

## EM WP 2.2 Bodybuilder CANopen Manual

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## Revision history

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1.4 in progress	04.02.2013	U.Hiermann	2.2.6 CAN bus load précised 8.9 TSC1 limitations précised HMI interface added (Chapters 10.4 ..10.6) Chapter 13 added
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1.7	24.05.2013	U.Hiermann	Structure modified to be aligned to BB webpage Dedicated chapter CAN basics - tutorial Hint to vehicle OPT ordering, interface approach selection added BB Market responsables added Usage of XDD file illustrated Dedicated chapter Requirements for Functional Safety CAN firewall aligned of BB webpage BB StoppedState aligned of BB webpage Basic rules for Vehcile CAN interface Busload and CAN troughput information added
1.8	06.06.2013	U.Hiermann	Busload and Trueput information added for Heavy PTO on automised gearboxes added
1.9	17.09.2013	U.Hiermann	IVECO internal connector numbering for CiA413 connectors added Supported BaudRate 125kB and 250kB Warning symbols added StoppedState management précised

## Reference Documents

#	Document Title	Document Number	Rev.
1	CiA DS-301 Application Layer and Communication Profile		
2	CiA DR-303 Indicator Specification		
3	CiA DS-306 Electronic data sheet specification for CANopen		
4	CiA DS-311 XML schema definition		
5	CiA DS-402 Device Profile for Drives and Motion Control		
6	CiA DS-413 Part 1 to 7 Device profile for truck Gateways		
7	ISO 11898: Road vehicles - Controller area network (CAN)		
8	EN1501-1		

## Abbreviations

PTO	Power Take OFF
ECU	Electronic Control Unit
EM	Expansion Module
CAN	Control Area Network
CiA	CAN in Automation : International Association of CAN device's manufacturers and users
CANopen	CANopen application and communication profile Defined by CiA
CAL (CAN Application Layer)	ISO 7 Layer for CAN applications defined by CiA, predecessor of CANopen application and communication profile
Object Dictionary	Represents a collection of all data items in a node which are accessible via the network.
COB (Communication Object)	On CAN bus data is sent as packets so called Communication Objects. A CAN device can send and receive COB's.
COB-ID (COB-Identifier)	Each COB is identified by a unique COB-identifier.
NMT (Network Management )	Necessary to do initialization, configuration and error processing.
Node-ID (Node identification)	Node ID identifies a device in CANopen net. All devices must have a unique Node ID. Node ID 0 is reserved and addresses all nodes in the network
PDO (Process Data Object)	PDO is used to access Application Objects in real time with no protocol overhead.
RPDO	Received PDO, (comparable to SAE Received Messages)
TPDO	Transmitted PDO, (comparable to SAE Transmitted Messages)
SDO (Service Data Object)	SDO 's provide access to a nodes Data Dictionary.
SYNC	Synchronisation Objects can be used to setup a synchronise nodes in a Network
EMCY	EMCY Objects indicate the occurrence of a node error to the network. An Emergency object is only triggered once at occurrence.
EDS	Electronic Data Sheet. The EDS file is a image of the CANopen node object dictionary.
XDC	XML device configuration file, contains the CANopen configuration of the current device
XDD	XML device description file, extension of a EDS file
RR	EM firewall - Request Restriction (on first occurrence)
RS	EM firewall - Request Shutoff (during Request being active)
KL15	Ignition Key
CS	Iveco Customer Service

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# 1 Additional Connectors

Iveco provides two positions where Bodybuilders can connect to the CAN Network (A + B), therefore also two connectors are available depending on the connector position.

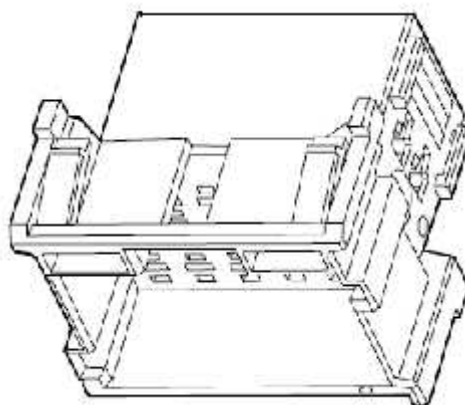
The further IVECO BB connectors are described in the Euro6 IVECO BB manuals for the various ranges.

The connectors shown are the counter parts **not** mounted on the Truck and can be ordered at Tyco, AMP by the Bodybuilder to connect to the Body to the Truck.

## 1.1 Connector Ordering Numbers

### 1.1.1 CiA-C413 Cab 9 Pole (always present if CANopen Interface ordered)

The IVECO internal connector numbering is ST 72072C



Drawing 1: CiA C413 - cab connector\*

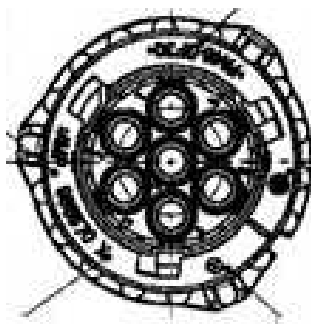
Tyco Code	Description
1-967626-1	CANOpen Cab connector

\*illustration only



### 1.1.2 CiA-F413 Frame 7 Pole (not available if power packer installed)

The IVECO internal connector numbering is ST 72072D



Drawing 2: CiA F413 - frame connector

Tyco Code	Description
1-718230-1	CANOpen Frame connector*

\*if you order the connector also order pin's, sealing and clip cover (90° or straight)

## 1.2 Connector Pin out

### 1.2.1 CiA-C413 Cab

Pin	Description	Wire code	Max. Load	Connected to
1	K 30	7796		K30
2	GND	0000		GND
3	Enable	0975	0,5 A	EM X4-28
4	BB Can	CAN-H		EM X4-17
5	CAN Gnd	0999		EM X4-09
6	BB Can	CAN-L		EM X4-19
7	reserved			
8	reserved			
9	reserved			

Tab 1: CiA-C413 Pin out

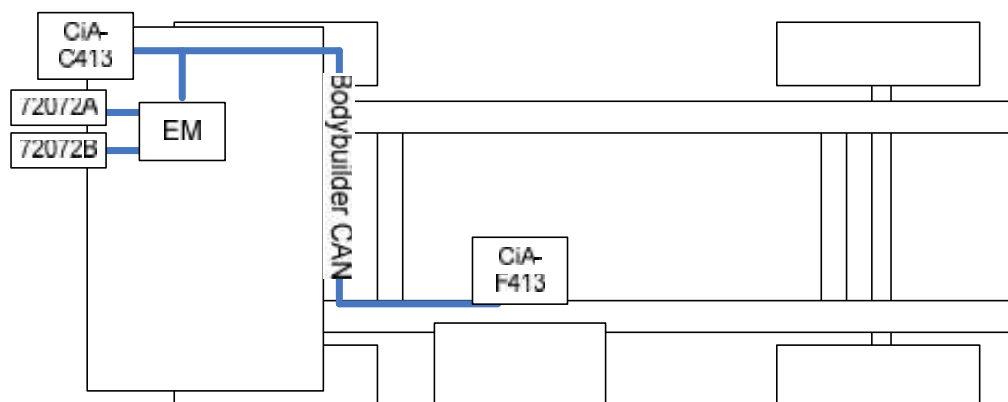
### 1.2.2 CiA-F413 Frame

Pin	Description	Wire code	Max. Load	Connected to
1	K 30	7795		K30
2	GND	0000		GND
3	Enable	0975	0,5 A	EM X4-28
4	BB CAN	CAN-H		EM X4-17
5	CAN Gnd	0999		EM X4-09
6	BB CAN	CAN-L		EM X4-19
7	reserved			

Tab 2: CiA-F413 Pin out

### 1.3 Connector Location

The connectors are located as shown in the drawing. As you can see the CiA-C413 and CiA-F413 are already connected by IVECO thus the Body Builder has no need to install a wire from the Cab to the Frame.



Drawing 3: Wiring Location

#### 1.3.1 CiA-C413 Cab

On Heavy Stralis and Trakker Range The connector is located in the co-driver foot compartment on the right side of the ECU panel.

On EuroCargo Range The connector is located behind the central electric inside the dashboard co-driver side.

#### 1.3.2 CiA-F413 Frame

The connector is located inside the frame closed to the battery case



## 2 CAN basics – Tutorial

The IVECO BodyBuilder interface is available in various configurations. Pls verify before placing the vehicle order that proper interface configuration is chosen. Installations and Updates in CustomerService are highly time and cost consuming. When you're intending to use a CAN based interface select the suitable CAN interface approach.

Get familiar with the information available on the IVECO BB homepage and pls contact your BB Market reference. They are trained on this subject and will support and guide you on following tasks:

- Selecting your needed vehicle optionals
- Chose the proper CAN interface approach – if intended
- Identify your special customization needs
- Support you on Cost and Project timing
- Support you on Workshop Programming – when needed

If you're familiar with CANopen pls also make use of the Extended Device Description file, which provide you plenty of detailed informations, such as:

- Signal content
- SAE J1939 SPN references
- Minimum and Maximum values
- Signal resolution
- Physical units

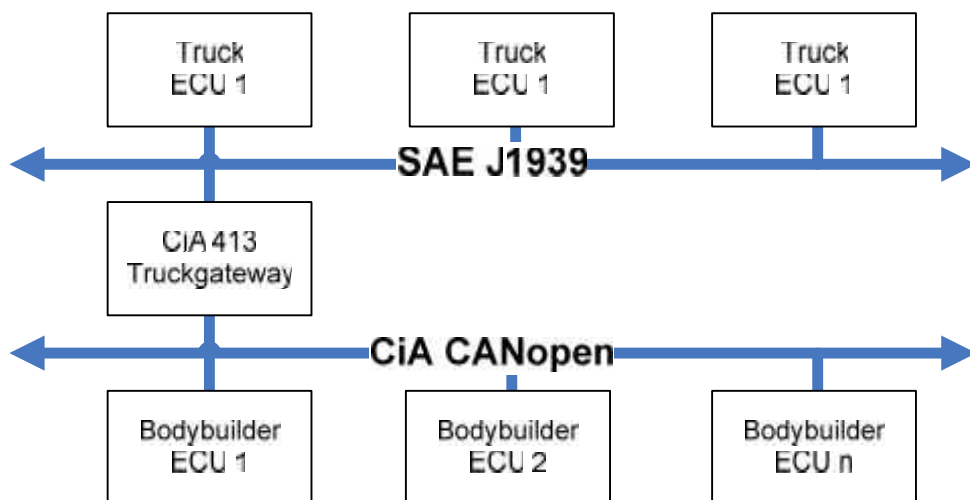
These information is highly useful for any CAN based application. There are FreeOfCharge EDS tools available – IVECO is using Freeware "CANeds" from VECTOR Informatik GmbH.

Furthermore the \*.XDD file offer you to integrate the Truckgateway inside your VECTOR CANopen simulation environment – allowing you to setup, test and optimize the communication.

### 2.1 CAN Interface Concept

The IVECO CAN interface shall provide a possibility to integrate third party CAN nodes seamlessly in the vehicle E/E architecture. To reduce integration effort and costs for Bodybuilders the interface provided by Iveco is identical over the whole Medium and Heavy vehicle range (Stralis/Trakker/Eurocargo), with minor variations due to different vehicle functionalities.

In order to follow a standardized, well defined and secure approach IVECO decided to implement the CiA 413 Truckgateway device profile in EM WP2.2. This profile defines a link between SAE J1939 In-Vehicle CAN communication frequently used in commercial vehicle applications and CANopen, a communication protocol widely spread in industrial automation. Since SAE J1939 communication is used in commercial vehicle body applications as well, measures to provide the SAE protocol on Body applications are foreseen in the CiA 413 Truckgateway profile too.



Drawing 4: Truckgateway Concept

Detailed information about the CANopen protocol can be obtained from documents [1, 2, 3, 4, 5, 6]

In order to use all benefits of the CANopen protocol it's recommended to be aware of above mentioned documents, nevertheless it's not necessarily mandatory to setup a CAN communication successful. The following paragraphs will provide detailed instructions how to setup a CAN communication also without deep knowledge of CANopen standards.

For security reasons the access towards the vehicle is under the control of the Truckgateway CAN Firewall. It permits for certain signals CAN access only under predefined conditions. Furthermore a set of functions require to have the BB-enable hardware input being activated.

To cover a wide range of use cases an individual adoption of the conditions is possible via IVECO workshop tool.

The described CAN interface is operational only during K15 on phase. During K15 off phase no Output signals are updated nor the Input signals are monitored.

The IVECO CAN interface offer four different approaches for the Body Builders: Detailed descriptions are available in Chapter 5. Independent on the selected approach the Rules for requests towards the vehicle (Chpt. 9) needs to be respected in any case.:

- 1<sup>st</sup> Approach: 'IVECO default CAN communication' aligned to SAE J1939 communication.
- 2nd Approach: Upload one of the customised **Public CANopen communication pre-sets**
- 3rd Approach: Contact IVECO to develop an individual & **Private CAN communication** preset.
- 4th Approach: setup individual CANopen configuration by CANopen configuration tools.

Detailed descriptions of the different approaches are available in Chpt. 5.

Independent on the chosen approach the following rules are to be respected:

- CAN boot-up behaviour (Chpt. 2.3.6)
- CAN timeout behaviour (Chpt. 2.4)
- Requirements for functional Safety (Chpt. 3)
- CAN Firewall (Chpt. 7)
- StoppedState for BB emergency handling (Chpt. 8)
- Rules for requests towards the vehicle (Chpt. 9)

IVECO recommends the BodyBuilder to be aware on the entire IVECO Euro 6 BB manual and respect all the related recommendations.

## 2.2 Physical Layer & CAN requirement

### 2.2.1 General

The Bodybuilder CAN Physical Layer characteristics shall be conform to ISO 11898 [7]. The CANopen Interface can handle 11 bit and 29 bit ID's according CAN 2.0A and CAN 2.0B

### 2.2.2 Physical Media

- An unshielded twisted pair of wires (UTP) shall be used.
- The 2 wires shall have a characteristic impedance of 120 +/- 12 Ohms.
- The 2 wires shall be protected by a plastic shield (jacket).
- The 2 wires shall be twisted with a rate being in the range 13-58 twists per meter.
- The wire maximum specific resistance, measured at 20 C, shall be 50 mOhm/m.
- The 2 wires maximum specific line delay shall be 5 ns/m.

### 2.2.3 Supported Baudrates

Following Baudrates could be supported by the EM.

CANopen Baudrates
50 kbps
100 kbps
125 kbps
250 kbps

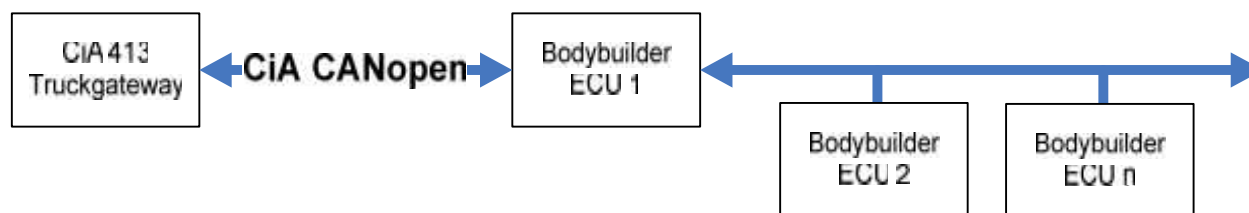
Tab 3: Supported Baudrates

The Default Baud Rate is 250 kbps. 125 kbps can be configured at Workshop level.  
If you need 100kbps or 50 kbps pls contact your BB Market reference.

### 2.2.4 Bus Topology

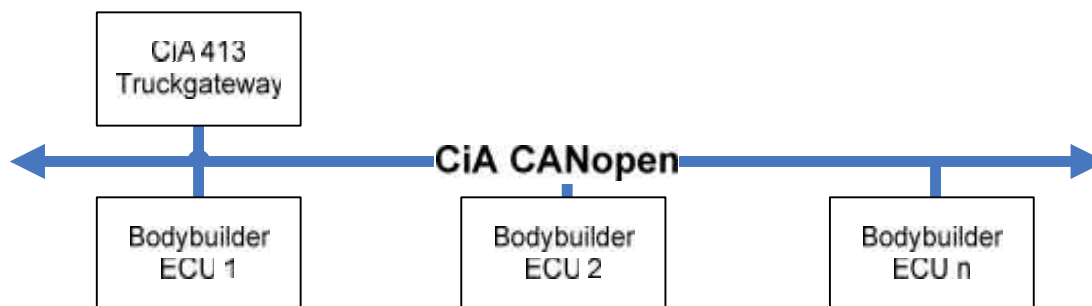
- The wiring topology should be as close as possible to a single line in order to avoid cable reflected waves. In practice short cable tails (stubs) maybe used to connect ECUs.
- To reduce the risk of interference, the bus cable shall be routed away from high current, rapidly switched loads and the wires connected to these devices, including return paths of ECU ground or power. Examples of the devices and associated wiring to avoid include: starter motors, wiper relays, turn signal (flasher) relays, and lamp relays.
- Additionally, the routing of the network and stubs should avoid close proximity to emission sensitive components (e.g. radios, CBs, and other electronic components).
- To minimize bus reflections nodes should not be equally spaced on the bus.
- To minimize bus reflections stubs should not have all the same length.
- The maximum bus length is 40 m (@ baudrate 250kB).
- The maximum number of nodes is 30.
- The minimum distance between nodes is 0.1 m.
- The maximum stub length is 1 m.
- Detailed definitions are described on ISO11898.

### Topology example 1, peer-to-peer connection



Drawing 5: peer-to-peer communication

### Topology example 2, direct network connection



Drawing 6: direct network connection

## 2.2.5 Bus Termination

Since IVECO does not know the Network topology of Bodybuilder applications, the Bodybuilder has to take care of bus termination. Following rules shall be obeyed:

- Terminating resistors shall be located at both ends of the network.
- Terminating resistors shall have an impedance of 120 +/- 10 Ohms.
- The terminating resistor shall have a minimum power dissipation rating of 220mW.
- Terminating resistors inside ECU's located at one or both ends of the network are allowed.
- From plant no termination is supplied

## 2.3 CANopen Communication

CANopen is a high-layer protocol based on standard CAN. CANopen foresees that the device's hardware has a CAN transceiver and controller as defined in ISO-11898.

The Physically Layer of CANopen is standardized in ISO-11898. Bus length is limited by baudrate (communication speed) in the following way :

Baudrate	Maximum Lenght Bus	Supported
1 Mbit/s	25 m	No
500 kbit/s	100 m	No
250 kbit/s	250 m	Yes
125 kbit/s	500 m	Yes
100 kbit/s	1000 m	Yes
50 kbit/s	1000 m	Yes

### 2.3.1 The Object Dictionary (OD)

The OD is the presentation of the application and communication specific data items used in a CANopen device. The OD represents the interface between application and communication. Each object is addressed by a 16 bit index and an optional 8 bit sub-index.

The structure of the Object Dictionary is shown below:

INDEX (HEXADECIMAL)	OBJECT
0000	Not used
0001-001F	Static Data Types
0020-003F	Complex Data Types
0040-005F	Manufacturer Specific Data Types
0060-007F	Device Profile Specific Static Data Types
0080-009F	Device Profile Specific Complex Data Types
00A0-0FFF	Reserved Future Application
1000-1FFF	Communication Profile Area
2000-5FFF	Manufacturer Specific Profile Area
6000-9FFF	Standardised Device Profile Area
A000-FFFF	Reserved Future Application

It is possible to distinguish 4 categories in the following way:

- **Data Types** : address to 0x0FFF;
- **Communication Profile Area**: address from 0x1000 to 0x1FFF. It contains communication parameters common for all devices;
- **Manufacturer Specific Profile Area**: address from 0x2000 to 0x5FFF. It is used by manufacturers for device specific functions.
- **Standardized Device Profile Area**: address from 0x6000 to 0x9FFF. It contains aspects related to standard devices (CiA 413 1-7 – Truck specific device profile).

Deepening the first category, we can describe individual Data Types:

- **Static Data Types**: standard data types (Boolean, integer, floating point, string etc..).They are equal on all the devices.
- **Complex Data Types**: standard predefined structures consisted of standard data types .They are equal on all the devices.
- **Manufacturer Data Types**: standard predefined structures consist of standard data types .They are related to a specific device.

Device Profiles can define further data types, specific for their device. In particular, static data types are defined between address 0x0060 and 0x007F, were as complex data types are defined between 0x0080 and 0x009F.

Each element present in Object Dictionary is defined in the following way:

Index	Object	Name	Type	Attribute	M/O
-------	--------	------	------	-----------	-----

Where:

- Index shows the position in the OD;
- Object shows the symbolic name of the object ( DOMAIN, VAR, ARRAY, RECORD etc..)
- Name shows a textual description;
- Type shows the data type ( BOOLEAN, UNSIGNED8, UNSIGNED16 etc..)
- Attribute shows the access type towards device (Read/Write, ReadOnly, WriteOnly etc..)
- M/O means Mandatory or Optional.



To access to the previous data, two mechanisms are foreseen:

PDO - Process Data Object	SDO - Service Data Object
Used to transfer process data, in real time.	Used to transfer service data. The real time is not a prior requirement.
Synchronous, asynchronous and driven by events messages.	Asynchronous messages.
High priority Identifier.	Low priority Identifier.
Optimized to exchange data in fast and effective way	Optimized to transfer large amount of data, (none time critical).
Direct correspondence with an OD object.	Access to an object indirectly through index and sub-index.
Transfer of one message.	Transfer on more messages.
Supported in NMT-operational only	Supported in all NMT states

### 2.3.2 Communication Model

CANopen implementation foresees a hierarchical master-slave structure. In this way, the system configuration and network management are simpler. This means that, even if in a CAN bus every node is a master, the interface with Application Layer needs an *Application Master* for every provided service. The same node could be master for different functions or more nodes could be masters. Moreover it is possible to change master in every cycle system, according to programmed algorithm.

Every master could have till 127 slaves: every node is identified through an only 7bit address (ID, to 1 to 127).

#### 2.3.2.1 Communication Object COB-ID

CANopen foresees information exchange through Communication Objects (COB). Communication Model CANopen specifies the different COB, communication services and the possible triggering types for data sending. Every COB is identified in an unique way by an ID. CAN2.0A standard supports till 2048 COB, 11bit. Transmission of synchronous and asynchronous messages is supported. Synchronous transmission indicates that it is possible the attainment and

actuation of information in coordinated way in the entire network. COB dedicated are *Sync Message* and *Time Stamp Message*.

Asynchronous transmission are sent in whatever moment, because they must not respect any predefined synchronization.

Objects related to network management (NMT, SYNC etc..) have high priority. They are followed by PDO and SDO.

### 2.3.2.2 Service Data Objects (SDO)

Service Data Object (SDO) allows the access to the OD objects of all nodes. It is not a real time communication, therefore SDO priority is lower than PDO one. It is a *peer-to-peer* communication. Every device could support one or more than one SDO.

COB-ID used for SDO communication are:

- From Master to Slave: 600h + Node-ID;
- From Slave to Master: 580h + Node-ID

### 2.3.2.3 Process Data Objects (PDO)

The exchange of data in real time passes through *Process Data Objects (PDO)*. Every PDO is mapped faithfully to a CAN frame. The data length of a PDO message is limited to 8 Byte.

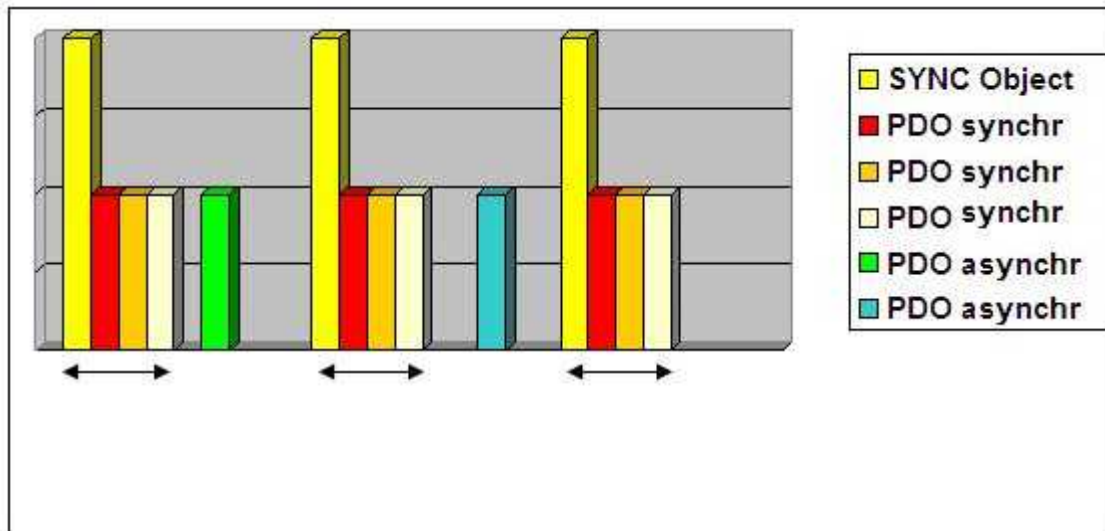
It is possible classify PDO in 2 categories: T-PDO (*Transmitted PDO*) and R-PDO (*Received PDO*).

A device (**PRODUCER**) sends PDO and another one or more device(s) (**CONSUMER**) may receive it. Every node can read message(s) and decide acceptance through the *Acceptance Filtering* procedure.

We can distinguish two different transmission possibilities:

- Synchronized transmission;
- Asynchronized transmission.

The following picture shows the principle of synchronized / asynchronized transmission. Synchronous PDOs are sent immediately after SYNC Object in a determined time interval. Instead asynchronous PDOs have not any relation with this time interval (and SYNC object):



### 2.3.3 Predefined Communication Objects

Predefined Communication Objects are subdivided in 3 categories:

- SYNC Objects
- Time Stamp Objects
- Emergency Objects

They are explained in the following paragraphs.

#### 2.3.3.1 SYNC Objects

The **SYNC Object** is sent periodically to all application devices (*SYNC Slave*) from synchronization device (*SYNC Master*). It scans network clock time, while the time between a SYNC object and another one is defined by standard parameter *Communication Cycle Period*, written by a configuration algorithm in boot-up process node. To guarantee a fast bus access, SYNC object priority is very high: synchronous nodes use SYNC object to adjust their timing with the SYNC Master device in correct way. Further details depend on single slave and for particular applications (higher precision in synchronization), Time Stamp mechanism could be used.

#### 2.3.3.2 Time Stamp Objects

The *time-stamping* mechanism corrects the inevitable clock drift of devices in network. **Time Stamp Object** is sent by Stamp Producer to all Stamp Consumer: this object contains reference time in ms, (if necessary, the resolution could be even in microseconds).

### 2.3.3.3 Emergency Objects

When a device notices an error situation, it sends an **Emergency Object** to the other devices with a higher priority. For every error event, it can be transmitted only one emergency object, so that the network will not be blocked due to the same error.

The following table defines the different CANopen Communication Profile emergency error codes:

ERROR CODE (hexadecimal)	Detail
00xx	Error Reset or No Error
10xx	Generic Error
20xx	Current
21xx	Current, input
22xx	Current, inside
23xx	Current, output
30xx	Voltage
31xx	Principle Voltage
32xx	Internal Voltage
33xx	External Voltage
40xx	Temperature
41xx	Environment Temperature
42xx	Device Temperature
50xx	Device Hardware
60xx	Device Software
61xx	Internal Software
62xx	User Software
63xx	Data Set
70xx	Additional Modules
80xx	Monitoring
81xx	Communication
90xx	External Error
F0xx	Additional Functions
FFxx	Device Specification

Table 1 – Emergency Error Code

The error register, and additional information about device error, are present in the following table:

BIT	M/O	Detail
0	M	Generic Error
1	O	Current
2	O	Voltage
3	O	Temperature
4	O	Communication Error
5	O	Specific of device's profile
6	O	Reserved
7	O	Producer's Specific

Table 2 – Error Register

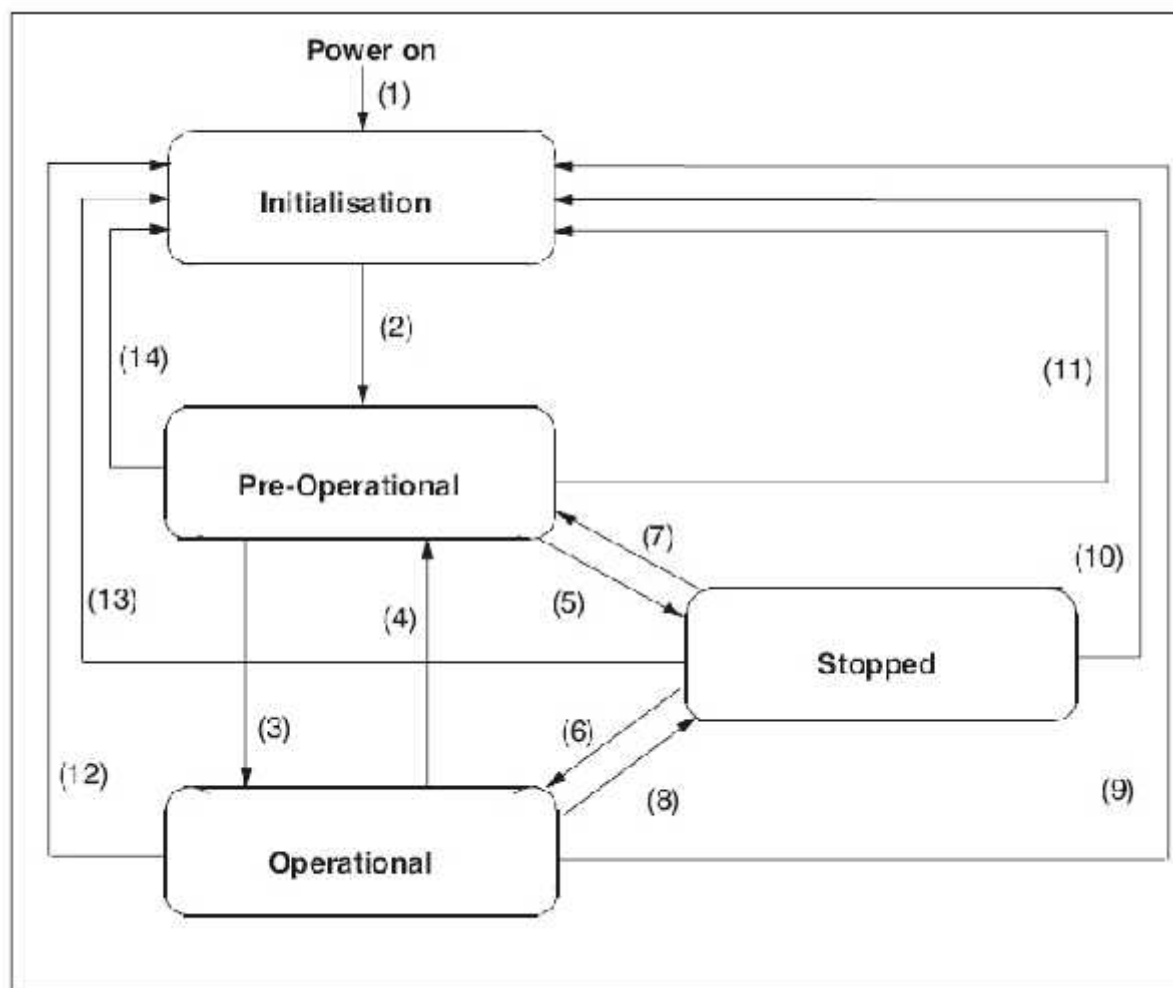
As all predefined communication objects, also Emergency Object, are optional.

When EMCY object is available the error codes (00xx and 10xx) must be supported.

### 2.3.4 Network Management (NMT service)

*Network Management* acts on nodes and follows a master-slave structure. NMT imposes the use of a single master during start and normal running. NMT services allow to initialize, start, reset, check and stop nodes. Typically one NMT master should be present on a CANopen network.

The following picture (see below) shows a flowchart about a CANopen node:



NMT CANopen node flowchart



**WARNING:** in the NMT Pre-Operational state it is possible SDO communication, whereas cyclic PDO communication is blocked. Only in NMT Operational state the PDO communication works.

In the following table (table 3 below), NMT services are listed:

Transition	Services
(1)	After Power-On, the following and mandatory state is Initialization
(2)	After Initialization, the first mandatory state is Pre-Operational
(3), (6)	Start_Remote_Node (CS = 128) command
(4), (7)	Enter_Pre-Operational_State (CS = 128) command
(5), (8)	Stop_Remote_Node (CS = 2) command
(9), (10), (11)	Reset_Node (CS = 129) command
(12), (13), (14)	Reset_Communication (CS = 130) command

Table 3 - NMT CANopen flowchart

As shown 4 principle status are defined:

- Initialisation or Boot-up;
- Pre-Operational;
- Operational;
- Stopped.

Initialization or Boot-up status are achieved automatically at Power on or after Reset ('Reset Node' or 'Reset communication').

After Initialisation, node enters in Pre-Operational mode autonomously. In Pre-Operational status, it is possible to assign ID and parameter values. Also SDO communication and EMCY messages are allowed. Device could be commuted in Operational status.

In Operational status, node can converse and all CAN messages are allowed. At any time, NMT master can force device to stop or boot-up.

NMT services have the following functions:

- *Start Remote Node*: it allows to switch to Operational from Pre-Operational. It is possible to transmit and to receive PDO data only in Operational.
- *Stop Remote Node*: it allows to switch to Stopped from Pre-Operational or Operational. In Stopped, node can process only NMT command.
- *Enter Pre Operational*: it allows to switch to Pre-Operational from Operational or Stopped. In Pre-Operational status, node cannot process PDOs. But it can be checked and set by SDO. It is possible to set reference values.
- *Reset Node*: it allows to switch to Initialization from Operational, Pre-Operational or Stopped. After Reset Node, all objects (1000 hex – 9FFF hex) are set.
- *Reset Communication*: it allows to switch to Initialization from Operational, Pre-Operational or Stopped. After Reset Node, all communication objects (1000 hex – 1FFF hex) are set to default value.

### 2.3.5 Heartbeat

To guarantee the CANopen network works correctly, CANopen offer 2 alternatives:

- Node guarding
- Automatic transmission heartbeat message from network node.

In Truckgateway the heartbeat message is implemented. Using heartbeat a node transmits proper communication status automatically at regular intervals. The interval between 2 heartbeat messages is set fix to 3000ms. The EM can monitors up to 7 Nodes. The NodeID's to be supervised via Heartbeat mechanism are configurable via IVECO CS.



**In order to detect a heartbeat missing from a node it's mandatory to have at least once received a heartbeat message from that node.**

### 2.3.6 CAN Boot up behaviour

Per default the EM is configured as NMT Master, on power-on (K15 on) it will send, after a delay of appr. 5s the NMT Start message is sent and set all nodes to operational. Afterwards the cyclic PDO communication will start. The start of the CANopen stack will be reported on BB connectors CiA-F413 / Pin3 and CiA-C413 / Pin 3 too.

For successful communication start it is essential that:

- there is at least one other node active on the CAN.
- the bus is terminated by 2 x 120 Ohm resistors.



**Pls consider that EM expects to receive an Acknowledge for all CAN message sent, also the NMT messages. This Acknowledged shall be sent by at least one CAN node on the BB network. Else the EM CAN error counter will increase and CAN controller goes to bus-off state according the CAN state machine.**

To adopt the start-up behaviour to specific Bodybuilder needs it is possible to configure the device boot-up on workshop level. The possible modifications are.

- NMT Master/Slave
- Communication Start trigger via K15 or HW input
- Variable start delay



## NMT Master/Slave

The CANopen device can be configured as Master or Slave. In slave mode no automatic communication start is provided. The Network must start the Truckgateway communication (set EM to operational).

If the EM is configured as Master the NMT boot-up behaviour can be configured in detail. Following actions are foreseen depending on the configuration:

CO_opCfg value	Behaviour
1	Maintain current state
2	Go to Pre-Operational
8	Go to Stop
16	Reset Node
32	Go to Operational (default)

## Communication Start trigger

It's possible to configure two different types of communication start up behaviours

- The Communication starts automatically with K15 on (default)
- The Communication starts if BB Enable (ST72072A/Pin3) is connected to GND

The second trigger is useful if bodybuilder CAN communication does not work synchronized to Vehicle K15.

## Variable start delay

If the bodybuilder has problems to synchronize their communication start-up to the vehicle/EM start-up it's possible to delay the start of the EM CAN interface by max 25s

### 2.3.7 CANopen Dummy Objects usage

In some cases individual Mapping requires that gaps between signals are to be filled with objects without meaning. In this case dummy objects as defined in Chapter 4.3 can be used to fill the gaps.

Pls respect that signals shall not overlap Byte limitations, therefore 8-bit, 16-bit resp. 32-bit signals shall start at bit 0, 8, 16, 24 and so on.

### 2.3.8 CANopen references

To understand this manual, it is recommended to have a good knowledge of CANopen concepts. This chapter contains the following items:

- A short introduction of principle concepts;
- An overview of CANopen communication objects used by Expansion Module.

The following standards should be known by body-builders:

- **CiA DS- 301 V4.02 (Application Layer and Communication Profile)**
- **CiA DR- 303-3 V1.2 (Indicator Specification)**
- **CiA DS- 306 V1.3: (Electronic data sheet specification for CANopen)**
- **CiA DS- 402 V2.0 (Device Profile for Drives and Motion Control)**
- **CiA DS 413-1 V2.0.10 (Device profile for truck gateways - Part 1 General definitions and default communication objects)**
- **CiA DS 413-2 V2.0.10 (Device profile for truck gateways - Part 2 Brake and running gear devices)**
- **CiA DS- 413-3 V2.0.10 (Device profile for truck gateways Part 3: Other than brake and running gear devices)**
- **CiA DS- 413-5 V1.0.3.2 (Device profile for truck gateways Part 5: Superstructure objects)**
- **CiA DS- 413-6 V1.0.2.1 (Device profile for truck gateways Part 6: Framework for J1939-based networks)**

## 2.4 CAN Timeout behaviour

To control the Bodybuilder Network communication (especially for Messages received by the Truck) IVECO has foreseen two mechanisms.

- Heartbeat control (See CiA 301 [1])
- Timeout Object control (for SAE communication)

Independently which of the mechanisms has been chosen for control, the Truckgateway can be configured to set the vehicle to a defined StoppedState if a timeout is recognized. The Bodybuilder has the possibility to adjust the StoppedState values up to a certain degree. Pls refer also to Chpt. 2.3.5.

### 2.4.1 Heartbeat control

For bodybuilders using pure CANopen the EM provides the Heartbeat mechanism as defined in CiA 301 [1]. Since CiA does not recommend Node guarding this is not supported by the EM.

To configure heartbeat control the Bodybuilder has to set the consumer node id **via customer service tool**. Up to 8 node id's can be handled in the EM. The Consumer Heartbeat time is set fix to 3000ms. In the Default Setting following NodeID are set: 0x01, 0x0A, 0x71

### 2.4.2 Timeout Object control

Another possibility to control the timeout of a CAN message is the usage of the "Message Timeout Object" 0x2000, 0x02.

If this object is used the Truckgateway expects that the "Message Timeout Object" is periodically received with the value 3. If the Message containing the "Message Timeout Object" is not received periodically a timeout will be generated after approximately 5 sec.

The period can be adjusted, therefore two parameters are foreseen.

### 2.4.3 Timeout reaction

As soon as one of the mechanisms creates a timeout the EM reacts by:

- Changing the NMT state of the EM.
- Changing the NMT state of other nodes in the Network. (only if EM is Master)
- Setting the received signals to predefined stopped state values.

## NMT state Change

EM device NMT:

According to the configuration the EM will change the NMT state if a timeout is recognized:

Value	Behaviour
1	Maintain current state
2	Go to Pre-Operational
4	Reserved
8	Go to Stop
16	Reset Node
32	Go to Operational

Network node NMT:

According to the configuration the EM will send a NMT command to other all devices if a timeout is recognized:

Value	Behaviour
1	Maintain current state
2	Go to Pre-Operational
4	Reserved
8	Go to Stop (default)
16	Reset Node
32	Go to Operational



### 3 Requirements for Functional Safety

- When BB application is interfacing the vehicle for Safety related functions then IVECO supports the BB application with a “Vehicle CAN fully operational” output. For Safety related BB applications, which are interfacing the vehicle, IVECO requires from the BodyBuilder to integrate this information in the BB application Technical Safety Concept. The “Vehicle CAN fully Operational” information do not check the content of any transmitted CAN message, but it ensures that CAN communication - and resulting also extracted information provided to the BodyBuilder via the CANopen interface - are still regularly updated within their timing constraints.
- Furthermore at each K15 cycle the delayed state change (between 4 to 6 sec after K15on) needs to be checked. When such check fails the “Vehicle CAN fully operational” output is not to be considered valid.
- The “Vehicle CAN fully operational” output being active provides an information that not any of the monitored Vehicle systems CAN messages remains in CAN timeout for more than 1 sec.
- With the CANopen interface (OPT 0384) the Bodybuilder:
  - is able to identify the vehicle degradation level and
  - use the CANopen HeartBeat mechanism as well as the BB EMCY input (ST 72072B / pin 2) for Vehicle Stopped State management
- When the “Vehicle CAN fully operational” output is not active then the BB application does not have to implement actions (or rather reactions) that relies on the EM nor on the entire IVECO BB CANopen interface functioning properly (as for instance for CANopen gateway). The BB is responsible initiating measures that the SafeState of its BB application is entered autonomously.
- When the specific BB application requires also a recovery strategy during “Vehicle CAN fully operational” output being resp. getting passive during BB operation, then contact Iveco for support in completing the technical design of these recovery strategy.
- The responsibility for functional safety of individual BB configurations is always up to the Bodybuilder.
- When in Customer Service a client specific programming have been required, then after each programming session the affected functionality is to be checked and confirmed by the BodyBuilder.
- The Bodybuilders have to ensure reliable design and wiring for all connections with the IVECO BodyBuilder interface

## 4 CANopen CiA 413 objects

The supported objects depend on the vehicle ranges as well as on the installed options.

### 4.1 Predefined Communication Objects 0x1000-0x1018

Type	Object	Sub-Index	Name
ro	0x1000	0x00	device type
ro	0x1001	0x00	error register
ro	0x1003	0x01-0x05	pre-defined error field
rw	0x1005	0x00	COB-ID sync
rw	0x1006	0x00	communication cycle period
rw	0x1007	0x00	synchronous window length
const	0x1008	0x00	manufacturer device name
const	0x1009	0x00	manufacturer hardware version
const	0x100A	0x00	manufacturer software version
rw	0x100C	0x00	guard time
rw	0x100D	0x00	life time factor
rw	0x1010	0x02	store communication parameters
rw	0x1011	0x01	restore all default parmeters
rw	0x1014	0x00	COB-ID EMCY
rw	0x1015	0x00	inhibit Time Emergency
ro	0x1016	0x00-0x0a	consumer Heartbeat Time *
rw	0x1017	0x00	producer Heartbeat Time
ro	0x1018	0x00-0x04	identity Objekt

\*is only writeable via CS Tool

### 4.2 PDO communication Objects 0x1400-0x1FFF









Type	Object	Name
Record	0x1400 – 0x1413	Recieve PDO Communication Parameter
Record	0x1600 – 0x1613	Recieve PDO Mapping Parameter
Record	0x1800 – 0x181d	Transmit PDO Communication Parameter
Record	0x1a00 – 0x1a1d	Transmit PDO Mapping Parameter

The EM supports up to 30 TPDOs and 20 RPDOs. Inside each PDO up to 16 objects can be assigned.











The objects shall not overlap the Byte borders (except 16 / 32 bit-signals). Instead eventual gaps between signals need to be filled with Dummy objects as defined in Chapter 2.3.7. Pls consider that also Dummy objects are affecting the PDO object limitation described before.

### 4.3 Dummy Objects

Direction	Object	Name
	0x2101	Dummy Boolean RX
	0x2102	Dummy Boolean 2 RX
	0x2103	Dummy Boolean 3 RX
	0x2104	Dummy Boolean 4 RX
	0x2201	Dummy Boolean TX
	0x2202	Dummy Boolean 2 TX
	0x2203	Dummy Boolean 3 TX
	0x2204	Dummy Boolean 4 TX

### 4.4 Objects CiA 413 Part 2

The resolution, offset and units of the signals are as defined in SAE J1939 and CANopen \*.XDD file.




















Direction	Object	Name	EMCY
	0x6002	Retarder demand	FF0B
	0x6006	Wheel based vehicle speed	FF27
	0x601B	Towing vehicle ABS active/passive	FF0B
	0x6021	ABS off-road request	FF0B
	0x6022	ASR brake control active/passive	FF0B
	0x6023	ASR engine control active/passive	FF0B
	0x6029	Brake light switch	FF27
	0x6035	Driven axle load	FF2F

























## 4.5 Objects CiA 413 Part 3




























The resolution, offset and unit of the signals are as defined in SAE J1939 and CANopen \*.XDD file.

Direction	Object	Name	EMCY
☒	0x6104	Obstacle detection device request	FF21
☒	0x6105	Anti-theft device request	FF21
☒	0x610A	Percent clutch slip	FF03
☒	0x610C	Current gear	FF03
☒	0x610E	Accelerator pedal low idle switch	FF27
☒	0x610F	Engine control allowed	n.a.
☒	0x6110	PTO control allowed	n.a.
☒	0x6111	Vehicle speed	FF27
☒	0x6113	Engine speed	FF27
☒	0x6115	Driver's demand engine percent torque	FF27
☒	0x6117	Actual engine percent torque	FF27
☒	0x6119	Reference engine torque	FF27
☒	0x611B	Percent load at current speed	FF27
☒	0x611D	Maximum vehicle speed limit	FF27
☒	0x611F	Engine speed upper limit	FF27
☒	0x6121	Engine speed lower limit	FF27
☒	0x6123	Engine coolant temperature warning	FF27
☒	0x6124	Engine oil pressure warning	n.a.
☒	0x6125	Engine oil temperature	FF27
☒	0x6127	Engine coolant temperature	FF27
☒	0x6129	Engine oil pressure	FF27
☒	0x612E	First clutch dependent PTO feedback	n.a.
☒	0x612F	Second clutch dependent PTO feedback	n.a.
☒	0x6130	Clutch independent PTO feedback	n.a.
☒	0x6131	First engine mounted PTO feedback	n.a.
☒	0x6132	Second engine mounted PTO feedback	n.a.
☒	0x6133	Starter active	n.a.
☒	0x6134	Engine running	n.a.
☒	0x6135	Engine torque mode	FF27
☒	0x614C	Accelerator pedal position	FF27
☒	0x614E	Ambient air temperature	FF27
☒	0x6150	Fuel level warning	n.a.
☒	0x618A	Trailer left-hand stop light(s) commhand	FF21
☒	0x618B	Trailer right-hand stop light(s) commhand	FF21
☒	0x618C	Trailer left-hand direction indicator light(s) commhand	FF21
☒	0x618D	Trailer right-hand direction indicator light(s) commhand	FF21
☒	0x618E	Trailer left-hand rear light(s) commhand	FF21
☒	0x618F	Trailer right-hand rear light(s) commhand	FF21
☒	0x6190	Trailer left-hand rear fog light(s) commhand	FF21
☒	0x6191	Trailer right-hand rear fog light(s) commhand	FF21
☒	0x6192	Trailer left-hand reversing light(s) commhand	FF21















	0x6193	Trailer right-hand reversing light(s) commhand	FF21
	0x6194	Trailer left-hand side marker light(s) commhand	FF21
	0x6195	Trailer right-hand side marker light(s) commhand	FF21
	0x6196	Trailer left-hand rear width indicator light(s) commhand	FF21
	0x6197	Trailer right-hand rear width indicator light(s) commhand	FF21
	0x6198	Trailer left-hand corner marker light(s) commhand	FF21
	0x6199	Trailer right-hand corner marker light(s) commhand	FF21
	0x619A	Trailer left-hand rear registration-plate light(s) commhand	FF21
	0x619B	Trailer right-hand rear registration-plate light(s) commhand	FF21
	0x619F	Trailer work light(s) command	FF21
	0x61A0	Transmission output shaft PTO feedback	n.a.
	0x61A1	Transfer case output shaft PTO feedback	n.a.
	0x61A2	At least one PTO engaged	n.a.
	0x61A5	First clutch dependent PTO engagement consent	n.a.
	0x61A6	Second clutch dependent PTO engagement consent	n.a.
	0x61A7	Clutch independent PTO engagement consent	n.a.
	0x61A8	First engine mounted PTO engagement consent	n.a.
	0x61A9	Second engine mounted PTO engagement consent	n.a.
	0x61AA	Transmission output shaft PTO engagement consent	n.a.
	0x61AB	Transfer case output shaft PTO engagement consent	n.a.

Direction	Object	Name	Firewall affected	Stopped State	EMB_xx
	0x6100	Rear obstacle distance	No	Yes	n.a. (fix)
	0x6102	Thermal body temperature	No	No	n.a.
	0x6106	Obstacle detection device avtive	No	Yes	n.a.
	0x6107	Anti-theft device	No	No	n.a.
	0x6136	First clutch dependent PTO switch	No	Yes	EMB25
	0x6137	Second clutch dependent PTO switch	No	Yes	EMB25
	0x6138	Clutch independent PTO switch	No	Yes	EMB25
	0x6139	First engine mounted PTO switch	No	Yes	EMB25
	0x613A	Second engine mounted PTO switch	No	Yes	EMB25
	0x613D	Starter lockout switch	Yes	Yes	EMB25
	0x613E	Engine Start switch	Yes	Yes	EMB25
	0x613F	Engine Stop switch	Yes	Yes	EMB25
	0x6140	Requested engine speed upper limit	Yes	Yes	EMB27
	0x6142	Requested engine speed lower limit	Yes	Yes	EMB27
	0x6144	Requested engine torque limit	Yes	Yes	EMB27
	0x6146	Requested vehicle speed limit	Yes	Yes	EMB27
	0x6148	Refuse packer Stepp switch	No	Yes	EMB25
	0x614A	Requested engine speed	Yes	Yes	EMB26
	0x6151	Trailer left-hand stop light(s)	No	No	n.a.
	0x6152	Trailer right-hand stop light(s)	No	No	n.a.
	0x6153	Trailer left-hand direction indicator light(s)	No	No	n.a.
	0x6154	Trailer right-hand direction indicator light(s)	No	No	n.a.
	0x6155	Trailer left-hand rear light(s)	No	No	n.a.
	0x6156	Trailer right-hand rear light(s)	No	No	n.a.

	0x6157	Trailer left-hand rear fog light(s)	No	No	n.a.
	0x6158	Trailer right-hand rear fog light(s)	No	No	n.a.
	0x6159	Trailer left-hand reversing light(s)	No	No	n.a.
	0x615A	Trailer right-hand reversing light(s)	No	No	n.a.
	0x615B	Trailer left-hand side marker light(s)	No	No	n.a.
	0x615C	Trailer right-hand side marker light(s)	No	No	n.a.
	0x615D	Trailer left-hand rear width indicator light(s)	No	No	n.a.
	0x615E	Trailer right-hand rear width indicator light(s)	No	No	n.a.
	0x615F	Trailer left-hand corner marker light(s)	No	No	n.a.
	0x6160	Trailer right-hand corner marker light(s)	No	No	n.a.
	0x6161	Trailer left-hand rear registration-plate light(s)	No	No	n.a.
	0x6162	Trailer right-hand rear registration-plate light(s)	No	No	n.a.
	0x6163	Trailer rear warning light(s)	No	No	n.a.
	0x6164	Trailer rotating identification light(s)	No	No	n.a.
	0x6165	Trailer interior light(s)	No	No	n.a.
	0x6166	Trailer work light(s)	No	No	n.a.
	0x6167	Body fluid level	No	No	n.a.
	0x6169	Body pressure	No	No	n.a.
	0x61A3	Transmission output shaft PTO switch	No	Yes	EMB25
	0x61A4	Transfer case output shaft PTO switch	No	Yes	EMB25
	0x61AC	First clutch dependent PTO engagement consent - trailer	No	No	n.a.
	0x61AD	Second clutch dependent PTO engagement consent - trailer	No	No	n.a.
	0x61AE	Clutch independent PTO engagement consent - trailer	No	No	n.a.
	0x61AF	First engine mounted PTO engagement consent - trailer	No	No	n.a.
	0x61B0	Second engine mounted PTO engagement consent - trailer	No	No	n.a.
	0x61B1	Transmission output shaft PTO engagement consent - trailer	No	No	n.a.
	0x61B2	Transfer case output shaft PTO engagement consent - trailer	No	No	n.a.

## 4.6 Objects CiA 413 Part 5

The resolution, offset and units of the signals are as defined in SAE J1939 and CANopen \*.XDD file.

Direction	Object	Name	EMCY
	0x6304	Electrical potential	FF27
	0x6306	Rated engine power	n.a.
	0x6308	Rated engine speed	n.a.
	0x630A	Engine oil level	FF27
	0x6310	Actual language	n.a.
	0x6311	Starter lockout device active	n.a.
	0x6314	Refuse stepper step switch active	n.a.
	0x6316	Parking brake device active	FF21
	0x6317	Parking light command	FF21
	0x6318	Low beam command	FF21
	0x6319	High beam command	FF21
	0x631A	Stopping brake device active	Tbv

☒	0x631C	Driver door open active	FF21
☒	0x631D	Co-driver door open active	FF21
☒	0x631E	Central door lock device active	FF21
☒	0x6320	Fuel filter clocked active	FF21
☒	0x6321	Oil filter clocked active	FF21
☒	0x6322	Air filter clocked active	FF21
☒	0x6323	Transfer case central lock device active	FF21
☒	0x6324	Inter-axle front lock device active	FF21
☒	0x6325	Inter-axle rear lock device active	FF21
☒	0x6326	Differential front lock device active	FF21
☒	0x6327	Differential rear lock device active	FF21
☒	0x6328	Additional light device active	FF21
☒	0x6329	Working light device active	FF21
☒	0x632F	Transmission neutral switch active	n.a.
☒	0x6330	Transmission reverse direction switch active	n.a.
☒	0x6331	Clutch closed state active	FF27
☒	0x6332	Clutch open state active	FF27
☒	0x6333	Transmission low range sense switch active	FF27
☒	0x6334	Transmission high range sense switch active	FF27
☒	0x6335	Horn active	FF21
☒	0x6336	Engine pre-heating active	n.a.
☒	0x6337	Engine speed control upper limit allowed	n.a.
☒	0x6338	Engine speed control lower limit allowed	n.a.
☒	0x6339	Engine speed control allowed	n.a.
☒	0x633A	Engine torque limit control allowed	n.a.
☒	0x633B	Engine Stopp allowed	n.a.
☒	0x633C	Vehicle speed limit control allowed	n.a.
☒	0x634A	KL15 status	n.a.

Direction	Object	Name	Firewall affected	Stopped State	EMB_xx
📄	0x630C	Power consumption (net torque) superstructure	No	No	n.a.
📄	0x631B	Stopping brake device request	No	No	n.a.
📄	0x633F	LHS low beam light status	No	No	n.a.
📄	0x6340	RHS low beam light status	No	No	n.a.
📄	0x6341	LHS high beam light status	No	No	n.a.
📄	0x6342	RHS high beam light status	No	No	n.a.
📄	0x6343	LHS parking light status	No	No	n.a.
📄	0x6344	RHS parking light status	No	No	n.a.
📄	0x6345	LHS front fog light status	No	No	n.a.
📄	0x6346	RHS front fog light status	No	No	n.a.
📄	0x6348	Remote emergency light request	No	Yes	EMB34
📄	0x6349	Inhibit TGC opening request	No	Yes	EMB34
📄	0x634B	Horn activation request	No	No	n.a.
📄	0x634C	Remote central door lock request	No	No	n.a.

## 4.7 Objects CiA 413 Part 6, SAE Predefined Messages

The signals included inside the messages as well as their resolution, offset and unit are as defined in SAE J1939. Inside CANopen \*.XDD file the signal reference is added.

Direction	Object	Name	Data Reference	EMCY
☒	0x6421	LFE	0xA440, 0x01	FF27
☒	0x6422	LFC	0xA440, 0x02	FF27
☒	0x6423	EBC1	0xA440, 0x03	FF0B
☒	0x6424	EBC2	0xA440, 0x04	FF0B
☒	0x6425	EEC1	0xA440, 0x05	FF27
☒	0x6426	EEC2	0xA440, 0x06	FF27
☒	0x6427	CCVS	0xA440, 0x07	FF27
☒	0x6428	ET1	0xA440, 0x08	FF27
☒	0x6429	TCO1	0xA440, 0x09	FFEE
☒	0x642A	VDHR	0xA440, 0x0A	FFEE
☒	0x642B	VW	0xA440, 0x0B	FF2F
☒	0x642C	PTO_info	0xA440, 0x0C	n.a.
☒	0x642D	TD	0xA440, 0x0D	FFEE
☒	0x642E	ETC1	0xA440, 0x0E	FF03
☒	0x642F	ETC2	0xA440, 0x0F	FF03
☒	0x6430	AIR1	0xA440, 0x10	FF21
☒	0x6431	VEP	0xA440, 0x11	FF27
☒	0x6432	ASC1	0xA440, 0x12	FF2F
☒	0x6433	ASC3	0xA440, 0x13	FF2F
☒	0x6434	ASC4	0xA440, 0x14	FF2F
☒	0x6435	EEC3	0xA440, 0x15	FF27
☒	0x6436	PTO_DE	0xA440, 0x16	n.a.
☒	0x6437	CAM11	0xA440, 0x17	n.a.
☒	0x6438	EBC5	0xA440, 0x18	FF0B
☒	0x6439	HMI_feedback	0xA440, 0x19	n.a.
☒	0x643A	ETC7	0xA440, 0x1A	FF03
☒	0x643B	ServInfo	0xA440, 0x1B	n.a.

## 4.8 Manufacturer Specific objects

### 4.8.1 Manufacturer Specific Transmit objects

The resolution, offset and unit of the signals are as defined in the CANopen XDD file.

Direction	Object	Name	EMCY	Length	Min	Max	Rem
☒	0x2004, 0x01	Cabin tilted	FF27	2	0	3	Boolean2
☒	0x2004, 0x02	Neutral Requested and engaged	FF27	2	0	3	Boolean2
☒	0x2004, 0x03	Timeout Object status	n.a.	2	0	3	Boolean2
☒	0x2004, 0x04	TSC1_ECtrlAlw	n.a.	2	0	3	Boolean2
☒	0x2004, 0x05	ASC2_CtrlAlw	n.a.	2	0	3	Boolean2
☒	0x2004, 0x06	TC1EM_CtrlAlw	n.a.	2	0	3	Boolean2
☒	0x2004, 0x07	BB_enable	n.a.	2	0	3	Boolean2
☒	0x2004, 0x08	Chassis Ready (acc. EN1501) for adaptations use EMB37	n.a.	2	0	3	Boolean2
☒	0x2005, 0x01	Fuel level	FF21	8	0%	100%	Word
☒	0x2005, 0x02	PTO Fault Index	n.a.	8	n.a.	n.a.	See Note1
☒	0x2006, 0x01	V-CAN Tunnel CAM11 Byte 5-6 Tx	n.a.	16	n.a.	n.a.	See CiA
☒	0x2006, 0x02	PTO1 Restriction/ShutOff	n.a.	16	n.a.	n.a.	See Note 2
☒	0x2006, 0x03	PTO2 Status - Byte4,5	n.a.	16	n.a.	n.a.	See Note 2
☒	0x2006, 0x04	PTO3 Status - Byte6,7	n.a.	16	n.a.	n.a.	See Note 2
☒	0x2006, 0x05	EM DI_status IN01....IN 16	n.a.	16	n.a.	n.a.	See Note 3
☒	0x2007, 0x01	V-CAN Tunnel CAM11 Byte 1-4 Tx	n.a.	32	n.a.	n.a.	See CiA
☒	0x2007, 0x02	Bus load and controller state	n.a.	32	n.a.	n.a.	See Note 4
☒	0x2007, 0x03	RX counter and TX counter	n.a.	32	n.a.	n.a.	See Note 5
☒	0x2007, 0x04	Utc_Time	n.a.	32	n.a.	n.a.	DWord
☒	0x2007, 0x05	Utc_Time_local	n.a.	32	n.a.	n.a.	DWord

**Note1:**

The PTO fault index field keeps BB informed which vehicle information are temporary not available for a successful PTO engagement. The information is available for up to 3 PTO and has the following layout:

PTO Fault index definition								
Index	PTO no	Fault description	Index	PTO no	Fault description	Index	PTO no	Fault description
0	All	No faults active	15	PTO2	Brake	29	PTO3	Brake
1	PTO1	Brake	15	PTO2	Brake	29	PTO3	Brake
2	PTO1	Handbrake	16	PTO2	Handbrake	30	PTO3	Handbrake
3	PTO1	EM input	17	PTO2	EM input	31	PTO3	EM input
4	PTO1	Clutch	18	PTO2	Clutch	32	PTO3	Clutch
5	PTO1	Gear	19	PTO2	Gear	33	PTO3	Gear
6	PTO1	RPM	20	PTO2	RPM	34	PTO3	RPM
7	PTO1	Vehicle speed	21	PTO2	Vehicle speed	35	PTO3	Vehicle speed
8	PTO1	Water temperature	22	PTO2	Water temperature	36	PTO3	Water temperature
9	PTO1	Eurotronic	23	PTO2	Eurotronic	37	PTO3	Eurotronic
10	PTO1	-	24	PTO2	-	38	PTO3	-
11	PTO1	-	25	PTO2	-	39	PTO3	-
12	PTO1	-	26	PTO2	-	40	PTO3	-
13	PTO1	-	27	PTO2	-	41	PTO3	-
14	PTO1	-	28	PTO2	-	42	PTO3	-
						43-255	-	Reserved for future use

**Note 2:**

The PTO Engagement\_Restriction resp. ShutOff\_Condition status keeps BB informed which PTO Engagement\_Restriction resp. ShutOff\_Condition is currently violated. The information is available for all the 3 PTO and has the following layout:

PTO_x EngagementRestriction/ShutOff		
Bit	Signal allocation	Description
1..2	PTO op_mode	=00 (Not in degraded mode) =01 (Degraded mode required but not confirmed) =10 (Operating in degraded mode - confirmed) =11 (PTO operation not possible)
3	Brake (depressed/not depressed)	Brake condition violated
4	Handbrake (engaged/disengaged)	Handbrake condition violated
5	EM input (open/short to ground)	EM input violated
6	Clutch (depressed/not depressed/slipping)	Clutch condition violated
7	Gear (neutral/reverse/out of limit)	Gear condition violated
8	Engine RPM	RPM out of range
9	Vehicle speed	Vehicle speed out of range
10	Water temperature	Water temperature out of range
11	PTO control allowed (Eurotronic)	Eurotronic PTO blocked
12	External ER BB CAN active	ER flag active
13	Reserved for future use	-
14	Reserved for future use	-
15	Reserved for future use	-
16	Reserved for future use	-

**Note 3:**

The signal 0x2006, sub 0x5 EM DI\_status informs the BB about the status of the physical EM inputs. The information has the following layout:

EM DI_status IN01...IN16		
IN	EM HW pin	Description
01	X3 - 13	K15 input
02	X3 - 05	PTO1 switch request
03	X3 - 06	PTO2 switch request
04	X3 - 07	PTO3 switch request
05	X3 - 08	PTO1 feedback switch
06	X3 - 09	PTO2 feedback switch
07	X3 - 10	PTO3 feedback switch
08	X3 - 11	PTO1 pressure switch
09	X3 - 12	PTO2 pressure switch
10	X3 - 16	PTO3 pressure switch
11	X3 - 17	BB enable
12	X3 - 18	Neutral requested (Automated /Automatic gearboxes only)
13	X3 - 19	BB EMCY input
14	X3 - 20	Ext. Stopping Brake request
15	X3 - 21	EN1501 / HSA feedback pressure switch
16	X4 - 06	EN1501 Stepper switch request / HSA activation switch request

**Note 4:**

The signal 0x2007, sub 0x02 RX counter and TX counter informs the BB about the status of the BB CAN bus load and the EM BB CAN controller state. The information has the following layout:

BB-CAN Bus load and controller state		
bit	Signal	Description
01...16	BB CAN bus load	0% .. 100%, min 0%, max 100%, resolution 1% per bit, offset =0% 0xFFFF not available
17... 32	BB CAN controller state	Bit 1: not initialised Bit 2: error active Bit 3: error passive Bit 4: Bus Off












**Note 5:**

The signal 0x2007, sub 0x03 Rx\_error\_counters and Tx\_error\_counters informs the BB about the status of the BB CAN transceiver Rx/Tx error counters. The information has the following layout:

BB-CAN Bus load and controller state		
bit	Signal	Description
01...16	BB CAN Rx errors	0... 0x00FF BB CAN Rx-errors 0xFFFF not available
17... 32	BB CAN Tx errors	0... 0x00FF BB CAN Tx-errors 0xFFFF not available

## 4.8.2 Manufacturer Specific Receive objects

The manufactures specific objects have to be used to send SAE J1939 conform messages to the Vehicle. Inside the selected RPDO configuration both \_LSB and \_MSB objects are to be mapped.

Direction	Object	Name	Firewall affected	Stopped State	EMB_xx
	0x2000, 0x01	Message Timeout Object	No	No	n.a.
	0x2003, 0x01	CAM21 LSB	No	No	n.a.
	0x2003, 0x02	CAM21 MSB	No	No	n.a.
	0x2003, 0x03	ASC2 LSB	Yes	Yes	EMB28
	0x2003, 0x04	ASC2 MSB	Yes	Yes	EMB28
	0x2003, 0x05	TSC1_E LSB	Yes	No	n.a. <sup>1)</sup>
	0x2003, 0x06	TSC1_E MSB	Yes	No	n.a. <sup>1)</sup>
	0x2003, 0x07	TC1_EM LSB	Yes	Yes	EMB29
	0x2003, 0x08	TC1_EM MSB	Yes	Yes	EMB29
	0x2003, 0x09	HMI_request (ICRW) LSB	No	No	n.a.
	0x2003, 0x0A	HMI_request (ICRW) MSB	No	No	n.a.

<sup>1)</sup> The TSC1 access is per default limited to 10sec. Inside the TSC1 only Byte 1..4 are supported.



**IVECO prefer the engine management via the following objects:**

- Requested engine speed upper limit **0x6140H**
- Requested engine speed lower limit **0x6142H**
- Requested engine torque limit **0x6144H**
- Requested engine speed **0x614AH**

Following this proposal all a.m. individual requests can be sent and serviced contemporaneously. When due to any reason the continuous engine management should be realised by means of TSC1 pls contact IVECO CS. (refer to PN 5801490917 for VCM customization - tbc)



## 5 Basic CANopen Interface configuration

To configure the EM CANopen interface four different approaches are foreseen. Pls see the presentation available on the BB home page for getting familiar with the different approaches.

- 1<sup>st</sup> Approach:  
Use the '**IVECO default CAN communication**' being aligned to SAE J1939 communication. The communication matrix is available on IVECO BB homepage.
- 2nd Approach:  
Upload one of the customised **Public CANopen communication pre-sets**
- 3rd Approach:  
Contact IVECO to develop an individual and **Private CAN communication** preset. Pls contact IVECO CS organisation and fill the BB\_IF\_SpecSheet available on IVECO BB homepage.
- 4th Approach:  
Body Builder do an individual CANopen configuration (by Bodybuilder) by means of standard CANopen configuration tools.

In the following paragraphs the configuration approaches are described in detail

### 5.1 CANopen IVECO defaults pre-set

Since Euro6 all vehicles ordered with CANopen (OPT0384) will be delivered with the "**IVECO default CAN communication**". Such default communication is closely aligned to SAE J1939 standard, completed by some IVECO proprietary messages. For details on available CAN messages and signals, assigned ID'S and signal ranges pls contact IVECO BB homepage.

The info is available in \*.xls as well as \*.dbc formats

### 5.2 Public CANopen communication pre-sets upload

To provide individual CAN configurations for Bodybuilders not dealing with CANopen, IVECO defined a dedicated process of CANopen configuration handling. Such public CANopen communication Pre-sets have been developed by IVECO following the requirements of various Branches. For example there are Public Pre-sets available for RCV vehicles and Concrete mixers. The process shall provide following benefits:

- Controlled setup of CAN communication to guarantee technical best solution.
- Bodybuilders must not deal with CANopen configuration details.
- Documentation of vehicle configuration to improve serviceability.
- Facilitate exchange of ECU in case of damage.

#### Process Steps:

1. The Bodybuilder associations defines a desired CAN communication.
2. IVECO check and approves the proposal.
3. IVECO inserts the approved proposal in the Bodybuilder database.
4. The workshop can download the Public preset from the central database and install it on the vehicle.

### 5.3 Private CANopen communication pre-sets upload

To provide individual CAN configurations for Bodybuilders not dealing with CANopen, IVECO defined a dedicated process of CANopen configuration handling.

To provide individual CAN configurations for Bodybuilders not dealing with CANopen, IVECO defined a dedicated process of CANopen configuration handling. Such Private CANopen communication Presets can be developed by IVECO individually upon client request. Pls contact your IVECO BB market responsible and fill the BB\_IF\_SpecSheet available on IVECO BB homepage.

The process shall provide following benefits:

- Controlled setup of CAN communication to guarantee technical best solution.
- Bodybuilders must not deal with CANopen configuration details.
- Documentation of vehicle configuration to improve serviceability.
- Facilitate exchange of ECU in case of damage.

#### Process Steps:

1. The Bodybuilder defines together with IVECO BB market responsible a desired CAN communication, cost and timing aspects. In best case the Bodybuilder submits the proposal in XDC format.
2. IVECO check and approves the proposal.
3. IVECO inserts the approved proposal in the Bodybuilder database.
4. The workshop can download the preset from the central database and install it on the vehicle.

#### Bodybuilder privacy handling:

Certain body builders might consider the agreed CAN communication as confidential; therefore the access to Private configurations is handled by a user control system. Each body builder receives a specific and private User Account with login name and password. Depending on the account used during vehicle configuration Bodybuilder specific presets are available for installation.

### 5.4 Individual CANopen configuration

For Bodybuilders that have already CANopen knowledge in house or want to make use of special CANopen features it's possible and allowed to configure the IVECO CANopen interface individually following the protocol defined in CiA 301 [1]. The CANopen objects listed in Chapter 4 of this document are supported by IVECO. For such advanced configuration IVECO will provide a device specific EDS/XDD file.

The following chapter provide an example how to setup an individual communication. In order to understand the examples basic knowledge of CANopen is required. Also CANopen standard tools are necessary:

Recommended tools necessary for individual CANopen configuration:

- CANopen configuration tool (e.g.: Vector, ProCANopen; IXXAT, CANopen ConfigurationStudio; SYSTEC, CANopen Configuration Suite )
- CAN Hardware interface

### 5.4.1 Default CANopen settings

From Plant the CiA 413 interface is configured as described in the table:

Property	Value
Node Id	0x70
Baudrate	250 kbit/s
NMT	Master
Boot-up behavior	Start with K15 on, auto NMT operational

Tab 4: CiA 413 default configuration

### 5.4.2 Usage of cyclic Communication, individual messages

#### Description:

In this example the user will learn how to configure

- 1 individual Received Message (RPDO1), ID = 0x100, cycletime = 100ms
- 1 individual Transmitted Message (TPDO1), ID = 0x200, cycletime = 200ms

#### Message content:

RPDO1			
Signal	Object Index	Start position	length
Requested engine speed value	0x614A, 1	1	16
Requested engine speed upper limit	0x6140, 1	16	16
Requested engine speed lower limit	0x6142, 1	32	16
Requested engine torque limit	0x6144, 1	48	8
Requested vehicle speed limit	0x6146, 1	56	8

TPDO1			
Signal	Object Index	Start position	length
Engine speed value	0x6113, 1	1	16
Vehicle speed value	0x6111, 1	16	16
Parking brake device active	0x6316, 0	32	2

### 5.4.3 Example: Mapping configuration of cyclic Communication

1. Write Object 0x1011:01, Restore default parameters

Object	Value	Name
0x1011, 0x01	64h 61h 6Fh 6Ch (daol)	Restore all Default Parameters

2. NMT reset ECU

Message ID	Data	Repetition
0x00	0x81 0x70	Once

3. Write Object 0x1400 Receive PDO1 communication parameters

Object	Value	Name
--------	-------	------

0x1400, 0x01	0x100	COB-ID
0x1400, 0x02	0xFF	Transmission Type

#### 4. Write Object 0x1600 Receive PDO1 mapping parameters

Object	Value	Name
0x1600, 0x00	0x05	Number of entries
0x1600, 0x01	0x614A010F	PDO Mapping Entry 1
0x1600, 0x02	0x6140010F	PDO Mapping Entry 2
0x1600, 0x03	0x6142010F	PDO Mapping Entry 3
0x1600, 0x04	0x61440108	PDO Mapping Entry 4
0x1600, 0x05	0x61460108	PDO Mapping Entry 5

#### 5. Write Object 0x1800 Transmit PDO1 communication parameters

Object	Value	Name
0x1800, 0x01	0x200	COB-ID
0x1800, 0x02	0xFE	Transmission Type
0x1800, 0x03	0x00	Inhibit Timer
0x1800, 0x05	0x64	Event Timer

#### 6. Write Object 0x1A00 Transmit PDO1 mapping parameters

Object	Value	Name
0x1A00, 0x00	0x03	Number of entries
0x1A00, 0x01	0x6113010F	PDO Mapping Entry 1
0x1A00, 0x02	0x6111010F	PDO Mapping Entry 2
0x1A00, 0x03	0x63160002	PDO Mapping Entry 3

#### 7. Write Object 0x1010:02 , Save Communication parameters

Object	Value	Name
0x1010, 0x02	65h 76h 61h 73h (evas)	Store Communication Parameters

### 5.4.4 Usage of predefined SAE messages

The CANopen Interface incorporates the possibility to gateway complete SAE messages from the vehicle to the Bodybuilder CAN. SAE J1939 transport protocol (BAM/MPM) is not yet supported. The available SAE messages are defined in Chapter 4.7. Further the message send on Bodybuilder CAN, can be configured like any other CANopen TPDO.

In the following example a mapping of the CCVS to CANopen Transmit PDO1 with the ID "0xC101072" and cycletime 100ms is demonstrated.

#### 5.4.5 Example: Mapping configuration of predefined SAE messages

1. Write Object 0x1011:01, Restore default parameters

Object	Value	Name
0x1011, 0x01	64h 61h 6Fh 6Ch (daol)	Restore all Default Parameters

2. NMT reset ECU

Message ID	Data	Repetition
0x00	0x81 0x70	Once

3. Write Object 0x1800 Transmit PDO1 communication parameters

Object	Value	Name
0x1800, 0x01	0xC101072	COB-ID
0x1800, 0x02	0xFE	Transmission Type
0x1800, 0x03	0x00	Inhibit Timer
0x1800, 0x05	0x64	Event Timer

4. Write Object 0x1A00 Transmit PDO1 mapping parameters

Object	Value	Name
0x1A00, 0x00	0x03	Number of entries
0x1A00, 0x01	0xA4400740	PDO Mapping Entry 1

5. Write Object 0x1010:02 , Save Communication parameters

Object	Value	Name
0x1010, 0x02	65h 76h 61h 73h (evas)	Store Communication Parameters

## 6 Extended CANopen Interface configuration

### 6.1 Error Handling

The error handling of the CANopen side of the interface is according to CiA 301[1]. The ECU will generate EMCY objects if a ECU internal or Vehicle network communication error is recognized in the Chassis.



**Remark: The EMCY object is only send once on generation and once on error reset. Meanwhile the error status can be read from the OD error registers.**

On the other hand timeout errors in the bodybuilder network will be send to the vehicle instrument cluster.

### 6.2 Vehicle Network Errors

If a communication error occurred in the vehicle network the Truckgateway will send manufacturer specific CANopen EMCY objects.

EMCY	Description	Error field
FF27	VCM in timeout	1
FF0B	Brake in timeout	
FF2F	ECAS in timeout	
FFEE	TCO in timeout	
FF21	BODY in timeout	
FF03	GEARBOX in timeout	
FFFF	more than one IVN (In Vehicle Network) timeout active	
8110	CAN Overrun	2
8101	Vehicle CAN Tx values set to stopped state values due to communication loss	

Beside this the EMCY objects defined in CiA 301 [1] are supported.



**When any EMCY gets active the 'Vehicle CAN fully operational' output will be deactivated. Via the EMCY object the Truckgateway provides more precise information. When not any EMCY timeout is being transmitted but the 'Vehicle CAN fully operational' output is deactivated it's an indication that the Truckgateway communication inside the vehicle might be affected.**

### 6.3 Bodybuilder Timeout Errors



**Body builder timeout errors are generated and send to the vehicle Instrument Cluster if a timeout was generated. In order to detect a heartbeat missing from a CANopen Node it's mandatory to have at least once received a heartbeat message from that node. The Node ID's are to be configured with the IVECO CS tool. When the BB node Heartbeat is missing for more than 3000ms the error 0x45 will be displayed on the vehicle Instrument Cluster. Via the FMI the configured Node 1..7 can be identified.**



**Another possibility to control the timeout of a CAN message is the usage of the "Message Timeout Object" 0x2000, 0x02. When the assigned CAN message is missing the error 0x45 with FMI 8 will be displayed on the vehicle Instrument Cluster.**

If this object is used the Truckgateway expects that the “Message Timeout Object” is periodically received with the value 3. If the Message containing the “Message Timeout Object” is not received periodically a timeout will be generated.

The period of the “Message Timeout Object” can be adjusted, therefore two parameters are foreseen.

The errors displayed on the vehicle Instrument Cluster are:

Description	DTC	FMI
CO Module: BB Node 1 Heartbeat Missing	0x47245	0x01
CO Module: BB Node 2 Heartbeat Missing	0x47245	0x02
CO Module: BB Node 3 Heartbeat Missing	0x47245	0x03
CO Module: BB Node 4 Heartbeat Missing	0x47245	0x04
CO Module: BB Node 5 Heartbeat Missing	0x47245	0x05
CO Module: BB Node 6 Heartbeat Missing	0x47245	0x06
CO Module: BB Node 7 Heartbeat Missing	0x47245	0x07
CO Module: BB Timeout Object not updated	0x47245	0x08

The EM timeout reaction can be configured, as described in Chpt. 2.4 and Chpt. 8.

## 6.4 Bodybuilder Node Errors

IVECO can display EMCY errors of BB CAN\_Nodes. The Node ID's are identical to the node ID'S configured for the Heartbeat monitoring (see chpt. 6.3). When the BB node sends an CANopen EMCY message the error 0x44 will be displayed on the vehicle Instrument Cluster. Via the FMI the configured Node 1..7 can be identified.












The errors displayed on the vehicle Instrument Cluster are:

Description	DTC	FMI
CO Module: BB Node 1 Error Active	0x47244	0x01
CO Module: BB Node 2 Error Active	0x47244	0x02
CO Module: BB Node 3 Error Active	0x47244	0x03
CO Module: BB Node 4 Error Active	0x47244	0x04
CO Module: BB Node 5 Error Active	0x47244	0x05
CO Module: BB Node 6 Error Active	0x47244	0x06
CO Module: BB Node 7 Error Active	0x47244	0x07

## 7 CAN Firewall configuration

For certain CAN received objects, especially for objects related to engine access, CAN requests are only permitted under defined conditions. The mechanism which handles the access is called CAN Firewall.

### 7.1 Receive CAN objects affected by CAN Firewall

Object	Value	Name	Boolean RR/RS	Engine Speed RR/RS
	0x613D	Starter lockout switch	X	
	0x613E	Engine Start switch	X	
	0x613F	Engine Stop switch	X	
	0x6140	Requested engine speed upper limit	X	X
	0x6142	Requested engine speed lower limit	X	X
	0x6144	Requested engine torque limit	X	X
	0x6146	Requested vehicle speed limit	X	X
	0x614A	Requested engine speed	X	X
	0x2003, 0x03 0x04	ASC2	x	X
	0x2003, 0x05 0x06	TSC1_E	x	X
	0x2003, 0x07 0x08	TC1	x	X

### 7.2 Boolean Firewall parameters

The Boolean Firewall parameters consist of two types of parameter sets

- Request restrictions (RR), if one of the RR is violated (the RR is activated and the condition is fulfilled) the request will not be serviced.
- Request Shutoff (RS), if one of the RS is violated (the RS is activated and the condition is fulfilled) the request will be aborted.

The restrictions are:

Boolean Request Restrictions	Boolean Request Shutoffs
Brake depressed	Brake depressed
Brake NOT depressed	Brake NOT depressed
Handbrake engaged	Handbrake engaged
Handbrake NOT engaged	Handbrake NOT engaged
Clutch open	Clutch open
Clutch closed	Clutch closed
Gear NOT in neutral	Gear NOT in neutral
Gear in reverse	Gear in reverse
Powertrain open	Powertrain open
Powertrain closed	Powertrain closed
Vehicle parked	Vehicle parked
Vehicle standstill	Vehicle standstill
Vehicle maneuvering	Vehicle maneuvering
Vehicle driving	Vehicle driving
Restrict if brake NOT depressed AND handbrake NOT engaged	Restrict if brake NOT depressed AND handbrake NOT engaged
BB enable input (72072A/3)	BB enable input (72072A/3)



### 7.3 Engine Speed Restrictions:

For some objects additional conditions are available

These are:

Engine Speed Request Restrictions	Engine Speed Request Shutoff
Minimum Engine Speed	Minimum Engine Speed
Maximum Engine Speed	Maximum Engine Speed

## 7.4 Default CAN Firewall settings:

	Starter lockout switch	Engine Start switch	Engine Stop switch	Requested engine speed upper limit	Requested engine speed lower limit	Requested engine torque limit	Requested vehicle speed limit	Requested engine speed	TSC1_E	ASC2	TC1
EMB_xx	12	13	14	15	16	17	18	19	22	20	21
Boolean Request Restrictions											
Brake depressed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Brake NOT depressed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Handbrake engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Handbrake NOT engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Clutch open	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Clutch closed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Gear NOT in neutral	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Gear in reverse	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Powertrain open	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Powertrain closed	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
Vehicle parked	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle standstill	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle maneuvering	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle driving	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
Restrict if brake NOT depressed AND handbrake NOT engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
BB enable input 72072A/3	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON

	Starter lockout switch	Engine Start switch	Engine Stop switch	Requested engine speed upper limit	Requested engine speed lower limit	Requested engine torque limit	Requested vehicle speed limit	Requested engine speed	TSC1_E	ASC2	TC1
EMB_xx	12	13	14	15	16	17	18	19	22	20	21
Boolean Request Shutoff											
Brake depressed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Brake NOT depressed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Handbrake engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Handbrake NOT engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Clutch open	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Clutch closed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Gear NOT in neutral	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Gear in reverse	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Powertrain open	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Powertrain closed	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
Vehicle parked	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle standstill	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle maneuvering	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Vehicle driving	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	ON	ON
Restrict if brake NOT depressed AND handbrake NOT engaged	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
BB enable input 72072A/3	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
Engine Speed Request Restrictions											
Minimum Engine Speed	n.a.	n.a.	n.a.	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Maximum Engine Speed	n.a.	n.a.	n.a.	OFF	1200	OFF	OFF	OFF	OFF	OFF	OFF
Engine Speed Request Shutoff											
Minimum Engine Speed	n.a.	n.a.	n.a.	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Maximum Engine Speed	n.a.	n.a.	n.a.	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF



**The parameters can be modified by the IVECO workshop. Anyway it's always the Bodybuilder responsibility to ensure proper and safe settings.**

## 7.5 Transparency

Increasing the transparency IVECO provides “xx\_control allowed” signals for major CAN requests. They indicate whether a CAN request from BodyBuilder can be serviced or not. The control allowed signals reflect the status of the CAN Firewall conditions.

## 8 StoppedState for BB emergency handling



Within complex BB application systems Safety aspects have to be considered. Safety can also be achieved, when in case of an emergency the system is entering a pre-defined state. Via the StoppedState parameters the vehicle supports the BodyBuilder on realizing his Safety Concept. The vehicle can enter autonomously such pre-defined state. Various Pre-Sets are available to comply with the Body-Builder application specific needs.

### Requirements for Functional Safety:



Pls note that the Vehicle StoppedState values are transmitted via the Vehicle CAN to the other vehicle sub-systems. Therefore the configured Vehicle StoppedState values activation requires the “Vehicle CAN fully operational” output being active.



Pls note that the Vehicle StoppedState values are transmitted only when the CAN Firewall permits access. When CAN Firewall rejects access the replacement values – typically don’t care - are sent. That concept allows to:

- continue a standard driving mission when the BB application is inactive
- activate StoppedState only when BB application is active

For basic details on CANopen State management pls refer Chpt 2.3.4

## 8.1 “BB Emergency” detection

As described in chapter 6.3 the Truckgateway is able to detect emergency inside the BB application using a CAN based interface. The Truck gateway is offering two monitoring mechanisms:

- Body-Builder CAN timeout monitoring
  - Via CANopen Heartbeat mechanism monitoring or
  - Via Message timeout object monitoring (for applications not using CANopen NMT)

When any of the described mechanism identify an emergency inside the BB application the Truckgateway can initiate an NMT action. Following configurations are selectable:

Value	Behaviour
1	Maintain current state
2	Go to Pre-Operational
4	Reserved
8	Go to Stop (default)
16	Reset Node
32	Go to Operational



**Vehicle StoppedStates are activated only when “Go to Stop” is configured**

- Via BB sending (autonomously) one NMT message “Stop node(s)”.

That’s typically available when the BB application contains a CANopen NMT Master

**Note:**

The message layout is as follows:

- CAN ID: 0x00, DLC: 0x02
- Byte1: 0x02 (enter Stopped)
- Byte2: 0x00 (all Nodes) or 0xEM CANopen Node-ID - Default 0x70

- BB activate “BB EMCY” Input (ST 72072B / Pin 2)



**For avoiding an unintended StoppedState activation, e.g. due to one single wiring short to GND, both “BB EMCY” input (ST 72072B / Pin 2) and “BB Enable” input (ST 72072A / Pin 3) needs to be activated. The “BB Enable” input is considered as an Indication that the BB application is in really mission.**

**Note:**

This function have been developed in order to allow this sophisticated StoppedState feature also for “non CAN based” BB applications. Anyway it might be used for also for CAN based applications.

## 8.2 StoppedState Value(s) activation

The StoppedState value(s) will be activated when one of the following events occur:

- Body-Builder CAN timeout monitoring
  - Via CANopen Heartbeat mechanism monitoring or
  - Via Message timeout object monitoring (for applications using CAN interface)
- Via BB sending (autonomously) one NMT message “Stop node(s)”

**Note:**

The message layout is as follows:

- CAN ID: 0x00, DLC: 0x02
  - Byte1: 0x02 (enter Stopped)
  - Byte2: 0x00 (all Nodes) or 0xEM CANopen Node-ID - Default 0x70
- “BB EMCY” and “BB Enable” input activated

The StoppedState value(s) will be sent when the CAN Firewall settings permit the access.

StoppedState value(s) will be ignored when the CAN Firewall rejects the access.

In this case the replacement value(s) – typically don’t care – are sent.



**For this reason IVECO recommends to activate the “BB Enable” input to indicate an BB application being in mission**

Note:

Using smart settings of the CAN Firewall(s) allows an easy integration. E.g. all CAN Firewall <<Ver\_2>> Variants settings are assigned to “BB Enable” input only. That allows to activate StoppedState value(s) when that “BB Enable” input is activated. When not activated The StoppedState value(s) are not sent.

## 8.3 StoppedState Value(s) exit

The StoppedState value(s) will be reset by a Restart of the CANopen Stack. Such CANopen Stack restart can be initiated by one of the following events:

- Cycling the K15
- BB sending an NMT command “Start node” or “Start All Nodes”





















**Note:**

The message layout is as follows:

- CAN ID: 0x00, DLC: 0x02
  - Byte1: 0x01 (enter Operational)
  - Byte2: 0x00 (all Nodes) or 0xEM CANopen Node-ID - Default 0x70
- Cycling the “BB Enable” input, when CANopen Start via HW input is configured
- For this feature a TeleService programming is needed.

## 8.4 StoppedState value parameters

The values applied in StoppedState can be defined by CS tool, in the default configuration following values are used:

Object	Value	Name	Default values	EMB_xx
	0x6100	Rear obstacle distance	0xFF	Fix, not changeable
	0x6106	Obstacle detection device active	0x03	Fix, not changeable
	0x6136	First clutch dependent PTO switch	0x03	EMB25
	0x6137	Second clutch dependent PTO switch	0x03	EMB25
	0x6138	Clutch independent PTO switch	0x03	EMB25
	0x6139	First engine mounted PTO switch	0x03	EMB25
	0x613A	Second engine mounted PTO switch	0x03	EMB25
	0x613D	Starter lockout switch	0x03	EMB25
	0x613E	Engine Start switch	0x03	EMB25
	0x613F	Engine Stop switch	0x03	EMB25
	0x6140	Requested engine speed upper limit	0xFFFF	EMB27
	0x6142	Requested engine speed lower limit	0xFFFF	EMB27
	0x6144	Requested engine torque limit	0xFF	EMB27
	0x6146	Requested vehicle speed limit	0xFF	EMB27
	0x6148	Refuse packer step switch	0x03	EMB25
	0x614A	Requested engine speed	0xFFFF	EMB26
	0x61A3	Transmission output shaft PTO switch	0x03	EMB25
	0x61A4	Transfer case output shaft PTO switch	0x03	EMB25
	0x6348	Remote emergency light request	0x03	EMB25
	0x6349	Inhibit TGC opening request	0x03	EMB25



**Attention:** If timeout handling is not configured or timeout handling is configured but StoppedState value(s) handling not, the last valid value written to a CANopen object. This will remain valid until ECU or NMT reset. Consequently also the value(s) send towards the vehicle will remain on the Initialisation values resp. the last received value(s).

## 9 Rules for interfacing the vehicle

### 9.1 General rules for CAN interface

#### 9.1.1 Basic rules

- If a request is not active the value must be 0x03, 0xFF, 0xFFFF  
Such requirement is aligned to SAE J1939 – 71 standard, using the “n.a.” information
- The value of the last request will be active until K15 OFF or it's overwritten by another value in case of cyclic communication
- The CANopen network must be in NMT operational
- The ‘Vehicle CAN fully operational’ output must active +24V
- Pls respect that signals shall not overlap Byte limitations, therefore 3-bit, 4-bit, 8-bit resp. 16-bit signals shall start at bit 0, 8, 16, 24 and so on. The filling of eventual gaps is to be performed by Dummy objects, pls refer to Chapter 4.3.
- Inside a TPDO / RPDO message max. 16 signals can be mapped.
- Also Dummy objects are considered as mapped signals.

#### 9.1.2 BB CAN Bus errors

CAN offers various mechanism to identify communication errors, such as:

- Bit and Bit stuffing errors
- CAN message Format errors
- Cyclic redundancy checks
- CAN Acknowledge

The detected errors are counted by each CAN transceiver, separately for received CAN and transmitted CAN messages. The IVECO CAN interface provide this BB-CAN Transmit & Receive error counter information by means of CANopen object 0x2007 sub0x03, so it's quite easy to measure BB CAN errors.

#### 9.1.3 Busload and CAN-throughput

The IVECO interface CAN throughput is defined as time between:

- Receiving a CAN message from the BodyBuilder CAN till sending it to the In-Vehicle CAN network
- Receiving a CAN message from the In-Vehicle CAN till sending it to the BodyBuilder CAN network

The IVECO interface CAN throughput depends on:

- Execution time needed for Internal applications tasks, such as:
  - PTO management
  - Receiving messages from and sending messages to the In-Vehicle CAN network
  - CAN Firewall
  - Supervision and Diagnostic tasks
- Execution time needed for external interface tasks, such as:
  - Receiving messages from BB-CAN network
  - Sending messages to the BB-CAN network
  - Supervision and Diagnostic tasks

The typical IVECO CAN interface throughput can be estimated by using the following formula:

$$\text{Throughput time [ms]} = 2 * \text{PLC Cycletime [ms]} + \text{CAN message cycle time [ms]}$$



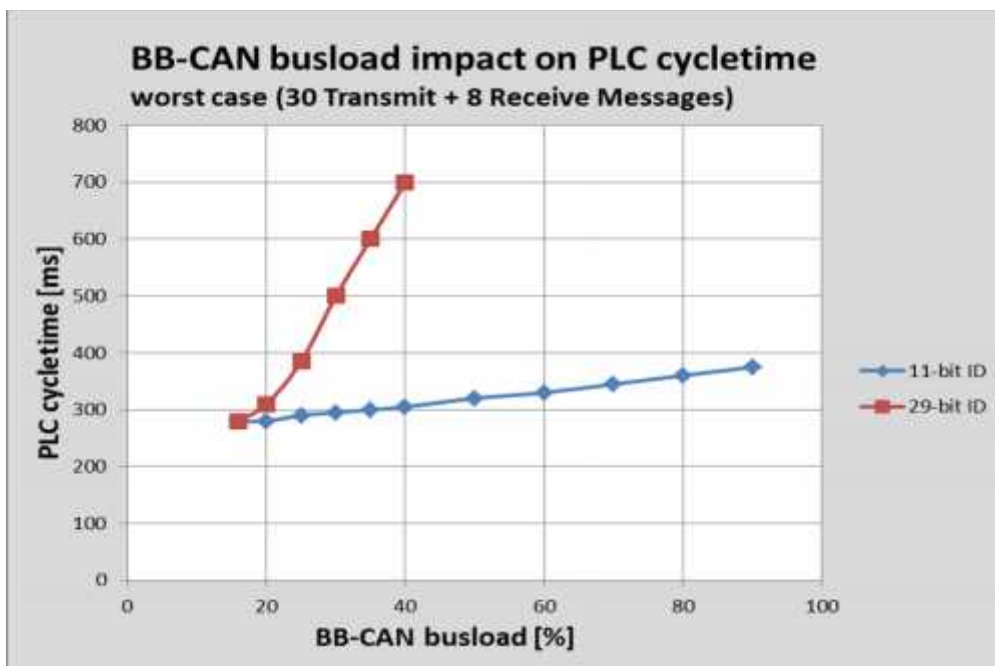


The overall execution time is defined as PLC cycletime, and actual value is provided on CANopen 0x2006, sub8. The experience with plenty client applications over the last years have shown good results, when the PLC cycletime 350 ms limit have been respected.

As already indicated the PLC cycletime is influenced also by the BB-CAN network. The IVECO CAN interface offers to use either:

- standard 11-bit CAN message Identifiers  
typical for CANopen applications and proposed for all time-critical applications
- extended 29-bit CAN message Identifiers (typical for SAE J1939 applications)  
When using 29-bit ID the PLC cycletime is directly influenced. Therefore BB-CAN busload using extended 29-bit ID should not exceed 25%, especially when Heavy-PTO's are mounted on automated gearboxes. Typical applications are blowers, generators and similar driven by gearbox PTO.

The BB CAN busload can be read by CANopen object 0x2007 sub0x02. The following graph illustrate the impact of the BB-CAN bus load and the PLC cycle time.



## 9.2 Engine speed request management

The external engine speed management is an integral part of the engine speed management. The speed management is composed by:

- Engine low idle speed management
- Engine high idle speed management
- Speed request management

The engine low idle speed is the maximum of:

- Default/Base engine idle speed
- External Engine speed request lower limit (CANopen object 0x6142)
- Vehicle internal requests, like:
  - Increased low idle due to cold start aid
  - ISC Mode 0,1,2,3 low idle speeds
  - Etc.

The engine low idle speed is valid for both internal and external request and will be kept in any case. E.g. also automatic gearboxes, braking system, etc. cannot force the engine to lower rpm.

The actual engine low idle speed value can be read via object 0x6112. The engine low idle speed can be increased depending on the engine family. The allowed maximum engine idle speed values are:

Tector 4 /6 cyl: ~ 1250rpm (tbc)

Cursor 9: ~ 1250rpm (tbc)

Cursor 11/13: ~ 1250rpm (tbc)

CNG F2G: ~ 1250rpm (tbc)

- Engine speed request lower limit can be performed only if:  
All firewall conditions are fulfilled

The engine high idle speed is the minimum of:

- Default/Base engine high speed
- External Engine speed request upper limit (CANopen object 0x6140)
- Vehicle internal requests, like:
  - ISC Mode 0,1,2,3 high idle speeds
  - ISC Mode 0,1,2,3 high idle speeds for Driver KickDown
  - ISC Mode 0,1,2,3 high idle speeds for CAN KickDown (ETC1 mom. engine over-speed)
  - Gear group depending High idle speed
  - Etc.

The engine high idle speed is valid for both internal and external request and will be kept. E.g. also ISC commands, Accelerator pedal, etc. cannot force the engine to higher rpm.



### Note:

**Automatic gearboxes can request a momentary engine overspeed.  
That feature can be disabled by IVECO CS.**

The actual engine high idle speed value can be read via object 0x6111. The engine high idle speed can be decreased depending on the engine family. The maximum engine high idle speed values are:

Tector 4 cyl: ~ 3000rpm (tbc)

Tector 6 cyl: ~ 2800rpm (tbc)

Cursor 9: ~ 2750rpm (tbc)

Cursor 11: ~ 2350rpm (tbc)

Cursor 13: ~ 2350rpm (tbc)

CNG F2G: ~ 2750rpm (tbc)

- Engine speed request upper limit can be performed only if:  
All firewall conditions are fulfilled.

The requested engine speed is considered internally as an External Intermediate Speed Control request. The requested engine speed is allowed within the engine lower and upper rpm limit thresholds. The requested engine speed can be increased by:

- Driver accelerator pedal
- Internal ISC setpoint (Driver using CC Set+ /Set- button)



**The requested engine speed can be temporarily suspended resp. overridden by:  
Internal systems directly controlling the engine via TSC1, e.g. automatic gearboxes**

### 9.3 Requested engine speed upper limit

- The default value after Start-up is 0xFFFF
  - The value of the last request will be active until K15 off or it's overwritten by another value
  - If a request is not active the value must be 0xFFFF
- Engine speed request upper limit can be performed only if:
- All firewall conditions are fulfilled

### 9.4 Requested engine speed lower limit

- The default value after Start-up is 0xFFFF
  - The value of the last request will be active until K15 off or it's overwritten by another value
  - If a request is not active the value must be 0xFFFF
- Engine speed request lower limit can be performed only if:
- All firewall conditions are fulfilled

### 9.5 Requested engine speed

- The default value after Start-up is 0xFFFF
  - The value of the last request will be active until K15 off or it's overwritten by another value
  - If a request is not active the value must be 0xFFFF
- Engine speed request can be performed only if
- All firewall conditions are fulfilled

### 9.6 Cranking and Engine stop requests

Engine start request, can be performed only if:

- Engine is off
- Contemporaneous engine stop request is not present
- Contemporaneous engine starter lockout request is not present
- The vehicle control module allows engine start
- All firewall conditions are fulfilled

Engine stop request, can be performed only if:

- Engine is on
- The vehicle control module allows engine stop
- All firewall conditions are fulfilled

Engine starter lockout request, can be performed only if:

- Engine is off.
- All firewall conditions are fulfilled

## 9.7 Requested engine torque limit

- The default value after Start-up is 0xFF
- The value of the last request will be active until K15 off or it's overwritten by another value
- If a request is not active the value must be 0xFF

Engine torque limit request can be performed only if:

- All firewall conditions are fulfilled

## 9.8 Requested vehicle speed limit

- The default value after Start-up is 0xFF
- The value of the last request will be active until K15 off or it's overwritten by another value
- If a request is not active the value must be 0xFF

Vehicle speed limit request can be performed only if:

- All firewall conditions are fulfilled

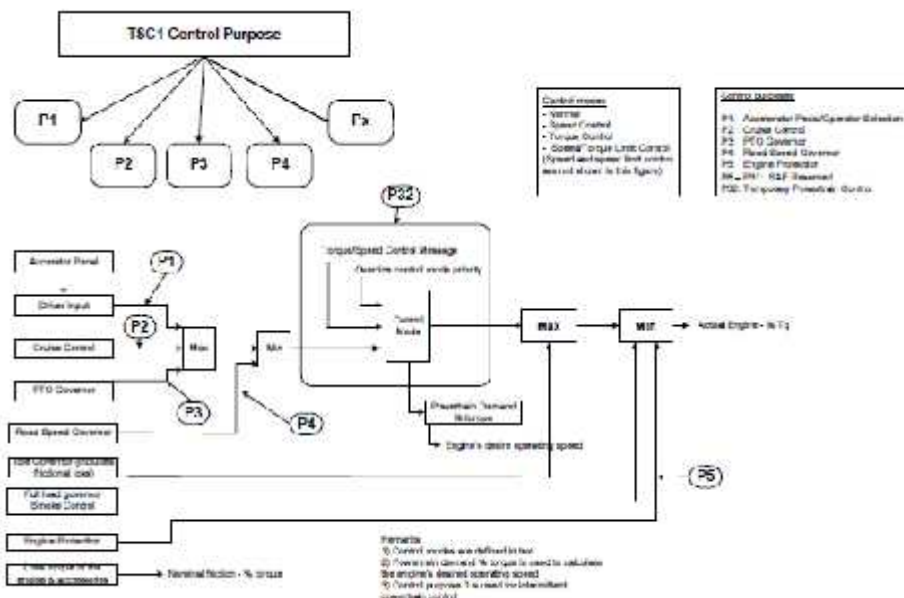
## 9.9 TSC1 Requests

TSC1 control requests are limited to 10s (Default). Only TSC1 message signals within Byte 1...4 are supported. Anyway IVECO prefer the engine management via the following objects:

- Requested engine speed upper limit 0x6140H
- Requested engine speed lower limit 0x6142H
- Requested engine torque limit 0x6144H
- Requested engine speed 0x614AH

Following this proposal all a.m. individual requests can be sent and serviced contemporaneously.

When due to any reason the continuous engine management should be realised by means of TSC1 control pls contact IVECO CS for 'unlimited TSC1 access'.



The TSC1 control purpose (SPN 3350) is not supported. Pls consider that TSC1 access is always considered as temporary PowerTrain control (P32).

## 9.10 ASC2 Requests

In default configuration the ECAS remote control via Truckgateway and ECAS System is disabled.  
For enabling ASC2 remote access pls contact IVECO Service.  
Both Systems EM and ECAS needs to be configured.

There are different configurations depending on ECAS 4x2 vehicles or ECAS 6x2 vehicles.  
When ASC2 remote access is enabled all the ECAS Dashboard switches will be disabled.  
In detail:

- 'Traction help' dashboard switch (6x2 version)
- 'Liftaxle' dashboard switch (6x2 version)
- 'Nominal level' (ECAS Reset) dashboard switch (4x2 and 6x2 versions)
- 'Second level' dashboard switch, when available w/ OPT 8378 (4x2 FP and 6x2 FP versions)
- Axle load distribution dashboard switch, when available (6x2 version)

The ECAS remote control will still be enabled and active in parallel to the ASC2 remote access. On concurrent activation the following items shall be respected:



**The last valid command is serviced, either received by ECAS remote control or ASC2 remote access**

**Receiving contemporaneously implausible commands between ECAS remote control and ASC2 remote access will interrupt the air suspension control.**

### Requirements for Functional Safety



**For Safety related BB applications, which are interfacing the vehicle, IVECO requires from the BodyBuilder to choose either ECAS remote control or ASC2 remote access. No contemporaneous activation shall be possible. For this reason IVECO recommends to deactivate the ECAS remote control via configuration. Pls contact IVECO Service**

The requests in column "allowed" are forwarded to the vehicle, all others will be replaced by don't care.  
When CAN Firewall denies ASC2 access the "Replacement Mask" values are sent:

ASC2 - Air Suspension Control 2	SPN	Position	Allowed	Replacement Mask
Automatic traction help (load transfer)	2984	1.1	N	11b
Kneeling Request Left Side	1749	1.3	N	11b
Kneeling Request Right Side	1748	1.5	N	11b
Kneeling Control Mode Request	1747	1.7	N	11b
Nominal Level Request Front Axle	1751	2.1	Y	1111b
Nominal Level Request Rear Axle	1750	2.5	Y	1111b
Level Control Mode Request	1753	3.1	Y	1111b
Lift Axle 1 Position Command	1752	3.5	Y	11b
Lift Axle 2 Position Command	1828	3.7	N	11b
Damper Stiffness Request Front Axle	1718	4	N	0xFF
Damper Stiffness Request Rear Axle	1719	5	N	0xFF
Damper Stiffness Request Lift / Tag Axle	1720	6	N	0xFF
Kneeling Command - Front Axle	1830	7.1	N	11b
Kneeling Command - Rear Axle	1829	7.3	N	11b
Prohibit air suspension Control	3215	7.5	N	11b

Available ECAS remote controls:



## 9.11 TC1 Requests

In default configuration the TC1 remote control via Truckgateway is disabled. The TC1 can be enabled for Stralis EURO VI vehicles with automatic gearboxes. For enabling TC1 requests pls contact IVECO Service.

There following TC1 signals are supported yet:

- SPN 683 Disengage Driveline
- SPN 525 Transmission Requested gear equal 0 (125d)



**A engagement of the gear via TC1 is not yet possible. Pls consider that this feature is only supported when the BB enable input (ST 72072A, pin3) is activated by the BodyBuilder contemporaneously.**

The requests in column “allowed” are forwarded to the vehicle, all others will be replaced by don’t care. When CAN Firewall denies TC1 access the “Replacement Mask” values are sent:

TC1 - Transmission Control 1	SPN	Position	Allowed	Replacement Mask
Transmission Gear Shift Inhibit Request	681	1.1	Y	11b
Transmission Torque Converter Lockup Disable Request	682	1.3	N	11b
Disengage Driveline Request	683	1.5	Y	11b
Requested Percent Clutch Slip	684	2	N	0xFF
Transmission Requested Gear	525	3	N	0xFF
Transmission Mode 1	1852	6.1	N	11b
Transmission Mode 2	1853	6.3	N	11b
Transmission Mode 3	1854	6.5	N	11b
Transmission Mode 4	1855	6.7	N	11b
Transmission Mode 5	4246	8.1	N	11b
Transmission Mode 7	4248	8.5	N	11b
Transmission Mode 8	4249	8.7	N	11b

## 10 PTO Control

With the Truckgateway interface it's possible to control the PTO engagement/disengagement via CAN requests, CAN requests can occur in parallel to Hardware Input requests. Each CAN request is evaluated with same ER/SC conditions as HW Input requests.

Furthermore it's possible that Bodybuilders block a PTO request with the "PTO consent" signal or disable an active PTO request with the "PTO consent" signal. For each PTO type a consent signal exists. Compare signals of chapter 4.5.

To Enable this feature the Parameters PTO1\_extCfg, PTO2\_extCfg, PTO3\_extCfg are available.

EASY Unified CS tool Parameter:

- PTOx\_extCfg = 0 (off) default
- PTOx\_extCfg = 1 (external engagement blocking)
- PTOx\_extCfg = 2 (external PTO shutoff)
- PTOx\_extCfg = 3 (external engagement blocking and external PTO shutoff)

For description of the PTO functionality and possible customisations pls refer to the IVECO BB manual.

## 11 Body Interface

In conjunction with other options the Bodybuilder can enable additional features of the CAN Interface. These features are described in detail in the following paragraphs.

### 11.1 Rear obstacle distance display (ODD)

With this function the Body Builder can display the distance to an obstacle behind the Truck in the vehicle instrument cluster. A Body Builder device with e.g. ultrasonic sensors must send the distance to the Truckgateway, this will forward it to the instrument. If the Object 0x6106 "Obstacle detection device active" is set to 1 the instrument cluster will switch to a dedicated page and indicate the distance as send in object 0x6100 "Rear obstacle distance" to the driver.



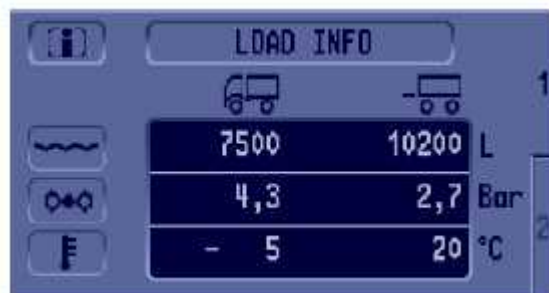
### 11.2 Body Builder payload display

The Body Builder payload display allows the body to transmit payload information to the vehicle instrument cluster. The Information displayed is:

Object	Name
0x6167	Body fluid level
0x6169	Body pressure
0x6102	Thermal body temperature

Using this function the driver can also set alarm thresholds for each type of payload.





Pls note that when the Hardwired inputs (ST72072B, pins 16,17,18) are used the CANopen information are no longer supported.

### 11.3 Additional lights request and error display

In some cases a Body Builder might wish to add light's to the existing vehicle.



**Attention:**

The Truckgateway CANopen interface is only supported during K15 ON phase. Therefore it's not possible to replace serial lights nor to implement additional lights expected working in K15 OFF phase.

To facilitate retrofit light mounting the CANopen interface provides the possibility to:

- Forward the status of the vehicle lights (compare chapter 4.5)
- Receive error information off additional Body Builder lights (compare chapter 4.5)
- Generate and display error messages in the Instrument cluster.

To generate an error message the Bodybuilder has to send the corresponding "light status" object with the value 2d, (10b)

## 12 Interface to the Driver Display

The BodyBuilder have the possibility to activate a popup on Driver display sending a spontaneous message. The text of the popup is fix <<ex>>. In addition the warning buzzer can be activated, either continuously or on first occurrence. Also different buzzer tones and levels are selectable. If needed the BB is informed by receiving the feedback from the Driver display.



In detail the following features are available:

- Activate one of 9 ICONs
- Select severity to assign the Popup background (red / yellow / no background)
- Activate the buzzer
- Select continuously warning or on first occurrence
- Select buzzer tone
- Select buzzer level

Furthermore the BodyBuilder can verify following feedbacks on the Driver display:

- Actual displayed Popup via '**Indicator Index**'
- Popup activation status (Foreground / Background)
- Popup Acknowledge by the driver
  - no ACK given
  - pos ACK by Driver
  - Neg ACK (when Popup auto-confirmed, after ~30 sec)
- Feedback buzzer Tone
- Feedback Buzzer Level



**Pls consider that the BB can sent only one Popup per time (either background or foreground). Popup's contemporaneously displayed from any other vehicle systems (Brake, gearbox, engine etc.) may override the BB activated popup. Same applies also to the warning buzzer management which might also be overridden by vehicle events.**

Anyway the BB is informed on the actual status reading the HMI\_feedback message.

## 12.1 HMI\_request Message

The HMI\_Request message is sent by Body Builder via CANOpen using the following manufacturer specific objects:

Object Index (hex)	Sub-index name	Variable Name	Sub-index (hex)	Size	Default (hex)
0x2003	IN_UNSIGNED32_RX_09	ICRW_EM LSB	0x09	32	0xFFFFFFFF
0x2003	IN_UNSIGNED32_RX_10	ICRW_EM MSB	0x0A	32	0xFFFFFFFF

The message layout is defined as follows:

SPN Name	SPN Position	SPN Length
Info Activation Mode New	1.1	2
Info Severity	1.3	2
Buzzer Activation Mode New	1.5	2
Buzzer Tone Extended	2.5	4
Buzzer Level Extended	3.1	4
Indicator Index	5,6.1	12
Popup Index	6.5,7	12

### 12.1.1 Info Activation Mode New

It is "General Activation Signal". Values should be the following:

- 0x00: Off
- 0x10: On
- 0x11: No action

EM should use only 0x00 and 0x10 values. Default value is 0x00 and with 0x00 a continuous transmission is not needed.

### 12.1.2 Info Severity

The Info Severity define the background of the popup. Values should be the following:

- 0x00: Lowest severity, No lamp
- 0x01: Medium severity, Yellow colour.
- 0x10: Highest severity, Red colour
- 0x11: No action

### 12.1.3 Buzzer Activation Mode New

The buzzer activation mode new defines if the driver display warning buzzer should be activated. Values should be the following:

- 0x00: Off
- 0x01: On at first occur or start-up.
- 0x10: On
- 0x11: No action

No action value 0x11 should not be used, to deactivate the buzzer information 0x00 must be used. Buzzer activation is triggered by Info Activation Mode new. EM should use only the following value: 0x00, 0x01 and 0x10.

Pls consider that the buzzer might be overridden by prior vehicle events. Sound priority list as follows:

1. ACC alert sound
2. ACC shutoff sound
3. LDW warning
4. "Handbrake not engaged" sound
5. Lights on Warning (Door open / KL15 off) & Eurotronic warning
6. Inducement warning
7. Warnpopup sound / Hill-Holder Sound both have the same level
8. BodyBuilder Buzzer activation

### 12.1.4 Buzzer Tone Extended

Command to select the sound tones. If signal is not available a Default Tone is used. Values should be the following:

Buzzer tone	Buzzer Tone Extended	Note
No tone	0h	
Tone 1	1h	
Tone 2	2h	
Tone 3	3h	
Tone 4	4h	
Not used	5h – Eh	Recovery tone: Tone 3
Not available	Fh	Recovery tone: Tone 3

### 12.1.5 Buzzer Level Extended

Command to set the volume of the sound tone. If signal is not available a Default Tone is used. Values should be the following:

Buzzer Level		Buzzer Volume %
0x0	Off	0%
0x1	Level 1	14%
0x2	Level 2	14%
0x3	Level 3	28%
0x4	Level 4	28%
0x5	Level 5	43%
0x6	Level 6	43%
0x7	Level 7	57%
0x8	Level 8	57%
0x9	Level 9	71%
0xA	Level 10	71%
0xB	Level 11	86%
0xC	Level 12	86%
0xD	Level 13	100%
0xE	Level 14	100%
0xF	No Available	100% (Default Level)

































EM default level is 0xF.

### 12.1.6 Indicator Index

The Indicator index selects the ICON to be displayed left from the Popup. If signal is not available no ICON is displayed. Values should be the following:

0x0:		Default Indicator
0xFFF:		No action, No indicator.

EM should use 0xFFFF as default value, no indication preferred.

Indicator Index	Coloured IC SPR2		MonoChrome ICM06		Comments
	Icon 52x52 pixel	description	Icon 30x30 pixel	description	
0x0CE		Body Builder warning		Body Builder warning	
0x0CF		Body Builder stop		Body Builder stop	
0x0D0		Body Builder remote control of vehicle		Body Builder remote control of vehicle	
0x0D1		Crane out/not in driving position		Crane out/not in driving position	
0x0D2		Stamps out/not in driving position		Stamps out/not in driving position	
0x0D3		Trailer correctly coupled		Trailer correctly coupled	
0x0D4		Trailer detected but not correctly coupled		Trailer detected but not correctly coupled	
0x0D5		Occupied footboard(s)		Occupied footboard(s)	
0x0D6		Overriding footboard safety device		Overriding footboard safety device	
0x0D8		Driver Attention System - Attention	free	free	tbv, if gatewayed to BB
0x0D9		Driver Attention System - Caution	free	free	tbv, if gatewayed to BB
0x0DA		Driver Attention System - Alert	free	free	tbv, if gatewayed to BB
0x0DB		Gear Shift Indicator - Shift UP	free	free	tbv, if gatewayed to BB
0x0DC		Gear Shift Indicator - Shift DOWN	free	free	tbv, if gatewayed to BB
0x0DD		Gear Shift Indicator - Wrong gearshifting	free	free	tbv, if gatewayed to BB
0x0DE		Driving style evaluation - Acceleration style	free	free	tbv, if gatewayed to BB
0x0DF		Driving style evaluation - Delay throttle / brake Driving style evaluation - Stop approach	-	not available	tbv, if gatewayed to BB
0x0E0		Driving style evaluation - Brakes usage	-	not available	tbv, if gatewayed to BB
0x0E1		Driving style evaluation - Hill driving	-	not available	tbv, if gatewayed to BB
0x0E2		Driving style evaluation - Auxiliary brakes usage	-	not available	tbv, if gatewayed to BB
0x0E3		Driving style evaluation - Generic indication	-	not available	tbv, if gatewayed to BB
0x0E4	free	free	-	not available	tbv, if gatewayed to BB
0x0E5		Generic warning yellow	-	not available	setting Indicator index = 0x000h
0x0E6		Generic warning red	-	not available	setting Indicator index = 0x000h

### 12.1.7 Popup Index

It selects a Popup text. The BB should always sent 0x1, else a unique identification is not possible.

- 0x0: Default Popup text "System info"
- 0x1: Popup Active Popup text "**ex**"
- 0xFFF: No action, No popup.

For any value, only one index will be available (0x1). The assigned Text is always "**ex**"

For disabling a popup text BB have to send 0xFFF " "

## 12.2 HMI\_feedback Message

The HMI\_feedback information is available at CANopen object 0x6439.

HMI\_feedback message signals are explained below:

SPN Name	SPN Position	SPN Length	Description	Value Table
Indicator Index	1, 2.1	12	It selects an Indicator Lamp (Tell Tale) or Icon index.	0x0 Default Indicator 0xFFF No action, No Indicator
Popup Index	3,4.1	12	It selects a Popup index.	0x0 Default Popup 0xFFF No action, No Popup
Popup Activation Status	4.5	2	Driver's activation status of the Popup specified by the signal "Popup Index".	0x00 Disabled/off 0x01 In foreground 0x10 In background 0x11 Not available or error
Popup Acknowledge Status	4.7	2	Driver's confirmation status of the Popup specified by the signal "Popup Index".	0x00 No acknowledge given 0x01 Positive acknowledge received 0x10 Negative acknowledge received 0x11 Not available
Buzzer Tone Extended	5.1	4	Command to select one of the sound tones available presets or status of the currently active one.	0x0 Off 0x1 Preset Tone 1 0x2 Preset Tone 2 0x3 Preset Tone 3 0x4 Preset Tone 4 0x5 Preset Tone 5 0x6 Preset Tone 6 0x7 Preset Tone 7 0x8 Preset Tone 8 0x9 Preset Tone 9 0xA Preset Tone 10 0xB Preset Tone 11 0xC Preset Tone 12 0xD Preset Tone 13 0xE Preset Tone 14 0xF No Available, Default Tone
Buzzer Level Extended	5.5	4	Command to set the volume of the sound tone or status of the currently active level.	0x0 Level 0 0x1 Level 1 0x2 Level 2 0x3 Level 3 0x4 Level 4 0x5 Level 5

				0x6 Level 6 0x7 Level 7 0x8 Level 8 0x9 Level 9 0xA Level 10 0xB Level 11 0xC Level 12 0xD Level 13 0xE Level 14 0xF Not Available, Default Level
--	--	--	--	--

### 12.3 HMI display on BB lamp failures

When BB has included lights on his application he may indicate defective lamps on the HMI Driver display, see also Chpt. 11.3 . When sending the defect value (0x02) of the related lamp then the following errors can be generated on the HMI Driver display:

Description	DTC	FMI
Right side direction light, B-CAN/Direct EM output (Stralis)	0x47219	0x02
Right side direction light, B-CAN/Direct EM output (Trakker)	0x47268	0x02
Right side trailer direction light, T-CAN (Stralis)	0x47208	0x02
Right side trailer direction light, T-CAN (Trakker)	0x47269	0x02
Left side direction light, B-CAN/Direct EM output (Stralis)	0x47213	0x02
Left side direction light, B-CAN/Direct EM output (Trakker)	0x4726B	0x02
Left side trailer direction light, T-CAN (Stralis)	0x4720E	0x02
Left side trailer direction light, T-CAN (Trakker)	0x4726C	0x02
Left side low beam light	0x4725C	0x02
Right side low beam light	0x4725D	0x02
Left side high beam light	0x4725E	0x02
Right side high beam light	0x4725F	0x02
Front fog light	0x4725B	0x02
Left/Right side rear fog light	0x47256	0x02
Left/Right side rear fog trailer light	0x47257	0x02
Left side stop light	0x47258	0x02
Right side stop light	0x47259	0x02
Left/Right side stop trailer light	0x4725A	0x02
Rear position light	0x47255	0x02
Front position light	0x47252	0x02
Trailer corner marker light	0x47262	0x02
BB corner marker light	0x47261	0x02
License light	0x47260	0x02
Reverse light	0x47267	0x02
Reverse trailer light	0x4726F	0x02
Work light	0x47270	0x02



## 13 EN 1501, functions

### 13.1 General Information

The function is an option (OPT 6821) for rear loaded Refuse Collector Vehicles, equipped with foot plate. In compliance to EN 1501-1 as soon as the foot plate is occupied the vehicle:

- Shall not Reverse
- Shall not drive above 30 km/h



The function does not prevent the vehicle from rolling backward in uphill conditions.  
**Pls consider the Warning instructions described on the BB connector EURO VI manual.**

### 13.2 Implementation

The function is handled by the Truckgateway, it will receive the footplate signal either via CAN 0x6148 or via digital input (ST72072B, pin5).

If the EM recognizes an occupied footplate the 2<sup>nd</sup> speed limiter will be set to 30 km/h immediately. This is indicated in the instrument cluster.

2<sup>nd</sup> speedlimiter indication





To prevent the vehicle from reversing the EM evaluates the status of the gearbox (Eurotronic/Allison/Manual), when a reverse gear is requested and the footplate is occupied. The EM will:

- Request the service brake
  - Reduce the engine torque
  - Disengage driveline on automatic gearboxes on Stralis range
- It is recommended that the "BB enable input" is activated

When the operator leaves the footplate the vehicle braking is only released if the driver switches the gearbox to neutral and afterwards to the desired forward gear.

Two lamps inside the dashboard shall indicate the status of the EN1501 function:

Lamp	Icon	Color	Status	Description
1		Yellow	On	Stopping brake active
		Yellow	Off	Stopping brake not active
		Yellow	Blinking	Error active, function not working
2		Yellow	On	Stepper board occupied Only when requested via HW input *)
		Yellow	Off	Stepper board not occupied

\*) when "Stepper board occupied" is to be displayed also when Stepper requested received via CAN 0x6148 then the HMI interface message is to be used. Details see Chpt 12.1

### 13.3 Stepper board status send on Pin

#### Signal Input:

Description	Wire	Connector	Pin
EN1501 Stepper swt request from IO	0996	72072B	5

Connected to low = Stepper board switch active  
Open connection = Stepper board switch not active

### 13.4 EN1501 CAN Interface


If a manufacturer has ordered the CANopen interface option it's possible to:

- Send the stepper board status to the vehicle.
- Read the status of a stepper board connected hardwired to the EM

#### 13.4.1 Stepper board request send on CAN

If the CAN request for EN1501 stepper switch is active the stepper board occupied signal can be send on CAN to the EM.

#### Signal:

Direction	Object	Description
	0x6148	Refuse packer Stepper switch

#### Signal meaning:

Value	Meaning
0	Stepper board not occupied
1	Stepper board is occupied
2	Stepper board error
3	Stepper board n.a.

The BodyBuilder shall use only values 1 (Stepper board is occupied) or 3 (Stepper board n.a.).

### 13.4.2 Stepper board status send on CAN

The status of a stepper board connected to the EM input is transmitted on CAN

#### Signal:

Direction	Object	Description
☒	0x6314	Refuse stepper step switch active

#### Signal meaning:

Value	Meaning
0	Stepper board not occupied
1	Stepper board is occupied
2	Stepper board error
3	Stepper board n.a.

## 14 IVECO Customization process

IVECO offers for different applications Easy2use configurations Pre-sets. In addition to the flexible CAN interface IVECO offers also a flexible CAN-Firewall as well as a flexible StoppedState variants. For both features various functional groups have being defined. If your application is not using certain functions the related Presets can remain unchanged, not any action is needed.

The functional groups have been developed following a functional approach, and within each group a certain set of Easy2use configurations are available. The available portfolio of configurations will be completed to satisfy the typical Bodybuilder applications. Therefore pls contact the BB homepage and your BB market responsible to be informed on the actual features.

The benefits are:

- Configurations are uniquely identified
- simple to define customized vehicle deliveries - client per client.
- No detailed knowledge needed, pls contact your BB market responsible for support

So the IVECO Customization process is a well-defined and simple mechanism to classify your individual customization needs. So you can agree with your BB market responsible a fully customized vehicle delivery. Having your customization needs once defined you can request this download on the entire IVECO CS network.