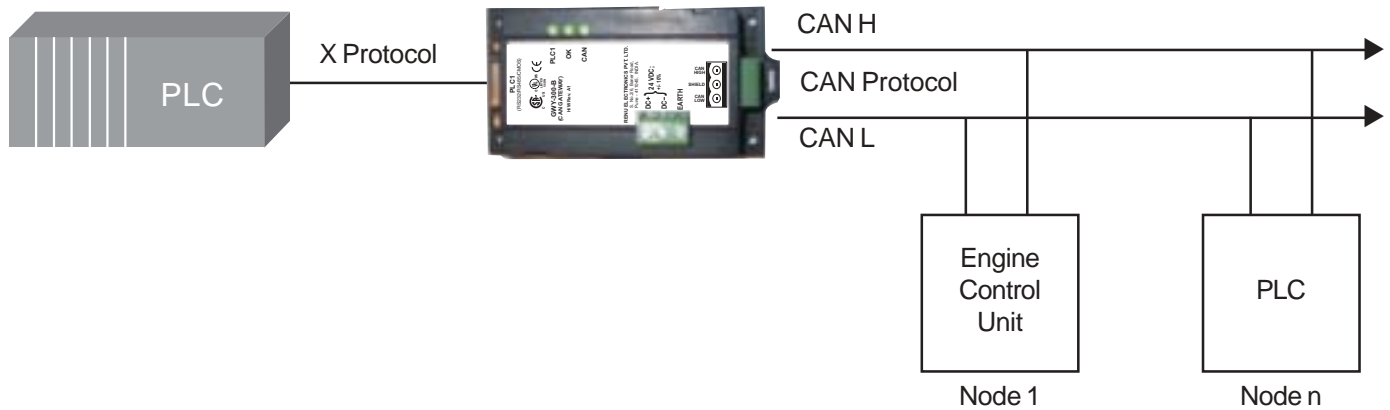


Note: Please refer 'IBM Download' in section 3.4.



Normal Operation:

GWY-300 connects one field device (serial link) to another over CAN BUS. User can define the blocks of registers to be fetched from one device and to be transferred to the other. Our users have used Gateway units in different applications across many industries. The typical configuration includes the following:



INTRODUCTION

1.3 GWY-300-B Specifications

| | | |
|---|---|---|
| Power | : | +24V DC + 10%, 100mA max |
| LED's | : | 3 Bicolour LEDs for status indication. |
| Communication Ports | : | 2 Communication port with |
| COM1 | : | RS232 / RS422 / RS485 / CMOS |
| COM2 | : | CAN-J1939/71 / CANopen Slave |
| (Isolation between communication ports and Power supply, through DC-DC coupler is 1 KV) | | |
| PLC1 / COM1 | : | Connects to PC for setup download or connects to PLC1 at runtime. |
| PLC2 / COM2 | : | Connects to CAN BUS(J1939/71 / CANopen Slave). |
| (Isolation between communication ports, through opto-isolation is 1KV rms for 1 min) | | |
| Operating Temperature | : | 0° to 60°C |
| Storage Temperature | : | -20° to 80°C |
| Humidity | : | 10% to 90% (Non condensing) |
| Mounting | : | DIN rail or back panel mounting |
| Dimensions (DIN rail) | : | 105mm(L) X 40mm(D) X 51mm(W) |
| Weight | : | 125 gm approx. |
| Certifications | : | CE / CSA with UL |
| Immunity to ESD | : | Level 3 as per IEC1000-4-2 |
| Immunity to Transients | : | Level 3 as per IEC1000-4-4 |
| Immunity to Radiated RF | : | Level 3 as per IEC1000-4-3 |
| Immunity to Conducted RF | : | Level 3 as per IEC1000-4-6 |
| Emissions | : | EN55011 CISPR A |



HARDWARE

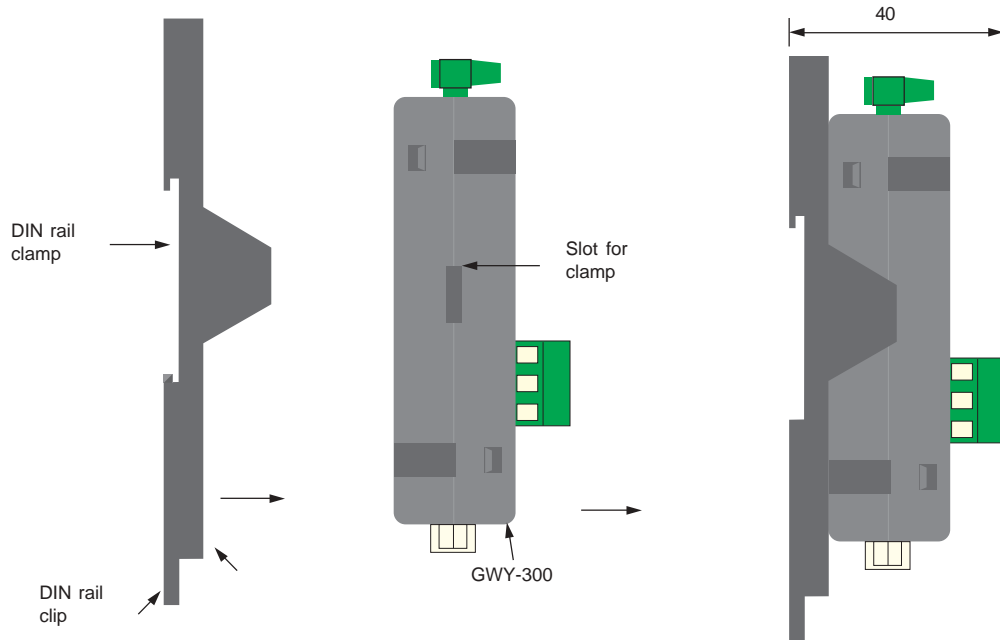
In this chapter. . . .

- ◆ Dimensional Details And Mounting Instructions
- ◆ Communication Port Details
- ◆ LED Status



2.1 Dimensional details And Mounting Instructions

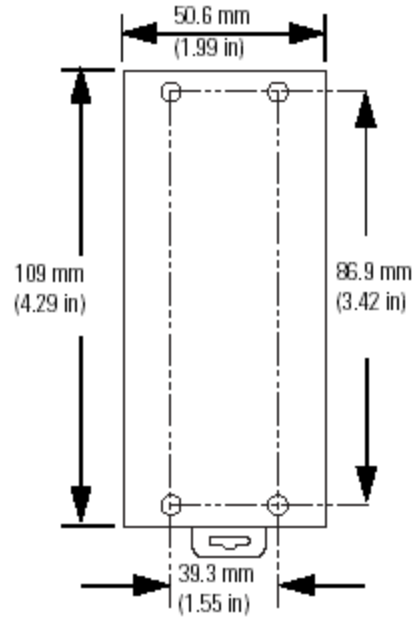
GWY-300 -B unit can be mounted on a back panel or on a DIN rail or can be left hanging. It comes with a separate DIN rail plate when it is packed. User will have to attach the DIN rail plate to the unit if it has to be mounted on a panel or DIN rail. If it has to be left hanging, make sure to screw the cables to the DB9 connectors on the Gateway unit. DIN rail plate also has the provision to screw the unit to the back panel. Following drawing shows how to attach the DIN rail plate to the unit:



Follow instructions given below:

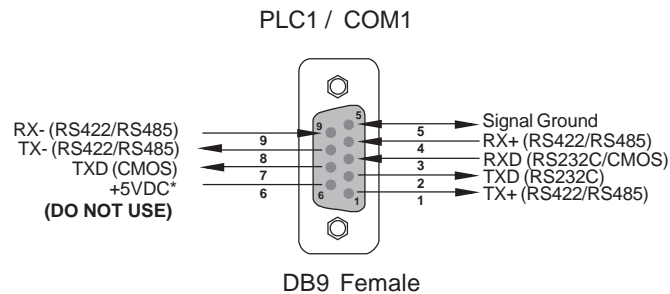
1. Attach the DIN rail plate to the unit using the clamps on the DIN rail plate.
2. Pull out the clip of the plate.
3. Put the unit on the DIN rail.
4. Push the clip in to secure the unit on the DIN rail.

GWY-300-B unit is shipped with a separate DIN rail plate which has to be attached to the unit, if needed. User can use the unit with or without the DIN rail plate. Following sketch shows mounting details of GWY-300-B with the DIN rail plate.



2.2 Communication Port Details

Gwy-300-B has two communication ports COM1 and COM2. COM1 port is compatible to RS232/ RS422/ RS485 and other is CAN communication port (COM2). Pinout of these ports are as shown below:



*Do not use pin no. 6 of PLC1 / COM1.

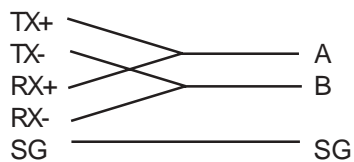
**Refer our website (www.renuelectronics.com) for your specific Cable requirements

HARDWARE

Pin Description

| Pin | Name | Signal Level | Description |
|-----|-------|---------------|---|
| 1. | TX+ | RS422 / RS485 | Differential Transmit +, also referred as TXA |
| 2. | TXD | RS232 | Transmit |
| 3. | RXD | RS232 / CMOS | Receive |
| 4. | RX+ | RS422 / RS485 | Differential Receive +, also referred as RXA |
| 5. | GND | - | Signal Ground common to all signals. |
| 6. | +5VDC | - | DO NOT USE |
| 7. | TXD | CMOS | Transmit |
| 8. | TX- | RS422 / RS485 | Differential Transmit -, also referred as TXB |
| 9. | RX- | RS422 / RS485 | Differential Receive -, also referred as RXB |

User can convert RS485 4 wire + Signal Ground system to a 2 Wire + Signal Ground system by shorting following signals in the communication cable:

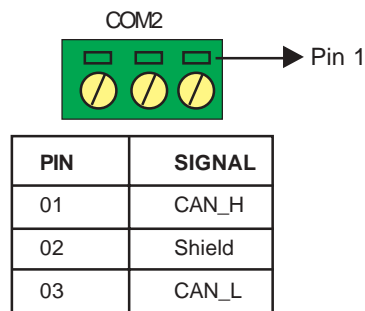


Note: If user has attached shield to Earth on Device end, leave the shield open on Gateway end. If user has connected shield to Signal Ground on Device end, connect shield to Signal Ground on Gateway end.

A and B are polarity insensitive. Twisted pair cable should be used for Rs485 Network.

Upto 31 Devices can be multi-dropped on RS485 port of Gateway.

Port Details for COM2



2.3 LED Status

There are 3 LEDs for status indication.

Bicolour LEDs status:

| LED | | | |
|------|-------|----------|--|
| OK | Green | OFF | No Firmware |
| | | Flashing | IBM Download |
| | | ON | Both side (COM1 and COM2) communication OK |
| | Red | OFF | Configuration Ok |
| | | ON | Configuration Fault |
| | | | |
| PLC1 | Green | OFF | No data received on PLC1 Port |
| | | Flashing | Receiving data on PLC1 Port |
| | | ON | - |
| | Red | OFF | No error in PLC1 attach or while block execution |
| | | Flashing | PLC1 attach error or error while block execution |
| | | ON | - |
| CAN | Green | OFF | No data received on CAN Port |
| | | Flashing | Receiving data on CAN Port |
| | | ON | - |
| | Red | OFF | - |
| | | Flashing | - |
| | | ON | - |

GETTING STARTED

In this chapter. . . .

- ◆ Introduction To CAN(J1939)
- ◆ Introduction To GWY-300-B
- ◆ GWY-300-B Operation



3.1 Introduction To CAN

The Controller Area Network (CAN) is a serial bus system, was defined in the late 1980 by Bosch, especially suited for networking 'intelligent' devices as well as sensors and actuators within a system or sub-system. CAN consists of 3 layers, Physical Layer, Data link Layer and Application Layer.

It has the following characteristics:

- Uses a single terminated twisted pair cable
- Is multi master
- Maximum Signal frequency used is 1 Mbit/sec
- Length is typically 40M at 1Mbit/sec up to 1KM at lower speed
- Has high reliability with extensive error checking

CAN is unusual in that the entities on the network, called nodes, are not given specific addresses. When data are transmitted by CAN, no stations are addressed, but instead the content of the message (e.g. rpm or engine temperature) is designated by an identifier that is unique throughout the network. Identifier not only defines the content but also determines the messages' priority.

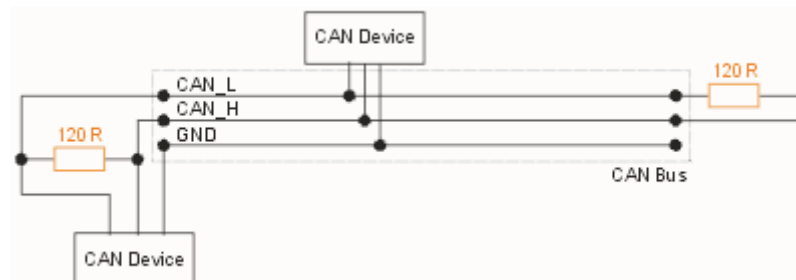
CAN Serial Bus

CAN is a serial bus system with multi-master capabilities, that is, all CAN nodes are able to transmit data and several CAN nodes can request the bus simultaneously. The serial bus system with real-time capabilities is the subject of the ISO 11898 international standard and covers the lowest two layers of the ISO/OSI reference model. In CAN networks there is no addressing of subscribers or stations in the conventional sense, but instead, prioritized messages are transmitted. A transmitter sends a message to all CAN nodes (broadcasting). Each node decides on the basis of the identifier received whether it should process the message or not. The identifier also determines the priority that the message enjoys in competition for bus access.

Signal Characteristics

CAN may be implemented over a number of physical media so long as the drivers are open-collector and each node can hear itself and others while transmitting (this is necessary for its message priority and error handling mechanisms). The most common media is a twisted pair 5v differential signal which will allow operations in high noise environments.

When running Full CAN (ISO 11898-2) at its higher speeds it is necessary to terminate the bus at both ends with 120 Ohms. The resistors are used to prevent reflections.



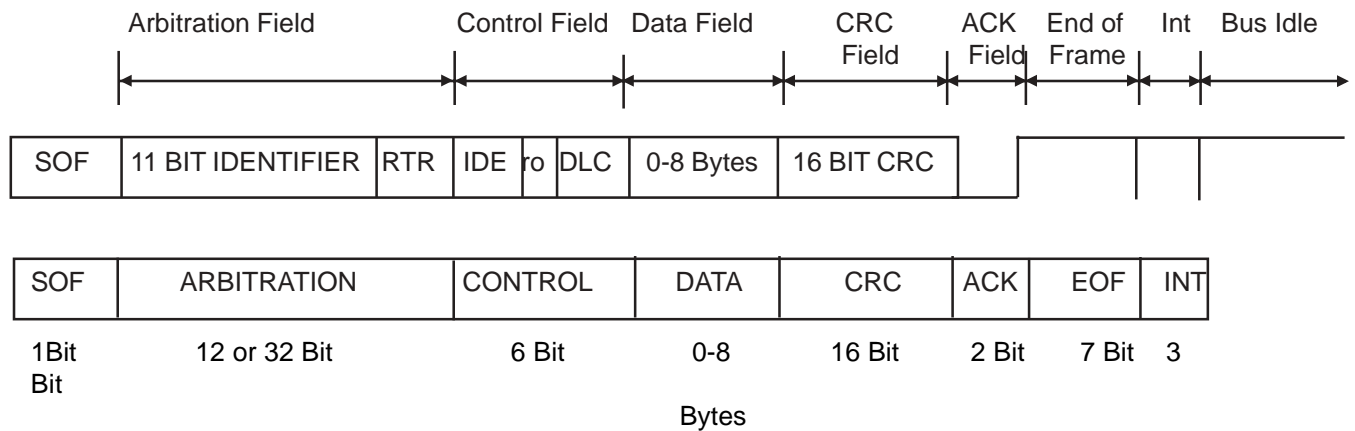
GETTING STARTED

Message Format

The CAN protocol uses a modified version of the Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) technique used on Ethernet. Should two messages determine that they are both trying to send at the same time then instead of both backing off and re-trying later as is done with Ethernet, in the CAN scheme, the transmitters detect which message has the highest priority and only the lower priority message gets delayed. This means that a high priority message is sure of getting through.

CAN protocol supports two message frame formats, only essential difference is in the length of the identifiers (ID). In Standard format, length of ID is 11 bits and in Extended format the length is 29 bits. The message frame for transmitting frames comprises 7 main fields.

A. Standard format CAN Message(CAN 2.0A)



B Extended format CAN Message(CAN 2.0B)



SAE J1939 Overview

J1939 is the automotive CAN standard developed by the Truck & Bus Control and Communications Network Subcommittee of the Society of Automotive Engineers (SAE). SAE maintains family of standards which govern the design and use of devices that transmit electronic signals and control information among vehicle components. Planned for use in light, medium and heavy duty trucks it is also now being used in conventional passenger vehicles.

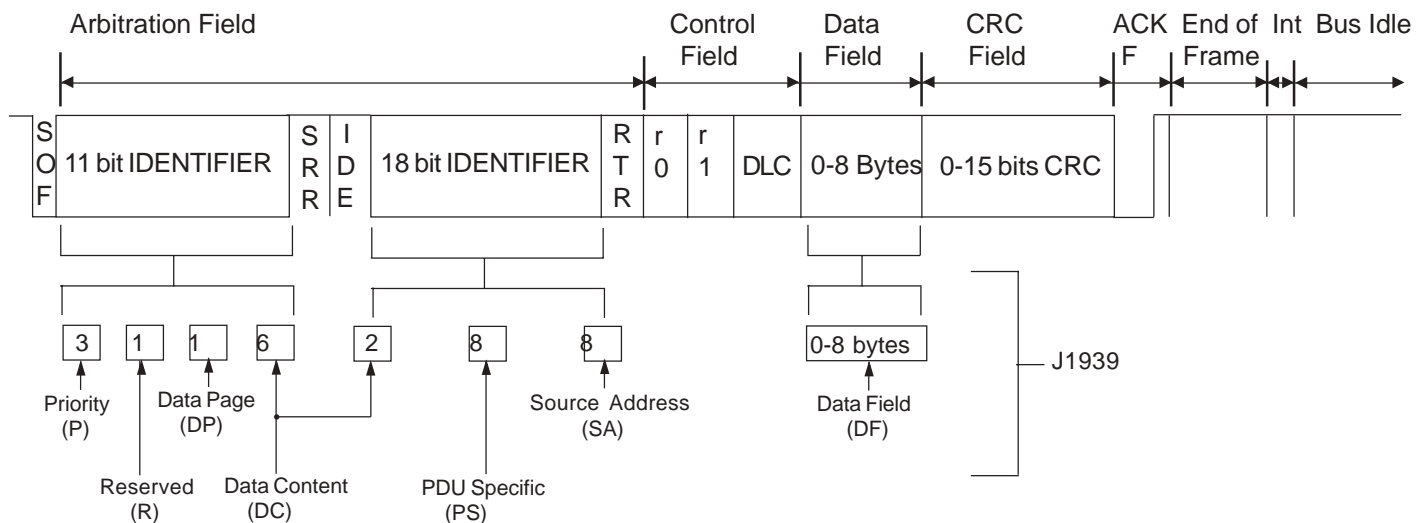
J1939 was designed for the CAN 2.0 (CAN Part B) specification. *It is the application layer that uses the larger 29 bit identifier.* It uses a peer to peer protocol where most messages are broadcasted versus directed to individual nodes. In J1939 each CAN Node is referred to as an Electronic Control Unit (ECU). Every ECU has node address.

SAE J1939 has following features:

1. 29 bit Identifier
2. 250Kbps Baud rate
3. 8 Priority Classes
4. Predefined message types
5. Destination specific communication and Broadcasting

The applications and/or network layer provide a string of information that is assimilated into a protocol data unit (PDU). The protocol data unit provides a framework for organising the information that is key to each CAN data frame that is sent. In J1939, Data type, Range, Repetition Rate etc together with the corresponding parameter group number determine the respective message identifier.

The SAE J1939 frame format is as shown.



Two PDU formats are defined PDU1 format (PS=Destination address) and PDU2 format (PS=Group Extension)

1. PDU1 format allows for direction of CAN data frame to a specific destination address(device).
2. PDU2 format can only communicate CAN data frames that are not destination specific.



GETTING STARTED

J1939 messages are sent using the CAN Extended Frame. A J1939 message consists of the following components:

Priority (P)– This 3-bit field is used to define the priority during arbitration. ‘000’ is the highest priority and is usually associated with high-speed control messages. Low priority is used for noncritical configuration and information messages.

Data Page (DP)– This 1-bit field defines on which data page (0 or 1) the message is defined in the J1939 specification. Page 0 contains the messages that are presently defined, while Page 1 is for future expansion.

Protocol Data Unit (PDU) Format (PF) – This 8-bit field determines the format of the message and is one of the fields that determines the Parameter Group Number of the message (see the “**Parameter Group Number**” section). If the value is between 0 and 239, the message is a PDU 1 Format message. These messages are sent to specific addresses (CAs). If the value is between 240 and 255, the message is a PDU 2 Format message. These messages are not sent to a specific address (CA), but are instead broadcast to the entire network.

PDU Specific (PS) – This 8-bit field is either the Destination Address (PDU 1 Format) or the Group Extension (PDU 2 Format).

Source Address(SA) – This 8-bit field is the address of the CA that sent the message.

Data Length (DL)– The number of data bytes in the message.

Data – Up to 8 bytes of data.

Most messages are intended to be broadcast messages, or PDU 2 Format, where the message is not sent to a particular address. The J1939 specification defines PDU Format and PDU Specific values for many messages by specifying the message Parameter Group Numbers (see the “**Parameter Group Number**” section).

A J1939 node can send messages to other nodes, or it can request messages from other nodes, either globally or with a specific destination address. If a node receives a request sent to it specifically, it must process the message and send some sort of acknowledgement. If a node receives a global request, it must respond if it can. If a node receives a broadcast message, it must determine whether or not it is relevant.

J1939 uses three methods to communicate over the CAN bus.

- Destination specific communications use the PDU1 (Protocol Data Unit 1) format to send and receive data. The PDU1 format allows a message to be directed to specific ECU (CAN Node). The destination address is included in the CAN PDU1 CAN frame.
- Broadcast Communications use the PDU2 (Process Data Unit 2) format to send a message to multiple nodes. The PDU2 message format identifies a message number versus a node number. In these applications receiving ECU's monitor the CAN bus for specific messages. For example a display unit may ignore all other messages as it monitors the bus waiting for the PDUs containing Fuel Temperature and Fuel Pressure.
- Proprietary Communications use both PDU1 and PDU2 formats to send data.

Parameter Group Number

The J1939 specification defines allowable messages by their Parameter Group Number (PGN). The Parameter Group Number is a 3-byte value that uniquely defines the message purpose. A PGN has the following format.



| | | | | |
|--------|----------|---------------|------------|-----------------|
| 0 | Reserved | Data page bit | PDU format | Group Extension |
| 6 bits | 1 bit | 1 bit | 8 bits | 8 bits |

Data transfered on the CAN bus is defined as Parameter Groups (PGs). PG's define where the data is located in the CAN Data frame, priority and transmission repetition rate. PG's are identified with Parameter Group Numbers (PGN's) . Parameters are grouped according to some similar characteristics into Parameter Groups and are expressed by its Parameter Group Number (PGN). This is the number used in J1939 to access the data about a particular parameter or a set of parameters.

3.2 Introduction To GWY-300-B

GWY-300 -B(CAN Gateway) allows serial device such as PLCs, Inverters and controllers to exchange data on CAN Bus. In the same way, it allows devices like ECU (Which support CAN J1939/71) to make their data available to devices like PLCs, so that some control actions can be taken. GWY-300 -B(CAN Gateway) supports SAEJ1939/71 Application Layer.

GWY-300-B has two serial ports, one is compatible to RS232/RS422/RS485/CMOS levels, which can be connected to device like PLCs, Inverters and controllers and the other is CAN port. The CAN connection is a two wire high speed network. These two ports are isolated from each other.

GWY-300-B communicates with the ECU(Electronic Control Unit) using SAE J1939/71 protocol. This allows gateway to access various engine parameters from CAN port. Gateway provides these parameters to third party serial devices like PLCs, Controllers. The PLC can then make decisions based on the parameter values. Following engine parameters are supported but not limited to.

- | | |
|------------------|----------------|
| 1 Engine Hours | 2 Engine RPM |
| 3 System Voltage | 4 Oil pressure |

Gateway setup software allows different engine parameters to be mapped to any register on the other side PLC/Device.

The complete configuration for a unit is termed as 'Project'. Project comprises of device names, Register addresses, condition for block execution etc.

Block may contain information like copy number of words from one device to other device and conditions for copy, if any. Gateway transfers data between two devices by execution of blocks.

After the Project is defined, Drivers for required devices and Project should be downloaded. Gateway can now communicate with the CAN devices and serial devices(e.g. PLC or SCADA).



3.3 GWY-300-B Operation-Configuration And Communication

Gateway can communicate with serial and CAN devices using appropriate cables and configuration. Microsoft Windows® based configuration software, Gateway Setup, configures the Gateway unit. 'Configuration' means making the Gateway unit work as per system requirements.

Complete configuration for a Gateway using the Gateway Setup is termed as a 'Project'. A Project consists of Devices to be attached on two ports, Communication settings for two ports to communicate with two devices, Register addresses for data transfer, Conditions for data transfer etc.

Gateway can now communicate with the specified devices without any change in the Gateway hardware. To communicate with a device, Gateway needs Communication Drivers for the devices and 'Gateway - Device' communication cables.

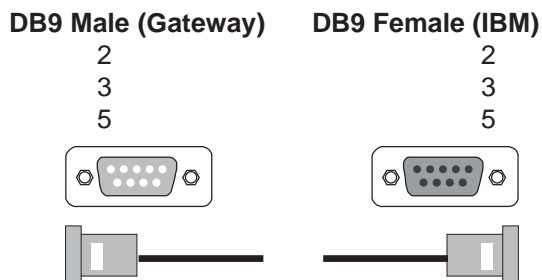
Each Device has a unique and predefined protocol for communication. Gateway driver has this protocol to communicate with the desired device. As two devices are connected on Gateway, it requires two drivers for communication.

3.4 Configuration of GWY-300-B (IBM Download)

User MUST download Project, PLC1 driver and PLC2 driver in Gateway before installing any system using Gateway. Gateway can accept drivers and configuration data on COM1 port. User needs a special IBM download cable for downloading configuration in Gateway. All configurations can be downloaded only from Serial port (Port 1). The other port is dedicated for CAN-J1939/71 (Port 2).

If any change in the current / working project is made, user must download the changed project in Gateway.

Pin details of IBM download cable for GWY-300-B are as follows:



1. For downloading Firmware, drivers and project switch off the GWY-300-B unit.
2. Power ON the unit again.

For Master-Master mode:

OK LED is on at power on, it checks if the PLC1 is attached. If PLC1 is not attached then PLC1 Red LED glows and then it goes in IBM download mode for 10 sec. In IBM download mode OK LED flashes.

For Master-Slave Mode:

The unit will go into the IBM download mode for 10 sec at power ON.

For the first time download Firmware, driver and project.

Only in IBM download mode firmware, drivers and project can be downloaded.

At power on, if OK LED does not glow indicating that the downloaded firmware, drivers or project CRC are not correct or either of them is not present.

IMPORTANT NOTE:

AS GATEWAY HAS MULTIPLE SIGNALS ON ITS COMMUNICATION PORTS, IBM CABLE FOR GATEWAY MUST HAVE ONLY THREE RS232 SIGNALS (TXD, RXD AND GND) AS MENTIONED ABOVE.

9-9 PIN CORE CABLE SHOULD NOT BE USED.



3.4.1 When GWY-300-B can accept configuration?

If current driver present for PLC1 port is Master (e.g. Modbus (Gateway as Master))

First, it is checked that whether device is connected on port1
If device is connected, it continues normal operation
If device is not connected, it checks for IBM download mode for 10sec.
This sequence continues until either is satisfied.

If current driver present for PLC1 port is Slave (e.g. Modbus (Gateway as Slave))

If Port1 of Gateway is Slave, all the configurations should be downloaded only at power on for 10sec.



GWY-300-B FEATURES

In this chapter. . . .

- ◆ Gateway Modes
- ◆ Repeat Cycle
- ◆ Control Word
- ◆ Error Indication Bits
- ◆ Communication Parameters



4.1 Gateway Modes

Gateway has two modes of operation: Master-Master and Master-Slave. Before explaining these modes further Master and Slave concept should be explained.

Master:

Master is a Device / device driver which initiates communication.

Slave:

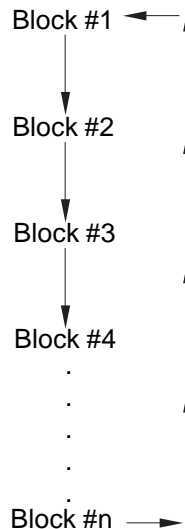
Slave is Device / Device driver which processes Master's query, takes necessary action and responds to the query, if necessary.

4.1.1 Master-Master Configuration

In this mode both Gateway ports are master in nature and devices connected on these ports are slave. Gateway ports initiate communication when the proper Gateway-Device communication cable is attached. Data is transferred in blocks. This transfer can either be a continuous process or as per requirement. A control word (Section 4.3), present in device on either side, enabled from Gateway Setup Software, can control the block execution.

When control word is disabled, then block transfer is a continuous process. A block of data is fetched from one device and transferred to the other device. The amount of data to be transferred (Number of words) depends on Block definition in "Block Definition Area" in Configuration Software. One block is executed at a time. A cycle consists of execution of blocks from #1 to #n.

Execution of blocks is performed as follows,

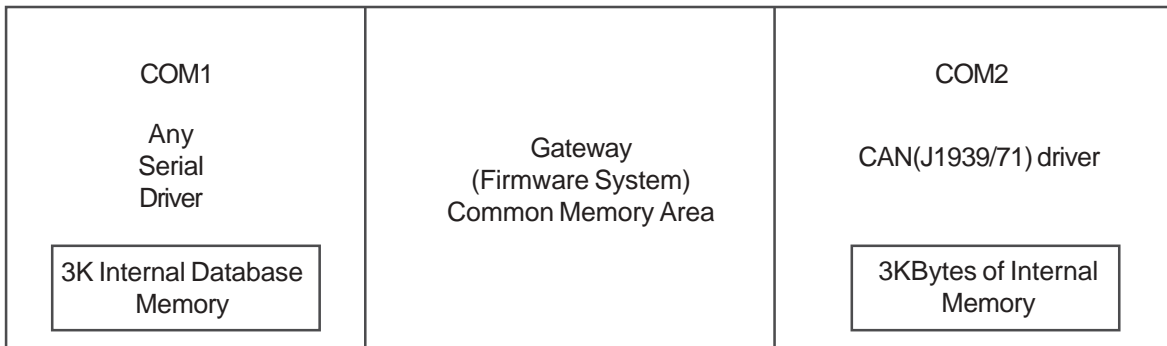


When Control word is enabled, it decides which block has to be executed by writing a specific data in the control word.

GWY-300-B FEATURES

Note on Gateway CAN driver:

CAN driver uses total 3KBytes of Internal Memory. Memory is allocated to the each PGN according to the entry in the internal tag database(IDB). The number of bytes allocated to each PGN is mentioned in PGN Length column of IDB.



In background, if the received PGN having source address matches with the defined PGN in internal tag database having same EXT Device ID then this data is kept in internal memory of CAN driver. The data transfer between the serial driver and CAN is taken place through the common memory area. If serial device wants to read CAN data then corresponding data is bring in the common memory area which is then read by the serial driver.

Note:

For receiving any PGN on the CAN, while creating the project, the corresponding PGN (User wants to receive) should have 0 suffix.

For transmitting any PGN on the CAN, while creating the project, the corresponding PGN (User wants to transmit) should have 1 suffix.

Note:

CAN open slave operates in Master Slave mode only.



Configure Gateway ports as: PLC1 Protocol: Modbus (Gateway as Master)
PLC2 Protocol: CAN(J1939/71)

[illegible]

Block #1: Gateway reads 4 words starting from 400001 from Modbus and write these 4 words data to internal memory of CAN. Since this data is transmitted on CAN PGN with suffix "1" is selected(PGN: P1:000F003)

As this example has only two blocks, Gateway will execute Block #1 after executing Block #2 continuing *this cycle forever*.

1) Internal tag database entry should be such that the total memory of CAN should not exceed more than 3KBytes. Care should be taken while creating the project.

4.1.2 Master-Slave Configuration

In this mode, one of the Gateway ports is a master and other is the slave so the devices connected on these ports are slave and master respectively. Blocks do not control data transfer in this mode. Data transfer takes place only when Master Device, connected on slave port of Gateway, sends a request to read / write data. This mode requires mapping registers for data transfer. Mapping means defining one or multiple registers in the Slave Device corresponding to one or multiple registers in the Master Device. Mapping can be done using the Block definition area, so in this mode, any Block is used for mapping registers of the two devices.

In Block Definition area, # Words Field indicates number of registers to be mapped **linearly** from the starting addresses of the Source Device to the Destination Device. Maximum number of registers that can be mapped is 255, but this does not mean that Master Device has to read / write 255 registers in one command.

In one command Master can read / write registers from one Block only, so if multiple registers are to be read / written using a single command, # Words also limits the maximum number of registers to be read / written. Number of registers to be read / written in one command also depends on

- protocol of BOTH the devices
- Buffer capacity of Gateway.

Note: In case of CAN, only the single PGN is mapped with the corresponding register i.e.PGN length of corresponding PGN (may be 4 words or less) can be mapped with corresponding register. If #Words field entry is greater than PGN Length (may be 4 words) then the remaining words are not mapped with any PGN.

For CAN open slave project please refer section 6.2

Now let us take the example of Master-Slave mode(COMM1 slave):

Configure Gateway ports as: PLC1 Protocol - Modbus (Gateway as Slave)
PLC2 Protocol - CAN(J1939/71).



GWY-300-B FEATURES

[illegible]

GWY-300-B FEATURES

Block #1 maps 4 words of Modbus starting from 400001 to CAN(J1939/71) starting from P0:000F003.
Block #2 maps 1 word of Modbus starting from 400005 to CAN(J1939/71) starting from P1:000F000.

In above example, request from Modbus Master is executed as follows:

1. Modbus Master connected on serial port (COM1) sends command to Gateway for reading holding register 400001.
2. Gateway searches defined Blocks and checks whether this register is mapped to any CAN PGN.

In example, holding register 400001 is mapped to P0:000F003 in Block 1. Gateway accepts this command and sends the data corresponding to PGN P0:000F003.

Since P0:000F003 is of receiving type of PGN, user can not write data in this PGN.

In Block2, P1:000F000 is of transmitting type of PGN, which is mapped with 400005. As only one word is mapped user can write data in 400005.

4 words (PGN Length) corresponding to P0:000F003 are sent on CAN but only first two bytes of this PGN can be changed using Modbus register 400005, since only one word is mapped.

If Master sends a command to read / write a register not defined in any Block then Gateway sends exception response to master.

NOTES:

- 1) **As Gateway Setup Software is common for both the Gateway Modes, titles in the Block Definition Area, may not be appropriate when using Gateway in Master - Slave mode (e.g. Source ID, Source PLC, Destination PLC).**
- 2) **In Master - slave mode, If somebody mapped read only registers at destination end to any registers at source end, it's users responsibility that these registers are not going to be written by master.**
- 3) **Internal tag database entry should be such that the total memory of CAN should not exceed more than 3KBytes. Care should be taken while creating the project.**



4.2 Repeat Cycle

User can control Block execution by using the Repeat Cycle field. This number decides whether the Block will be executed in each cycle. Larger the number lower the priority of the Block. Range for Repeat Cycle setting is 1-99.

Repeat Cycle = 1 Highest priority

Repeat Cycle = 99 Lowest priority

Repeat cycle is important when using Gateway in Master - Master mode. **If Gateway is used in Master - Slave mode, Repeat Cycle field should be kept as '1'.**

Repeat cycle defines the number of times a Block will be skipped while executing Blocks in a sequential manner. Block will not be executed for [Repeat Cycle - 1] cycles. So if Repeat Cycle for a Block is 1, it will be executed in each cycle whereas if Repeat Cycle is 2, then this Block will NOT be executed in alternate cycles.

For example, suppose Blocks are defined with following Repeat Cycles:

| | |
|----------|------------------|
| Block #1 | Repeat Cycle = 1 |
| Block #2 | Repeat Cycle = 2 |
| Block #3 | Repeat Cycle = 3 |
| Block #4 | Repeat Cycle = 4 |

After power up, Cycles will be executed as follows:

Cycle 1:

Block #1
Block #2
Block #3
Block #4

Cycle 2:

Block #1

Cycle 3:

Block #1
Block #2

Cycle 4:

Block #1
Block #3

Cycle 5:

Block #1
Block #2
Block #4

4.3 Control Word

Another way of controlling Block execution is by use of the Control Words. 16 control words i.e. 256 control bits are available by which user can control 256 blocks. 0th Control bit corresponds 0th bit of control word 1, ..., 16th Control bit corresponds 0th bit of control word 2, ..., 255th Control bit corresponds 15th bit of control word 16. By default 0 to 255 control bits are mapped to 1 to 256 blocks. User can change value of the control bit. Control Word can be enabled or disabled in Gateway Configuration. Normally Control Word is disabled for a New project. It can be enabled just by clicking on check box in the setup software. Control Word can be chosen from any of the Devices connected.

If the Control Word field is enabled, for the control bit chosen in the project block, accordingly the number of words in the control field should be taken.

For example, if 36th Control bit is chosen to control the block then number of words in the Control Word field should be 3. Number of control bits / 16 = Number of control words.

If Number of control bits % 16 != 0 (Non-zero so add 1 in the number of words in the control field) then Number of control words = Number of control words + 1



GWY-300-B FEATURES

In the above example, number of control bits are 36.

So $36 / 16 = 2$ (Number of words in control field)

$36 \% 16 = 4$ (i.e. Non-zero so add 1 in the number of words in the control field), so number of words in control field are $2 + 1 =$

3. So number of words in the control field should be chosen as 3. For any block any control bit can be chosen.

Control Word can only be used in Master-Master mode since no continuous data transfer takes place in Master -Slave mode (data transfer only takes place on Master's request)

When the Control Word is disabled, Block execution is totally controlled by Repeat Cycle settings. When the Control Word is enabled, Block execution is controlled using discrete bits of that word.

Bit 0 in control word controls execution of Block #1

Bit 1 in control word controls execution of Block #2

:

Bit 15 in control word controls execution of Block #16

When a bit is high, '1', corresponding Block is executed depending on its Repeat Cycle. When a bit is low, '0', execution of corresponding Block is disabled.

4.4 Error Indication Bit

This feature enables detection of communication breaks during error free communication between Gateway and two devices. Communication breaks can occur due to no cable connection, wire faults, device power failure at both ends of Gateway. An Error bit can be designated in each external device connected to Gateway. Using this bit, fault at the PLC1 end can be reported to PLC2 Device and fault at PLC2 end can be reported to PLC1 Device. When communication error occurs on PLC1, Gateway sets error bit in PLC2 device. *Error Indication Bit can only be used in Master-Master mode. In Master-Slave mode any error can easily be detected by a communication time out on the Master.*

Error indication bit can be enabled using Gateway configuration software. Normally Error bit is disabled for a New project. It can be enabled just by clicking on the check box in the setup software. Error indication bit can be enabled in both or any one of the Devices connected to Gateway. Error Indication bit is "OFF" to indicate error free communication. In case of communication error on PLC2, Gateway sets error bit on PLC1 port and vice versa.

4.5 Communication Parameters

Communication Parameters of Gateway can be set from configuration Software. This enables Gateway to readily communicate with any device. Communication parameters for PLC1 and PLC2 ports can be configured independently. This feature allows changes in Baud rate, Number. of stop bits, Parity etc. at any time without downloading the driver for that particular device. After the driver for a particular device is downloaded, the communication parameters can be changed simply by selecting new communication parameters and downloading the same project.



NOTE ON COMMUNICATION DRIVERS

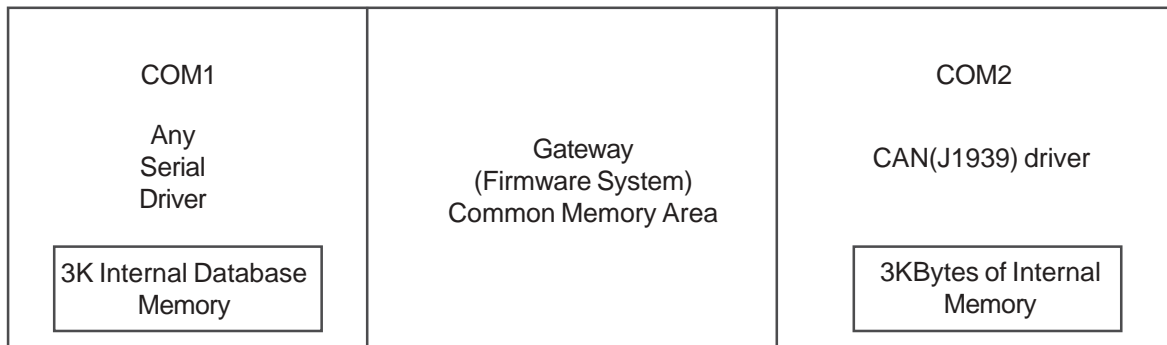


NOTE ON COMMUNICATION DRIVERS

5.1 Note On Communication Drivers

How Gateway CAN(J1939/71) driver works?

CAN driver uses total 3KBytes of Internal Memory. Memory is allocated to the each PGN according to the entry in the internal tag database(IDB). The number of bytes allocated to each PGN is mentioned in PGN Length column of IDB.



The total PGNs defined in actual project are automatically updated in the internal tag database with the corresponding information of the defined PGN. In background, if the received PGN having source address matches with the defined PGN in internal tag database having same EXT Device ID then this data is kept in internal memory of CAN driver.

Note:

For receiving any PGN on the CAN, while creating the project, the corresponding PGN (User wants to receive) should have 0 suffix.

For example, P0:000F000

For transmitting any PGN on the CAN, while creating the project, the corresponding PGN (User wants to transmit) should have 1 suffix.

For example, P1:000F000

How other serial drivers work?

Example1: Toshiba PLC or Modbus Master

Since drivers like Toshiba PLC, Modbus allow multiple register reading in one block, in this case concept of Internal Database* is used.

* Note: Concept of Internal database (IDB) is explained on next page.



NOTE ON COMMUNICATION DRIVERS

Let us have a glance at Internal database.
Please refer the following example.

[illegible]

NOTE ON COMMUNICATION DRIVERS

According to the project defined in Gateway software, the Gateway software automatically generates its own IDB, (Gateway drivers use this IDB for optimized communication) as explained below.

1. Registers required for a project are grouped in a block of registers (calculation based optimized block) and entire block is read (By Gateway) in one cycle instead of reading individual registers.

4 words from 400001, 4 words from 400005, 4 words from 400010 are grouped in one block.
(Please refer the first block, IDB FOR COM1)

These blocks are uploaded/read in continuous fashion (in the background by Gateway driver) and data is stored in internal database memory. So time required for read cycle is optimized.

2. Write operations are on comparison basis.

Since all the registers data is already present in internal database memory of Gateway driver, every time before performing write operation data is compared with the internal memory data. In this way unnecessary write operations can be avoided.

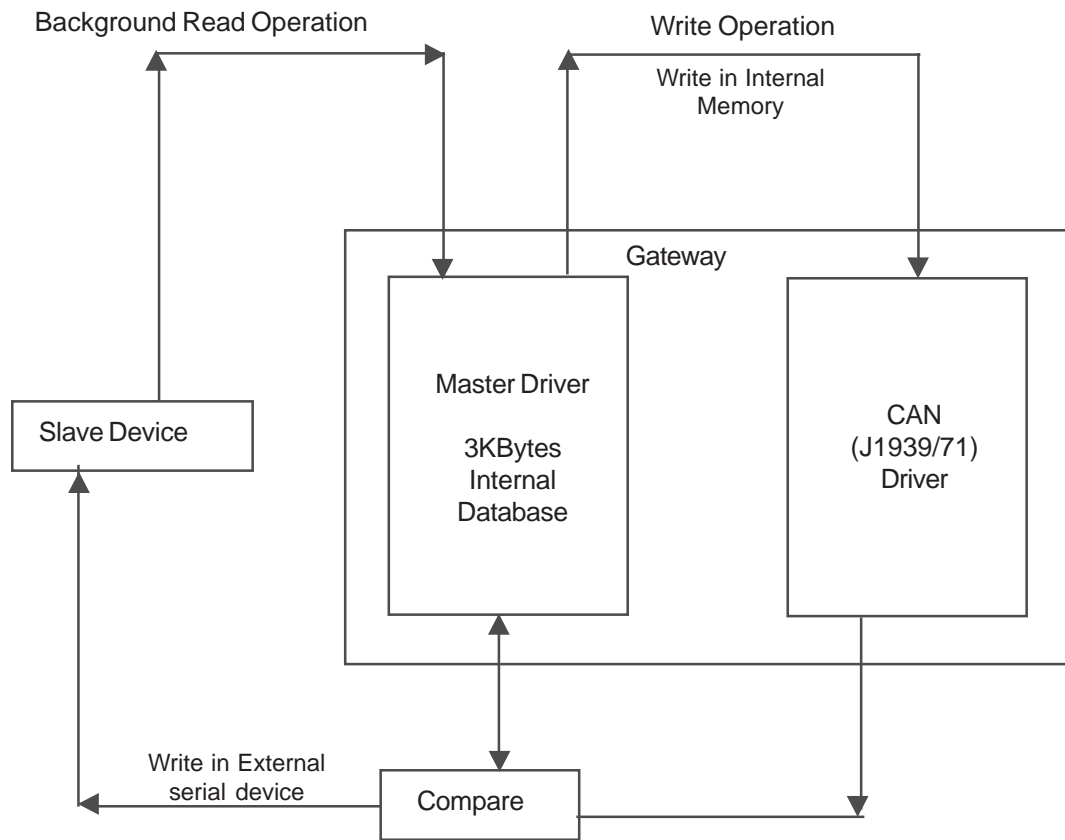
The PLC2 driver uses this data whenever needed according to gateway project.

The Internal database is associated only with Master drivers. Every Master driver has its own internal database of 3KBytes. Data fetched by the master driver from external slave device is loaded into its internal memory in continuous fashion irrespective of block execution of Gateway project.

“Background communication Enable/Disable” default setting depends on PLC or Device protocol.

The speed of data transfer is improved because of Internal database since it reduces the number of block executions required by the Gateway software.





Above figure explains the operation of Master-Master mode with background communication.

At power on each master driver will get all inputs from their internal database Setup and according to that information starts fetching and loading data into its internal database memory irrespective of execution of project blocks.

The master driver will read all the data and load it into the internal database memory. But in case of write operation, each master driver will check the data available in the internal memory with the new data to be written. If the data in the internal memory is same as the new data, then Gateway software will skip the write command. In case of different data, master driver will initiate the write command.

TYPICAL PROJECTS AND APPLICATIONS

In this chapter. . . .

- ◆ Project Setup
- ◆ Applications
- ◆ Support for Diagnostics



6.1 Project Setup

This Chapter explains, how a simple Gateway project can be created and tested. To develop a Gateway system, select appropriate Gateway model depending on the system requirements. A new project can be created as follows:

User should follow the given sequence to configure and use GWY-300-B unit:

1. Install Gateway Setup Software.
2. Select GWY-300-B from product list.
3. Create a project using gateway software. Set Baud rate through PLC settings. For J1939 baud rate is 250Kbps. Source address for CAN port can be set through the PLC2 settings - advanced settings. For CAN driver, user selects the PGN as receiving PGN, then enter source ID or destination ID (For CAN Only) as the Source ID of the transmitting device.

Refer Application note for mapping the registers.

4. Connect IBM cable and CAN cable.
5. Power up the unit.

If current driver present for PLC1 port is Master (e.g. Modbus (Gateway as Master))

First, it is checked that whether device is connected on port1

If device is connected, it continues normal operation

If device is not connected, it checks for IBM download mode for 10sec.

This sequence continues until either is satisfied.

If current driver present for PLC1 port is Slave (e.g. Modbus (Gateway as Slave))

If Port1 of Gateway is Slave, all the configurations should be downloaded only at power on for 10sec.

6. Download Firmware, driver for the PLCs & project.

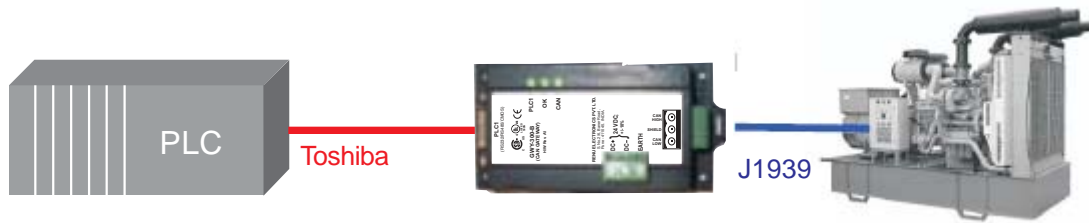
After downloading firmware, driver or project, software will ask to restart the unit. If user click on NO, then gateway will remain in Download mode. If user click on YES, then gateway unit is ready for application.



TYPICAL PROJECTS

6.2 Applications

An on-vehicle gateway used to interface a J1939 network to an onboard industrial automation based control system supporting the Modbus protocol.



To create a new project mapping in Gateway can be done in following way-

Concept for mapping is same as GWY-00. Refer GWY-00 User Manual .

Single PGN defined in GWY-300 corresponds to 8 byte (4 word) data. Only single PGN (having defined PGN length- Mostly 4 words) is mapped at a time.

If the PGN is of receiving type, then while selecting the PGN, select "0" suffix.

If the PGN is of transmitting type, then while selecting the PGN, select "1" suffix.

Mapping for Gateway

1. Master - Slave mode (Modbus slave - CAN)

PLC/SCADA acts as Modbus master & GWY-300-B as modbus slave.

For eg -

1. Modslave (40001) corresponds to PGN P0:000F001 and

No of words field contains 4 words i.e. Modbus Master on other side can read data of PGN P0:000F001 which receive on CAN. The destination ID Field (Next to destination field in the project) should contain the source ID of the device which transmits this PGN F001.

Please refer to Master-Slave configuration from Chapter 4.1.2



2. Master- Master Mode (e.g. Toshiba-CAN)

GWY-300-B acts as Toshiba Master.

For eg -

To read data on CANBUS and writes the data into the Toshiba PLC.

Select CAN as a Source PLC & Toshiba as destination PLC in gateway project. Only single PGN (having defined PGN length- Mostly 4 words) is mapped at a time.

Block execution is same as in GWY-00 Master – Master mode

Baud rate for com1 and com2 side can be set through the PLC Settings in the set up software.

NOTE: Defined PGNs in Internal tag database are kept in internal memory in same order as in the Internal tag database table.

3. Get Engine RPM and Engine Oil Temperature from Diesel Engine. Store RPM and oil temperature in PLC data registers. PLC should set an alarm bit on when RPM or oil temperature exceed presets.

First: Find the PGNs (parameter group numbers) that have the engine RPM and oil temperature.

PGN for RPM is 61444 (00F004), see page no-20, 7. Electronic Engine Controller

PGN for Temp is 65262 (00FEEE), see page no-40, 45. Engine Oil Temperature

Note: Both of these PGNs map data across 8 bytes (4 PLC data registers).

Second: Use the Gateway setup software to create a program that maps RPM and Oil Temperature into the PLC data registers.



TYPICAL PROJECTS

[illegible]

F004 is selected from the given PGNs F000-F006 and FEEE is selected from given PGNs FEE4-FEEF

Third: Understand where RPM and Oil Temperature values are stored in the PLC data registers.

The data bytes of F004 are stored in D0-D3 as shown.

| | High Byte | Low Byte |
|------|---|--|
| D000 | Byte1 of F004 Status_EEC1 | Byte2 of F004 Driver's demand engine - percent torque |
| D001 | Byte3 of F004 Actual engine - percent torque | Byte4 of F004 Engine speed |
| D002 | Byte5 of F004 Engine speed | Byte6 of F004 Not defined |
| D003 | Byte7 of F004 Not defined | Byte8 of F004 Not defined |

As per the description of F004 given in Appendix

Byte: 1 Status_EEC1 Bit: 8-5 Not defined
4-1 Engine/retarder torque mode
2 Driver's demand engine - percent torque
3 Actual engine - percent torque
4,5 Engine speed
6-8 Not defined

In the same way FEEE data is also mapped to D4-D7.

The values seen in the PLC registers are with Offset and Multiplying factor.

So the actual values are calculated as follows:

(Value seen in the PLC register * Data resolution factor) - Offset

Data Resolution factor and Offset are given in the corresponding PGN description.

For Engine oil temperature

Data Length :2 bytes

Resolution :0.03125 °C/bit gain, -273 °C offset

Data Range :-273 to +1735.0 °C (-459.4 to 3155.0 °F)

The value seen for PLC data register is 'X'. Then the actual value is Y in °C = $(X * 0.03125) - 273$ °C

The minimum and maximum values for Y are given in data range i.e -273 (min) & +1735 °C (max).

In this way the PLC registers are mapped with the CAN PGNs.

6.3 Support for Diagnostics

The GWY-300 is capable of supporting multi packet Diagnostic messages that is Active Diagnostic Codes (DTCs) in the form of SPN (Suspect Parameter Number) and FMI (Failure Mode Identifier) combinations. This is achieved with the use of the PGN 0xFECA. This PGN is used to transmit the current occurrences of Fault codes.

The current CAN gateway, GWY-300 supports the following:

- 1) The Data Link Layer i.e. J1939-21.
- 2) The Application Layer i.e. J1939-71.
- 3) The Diagnostic messages J1939-73.

Most of the PGNs are of 8 byte length and hence do not require the support of the transportation layer. But there are some PGNs, which can have length more than 8 bytes (i.e. 9 up to 1785 bytes). Such PGNs require the support of the transportation layer and the J1939-21 comes in to picture. It provides facilities like connection initiation, holding and termination for one to one to connection and broadcast message facilities all for multi packet transmission.

To implement multi packet transmission two schemes are provided:

- 1) The broadcast message scheme.
- 2) The RTS / CTS (Ready To Send/Clear To Send) scheme.

How does this operate?

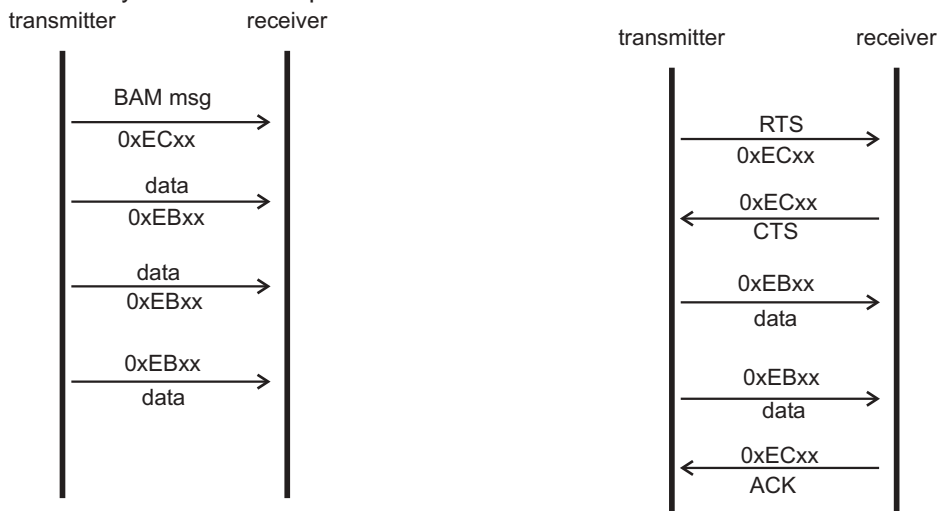
For the BAM message scheme the transmitter that wants to transmit a multi packet data sends a BAM (Broadcast Announce Message) declaring to all the other nodes. Now all the nodes interested in that data (details is obtained in the BAM message), accept that data while other nodes reject it. There is no connection initiation or Acknowledgement.

For RTS/CTS scheme: the transmitter sends the RTS frame to the concerned node which has to respond with a CTS frame and thereby setup a connection and data transfer takes place from the transmitter to the receiver. Several other frames may be send by the responder in between to keep the connection active. In the end, the responder sends an Acknowledge frame to indicate successful termination of the connection. For all successful/unsuccessful aborts, holding a connection, the responder is responsible and is in control of the line.

NOTE: 0xEC00 and 0xEB00 are PDU-I format and hence can be destination specific (0-254) / global (FF).

The PGN 0xEC00 is used for the transportation layer. Its first byte is the control word that states whether this frame (i.e. 0xEC00) is a BAM, RTS, CTS, ACK or ABORT message.

This is followed by transmission of PGN 0xEB00, used for data transfer in transport layer, that carries the sequence number, and seven data bytes of the multi packet frame.



Currently the fault codes for the 'active diagnostic codes' and 'previously active diagnostic codes' are been supported. Hence, we provide the support for J1939-73.

But there are still some issues that are yet to be implemented in this gateway to completely support these protocols.

- 1) Currently the gateway supports the BAM message scheme only, for multi packet transmission. The RTS/ CTS scheme will be implemented on request.
- 2) Also the related timing constraint to hold or disconnect a connection is yet to be supported. For example, the 21 protocol states that data frame has to be received within 200ms after BAM message has been transmitted. This time constraint is not implemented in the gateway.
- 3) Our gateway currently supports maximum length of 500 bytes for multi packet frame transmission.

Diagnostic Message:

The GWY-300 supports the active diagnostics code via the PGN 0xFECA. This PGN is maybe of variable length and hence multipacketed too. This PGN supports Active Diagnostics i.e. Faults that are currently present. These faults are used to convey the fault cause and other related information as a combination of SPN , FMI and OC.

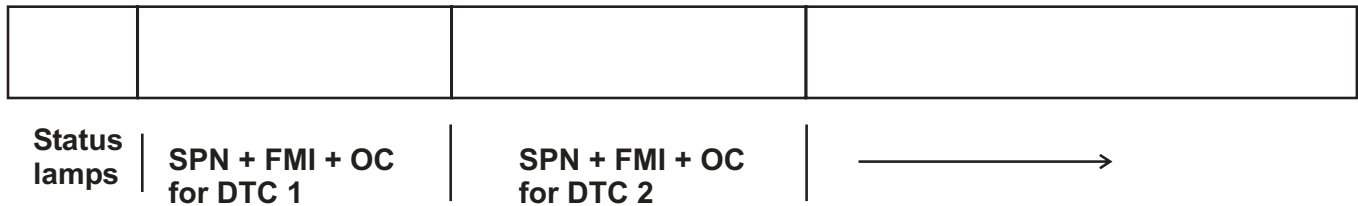
SPN: Suspect Parameter Number.

FMI: Failure Mode Identifier.

OC: Occurrence Count.

The first byte of the PGN 0xFECA always indicates the states of the Status Lamps used for faults for Diagnostics. From the 2nd byte onwards the Faults, also termed DTC (Diagnostic Trouble Codes) as follows:

Byte 1



TYPICAL PROJECTS

Example:

PGN 61443 (R) Electronic Engine Controller 2 - EEC2

Transmission Repetition 50 ms

Data Length: 8

Data Page: 0

PDU Format: 240

PDU Specific: 3 PGN Supporting Information:

Default Priority: 3

Parameter Group Number: 61443 (0xF003)

| Start Position | Length | Parameter Name | SPN |
|----------------|--------|--|------|
| 1.1 | 2 bits | Accelerator Pedal 1 Low Idle Switch | 558 |
| 1.3 | 2 bits | Accelerator Pedal Kickdown Switch | 559 |
| 1.5 | 2 bits | Road Speed Limit Status | 1437 |
| 1.7 | 2 bits | Accelerator Pedal 2 Low Idle Switch | 2970 |
| 2 | 1 byte | Accelerator Pedal Position 1 | 91 |
| 3 | 1 byte | Engine Percent Load at Current Speed | 92 |
| 4 | 1 byte | Remote Accelerator Pedal Position | 974 |
| 5 | 1 byte | Accelerator Pedal Position 2 | 29 |
| 6.1 | 2 bits | Vehicle Acceleration Rate Limit Status | 2979 |

Above are the SPN mentioned for several Parameters. Now when this fault occurs, the corresponding SPN along with the FMI is transmitted. The FMI as the name indicates gives the reason/ mode for the Fault. OC gives the number of times the Fault has occurred.



CONFIGURATION SOFTWARE

In this chapter...

- ◆ System Requirements
- ◆ Installation Instruction



7.1 System Requirements

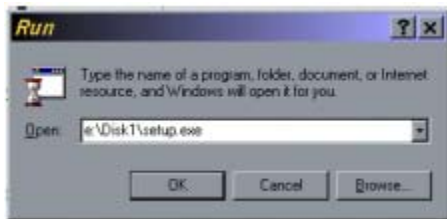
System Requirement for Gateway setup software are:

| | |
|---------------------|---|
| Windows Version: | Microsoft Windows XP / 2000, Windows 7 / VISTA (32/64 bits) |
| Processor: | PENTIUM or higher |
| Hard disk Space: | 5 MB or more |
| Serial Mouse: | Required |
| RAM: | 64 MB or more |
| Display resolution: | 800 X 600 (VGA) or better |
| Display colors: | 16 bit color |

7.2 Installation Instruction

Use the following procedure to install the Microsoft Windows® based Gateway setup software. This installation shows the procedure to install the software from a CD Disk on drive E. On machines with different drive configurations, change the names as needed. It is recommended that a backup disk of the Gateway setup software disk be created and stored in a safe place.

1. Launch the Windows operating system.
2. Insert the setup CD into CD-drive.
3. Point to the start button then click RUN
4. In the command line box enter E:\Disk1\setup.exe. Click OK. This will launch the Gateway installer.
5. Follow the instructions to complete setup.



Gateway Project:

Each Gateway must be configured before connecting it to the PLC. Gateway configuration software allows the following:

1. Create a new Gateway project
 - Select protocols for both communication ports of gateway.
 - Create blocks for data to be shared.
 - Set Communication Parameters for both the ports.
 - Set Control Word. (Optional)
 - Set Error Indication Bit, etc. (Optional)
2. Downloading.
 - Download Project
 - Download drivers
 - Download new firmware, if required (only for upgrading).
3. Upload Project.

The existing project in the gateway module can be viewed/edited.
4. Upload System Data.

This option enables viewing of version number, status of firmware, drivers used, and boot block.



APPENDIX

In this chapter. . . .

- ◆ Parameter Group Number
- ◆ Description of PGNs
- ◆ Details of Rotochopper Application
- ◆ Troubleshooting



APPENDIX

A Parameter Group Number

The J1939 specification defines allowable messages by their Parameter Group Number (PGN). The Parameter Group Number is a 3-byte value that uniquely defines the message purpose. A PGN has the following format.

| | | | | |
|--------|----------|---------------|------------|-----------------|
| 0 | Reserved | Data page bit | PDU format | Group Extension |
| 6 bits | 1 bit | 1 bit | 8 bits | 8 bits |

Data transferred on the CAN bus is defined as Parameter Groups (PGs). PG's define where the data is located in the CAN Data frame, priority and transmission repetition rate. PG's are identified with Parameter Group Numbers (PGN's) . Parameters are grouped according to some similar characteristics into Parameter Groups and are expressed by its Parameter Group Number (PGN). This is the number used in J1939 to access the data about a particular parameter or a set of parameters.

| Parameter group Number | Parameter Description |
|------------------------|---|
| 0x0000(00000) | TORQUE/SPEED CONTROL #1: TSC1 |
| 0xDE00(56832) | RESET |
| 0xE000(57344) | CAB MESSAGE #1: CM1 |
| 0xEA00(59904) | REQUEST PGN |
| 0xEB00(60160) | TRANSPORT PROTOCOL - DATA TRANSFER (TP.DT) |
| 0xEC00(60416) | TRANSPORT PROTOCOL CONNECTION MANAGEMENT (TP.CM) |
| 0xF000(61440) | ELECTRONIC RETARDER CONTROLLER #1: ERC1 |
| 0xF001(61441) | ELECTRONIC BRAKE CONTROLLER #1: EBC1 |
| 0xF002(61442) | ELECTRONIC TRANSMISSION CONTROLLER #1: ETC1 |
| 0xF003(61443) | ELECTRONIC ENGINE CONTROLLER #2: EEC2 |
| 0xF004(61444) | ELECTRONIC ENGINE CONTROLLER #1: EEC1 |
| 0xF005(61445) | ELECTRONIC TRANSMISSION CONTROLLER #2: ETC2 |
| 0xF006(61446) | ELECTRONIC AXLE CONTROLLER #1: EAC1 |
| 0xFEAC(65196) | WHEEL BRAKE LINING REMAINING INFORMATION: EBC4 |
| 0xFEAD(65197) | WHEEL APPLICATION PRESSURE HIGH RANGE INFORMATION: EBC3 |
| 0xFEAE(65198) | SUPPLY PRESUURE |
| 0xFEAF(65199) | FUEL CONSUMPTION (GASEOUS) |
| 0xFEB1(655201) | ECU HISTORY |
| 0xFEB2(655202) | FUEL INFORMATION (GASEOUS) |



| Parameter group Number | Parameter Description |
|------------------------|---|
| 0xFEB3(65203) | FUEL INFORMATION |
| 0xFEB4(65204) | TRIP TIME INFORMATION #1 |
| 0xFEB5(65205) | TRIP SHUTDOWN INFORMATION |
| 0xFEB6(65206) | TRIP VEHICLE SPEED/ CRUISE DISTANCE INFORMATION |
| 0xFEBD(65213) | FAN DRIVE |
| 0xFEBE(65214) | ELECTRONIC ENGINE CONTROLLER #4 : EEC4 |
| 0xFEBF(65215) | WHEEL SPEED INFORMATION |
| 0xFEC0(65216) | SERVICE |
| 0xFEC1(65217) | HIGH RESOLUTION VEHICLE DISTANCE |
| 0xFEC2(65218) | ELECTRONIC RETARDER CONTROLLER #2:ERC2 |
| 0xFEC3(65219) | ELECTRONIC TRANSMISSION CONTROLLER #5:ETC5 |
| 0xFEC5(65221) | ELECTRONIC TRANSMISSION CONTROLLER #4:ETC4 |
| 0xFEC7(65223) | ELECTRONIC TRANSMISSION CONTROLLER #3:ETC3 |
| 0xFED5(65237) | ALTERNATOR SPEED |
| 0xFED9(65241) | AUXILIARY DISCRIPIT INPUT / OUTPUT STATUS |
| 0xFEDB(65243) | ENGINE FLUID LEVEL / PRESSURE #2 |
| 0xFEDC(65244) | IDLE OPERATION |
| 0xFEDD(65245) | TURBOCHARGER |
| 0xFEDE(65246) | AIR START PRESSURE |
| 0xFEDF(65247) | ELECTRONIC ENGINE CONTROLLER |
| 0xFEE0(65248) | VEHICLE DISTANCE |
| 0xFEE4(65252) | IDLE SHUTDOWN |
| 0xFEE5(65253) | ENGINE HOURS, REVOLUTIONS |
| 0xFEE6(65254) | TIME/DATE |
| 0xFEE7(65255) | VEHICLE HOURS |



APPENDIX

| Parameter group Number | Parameter Description |
|------------------------|----------------------------------|
| 0xFEE8(65256) | VEHICLE DIRECTION/SPEED |
| 0xFEE9(65257) | FUEL CONSUMPTION |
| 0xFEEA(65258) | VEHICLE WEIGHT |
| 0xFEED(65261) | CRUISE CONTROL/VEHICLE SPEED SET |
| 0xFEEE(65262) | ENGINE TEMPERATURE |
| 0xFEEF(65263) | ENGINE FLUID LEVEL/PRESSURE |
| 0xFEFO (65264) | POWER TAKEOFF INFORMATION |
| 0xFEFO (65265) | CRUISE CONTROL/VEHICLE SPEED |
| 0xFEFO (65266) | FUEL ECONOMY |
| 0xFEFO (65267) | VEHICLE POSITION |
| 0xFEFO (65268) | TIRE CONDITION |
| 0xFEFO (65269) | AMBIENT CONDITIONS |
| 0xFEFO (65270) | INLET/EXHAUST CONDITIONS |
| 0xFEFO (65271) | VEHICLE ELECTRICAL POWER |
| 0xFEFO (65272) | TRANSMISSION FLUIDS |
| 0xFEFO (65273) | AXLE INFORMATION |
| 0xFEFO (65274) | BRAKES |
| 0xFEFO (65275) | RETARDER FLUIDS |
| 0xFEFO (65276) | DASH DISPLAY |
| 0xFEFO (65277) | ALTERNATE FUEL #1 |
| 0xFEFO (65278) | AUXILIARY WATER PUMP PRESSURE |
| 0xFEFO (65279) | WATER IN FUEL INDICATOR |
| 0xFF00(65280) | PROPRIETARY B PGN |



The above PGNs are kept in the ascending order in internal memory as shown .

If the user selects FED5 PGN and No of Words is 12 then he gets the data of FED5(4 words), FED9 (4 words) , FEDB(4 words) PGNs in the respective registers.

Note - GWY-300 receives messages in PDU2 format(Broadcasted messages) of one ECU only.

B Description of Parameter Group Number

Note: If the PGN is mapped with the corresponding register of PLC, then the data length of PGN is considered. If PGN has 8 bytes and it is mapped with register e.g. Toshiba's D0000 to D0004, then high byte of D0000 contains first byte of PGN, low byte contains second byte,.....,low byte of D0004 contains eighth byte of PGN. The sequence of bytes of PGN is defined as follows.

1. TORQUE/SPEED CONTROL #1: TSC1

| | | |
|------------------------------|---|--|
| Transmission repetition rate | : | when active; 10 ms to the engine - 50 ms to the retarder |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 0 |
| PDU specific | : | Destination address |
| Default priority | : | 3 |
| Parameter group number | : | 0 (000000 ₁₆) |

| | | |
|-------|-----|-------------------------------|
| Byte: | 1 | Control Bits |
| | 2-3 | Requested speed/Speed limit |
| | 4 | Requested torque/Torque limit |
| | 5-8 | Not defined |

| | | |
|------|-----|------------------------------------|
| Bit: | 8-7 | Not defined |
| | 6,5 | Override control mode priority |
| | 4,3 | Requested speed control conditions |
| | 2,1 | Override control modes |

Note: Retarder may be disabled by commanding a torque limit of 0%. For example, this permits the brake switch to enable the retarder, up to an amount selected by another device or the operator. Note that the brake switch can be treated as an operator input (mode 0001₂) or as a brake system input (mode 1010₂) relative to the active torque mode.



2. RESET

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | When needed |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 222 |
| PDU specific | : | Destination address |
| Default priority | : | 7 |
| Parameter group number | : | 56,832 (00DE00 ₁₆) |

| | | |
|-------|-----|----------------------------|
| Byte: | 1 | Trip reset |
| | 2 | Service component to reset |
| | 3-8 | Not defined |

| | | |
|------|-----|----------------------------|
| Bit: | 8-5 | Not defined |
| | 4,3 | Trip group 2 - Proprietary |
| | 2,1 | Trip group 1 |

Note: This message requires an Acknowledgement response (See J1939/21, 3.4.4) from the receiving node. The use of individual proprietary protocols can still be used instead of the "trip reset" PGN to maintain security.

3. CAB MESSAGE #1: CM1

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 224 |
| PDU specific | : | Destination address |
| Default priority | : | 6 |
| Parameter group number | : | 57,344 (00E000 ₁₆) |

| | | |
|-------|-----|-----------------------------|
| Byte: | 1 | Requested percent fan speed |
| | 2-8 | Not defined |

4. REQUEST

| | | |
|------------------------------|---|--|
| Transmission repetition rate | : | Per user requirements, generally recommended that requests occur no more than 2 or 3 times per second. |
| Data length | : | 3 bytes (The CAN frame for this PG shall set the DLC to 3.) |
| Data page | : | 0 |
| PDU format | : | 234 |
| PDU specific field | : | Destination Address (global or specific) |
| Default priority | : | 6 |
| Parameter group number | : | 59,904 (00EA00 ₁₆) |
| Byte: 1, 2, 3 | : | Parameter Group Number being requested |



5. TRANSPORT PROTOCOL DATA TRANSFER (TP.DT)

Transmission repetition rate : Per the Parameter Group to be transferred
 Data length : 8 bytes
 Data page : 0
 PDU format : 235
 PDU specific field : Destination Address (Global (DA = 255) for TP.CM.BAM data transfers)
 (Global not allowed for RTS/CTS data transfers)
 Default priority : 7
 Parameter group number : 60,160 (00EB00₁₆)
 Data ranges for parameters used by this Group Function:
 Sequence Number: 1 to 255 (1 byte)
 Byte: 1 Sequence Number
 2-8 Packetized Data (7 bytes). Note the last packet of a multipacket Parameter Group may require less than 8 data bytes. The extra bytes should be filled with FF16.

6. TRANSPORT PROTOCOL CONNECTION MANAGEMENT (TP.CM)

Transmission repetition rate : Per the Parameter Group Number to be transferred
 Data length : 8 bytes
 Data page : 0
 PDU format : 236
 PDU specific field : Destination Address
 Default priority : 7
 Parameter group number : 60,416 (00EC00₁₆)
 Data ranges for parameters used by this Group Function:
 Control byte : 0-15, 18, 20-31, 33-254 are Reserved for SAE Assignment
 Total Message Size, number of bytes: 9 to 1785 (2 bytes), zero to 8 and 1786 to 65535 not allowed
 Total Number of Packets : 2 to 255 (1 byte), zero not allowed
 Maximum Number of Packets : 2 to 255 (1 byte), zero through 1 are not allowed
 Number of Packets that can be sent: 0 to 255 (1 byte)
 Next Packet Number to be Sent : 1 to 255 (1 byte), zero not allowed
 Sequence Number : 1 to 255 (1 byte), zero not allowed



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7. ELECTRONIC RETARDER CONTROLLER #1: ERC1

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 240
 PDU specific : 0
 Default priority : 6
 Parameter group number : 61,440 (**00F000**₁₆)

Note-This message can also be used by the engine exhaust brake. The distinction of engine brake and retarder is done by the source address.

| | | | | | |
|-------|-----|----------------------------------|------|-----|---------------------------------------|
| Byte: | 1 | Status_ERC1 | Bit: | 8,7 | Retarder enable - shift assist switch |
| | | | | 6,5 | Retarder enable - brake assist switch |
| | | | | 4-1 | Engine/retarder torque mode |
| | 2 | Actual retarder - percent torque | | | |
| | 3 | Intended retarder percent torque | | | |
| | 4 | Coolant load increase | Bit: | 8-3 | Not defined |
| | | | | 2,1 | Engine coolant load increase |
| | 5-8 | Not defined | | | |

8. ELECTRONIC BRAKE CONTROLLER #1: EBC1-Used for brake control information.

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 240
 PDU specific : 1
 Default priority : 6
 Parameter group number : 61,441 (**00F001**₁₆)

| | | | | | |
|-------|-----|---------------------------|--------------|--------------------------|----------------------------------|
| Byte: | 1 | Status_EBC1 | Bit: | 8-7 | Not defined |
| | | | | 6,5 | ABS active |
| | | | | 4,3 | ASR brake control active |
| | | | | 2,1 | ASR engine control active |
| | 2 | Brake pedal position | Data Length: | 1 byte | |
| | | | Resolution: | 0.1%/bit gain, 0% offset | |
| | | | Data Range: | 0-100% | |
| | 3 | Status_EBC2 | Bit: | 8-7 | Not defined |
| | | | | 6,5 | ASR "hill holder" switch |
| | | | | 4,3 | ASR offroad switch |
| | | | | 2,1 | ABS offroad switch |
| | 4 | Measured_Aux_1 | Bit: | 8,7 | Remote accelerator enable switch |
| | | | | 6,5 | Auxiliary engine shutdown switch |
| | | | | 4,3 | Engine derate switch |
| | | | | 2,1 | Accelerator interlock switch |
| | 5 | Engine retarder selection | | | |
| | 6-8 | Not defined | | | |



9. ELECTRONIC TRANSMISSION CONTROLLER #1: ETC1

Transmission repetition rate : 10 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 240
 PDU specific : 2
 Default priority : 3
 Parameter group number : 61,442 (**00F002**₁₆)

| | | | |
|---------|---------------------|--------------|--|
| Byte: 1 | Status_ETC1 | Bit: 8-7 | Not defined |
| | | 6,5 | Shift in process |
| | | 4,3 | Torque converter lockup engaged |
| | | 2,1 | Driveline engaged |
| 2,3 | Output shaft speed | Data Length: | 2 bytes |
| | | Resolution: | 0.125 rpm/bit gain, 0 rpm offset(Upper byte resolution:32 rpm/bit) |
| | | Data Range: | 0 to +8031.875rpm |
| 4 | Percent clutch slip | Data Length: | 1 byte |
| | | Resolution: | 0.4%/bit gain, 0% offset |
| | | Data Range: | 0 to 100% |
| 5 | Command_ETC1 | Bit: 8-5 | Not defined |
| | | 4,3 | Progressive shift disable |
| | | 2,1 | Momentary engine overspeed enable |
| 6,7 | Input shaft speed | Data Length: | 2 byte |
| | | Resolution: | 0-125rpm/bit gain, 0rpm offset |
| | | Data Range: | 0 to +8031.875rpm |
| 8 | Not defined | | |

10.ELECTRONIC ENGINE CONTROLLER #2: EEC2

Transmission repetition rate : 50 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 240
 PDU specific : 3
 Default priority : 3
 Parameter group number: 61,443 (**00F003**₁₆)

| | | | |
|---------|---------------------------------|--------------|--------------------------|
| Byte: 1 | Status_EEC2 | Bit: 8-5 | Not defined |
| | | 4-3 | AP kickdown switch |
| | | 2-1 | AP low idle switch |
| 2 | Accelerator pedal (AP) position | Data Length: | 1 byte |
| | | Resolution: | 0.4%/bit gain, 0% offset |
| | | Data Range: | 0-100% |
| 3 | Percent load at current speed | Data Length: | 1 byte |
| | | Resolution: | 1%/bit gain, 0% offset |
| | | Data Range: | 0-125% |



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| | | | | |
|------|---|--------------------|--------------|--------------------------|
| Byte | 4 | Remote accelerator | Data Length: | 1 byte |
| | | | Resolution: | 0-4%/bit gain, 0% offset |
| | | | Data Range: | 0-100% |

5-8 Not defined

11. ELECTRONIC ENGINE CONTROLLER #1: EEC1

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | Engine speed dependent |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 240 |
| PDU specific | : | 4 |
| Default priority | : | 3 |
| Parameter group number | : | 61,444 (00F004 ₁₆) |

| | | | | | |
|-------|-----|---|------|-----|-----------------------------|
| Byte: | 1 | Status_EEC1 | Bit: | 8-5 | Not defined |
| | | | | 4-1 | Engine/retarder torque mode |
| | 2 | Driver's demand engine - percent torque | | | |
| | 3 | Actual engine - percent torque | | | |
| | 4,5 | Engine speed | | | |
| | 6-8 | Not defined | | | |

12. ELECTRONIC TRANSMISSION CONTROLLER #2: ETC2

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 100 ms |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 240 |
| PDU specific | : | 5 |
| Default priority | : | 6 |
| Parameter group number | : | 61,445 (00F005 ₁₆) |

| | | | | |
|-------|-----|-------------------|--|---|
| Byte: | 1 | Selected gear | Data Length | :1 byte |
| | | | Resolution | :1 gear value/bit, -125 offset |
| | | | Data Range | : -125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral |
| | | | Parameter Specific Indicator: FB16 is park | |
| | 2,3 | Actual gear ratio | Data Length | :2 bytes |
| | | | Resolution | :0.001/bit, 0 offset |
| | | | Data Range | :0 to 64.255 |
| | 4 | Current gear | Data Length | :1 byte |
| | | | Resolution | :1 gear value/bit, -125 offset |
| | | | Data Range | : -125 to +125, negative values are reverse gears, positive values are forward gears, zero is neutral |
| | | | Parameter Specific Indicator: FB16 is park | |



| | | | |
|-----|------------------------------|-------------|-----------------------|
| 5,6 | Transmission requested range | Data Length | :2 bytes |
| | | Resolution | :ASCII |
| | | Data Range | :0 to 250 (each byte) |
| 7,8 | Transmission current range | Data Length | :2 bytes |
| | | Resolution | :ASCII |
| | | Data Range | :0 to 250 (each byte) |

13. ELECTRONIC AXLE CONTROLLER #1: EAC1

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 500 ms |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 240 |
| PDU specific | : | 6 |
| Default priority | : | 6 |
| Parameter group number | : | 61,446 (00F006 ₁₆) |

| | | | | |
|-------|-----|----------------------------|-------------|-------------------|
| Byte: | 1 | Location | Data Length | :1 byte |
| | | | Resolution | :Bit-mapped |
| | | | Data Range | :N/A |
| | 2 | Differential lock status 1 | Bit: | 8,7 Rear axle 2 |
| | | | | 6,5 Rear axle 1 |
| | | | | 4,3 Front axle 2 |
| | | | | 2,1 Front axle 1 |
| | 3 | Differential lock status 2 | Bit: | 8-7 Not defined |
| | | | | 6,5 Central rear |
| | | | | 4,3 Central front |
| | | | | 2,1 Central |
| | 4-8 | Not defined | | |

14. WHEEL BRAKE LINING REMAINING INFORMATION: EBC4

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | On request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 172 |
| Default priority | : | 7 |
| Parameter group number | : | 65,196 (00FEAC ₁₆) |

| | | | | |
|-------|---|---|-------------|-------------------------------|
| Byte: | 1 | Brake Lining Remaining, front axle, left wheel | Data Length | :1 byte |
| | | | Resolution | :0.4% per bit gain, 0% offset |
| | | | Data Range | :0% to 100% |
| | 2 | Brake Lining Remaining, front axle, right wheel | Data Length | :1 byte |
| | | | Resolution | :0.4% per bit gain, 0% offset |
| | | | Data Range | :0% to 100% |



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| | | | |
|---|---|---|---|
| 3 | Brake Lining Remaining, rear axle #1, left wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |
| 4 | Brake Lining Remaining, rear axle #1, right wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |
| 5 | Brake Lining Remaining, rear axle #2, left wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |
| 6 | Brake Lining Remaining, rear axle #2, right wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |
| 7 | Brake Lining Remaining, rear axle #3, left wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |
| 8 | Brake Lining Remaining, rear axle #3, right wheel | Data Length Resolution Data Range | :1 byte :0.4% per bit gain, 0% offset :0% to 100% |

15. WHEEL APPLICATION PRESSURE HIGH RANGE INFORMATION: EBC3

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 173
 Default priority : 6
 Parameter group number : 65,197 (00FEAD₁₆)

| | | | |
|---------|--|---|--|
| Byte: 1 | Brake application pressure high range, front axle, left wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 2 | Brake application pressure high range, front axle, right wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 3 | Brake application pressure high range, rear axle #1, left wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 4 | Brake application pressure high range, rear axle #1, right wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 5 | Brake application pressure high range, rear axle #2, left wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |



| | | | |
|---|---|---|--|
| 6 | Brake application pressure high range, rear axle #2, right wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 7 | Brake application pressure high range, rear axle #3, left wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |
| 8 | Brake application pressure high range, rear axle #3, right wheel | Data Length Resolution Data Range | :1 byte :5 kPa per bit gain, 0 kPa offset :0 kPa to +1250 kPa (0 to 181 psi) |

16 SUPPLY PRESSURE

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 174 |
| Default priority | : | 6 |
| Parameter group number | : | 65,198 (00FEAE ₁₆) |

| | | | | |
|-------|-----|--|---|--|
| Byte: | 1 | Pneumatic supply pressure | | |
| | 2 | Parking and/or trailer air pressure | Data Length Resolution Data Range | :1 byte :8 kPa per bit gain, 0 kPa offset :0 kPa to +2000 kPa (0 to 290 psi) |
| | 3 | Service brake air pressure, circuit #1 | Data Length Resolution Data Range | :1 byte :8 kPa per bit gain, 0 kPa offset :0 kPa to +2000 kPa (0 to 290 psi) |
| | 4 | Service brake air pressure, circuit #2 | Data Length Resolution Data Range | :1 byte :8 kPa per bit gain, 0 kPa offset :0 kPa to +2000 kPa (0 to 290 psi) |
| | 5 | Auxiliary equipment supply pressure | Data Length Resolution Data Range | :1 byte :8 kPa per bit gain, 0 kPa offset :0 kPa to +2000 kPa (0 to 290 psi) |
| | 6 | Air suspension supply pressure | Data Length Resolution Data Range | :1 byte :8 kPa per bit gain, 0 kPa offset :0 kPa to +2000 kPa (0 to 290 psi) |
| | 7-8 | Not defined | | |



APPENDIX

17 FUEL CONSUMPTION (GASEOUS)

| | | | |
|------------------------------|-----------------|--------------------------------|-----------------------------------|
| Transmission repetition rate | : | On request | |
| Data length | : | 8 bytes | |
| Data page | : | 0 | |
| PDU format | : | 254 | |
| PDU specific | : | 175 | |
| Default priority | : | 7 | |
| Parameter group number | : | 65,199 (00FEAF ₁₆) | |
| Byte: 1-4 | Trip fuel | Data Length | :4 bytes |
| | | Resolution | :0.5 kg per bit gain, 0 kg offset |
| | | Data Range | :0 kg to +2 105 540 607.5 kg |
| 5-8 | Total fuel used | Data Length | :4 bytes |
| | | Resolution | :0.5 kg per bit gain, 0 kg offset |
| | | Data Range | :0 kg to +2 105 540 607.5 kg |

18 ECU HISTORY

| | | | |
|------------------------------|--------------------|--------------------------------|--|
| Transmission repetition rate | : | On request | |
| Data length | : | 8 bytes | |
| Data page | : | 0 | |
| PDU format | : | 254 | |
| PDU specific | : | 177 | |
| Default priority | : | 7 | |
| Parameter group number | : | 65,201 (00FEB1 ₁₆) | |
| Byte: 1-4 | Total ECU distance | Data Length | :4 bytes |
| | | Resolution | :0.125 km per bit, 0 km offset |
| | | Data Range | :0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi) |
| 5-8 | Total ECU run time | Data Length | :4 bytes |
| | | Resolution | :0.05 h/bit, 0 h offset |
| | | Data Range | :0 to 210 554 060.75 h |

19 FUEL INFORMATION (GASEOUS)

| | | | |
|------------------------------|----------------------------|--------------------------------|-----------------------------------|
| Transmission repetition rate | : | On request | |
| Data length | : | 8 bytes | |
| Data page | : | 0 | |
| PDU format | : | 254 | |
| PDU specific | : | 178 | |
| Default priority | : | 7 | |
| Parameter group number | : | 65,202 (00FEB2 ₁₆) | |
| Byte: 1-4 | Total engine PTO fuel used | Data Length | :4 bytes |
| | | Resolution | :0.5 kg per bit gain, 0 kg offset |
| | | Data Range | :0 kg to +2 105 540 607.5 kg |



| | | | |
|-----|------------------------|-------------|--|
| 5-6 | Trip average fuel rate | Data Length | :2 bytes |
| | | Resolution | :0.05 kg/h per bit gain, 0 kg/h offset |
| | | Data Range | :0 kg/h to 3212.75 kg/h |
| 7-8 | Not defined | | |

20 FUEL INFORMATION

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | On request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 179 |
| Default priority | : | 7 |
| Parameter group number | : | 65,203 (00FEB3 ₁₆) |

| | | | |
|-----------|----------------------------|-------------|--------------------------------------|
| Byte: 1-4 | Total engine PTO fuel used | Data Length | :4 bytes |
| | | Resolution | :0.5 L per bit gain, 0 L offset |
| | | Data Range | :0 L to +2 105 540 607.5 L |
| 5-6 | Trip average fuel rate | Data Length | :2 bytes |
| | | Resolution | :0.05 L/h per bit gain, 0 L/h offset |
| | | Data Range | :0 L/h to 3212.75 L/h |
| 7-8 | Not defined | | |

21 TRIP TIME INFORMATION #1

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | On request |
| Data length | : | 16 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 180 |
| Default priority | : | 7 |
| Parameter group number | : | 65,204 (00FEB4 ₁₆) |

| | | | |
|-----------|-------------------------------|-------------|-------------------------|
| Byte: 1-2 | Trip time in VSL | Data Length | :4 bytes |
| | | Resolution | :0.05 h/bit, 0 h offset |
| | | Data Range | :0 to 210 554 060.75 h |
| 3-4 | Trip time in top gear | Data Length | :4 bytes |
| | | Resolution | :0.05 h/bit, 0 h offset |
| | | Data Range | :0 to 210 554 060.75 h |
| 5-6 | Trip time in gear down | Data Length | :4 bytes |
| | | Resolution | :0.05 h/bit, 0 h offset |
| | | Data Range | :0 to 210 554 060.75 h |
| 7-8 | Trip time in derate by engine | Data Length | :4 bytes |
| | | Resolution | :0.05 h/bit, 0 h offset |
| | | Data Range | :0 to 210 554 060.75h |



22 TRIP SHUTDOWN INFORMATION

Transmission repetition rate : On request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 181
 Default priority : 7
 Parameter group number : 65,205 (**00FEB5**₁₆)

| | | | | |
|-------|-----|--|-------------|-----------------------------------|
| Byte: | 1-2 | Trip number of hot shutdowns | Data Length | :2 bytes |
| | | | Resolution | :1 count per bit, 0 counts offset |
| | | | Data Range | :0 to 64 255 counts |
| | 3-4 | Trip number of idle shutdowns | Data Length | :2 bytes |
| | | | Resolution | :1 count per bit, 0 counts offset |
| | | | Data Range | :0 to 64 255 counts |
| | 5-6 | Trip number of idle shutdown overrides | Data Length | :2 bytes |
| | | | Resolution | :1 count per bit, 0 counts offset |
| | | | Data Range | :0 to 64 255 counts |
| | 7-8 | Trip number of sudden decelerations | Data Length | :2 bytes |
| | | | Resolution | :1 count per bit, 0 counts offset |
| | | | Data Range | :0 to 64 255 counts |

23 TRIP VEHICLE SPEED/CRUISE DISTANCE INFORMATION

Transmission repetition rate : On request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 82
 Default priority : 7
 Parameter group number : 65,206 (**00FEB6**₁₆)

| | | | | |
|-------|-----|----------------------------|-------------|--|
| Byte: | 1-2 | Trip maximum vehicle speed | Data Length | :2 bytes |
| | | | Resolution | :1/256 kph per bit, 0 kph offset |
| | | | Data Range | :0 to 250.996 kph |
| | 3-6 | Trip cruise distance | Data Length | :4 bytes |
| | | | Resolution | :0.125 km per bit, 0 km offset |
| | | | Data Range | :0 km to +526 385 151.9 km (0 mi to +327 080 569.4 mi) |
| | 7-8 | Not defined | | |



24 FAN DRIVE

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 189
 Default priority : 6
 Parameter group number : 65,213 (00FEBD₁₆)

Byte: 1 Estimated percent fan speed Data Length :1 byte
 Resolution :0.4%/bit gain, 0% offset
 Data Range :0% to 100%

2 State_Fan_Drive Bit: 8-5 Not defined
 4-1 Fan drive state
 3-8 Not defined

25 ELECTRONIC ENGINE CONTROLLER #4: EEC4

Transmission repetition rate : On request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 190
 Default priority : 7
 Parameter group number : 65,214 (00FEBE₁₆)

Byte: 1,2 Rated engine power Data Length :1 byte
 Resolution :0.5 kW/bit, 0 kW offset (0.67 hp/bit, 0 hp offset)
 Range :0 to 32 127.5 kW (0 to 43 083.7 hp)

3,4 Rated engine speed Data Length :1 byte
 Resolution :0.125 rpm/bit, 0 offset
 Range :0 to 8031.875 rpm

5-8 Not defined

26 WHEEL SPEED INFORMATION

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 191
 Default priority : 6
 Parameter group number : 65,215 (00FEBF₁₆)



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| | | | |
|-----------|---|-------------------------|--|
| Byte: 1,2 | Front axle speed | Data Length | :2 bytes |
| | | Resolution | :1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) |
| | | upper byte resolution = | 1.0 km/h/bit (0.62 mph/bit) |
| | | Data Range | :0 to 251 km/h (0 to 156 mph) |
| 3 | Relative speed; front axle, left wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |
| 4 | Relative speed; front axle, right wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |
| 5 | Relative speed; rear axle #1, left wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |
| 6 | Relative speed; rear axle #1, right wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |
| 7 | Relative speed; rear axle #2, left wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |
| 8 | Relative speed; rear axle #2, right wheel | Data Length | :1 byte |
| | | Resolution | :1/16 km/h/bit gain, 7.8125 km/h offset (1/26 mph/bit gain, 4.844 mph offset) |
| | | Data Range | :-7.8125 km/h to +7.8125 km/h (-4.844 mph to +4.844 mph) |



27 SERVICE-Transmitted with the service component identification that has the shortest distance or nearest time until the next service inspection.

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | On request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 192 |
| Default priority | : | 6 |
| Parameter group number | : | 65,216 (00FEC0 ₁₆) |

| | | | | |
|-------|-----|--------------------------------------|-------------|--|
| Byte: | 1 | Service component identification | Data Length | :1 byte |
| | | | Resolution | :1 Component ID/bit |
| | | | Data Range | :0 to 250 |
| | 2,3 | Service distance | Data Length | :2 bytes |
| | | | Resolution | :5 km/bit gain, -160 635 km offset (3.1 mi/bit gain, 99 593.7 mi offset) |
| | | | Data Range | :-160 635 to +160 640 km (-99 593.7 to +99 596.8 mi) |
| | 4 | Service component identification | Data Length | :1 byte |
| | | | Resolution | :1 Component ID/bit |
| | | | Data Range | :0 to 250 |
| | 5 | Service delay/calendar time based | Data Length | :1 byte |
| | | | Resolution | :1 week/bit gain, -125 weeks offset |
| | | | Data Range | :-125 to +125 weeks |
| | 6 | Service component identification | Data Length | :1 byte |
| | | | Resolution | :1 Component ID/bit |
| | | | Data Range | :0 to 250 |
| | 7,8 | Service delay/operational time based | Data Length | :2 bytes |
| | | | Resolution | :1 h/bit gain, -32 127 h offset |
| | | | Data Range | :-32 127 to 32 128 h |



28 HIGH RESOLUTION VEHICLE DISTANCE

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 193
 Default priority : 6
 Parameter group number : 65,217 (00FEC1₁₆)

| | | | |
|-----------|--|-------------|---|
| Byte: 1-4 | High resolution total vehicle distance | Data Length | :4 bytes |
| | | Resolution | :5 m/bit gain, 0 m offset (16.4 ft/bit gain, 0 ft offset) |
| | | Data Range | :0 to +21 055 406 km (0 to 13 054 351.8 mi) |
| 5-8 | High resolution trip distance | Data Length | :4 bytes |
| | | Resolution | :5 m/bit gain, 0 m offset (16.4 ft/bit gain, 0 ft offset) |
| | | Data Range | :0 to +21 055 406 km (0 to 13 054 351.8 mi) |

29 ELECTRONIC RETARDER CONTROLLER #2: ERC2

Transmission repetition rate : 1 s when active; or on change of state
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 194
 Default priority : 7
 Parameter group number : 65,218 (00FEC2₁₆)

| | | | |
|---------|-----------------|----------|------------------------------|
| Byte: 1 | Retarder_status | Bit: 8-3 | Not defined |
| | | 2,1 | Transmission output retarder |
| 2-8 | Not defined | | |

30 ELECTRONIC TRANSMISSION CONTROLLER #5: ETC5

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 195
 Default priority : 7
 Parameter group number : 65,219 (00FEC3₁₆)

| | | | |
|---------|------------------|----------|------------------|
| Byte: 1 | Range_switch | Bit: 8-5 | Not defined |
| | | 4,3 | Low range sense |
| | | 2,1 | High range sense |
| 2 | Direction_switch | Bit: 8-7 | Not defined |
| | | 6,5 | Forward switch |
| | | 4,3 | Neutral switch |
| | | 2,1 | Reverse switch |



3-8 Not defined

31 ELECTRONIC TRANSMISSION CONTROLLER #4: ETC4

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 197
 Default priority : 7
 Parameter group number : 65,221 (00FEC5₁₆)

| | | |
|---------|--|---|
| Byte: 1 | Transmission synchronizer clutch value | Data Length :1 byte Resolution :0.4%/bit gain, 0% offset Data Range :0 to +100% |
| 2 | Transmission synchronizer brake value | Data Length :1 byte Resolution :0.4%/bit gain, 0% offset Data Range :0 to +100% |

3-8 Not defined

32 ELECTRONIC TRANSMISSION CONTROLLER #3: ETC3

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 199
 Default priority : 7
 Parameter group number : 65,223 (00FEC7₁₆)

| | | |
|---------|----------------------------|--|
| Byte: 1 | Shift finger gear position | Data Length :1 byte Resolution :0.4%/bit gain, 0% offset Data Range :0 to +100% |
| 2 | Shift finger rail position | Data Length :1 byte Resolution :0.4%/bit gain, 0% offset Data Range :0 to +100% |
| 3 | Shift_finger_status_1 | Bit: 8-7 Not defined 6,5 Center rail indicator 4,3 Engagement indicator 2,1 Neutral indicator |
| 4 | Shift_finger_status_2 | Bit 8,7 Gear actuator #2 6,5 Rail actuator #2 4,3 Gear actuator #1 2,1 Rail actuator #1 |



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| | | | | |
|-----|-------------------------|------|-----|----------------------------|
| 5 | Transmission_actuator_1 | Bit: | 8,7 | Splitter indirect actuator |
| | | | 6,5 | Splitter direct actuator |
| | | | 4,3 | Range low actuator |
| | | | 2,1 | Range high actuator |
| 6 | Transmission_actuator_2 | Bit: | 8,7 | Inertia brake actuator |
| | | | 6,5 | Defuel actuator |
| | | | 4,3 | Lockup clutch actuator |
| | | | 2,1 | Clutch actuator |
| 7-8 | Not defined | | | |

33 ALTERNATOR SPEED

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 213 |
| Default priority | : | 6 |
| Parameter group number | : | 65,237 (00FED5 ₁₆) |

| | | | | |
|-------|-----|------------------|-------------|-----------------------------|
| Byte: | 1,2 | Alternator speed | Data Length | :2 bytes |
| | | | Resolution | :0.5 rpm gain, 0 rpm offset |
| | | | Data Range | :0 to 32 127.5 |

3-8 Not defined

34 AUXILIARY DISCRETE INPUT/OUTPUT STATUS

| | | |
|------------------------------|---|--|
| Transmission repetition rate | : | manufacturer defined, not faster than 100 ms |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 217 |
| Default priority | : | 6 |
| Parameter group number | : | 65,241 (00FED9 ₁₆) |

| | | | | |
|---------|-------------|------|-----|-----------------|
| Byte: 1 | I/O_Status1 | Bit: | 8,7 | I/O channel #1 |
| | | | 6,5 | I/O channel #2 |
| | | | 4,3 | I/O channel #3 |
| | | | 2,1 | I/O channel #4 |
| 2 | I/O_Status2 | Bit: | 8,7 | I/O channel #5 |
| | | | 6,5 | I/O channel #6 |
| | | | 4,3 | I/O channel #7 |
| | | | 2,1 | I/O channel #8 |
| 3 | I/O_Status3 | Bit: | 8,7 | I/O channel #9 |
| | | | 6,5 | I/O channel #10 |
| | | | 4,3 | I/O channel #11 |
| | | | 2,1 | I/O channel #12 |



| | | | | |
|---|-------------|------|-----|--------------------------|
| 4 | I/O_Status4 | Bit: | 8,7 | I/O channel #13 |
| | | | 6,5 | I/O channel #14 |
| | | | 4,3 | I/O channel #15 |
| | | | 2,1 | I/O channel #16 |
| | | | 5,6 | Auxiliary I/O channel #1 |
| | | | 7,8 | Auxiliary I/O channel #2 |

35 ENGINE FLUID LEVEL/PRESSURE #2

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 0.5 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 219 |
| Default priority | : | 6 |
| Parameter group number | : | 65,243 (00FEDB ₁₆) |

| | | | | |
|-------|-----|---------------------------------|-------------|-----------------------------------|
| Byte: | 1,2 | Injection control pressure | Data Length | :2 bytes |
| | | | Resolution | :1/256 MPa/bit gain, 0 MPa offset |
| | | | Data Range | :0 to +251 MPa (0 to 36 404 psi) |
| | 3,4 | Injector metering rail pressure | Data Length | :2 bytes |
| | | | Resolution | :1/256 MPa/bit gain, 0 MPa offset |
| | | | Data Range | :0 to +251 MPa (0 to 36 404 psi) |
| | 5-8 | Not defined | | |

36 IDLE OPERATION

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 220 |
| Default priority | : | 6 |
| Parameter group number | : | 65,244 (00FEDC ₁₆) |

| | | | | |
|-------|-----|----------------------|-------------|---------------------------------|
| Byte: | 1-4 | Total idle fuel used | Data Length | :4 bytes |
| | | | Resolution | :0.5 L per bit gain, 0 L offset |
| | | | Data Range | :0 to +2 105 540 607.5 L |
| | 5-8 | Total idle hours | Data Length | :4 bytes |
| | | | Resolution | :0.05 h/bit gain, 0 h offset |
| | | | Data Range | :0 to +210 554 060.75 h |



APPENDIX

37 TURBOCHARGER

Transmission repetition rate : 1 sec
Data length : 8 bytes
Data page : 0
PDU format : 254
PDU specific : 221
Default priority : 6
Parameter group number : 65,245 (00FEDD₁₆)

| | | | |
|---------|--------------------|-------------|--------------------------------|
| Byte: 1 | Turbo oil pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 2,3 | Turbo speed | Data Length | :2 bytes |
| | | Resolution | :4 rpm/bit gain, 0 rpm offset |
| | | Data Range | :0 to +257 020 rpm |
| 4-8 | Not defined | | |

38 AIR START PRESSURE

Transmission repetition rate : on request
Data length : 8 bytes
Data page : 0
PDU format : 254
PDU specific : 222
Default priority : 6
Parameter group number : 65,246 (00FEDE₁₆)

| | | | |
|---------|--------------------|-------------|--------------------------------|
| Byte: 1 | Air start pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 2-8 | Not defined | | |

39 ELECTRONIC ENGINE CONTROLLER #3: EEC3

Transmission repetition rate : 250 ms
Data length : 8 bytes
Data page : 0
PDU format : 254
PDU specific : 223
Default priority : 6
Parameter group number : 65,247 (00FEDF₁₆)

| | | | |
|---------|-----------------------------------|-----------------|----------------------------|
| Byte: 1 | Nominal friction - percent torque | Data Length | :1 byte |
| | | Resolution | :1%/bit gain, -125% offset |
| | | Data Range | :-125 to 125% |
| | | Operating Range | :0 to 125% |



| | | | |
|-----|---|-------------|---|
| 2,3 | Engine's desired operating speed | Data Length | :2 bytes |
| | | Resolution | :0.125 rpm/bit gain, 0 rpm offset (upper byte resolution = 32 rpm/bit) |
| | | Data Range | :0 to 8031.875 rpm |
| 4 | Engine's operating speed asymmetry adjustment | Data Length | :1 byte |
| | | Resolution | :ratio |
| | | Range | :0 to 250 |
| 5-8 | Not defined | | |

40 VEHICLE DISTANCE

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 224 |
| Default priority | : | 6 |
| Parameter group number | : | 65,248 (00FEE0 ₁₆) |

| | | | |
|-----------|---------------|-------------|--|
| Byte: 1-4 | Trip distance | Data Length | :4 bytes |
| | | Resolution | :0.125 km/bit gain, 0 km offset |
| | | Data Range | :0 to +526 385 151.9 km (0 to +327 080 569.4 mi) |

| | | | |
|-----|------------------------|-------------|--|
| 5-8 | Total vehicle distance | Data Length | :4 bytes |
| | | Resolution | :0.125 km/bit gain, 0 km offset |
| | | Data Range | :0 to +526 385 151.9 km (0 to +327 080 569.4 mi) |

41 IDLE SHUTDOWN

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 228 |
| Default priority | : | 6 |
| Parameter group number | : | 65,252 (00FEE4 ₁₆) |

| | | | |
|---------|-------------------------|-----|----------------------------------|
| Byte: 1 | Idle shutdown_1 Bit | 8,7 | Idle shutdown timer state |
| | | 6,5 | Idle shutdown timer override |
| | | 4,3 | Driver alert mode |
| | | 2,1 | Engine has shutdown by system |
| 2 | Idle shutdown_2 Bit | 8,7 | Idle shutdown timer function |
| | | 6-1 | Not defined |
| 3 | Refrigerant_press_1 Bit | 8,7 | Not defined |
| | | 6,5 | Refrigerant high pressure switch |
| | | 4,3 | Refrigerant low pressure switch |
| | | 2,1 | A/C high pressure fan switch |



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| | | | | |
|-----|-------------------|-----|-----|--|
| 4 | Lamp_commands | Bit | 8-3 | Not defined |
| | | | 2,1 | Wait to start lamp |
| 5 | Engine shutdown_1 | Bit | 8,7 | Engine protection shutdown timer state |
| | | | 6,5 | Engine protection shutdown override |
| | | | 4,3 | Engine shutdown approaching |
| | | | 2,1 | Engine has shutdown by protection system |
| 6 | Engine shutdown_2 | Bit | 8,7 | Engine protection timer system configuration |
| | | | 6-1 | Not defined |
| 7-8 | Not defined | | | |

42 ENGINE HOURS, REVOLUTIONS

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 229 |
| Default priority | : | 6 |
| Parameter group number | : | 65,253 (00FEE5 ₁₆) |

| | | | | |
|-------|-----|--------------------------|-------------|------------------------------|
| Byte: | 1-4 | Total engine hours | Data Length | :4 bytes |
| | | | Resolution | :0.05 h/bit gain, 0 h offset |
| | | | Data Range | :0 to +210 554 060.75 h |
| | 5-8 | Total engine revolutions | Data Length | :4 bytes |
| | | | Resolution | :1000 r/bit gain, 0 r offset |
| | | | Data Range | :0 to +4 211 081 215 000 r |

43 TIME/DATE

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 230 |
| Default priority | : | 6 |
| Parameter group number | : | 65,254 (00FEE6 ₁₆) |

| | | | | |
|-------|---|---------|------------------|-----------------------------------|
| Byte: | 1 | Seconds | Data Length | :1 byte |
| | | | Resolution | :0.25 s/bit gain, 0 s offset |
| | | | Operating Range: | 0 to 59.75 s |
| | 2 | Minutes | Data Length | :1 byte |
| | | | Resolution | :1 min/bit gain, 0 min offset |
| | | | Operating Range: | 0 to 59 min |
| | 3 | Hours | Data Length | :1 byte |
| | | | Resolution | :1 h/bit gain, 0 h offset |
| | | | Operating Range: | 0 to 23 h |
| | 4 | Month | Data Length | :1 byte |
| | | | Resolution | :1 month/bit gain, 0 month offset |
| | | | Operating Range: | 1 to 12 month |



| | | |
|-----|-------------|--|
| 5 | Day | Data Length :1 byte Resolution :0.25 day/bit gain, 0 day offset Operating Range:0.25 to 31.75 day |
| 6 | Year | Data Length :1 byte Resolution :1 year/bit gain, +1985 year offset Operating Range:1985 to 2235 year |
| 7,8 | Not defined | |

44 VEHICLE HOURS

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 231
 Default priority : 6
 Parameter group number : 65,255 (00FEE7₁₆)

| | | |
|-----------|---------------------|---|
| Byte: 1-4 | Total vehicle hours | Data Length :4 bytes Resolution :0.05 h/bit gain, 0 h offset Data Range :0 to +210 554 060.75 h |
|-----------|---------------------|---|

| | | |
|-----|---------------------------|---|
| 5-8 | Total power takeoff hours | Data Length :4 bytes Resolution :0.05 h/bit gain, 0 h offset Data Range :0 to +210 554 060.75 h |
|-----|---------------------------|---|

45 VEHICLE DIRECTION/SPEED

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 232
 Default priority : 6
 Parameter group number: 65,256 (00FEE8₁₆)

| | | |
|-----------|-----------------|--|
| Byte: 1,2 | Compass bearing | Data Length :2 bytes Resolution :1/128 degree/bit gain, 0 degree offset Data Range :0 to +502 degrees |
|-----------|-----------------|--|

| | | |
|-----|--------------------------------|---|
| 3,4 | Navigation-based vehicle speed | Data Length :2 bytes Resolution :1/256 km/h/bit gain, 0 km/h offset (1/412 mph/bit gain, 0 mph offset) upper byte resolution = 1.0 km/h/bit (0.62 mph/bit) Data Range :0 to 251 km/h (0 to 156 mph) |
|-----|--------------------------------|---|



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| | | | |
|-----|----------|-------------|---|
| 5,6 | Pitch | Data Length | :2 bytes |
| | | Resolution | :1/128 degree/bit gain, -200 degrees offset |
| | | Data Range | :-200 degrees (DESCENT) to +302 degrees (ASCENT) |
| 7,8 | Altitude | Data Length | :2 bytes |
| | | Resolution | :0.125 m/bit gain, -2500 m offset |
| | | Data Range | :-2500 to +5531.875 m (-8202.1 to +15 896.193 ft) |

46 FUEL CONSUMPTION

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 233 |
| Default priority | : | 6 |
| Parameter group number | : | 65,257 (00FEE9 ₁₆) |

| | | | |
|-----------|-----------|-------------|---------------------------------|
| Byte: 1-4 | Trip fuel | Data Length | :4 bytes |
| | | Resolution | :0.5 L per bit gain, 0 L offset |
| | | Data Range | :0 to +2 105 540 607.5 L |

| | | | |
|-----|-----------------|-------------|---------------------------------|
| 5-8 | Total fuel used | Data Length | :4 bytes |
| | | Resolution | :0.5 L per bit gain, 0 L offset |
| | | Data Range | :0 to +2 105 540 607.5 L |

47 VEHICLE WEIGHT

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | on request |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 234 |
| Default priority | : | 6 |
| Parameter group number | : | 65,258 (00FEEA ₁₆) |

| | | | |
|---------|---------------|-------------|-------------|
| Byte: 1 | Axle location | Data Length | :1 byte |
| | | Resolution | :Bit-mapped |
| | | Data Range | :N/A |

| | | | |
|-----|-------------|-------------|-------------------------------------|
| 2,3 | Axle weight | Data Length | :2 bytes |
| | | Resolution | :0.5 kg/bit gain, 0 kg offset |
| | | Data Range | :0 to +32 127.5 kg (0 to 70 829 lb) |

| | | | |
|-----|----------------|-------------|-------------------------------------|
| 4,5 | Trailer weight | Data Length | :2 bytes |
| | | Resolution | :2.0 kg/bit gain, 0 kg offset |
| | | Data Range | :0 to +128 510 kg (0 to 283 316 lb) |



| | | | |
|-----|--------------|-------------|-------------------------------------|
| 6,7 | Cargo weight | Data Length | :2 bytes |
| | | Resolution | :2.0 kg/bit gain, 0 kg offset |
| | | Data Range | :0 to +128 510 kg (0 to 283 316 lb) |
| 8 | Not defined | | |

48 CRUISE CONTROL/VEHICLE SPEED SETUP

Transmission repetition rate : on request
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 237
 Default priority : 6
 Parameter group number : 65,261 (00FEED₁₆)

| | | | |
|---------|-------------------------------------|-------------|--------------------------------------|
| Byte: 1 | Maximum vehicle speed limit | Data Length | :1 byte |
| | | Resolution | :1 km/h/bit gain, 0 km/h offset |
| | | Data Range | :0 to +250 km/h (0 km/h to +155 mph) |
| 2 | Cruise control high set limit speed | Data Length | :1 byte |
| | | Resolution | :1 km/h/bit gain, 0 km/h offset |
| | | Data Range | :0 to +250 km/h (0 km/h to +155 mph) |
| 3 | Cruise control low set limit speed | Data Length | :1 byte |
| | | Resolution | :1 km/h/bit gain, 0 km/h offset |
| | | Data Range | :0 to +250 km/h (0 km/h to +155 mph) |

4-8 Not defined

49 ENGINE TEMPERATURE

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 238
 Default priority : 6
 Parameter group number : 65,262 (00FEEE₁₆)

| | | | |
|---------|----------------------------|-------------|---------------------------------|
| Byte: 1 | Engine coolant temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |
| 2 | Fuel temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |



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| | | | |
|-----|--------------------------------|-------------|---|
| 3,4 | Engine oil temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 8 | Not defined | | |
| 5,6 | Turbo oil temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 7 | Engine intercooler temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |

50 ENGINE FLUID LEVEL/PRESSURE

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 0.5 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 239 |
| Default priority | : | 6 |
| Parameter group number | : | 65,263 (00FEEF ₁₆) |

| | | | |
|---------|------------------------|-------------|---|
| Byte: 1 | Fuel delivery pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 2 | Not defined | | |
| 3 | Engine oil level | Data Length | :1 byte |
| | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | Data Range | :0 to +100 % |
| 4 | Engine oil pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 5,6 | Crankcase pressure | Data Length | :2 bytes |
| | | Resolution | :7.8125 x 10 ⁻³ kPa/bit gain (1/128 kPa/bit), -250 kPa offset |
| | | Data Range | :-250 to +251.99 kPa (-36.259 to +36.548 lbf/in2) |
| 7 | Coolant pressure | Data Length | :1 byte |
| | | Resolution | :2 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +500 kPa (0 to 72.5 psi) |
| 8 | Coolant level | Data Length | :1 byte |
| | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | Data Range | :0 to +100 % |



51 POWER TAKEOFF INFORMATION

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 240
 Default priority : 6
 Parameter group number : 65,264 (00FEF0₁₆)

| | | |
|---------|-------------------------------|---|
| Byte: 1 | Power takeoff oil temperature | Data Length :1 byte Resolution :1 °C/bit gain, -40 °C offset Data Range :-40 to +210 °C (-40 to 410 °F) |
| 2,3 | Power takeoff speed | Data Length :2 bytes Resolution :0.125 rpm/bit gain, 0 rpm offset Data Range :0 to +8031.875 rpm |
| 4,5 | Power takeoff set speed | Data Length :2 bytes Resolution :0.125 rpm/bit gain, 0 rpm offset Data Range :0 to +8031.875 rpm |
| 6 | Measured_PTO_1 | Bit: 8,7 Not defined 6,5 Remote PTO variable speed control switch 4,3 Remote PTO preprogrammed speed control switch |
| 7 | Measured_PTO_2 | Bit: 2,1 PTO enable switch 8,7 PTO accelerate switch 6,5 PTO resume switch 4,3 PTO coast/decelerate switch 2,1 PTO set switch |
| 8 | Not defined | |

52 CRUISE CONTROL/VEHICLE SPEED

Transmission repetition rate : 100 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 241
 Default priority : 6
 Parameter group number : 65,265 (00FEF1₁₆)

| | | |
|---------|---------------------------|---|
| Byte: 1 | Measured_SW1 | Bit: 8-5 Not defined 4,3 Parking brake switch 2,1 Two speed axle switch |
| 2,3 | Wheel-based vehicle speed | Data Length :2 bytes Resolution :1/256 km/h/bit gain, 0 km/h offset (1/412 mph/ bit gain, 0 mph offset) Upper byte resolution = 1.0 km/h/bit (0.62 mph/bit) Data Range :0 to 251 km/h (0 to 156 mph) |



APPENDIX

| | | | | |
|---|--------------------------|---|--|--|
| 4 | Measured_CC_SW1 | Bit: | 8,7 6,5 4,3 2,1 | Clutch switch Brake switch Cruise control enable switch Cruise control active |
| 5 | Measured_CC_SW2 | Bit: | 8,7 6,5 4,3 2,1 | Cruise control accelerate switch Cruise control resume switch Cruise control coast switch Cruise control set switch |
| 6 | Cruise control set speed | Data Length Resolution Data Range | :1 byte :1 km/h/bit gain, 0 km/h offset :0 to +250 km/h (0 km/h to +155 mph) | |
| 7 | State_CC | Bit: | 8-6 5-1 | Cruise control state PTO state |
| 8 | Measured_Idle_SW1 | Bit: | 8,7 6,5 4,3 2,1 | Not defined Engine test mode switch Idle decrement switch Idle increment switch |

53 FUEL ECONOMY

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 100 ms |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 242 |
| Default priority | : | 6 |
| Parameter group number | : | 65,266 (00FEF2 ₁₆) |

| | | | | |
|-------|-----|----------------------------|---|--|
| Byte: | 1,2 | Fuel rate | Data Length Resolution Data Range | :2 bytes :0.05 L/h per bit gain, 0 L/h offset (13.9 x 10 ⁻⁶ L/s per bit) :0 to +3212.75 L/h |
| | 3,4 | Instantaneous fuel economy | Data Length Resolution Data Range | :2 bytes :1/512 km/L per bit gain, 0 km/L offset :0 to +125.5 km/L |
| | 5,6 | Average fuel economy | Data Length Resolution Data Range | :2 bytes :1/512 km/L per bit gain, 0 km/L offset :0 to +125.5 km/L |
| | 7,8 | Not defined | | |



54 VEHICLE POSITION

Transmission repetition rate : 5 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 243
 Default priority : 6
 Parameter group number : 65,267 (00FEF3₁₆)

| | | | |
|-----------|-----------|-------------|--|
| Byte: 1-4 | Latitude | Data Length | :4 bytes |
| | | Resolution | :10-7 degree/bit gain, -210 degree offset |
| | | Data Range | :-210 degrees (SOUTH) to + 211.108 122 degrees (NORTH) |
| 5-8 | Longitude | Data Length | :4 bytes |
| | | Resolution | :10-7 degree/bit gain, -210 degree offset |
| | | Data Range | :-210 degrees (WEST) to + 211.108 121 degrees (EAST) |

55 TIRE CONDITION

Transmission repetition rate : 10 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 244
 Default priority : 6
 Parameter group number : 65,268 (00FEF4₁₆)

| | | | |
|---------|------------------|-------------|------------------------------------|
| Byte: 1 | Location | Data Length | :1 byte |
| | | Resolution | :Bit-mapped |
| | | Data Range | :N/A |
| 2 | Tire pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 3,4 | Tire temperature | Data Length | :1 byte |
| | | Resolution | :5 kPa per bit gain, 0 kPa offset |
| | | Data Range | :0 kPa to +1250 kPa (0 to 181 psi) |
| 5-8 | Not defined | | |



APPENDIX

56 AMBIENT CONDITIONS

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 245
 Default priority : 6
 Parameter group number : 65,269 (00FEF5₁₆)

| | | | |
|---------|--------------------------|-------------|---|
| Byte: 1 | Barometric pressure | Data Length | :1 byte |
| | | Resolution | :0.5 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +125 kPa (0 to +18.1 psi) |
| 2,3 | Cab interior temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 4,5 | Ambient air temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 6 | Air inlet temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |
| 7,8 | Road surface temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |

57 INLET/EXHAUST CONDITIONS

Transmission repetition rate : 0.5 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 246
 Default priority : 6
 Parameter group number : 65,270 (00FEF6₁₆)

| | | | |
|---------|---------------------------------|-------------|---------------------------------|
| Byte: 1 | Particulate trap inlet pressure | Data Length | :1 byte |
| | | Resolution | :0.5 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +125 kPa (0 to +18.1 psi) |
| 2 | Boost pressure | Data Length | :1 byte |
| | | Resolution | :2 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +500 kPa (0 to 72.5 psi) |
| 3 | Intake manifold temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |



| | | | |
|-----|--------------------------------------|---|---|
| 4 | Air inlet pressure | Data Length Resolution Data Range | :1 byte :2 kPa/bit gain, 0 kPa offset :0 to +500 kPa (0 to 72.5 psi) |
| 5 | Air filter differential pressure | Data Length Resolution Data Range | :1 byte :0.05 kPa/bit gain, 0 kPa offset :0 to +12.5 kPa (0 to +1.8 psi) |
| 6,7 | Exhaust gas temperature | Data Length Resolution Data Range | :2 bytes :0.03125 °C/bit gain, -273 °C offset :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 8 | Coolant filter differential pressure | Data Length Resolution Data Range | :1 byte :0.5 kPa/bit gain, 0 kPa offset :0 to +125 kPa (0 to +18.1 psi) |

58 VEHICLE ELECTRICAL POWER

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 247 |
| Default priority | : | 6 |
| Parameter group number | : | 65,271 (00FEF7 ₁₆) |

| | | | |
|---------|---------------------------------------|---|--|
| Byte: 1 | Net battery current | Data Length Resolution Data Range | :1 byte :1.0 A/bit gain, -125 A offset :-125 to +125 A |
| 2 | Alternator current | Data Length Resolution Data Range | :1 byte :1.0 A/bit gain, 0 A offset :0 to +250 A |
| 3,4 | Alternator potential (voltage) | Data Length Resolution Data Range | :2 bytes :0.05 V/bit gain, 0 V offset :0 to +3212.75 V |
| 5,6 | Electrical potential (voltage) | Data Length Resolution Data Range | :2 bytes :0.05 V/bit gain, 0 V offset :0 to +3212.75 V |
| 7,8 | Battery potential (voltage), switched | Data Length Resolution Data Range | :2 bytes :0.05 V/bit gain, 0 V offset :0 to +3212.75 V |



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59 TRANSMISSION FLUIDS

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 248
 Default priority : 6
 Parameter group number : 65,272 (00FEF8₁₆)

| | | | |
|---------|---|-------------|---|
| Byte: 1 | Clutch pressure | Data Length | :1 byte |
| | | Resolution | :16 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +4000 kPa (0 to 580 psi) |
| 2 | Transmission oil level | Data Length | :1 byte |
| | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | Data Range | :0 to +100 % |
| 3 | Transmission filter differential pressure | Data Length | :1 byte |
| | | Resolution | :2 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +500 kPa (0 to 72.5 psi) |
| 4 | Transmission oil pressure | Data Length | :1 byte |
| | | Resolution | :16 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +4000 kPa (0 to 580 psi) |
| 5,6 | Transmission oil temperature | Data Length | :2 bytes |
| | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| 7,8 | Not defined | | |

60 AXLE INFORMATION

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 249
 Default priority : 6
 Parameter group number : 65,273 (00FEF9₁₆)

| | | | |
|---------|---------------------------|-------------|---------------------------------|
| Byte: 1 | Steering axle temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |
| 2 | Drive axle location | Data Length | :1 byte |
| | | Resolution | :Bit-mapped |
| | | Data Range | :N/A |



| | | | |
|-----|------------------------------|-------------|---------------------------------|
| 3 | Drive axle lift air pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 4 | Drive axle temperature | Data Length | :1 byte |
| | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | Data Range | :-40 to +210 °C (-40 to 410 °F) |
| 5-8 | Not defined | | |

61 BRAKES

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 250
 Default priority : 6
 Parameter group number : 65,274 (00FEFA₁₆)

| | | | |
|---------|----------------------------|-------------|--------------------------------|
| Byte: 1 | Brake application pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 2 | Brake primary pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 3 | Brake secondary pressure | Data Length | :1 byte |
| | | Resolution | :4 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +1000 kPa (0 to 145 psi) |
| 4 | Brake_status | Bit: 8-3 | Not defined |
| | | 2,1 | Parking brake actuator |
| 5-8 | Not defined | | |

62 RETARDER FLUIDS

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 251
 Default priority : 6
 Parameter group number : 65,275 (00FEFB₁₆)



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| | | | | |
|-------|-----|------------------------------------|-------------|---------------------------------|
| Byte: | 1 | Hydraulic retarder pressure | Data Length | :1 byte |
| | | | Resolution | :16 kPa/bit gain, 0 kPa offset |
| | | | Data Range | :0 to +4000 kPa (0 to 580 psi) |
| | 2 | Hydraulic retarder oil temperature | Data Length | :1 byte |
| | | | Resolution | :1 °C/bit gain, -40 °C offset |
| | | | Data Range | :-40 to +210 °C (-40 to 410 °F) |
| | 3-8 | Not defined | | |

63 DASH DISPLAY

| | | |
|------------------------------|---|--------------------------------|
| Transmission repetition rate | : | 1 s |
| Data length | : | 8 bytes |
| Data page | : | 0 |
| PDU format | : | 254 |
| PDU specific | : | 252 |
| Default priority | : | 6 |
| Parameter group number | : | 65,276 (00FEFC ₁₆) |

| | | | | |
|-------|-----|---|-------------|---|
| Byte: | 1 | Washer fluid level | Data Length | :1 byte |
| | | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | | Data Range | :0 to +100 % |
| | 2 | Fuel level | Data Length | :1 byte |
| | | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | | Data Range | :0 to +100 % |
| | 3 | Fuel filter differential pressure | Data Length | :1 byte |
| | | | Resolution | :2 kPa/bit gain, 0 kPa offset |
| | | | Data Range | :0 to +500 kPa (0 to 72.5 psi) |
| | 4 | Engine oil filter differential pressure | Data Length | :1 byte |
| | | | Resolution | :0.5 kPa/bit gain, 0 kPa offset |
| | | | Data Range | :0 to +125 kPa (0 to +18.1 psi) |
| | 5,6 | Cargo ambient temperature | Data Length | :2 bytes |
| | | | Resolution | :0.03125 °C/bit gain, -273 °C offset |
| | | | Data Range | :-273 to +1735.0 °C (-459.4 to 3155.0 °F) |
| | 7-8 | Not defined | | |



64 ALTERNATE FUEL #1

Transmission repetition rate : 500 ms
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 253
 Default priority : 6
 Parameter group number : 65,277 (00FEFD₁₆)

| | | | |
|---------|------------------------------|-------------|--|
| Byte: 1 | Blower bypass valve position | Data Length | :1 byte |
| | | Resolution | :0.4 %/bit gain, 0 % offset |
| | | Data Range | :0 to +100 % |
| 2,3 | Gas supply pressure | Data Length | :2 bytes |
| | | Resolution | :0.5 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +32 127.5 kPa (0 to 4 659.7 psi) |
| 2-8 | Not defined | | |

65 AUXILIARY WATER PUMP PRESSURE

Transmission repetition rate : 1 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 254
 Default priority : 6
 Parameter group number : 65,278 (00FEFE₁₆)

| | | | |
|---------|-------------------------|-------------|--------------------------------|
| Byte: 1 | Auxiliary pump pressure | Data Length | :1 byte |
| | | Resolution | :16 kPa/bit gain, 0 kPa offset |
| | | Data Range | :0 to +4000 kPa (0 to 580 psi) |
| 2-8 | Not defined | | |

66 WATER IN FUEL INDICATOR

Transmission repetition rate : 10 s
 Data length : 8 bytes
 Data page : 0
 PDU format : 254
 PDU specific : 255
 Default priority : 6
 Parameter group number : 65,279 (00FEFF₁₆)

| | | | |
|---------|-------------------------|----------|-------------------------|
| Byte: 1 | Water in fuel indicator | Bit: 8-3 | Not defined |
| | | 2,1 | Water in fuel indicator |
| 2-8 | Not defined | | |



APPENDIX

67 PROPRIETARY B PGN

| | | |
|------------------------------|---|---|
| Transmission repetition rate | : | Per user requirements |
| Data length | : | 0 to 1785 bytes (multipacket supported) |
| Data Page | : | 0 |
| PDU Format | : | 255 |
| PDU Specific | : | Group Extension (manufacturer assigned) |
| Default priority | : | 6 |
| Parameter Group Number | : | 65280 to 65535 (00FF00₁₆ to 00FFFF₁₆) |
| Byte | : | 1-8 Manufacturer defined usage |



C Details of Rotochopper Application

This is the customized application. There are two option available in the COM2 Protocol list.

1. CAN(J1939/71)
2. CAN(J1939/71For Rotochopper)

First option CAN(J1939/71) is the generic CAN (J1939/71) Protocol. That means all the PGNs defined in the Appendix A are available and can be mapped to any register. The mapping is explained in Chapter 6.

For e.g.: If user wants to map a PGN of 8 bytes to registers, then mapping is, first two bytes of PGN mapped with first register, next two bytes are mapped with second register and so on.

In the second option, according to the Customer's specifications only few PGNs are defined and mapping is done accordingly. This is for single node application. The list of PGNs and their mapping for this application is as follows:

CAN Parameter Mapping to Modbus Registers and Toshiba PLC Registers:

| CAN Group Number | Parameter Description | Modbus Register | Toshiba Register |
|---|--|--|--|
| 00F003 (#EEC2) | Status_EEC2 Accelerator Pedal (AP)Position Percent load at current speed Remote accelerator Not Defined | 40001 40002 40003 40004 | D0000 D0001 D0002 D0003 |
| 00F004 (#EEC1) | Status_EEC1 Driver's demand Engine-percent Torque Actual Engine -percent Torque Engine Speed Not Defined | 40005 40006 40007 40008 | D0004 D0005 D0006 D0007 |
| 00FEBD (#FAN Drive) | Estimated Percent Fan Speed State_Fan_Drive Not Defined | 40009 40010 | D0008 D0009 |
| 00FEDB (#Engine Fluid Level Pressure) | Injection control pressure Injector metering rail pressure Not Defined | 4011 4012 | D0010 D0011 |
| 00FEE0 (Vehicle Distance) | Trip Distance Total Vehicle distance | 4013(Hi Word) 4014(Low Word) 4015(Hi Word) 4016(Low Word) | D0012(Hi Word) D0013(Low Word) D0014(Hi Word) D0015(Low Word) |
| 00FEE5 (Engine Hours, Revolutions) | Total Engine houres Total Engine Revolutions | 4017(Hi Word) 4018(Low Word) 4019(Hi Word) 4020(Low Word) | D0015(Hi Word) D0016(Low Word) D0017(Hi Word) D0019(Low Word) |



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| CAN Group Number | Parameter Description | Modbus Register | Toshiba Register |
|---|---|--|--|
| 00FEE9 (Fuel Consumption) | Trip Fuel Total Fuel Used | 4021(Hi Word) 4022(Low Word) 4023(Hi Word) 4024(Low Word) | D0020(Hi Word) D0021(Low Word) D0022(Hi Word) D0023(Low Word) |
| 00FEEE (Engine Temperature) | Engine Coolant Temperature Fuel Temperature Engine Oil Temperature Turbo Oil Temperature Engine Intercooler Temperature Not Defined | 40025 40026 40027 40028 40029 | D0024 D0025 D0026 D0027 D0028 |
| 00FEF (Engine Fluid Level /Pressure) | Fuel Delivery Pressure Not Defined Engine Oil Level Engine Oil Pressure Crankcase Pressure Coolant Pressure Coolant Level | 40030 40031 40032 40033 40034 40035 | D0029 D0030 D0031 D0032 D0033 D0034 |
| 00FEF1 (Cruise Control /Vehicle speed) | Measured_SW1 Wheel-based vehicle speed Measured_CC_SW1 Measured_CC_SW2 Cruise control set speed State_CC Measured_Idle_SW1 | 40036 40037 40038 40039 40040 40041 40042 | D0035 D0036 D0037 D0038 D0039 D0040 D0041 |
| 00FEF2 (Fuel Economy) | Fuel Rate Instantaneous fuel economy Average fuel economy Not Defined | 40043 40044 40045 | D0042 D0043 D0044 |
| 00FEF5 (Ambient Conditions) | Barometric Pressure Cab Interior temperature Ambient air Temperature Air Inlet Temperature Road surface temperature | 40046 40047 40048 40049 40050 | D0045 D0046 D0047 D0048 D0049 |
| 00FEF6 (Inlet/Exhaust Conditions) | Particulate trap inlet pressure Boost Pressure Intake manifold temperature Air inlet pressure Air filter differential pressure Exhaust gas temperature Coolant filter differential pressure | 40051 40052 40053 40054 40055 40056 40057 | D0050 D0051 D0052 D0053 D0054 D0055 D0056 |



| CAN Group Number | Parameter Description | Modbus Register | Toshiba Register |
|---|---|-----------------|------------------|
| 00FEF7 (Vehicle Electrical Power) | Net Battery Current | 40058 | D0057 |
| | Alternator Current | 40059 | D0058 |
| | Alternator Potential(voltage) | 40060 | D0059 |
| | Electrical Potential(voltage) | 40061 | D0060 |
| | Battery Potential(voltage),switched | 40062 | D0061 |
| 00FEF8 (Transmission Fluids) | Clutch pressure | 40063 | D0062 |
| | Transmission oil level | 40064 | D0063 |
| | Transmission filter differential pressure | 40065 | D0064 |
| | Transmission oil pressure | 40066 | D0065 |
| | Transmission oil temperature | 40067 | D0066 |
| | Not Defined | | |

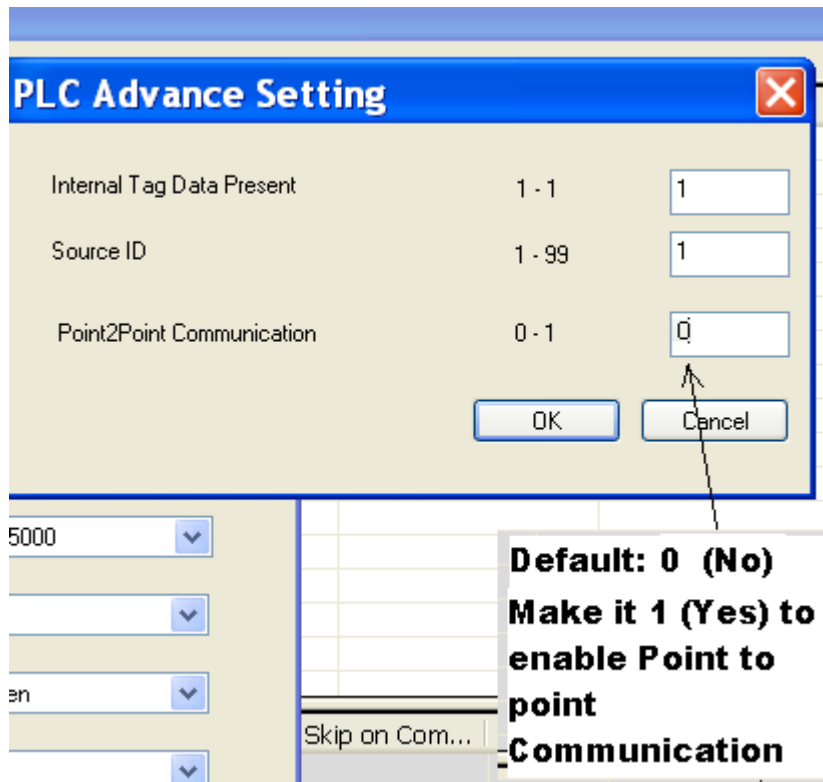


D Troubleshooting

If you do not know the ID of your ECU:

Point To Point Communication:

If ONLY TWO nodes will communicate with one another :one our Gateway and the other say for e.g. an ECU (Electronic Control Unit) of an Engine whose station ID is unknown, Enable the Point-to-Point Communication by making the following tab as one. Now irrespective of the Station ID of the ECU communication will take place successfully.



If CAN LED is not blinking:

The CAN led is for indicating that proper communication has been enabled on the CAN network. If it does not blink after downloading the 2 probable reasons could be:

- 1) Improper selection of Baud Rate in the PLC2 Settings in the Project file.
- 2) Improper Termination, this can be solved by using a 120ohm resistor at the CAN terminal on the GWY-300 CAN port.

Now the CAN Led blinking is an indication that the communication is right. So if the LED blinks and yet data is not available indicates that the Station ID of the external device and the one entered in the Target ID column of the downloaded project do not match. As mentioned earlier if only two nodes are been used Point To Point Communication can be enabled else the right value (of the station ID) has to be determined and used in the project.

Note:

For receiving any PGN on the CAN, while creating the project, the corresponding PGN (User wants to receive) should have 0 suffix.

For example, P0:000F000

For transmitting any PGN on the CAN, while creating the project, the corresponding PGN (User wants to transmit) should have 1 suffix.

For example, P1:000F000



If serial data is not displayed on CAN:

For receiving any PGN on the CAN, while creating the project, the corresponding PGN (User wants to receive) should have 0 suffix.

For example, **P0:000F000**

For transmitting any PGN on the CAN, while creating the project, the corresponding PGN (User wants to transmit) should have 1 suffix.

For example, **P1:000F000**

