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## Document release control

Release	Date	Changes
001	04/14/2016	Initial release
002	06/21/2016	Added information about data endianness and signal Corrected the MAP value on the example of page 17.
003	06/24/2016	Added connector pinout information
004	06/27/2016	Added source information on the DataID list
005	07/20/2016	Added broadcast rate information on the DataID list
006	12/27/2016	Added FTSPARK's CAN information Added GND signal in the CAN connector drawing Added the possibles MeasureIDs for one DataID in the MeasureID table
007	01/18/2017	Corrected text typos
008	04/07/2017	Added information about external keypad Added new DataIDs for button operations Added new DataIDs for temperature reading
009	12/12/2017	Modified the FTSpark's ProductID range allowing 2 units to be used on the CAN bus
010	01/05/2018	Added PitLimit Switch DataID
011	03/15/2018	Added new DataIDs (0x008E to 0x0115)
012	10/16/2018	Added new DataIDs (0x0116 to 0x0119)
013	11/26/2018	Removed unused DataIDs related to aborted projects
014	02/21/2019	Added new switchpanel options
015	04/17/2019	Added new DataIDs (0x011A to 0x0136) Changed individual ECU's name to "PowerFT ECU"
016	05/20/2019	Changed injection duty cycle's broadcast rate from 100 to 10Hz
017	08/21/2019	Added new MessagesIDs (0x0600, 0x0601 e 0x0602)
018	11/28/2019	Added new DataIDs (0x0137 to 0x0138) Added new Injector Driver ProductID
019	07/20/2020	Added new DataIDs (0x0148 to 0x0153) Added segment packet flowchart Added EGT-4's ProductIDs Modified the maximum number of gears from 6 to 10

020	08/19/2020	Added new DataIDs (0x0154 to 0x016A) Added FTSpark B ProductID
021	08/13/2021	Added warning about ECU's broadcast transmission rate variation under hi RPM
022	03/04/2022	Added information about the ECU's simplified broadcast packets
023	04/06/2022	Added information about the ECU's simplified broadcast packets
024	22/06/2022	Added new MessagesIDs (0x0608)
026	24/08/2022	Added new Measure ID (0x0170 ~ 0x01B8) Added brake pressure in the simplified packets Fixed ECU O2 Sensor Unit information (note 3)
027	08/05/2023	Fixed MeasureID sequence error starting at 0x02E0 Added EV DataID Added TPMS device information

## FTCAN 2.0 protocol

### Physical layer

CAN 2.0B extended mode  
Rate: 1Mbps

### Features

In this document we will approach the implementation of a custom protocol (FTCAN) running on top of a CAN 2.0B physical layer. One main feature of the FTCAN protocol is to provide a means to segment a large stream of data into many smaller CAN packets. We will consider a CAN FRAME as indicated below:

CAN FRAME	
29 bits	0 to 8 bytes
IDENTIFICATION	DATA FIELD

### IDENTIFICATION

The FTCAN will use the 29 bits of the IDENTIFICATION header to identify the device that originated the message. The 29 bits will be divided in order to provide information about: the unique product identifier, type of data and the type of message that is being sent. The bit division was planned in order to have multiple message priorities for the same type of product, and to have multiple priorities for the many different products inside the same CAN physical layer.

IDENTIFICATION (29 bits)		
Bits 28 to 14 (15 bits)	Bits 13 to 11 (3 bits)	Bits 10 to 0 (11 bits)
<i>ProductID</i>	<i>DataFieldID</i>	<i>MessageID</i>

### ProductID

Identifies the product that has sent the message. The lower the ProductID the higher is the priority in the CAN bus. In the network two devices that are the same type of product (two O2 sensors for example) cannot have the same ProductID. In order to differentiate two products of the same type the ProductID bits are divided as show below.

ProductID (15 bits)	
Bit 14 to 5 (10 bits)	Bits 4 to 0 (5 bits)
ProductTypeID	Unique identifier

Each product that wants to send data to the CAN bus must have a unique identifier. Devices that will only receive data from the CAN bus doesn't need to have a unique ID. The ProductIDs are divided in priority ranges:

- Critical priority: 0x0000 to 0x1FFF
- High priority: 0x2000 to 0x3FFF
- Medium priority: 0x4000 to 0x5FFF
- Low priority: 0x6000 to 0x7FFF

A list with all the possible ProductTypeIDs is presented later in this document.

## DataFieldID

Identifies the type of data structure that is being sent in the *CAN FRAME -> DATA FIELD*. There are 4 possible data layouts:

- 0x00: Standard CAN data field
- 0x01: Standard CAN data field coming from/going to a bus converter.
- 0x02: FTCAN 2.0 data field
- 0x03: FTCAN 2.0 data field coming from/going to a bus converter.

## MessageID

Identifies the data in the *DATA FIELD*. Example: commands, configuration data, real time readings, etc. The lower the *MessageID* the higher is the priority. The MessageID's most significant bit is reserved in order to identify a response from a command:

MessageID (11 bits)	
Bit 10	Bits 9 to 0 (10 bits)
Response (value 1)	Message code

The priorities ranges are:

- Critical priority: 0x000 a 0x0FF
- High priority: 0x100 a 0x1FF
- Medium priority: 0x200 a 0x2FF
- Low priority: 0x300 a 0x3FF

A list with all the possible *MessageIDs* is presented later in this document.

## DATA FIELD

The *DATA FIELD* can have up to 8 data layouts accordingly to the *DataFieldID's* value. All values in the *DATA FIELD* are transmitted as big-endian.

### DataFieldID 0x00: Standard CAN

In this data layout all 8 bytes of the *DATA FIELD* are used as valid data (*PAYLOAD*). All data are transmitted in one shot since this mode doesn't implement data segmentation.

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
PAYLOAD							

### DataFieldID 0x01: Standard CAN Bridge (bridge, gateway ou converter)

In this data layout all 8 bytes of the *DATA FIELD* will be forwarded by the bus converter. The *DataFieldID* (0x01) is also used to identify packets that are originated outside the CAN bus. Bridge examples are: Standalone USB-CAN converter, FT500's USB-CAN bridge, etc.

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
PAYLOAD							

### DataFieldID 0x02: FTCAN 2.0

This is the *DataFieldID* that all FuelTech's devices will use to communicated with each other in the CAN bus. The data segmentation feature is implemented in this type of data layout. As can be seen in the diagrams below the segmentation feature uses the first byte of the *DATA FIELD* to indicate which segment of the following bytes is. There can be 2 types of packets:

- Single packet (all data is transmitted in one CAN packet)
- Segmented packet (data is transmitted in multiples CAN packets)

#### **Single packet**

The first byte of the *DATA FIELD* will have the value of 0xFF. The following 7 bytes will have the message data (*PAYLOAD*).

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
0xFF	PAYLOAD						

### Segmented packet

In the first byte of the *DATA FIELD* there will be values ranging from 0x00 to 0xFE. The first segment will have the 0x00 value and the following packets will contain 0x01, 0x02 and so on. In the first segment the 2 bytes following the 0x00 value contain the segmentation data.

#### First segment

DATA FIELD (8 bytes)							
0	1	2	3	4	5	6	7
0x00	SEGMENTATION DATA		PAYLOAD				

#### Second segment

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
0x01	PAYLOAD						

#### Third segment (if present)

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
0x02	PAYLOAD						

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#### Last segment (if present)

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
0xFE	PAYLOAD						

The maximum PAYLOAD length will be:  $5 + (0xFD * 7) = 1776$  bytes.

The segmentation data contains the following information:

SEGMENTATION DATA (2 bytes)																
Bytes	1					2										
Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	RFU	RFU	RFU	RFU	RFU	PAYLOAD total length (in bytes)										

RFU: Reserved for Future Use

### **DataFieldID 0x03: FTCAN 2.0 Bridge (bridge, gateway ou converter)**

This DataFieldID uses the same data layout from DataFieldID's 0x02 when the data is going to or coming from a BUS converter.



## Attachements

### ProductID's list

Since the 5 least significant bits of the ProductID are used for the unique value the FTCAN protocol can have up to 32 devices of the same product type at the same time. The unique value will range from 0x00 to 0x1F. The limit for different products types will be 1024.

Priority	ProductID			Product Type
	ProductTypeID	Range		
		Start	Finish	
Critical	-----	0x0FFF	0x0FFF	Device searching a ProductID (unique value undefined)
High	0x0140	0x2800	0x281F	Gear Controller
High	0x0141	0x2820	0x283F	Knock Meter
High	0x0142	0x2840	0x285F	Boost Controller 2
High	0x0150	0x2A00	0x2A1F	Injector Driver
Medium	0x023F	0x47E0	0x47FF	Input Expander
Medium	0x0240	0x4800	0x481F	WBO2 Nano
Medium	0x0241	0x4820	0x483F	WBO2 Slim
Medium	0x0242	0x4840	0x485F	Alcohol O2
Medium	0x0243	0x4860	0x4860	FTSPARK A
Medium	0x0243	0x4861	0x4861	FTSPARK B
Medium	0x0244	0x4880	0x4881	Switchpad-8
Medium	0x0244	0x4882	0x4883	Switchpad-4
Medium	0x0244	0x4884	0x4885	Switchpad-5
Medium	0x0244	0x4886	0x4887	Switchpad-8 mini
Medium	0x0245	0x48A0	0x48A0	TPMS reader
Medium	0x0246	0x48C0	0x48DF	Reserved for Future Use
Medium	0x0280	0x5000	0x501F	FT500 ECU
Medium	0x0281	0x5020	0x503F	FT600 ECU
Medium	0x0282	0x5040	0x505F	First reserved range for future ECUs
Medium	...	...	...	...
Medium	0x02E4	0x5C80	0x5C9F	Last reserved range for future ECUs
Low	0x0340	0x6800	0x681F	Reserved for Future Use
Low	0x0380	0x7000	0x7000	Internal use
Reserved	-----	0x0800	0x0800	FuelTech EGT-8 CAN (model A)
Reserved	-----	0x0880	0x0880	FuelTech EGT-8 CAN (model B)
Reserved	-----	0x0900	0x0900	FuelTech EGT-4 CAN (model A)

Reserved	-----	0x0920	0x0920	FuelTech EGT-4 CAN (model B)
Reserved	-----	0x0940	0x0940	FuelTech EGT-4 CAN (model C)
Reserved	-----	0x0960	0x0960	FuelTech EGT-4 CAN (model D)
Reserved	-----	0x0980	0x0980	Reserved for Future Use
Reserved	-----	0x09A0	0x09A0	Reserved for Future Use
Reserved	-----	0x09C0	0x09C0	Reserved for Future Use
Reserved	-----	0x09E0	0x09E0	Reserved for Future Use

Example: A FT500 device with the unique value of 3 will have the following ProductID:

$$(0x0280 \ll 5) + 3 = 0x5003$$

Where 0x0280 is the ProductTypeID for FT500 and 3 is the unique value. The “<<” is the C language command rotate bit left, 0x0280 << 5 is the same as multiply 0x0280 with 0x0020.

## MessageID's list

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- **0x0FF, 0x1FF, 0x2FF e 0x3FF – Real time reading broadcast**

0x0FF – Critical priority

0x1FF – High priority

0x2FF – Medium priority

0x3FF – Low priority

Those are the MessageIDs that the FuelTech's device will use to transmit its real time readings. The rate for each broadcast will depend on the type of data, critical data will be broadcasted more often. Examples of critical data: Ignition Cut, Two Step signal, emergency signals, etc. Examples of high priority data: RPM, ignition timing, actual injection flow, MAP, TPS, etc.

Values are always transmitted as signed 16 bits in big-endian byte order.

Statuses are transmitted as big-endian unsigned 16 bits.

Each real time data will be composed of 4 bytes:

REAL TIME DATA	
0-1	2-3
Data identifier (MeasureID)	Value or status (big endian)

If a device needs to broadcast more than one reading at the same time it can do so using a segmented packet:

Segmented packet PAYLOAD					
MEASURE 1		MEASURE 2		MEASURE 3	
0-1	2-3	4-5	6-7	8-9	10-11
MeasureID	Value/Stat	MeasureID	Value/Stat	MeasureID	Value/Stat

The maximum number of measures that can be transmitted on segmented packages are:  
 $1776/4 = 444$

Another possibility is to use a CAN standard data frame to transmit 2 measures at a time, all the devices in the CAN bus must be capable of receiving data using all the data layouts.

Standard packet PAYLOAD			
MEASURE 1		MEASURE 2	
0-1	2-3	4-5	6-7
MeasureID	Value	MeasureID	Value

A list with the available MeasureIDs is presented further in this document.

- **0x600 ~ 0x608 – Real time simple broadcast**

Those are the MessageIDs that the FuelTech’s device will use to transmit its real time readings using a fixed set of MeasureIDs. Each measure value is prefixed in a specific position in payload. The rate for each broadcast is 100Hz.

Values are always transmitted as signed 16 bits in big-endian byte order.

The data is transmitted **always** using a CAN standard data frame (DataFieldID 0x00) to transmit 4 measures at a time as shown in the following image:

Standard packet PAYLOAD			
MEASURE 1	MEASURE 2	MEASURE 3	MEASURE 4
0-1	2-3	4-5	6-7
Value	Value	Value	Value

## MeasureIDs

The least significant bit of the MeasureID is used to indicate if the following value is the actual value or the reading status. Considering that the MeasureID have 16 bits in total we will use 15 bits to identify the data that is being transmitted.

MeasureID	
Bits 15 to 1	Bit 0
Data identifier (DataID)	0: Data value 1: Data status

MeasureID	DataID	Description	Unity	Multiplier	Broadcast source (rate*)
0x0000	0x0000	Unknown	-	-	-
0x0002	0x0001	TPS	%	0.1	PowerFT ECU 100Hz
0x0004	0x0002	MAP	Bar	0.001	PowerFT ECU 100Hz
0x0006	0x0003	Air temperature	°C	0.1	PowerFT ECU 10Hz
0x0008	0x0004	Engine temperature	°C	0.1	PowerFT ECU 10Hz
0x000A	0x0005	Oil pressure	Bar	0.001	PowerFT ECU 100Hz
0x000C	0x0006	Fuel pressure	Bar	0.001	PowerFT ECU 100Hz
0x000E	0x0007	Water pressure	Bar	0.001	PowerFT ECU 100Hz
0x0010	0x0008	ECU Launch Mode (2-Step, 3-Step, Burnout, Burnout + Spool)	-	Note 1	PowerFT ECU 100Hz
0x0012	0x0009	ECU Battery voltage	Volts	0.01	PowerFT ECU 100Hz
0x0014	0x000A	Traction speed	Km/h	1	PowerFT ECU 100Hz Gear Controller 100Hz
0x0016	0x000B	Drag speed	Km/h	1	PowerFT ECU 100Hz Gear Controller 100Hz
0x0018	0x000C	Left front wheel speed	Km/h	1	PowerFT ECU 100Hz
0x001A	0x000D	Right front wheel speed	Km/h	1	PowerFT ECU 100Hz
0x001C	0x000E	Left rear wheel speed	Km/h	1	PowerFT ECU 100Hz
0x001E	0x000F	Right rear wheel speed	Km/h	1	PowerFT ECU 100Hz
0x0020	0x0010	Driveshaft RPM	RPM	1	PowerFT ECU 100Hz
0x0022	0x0011	Gear	-	Note 2	PowerFT ECU 100Hz Gear Controller 100Hz
0x0024	0x0012	Disabled O2	λ	0.001	WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0026 0x0027	0x0013	Cylinder 1 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0028 0x0029	0x0014	Cylinder 2 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz

0x002A 0x002B	0x0015	Cylinder 3 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x002C 0x002D	0x0016	Cylinder 4 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x002E 0x002F	0x0017	Cylinder 5 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0030 0x0031	0x0018	Cylinder 6 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0032 0x0033	0x0019	Cylinder 7 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0034 0x0035	0x001A	Cylinder 8 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0036 0x0037	0x001B	Cylinder 9 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0038 0x0039	0x001C	Cylinder 10 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003A 0x003B	0x001D	Cylinder 11 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003C 0x003D	0x001E	Cylinder 12 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003E 0x003F	0x001F	Cylinder 13 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0040 0x0041	0x0020	Cylinder 14 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0042 0x0043	0x0021	Cylinder 15 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz

					WBO2 Slim 100Hz Alcohol O2 100Hz
0x0044 0x0045	0x0022	Cylinder 16 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0046 0x0047	0x0023	Cylinder 17 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0048 0x0049	0x0024	Cylinder 18 O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x004A 0x004B	0x0025	Left bank O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x004C 0x004D	0x0026	Right bank O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x004E 0x004F	0x0027	Exhaust O2	λ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0050	0x0028	Disabled EGT	°C	0.1	---
0x0052	0x0029	Cylinder 1 EGT	°C	0.1	PowerFT ECU 100Hz
0x0054	0x002A	Cylinder 2 EGT	°C	0.1	PowerFT ECU 100Hz
0x0056	0x002B	Cylinder 3 EGT	°C	0.1	PowerFT ECU 100Hz
0x0058	0x002C	Cylinder 4 EGT	°C	0.1	PowerFT ECU 100Hz
0x005A	0x002D	Cylinder 5 EGT	°C	0.1	PowerFT ECU 100Hz
0x005C	0x002E	Cylinder 6 EGT	°C	0.1	PowerFT ECU 100Hz
0x005E	0x002F	Cylinder 7 EGT	°C	0.1	PowerFT ECU 100Hz
0x0060	0x0030	Cylinder 8 EGT	°C	0.1	PowerFT ECU 100Hz
0x0062	0x0031	Cylinder 9 EGT	°C	0.1	PowerFT ECU 100Hz
0x0064	0x0032	Cylinder 10 EGT	°C	0.1	PowerFT ECU 100Hz
0x0066	0x0033	Cylinder 11 EGT	°C	0.1	PowerFT ECU 100Hz
0x0068	0x0034	Cylinder 12 EGT	°C	0.1	PowerFT ECU 100Hz
0x006A	0x0035	Cylinder 13 EGT	°C	0.1	PowerFT ECU 100Hz
0x006C	0x0036	Cylinder 14 EGT	°C	0.1	PowerFT ECU 100Hz
0x006E	0x0037	Cylinder 15 EGT	°C	0.1	PowerFT ECU 100Hz
0x0070	0x0038	Cylinder 16 EGT	°C	0.1	PowerFT ECU 100Hz
0x0072	0x0039	Cylinder 17 EGT	°C	0.1	PowerFT ECU 100Hz
0x0074	0x003A	Cylinder 18 EGT	°C	0.1	PowerFT ECU 100Hz
0x0076	0x003B	Left bank EGT	°C	0.1	PowerFT ECU 100Hz
0x0078	0x003C	Right bank EGT	°C	0.1	PowerFT ECU 100Hz

0x007A	0x003D	Exhaust EGT	°C	0.1	PowerFT ECU 100Hz
0x007C	0x003E	ECU O2 Sensor Unit	-	Note 3	PowerFT ECU 0.5Hz
0x007E	0x003F	ECU Speed Sensor Unit	-	Note 4	PowerFT ECU 0.5Hz
0x0080	0x0040	ECU Pressure Sensor Unit	-	Note 5	PowerFT ECU 05.Hz
0x0082	0x0041	ECU Temperature Sensor Unit	-	Note 6	PowerFT ECU 05.Hz
0x0084	0x0042	ECU RPM	RPM	1	PowerFT ECU 1KHz
0x0086	0x0043	ECU Injection Bank A Time	ms	0.01	PowerFT ECU 100Hz
0x0088	0x0044	ECU Injection Bank B Time	ms	0.01	PowerFT ECU 100Hz
0x008A	0x0045	ECU Injection Bank A Duty Cycle	%	0.1	PowerFT ECU 100Hz
0x008C	0x0046	ECU Injection Bank B Duty Cycle	%	0.1	PowerFT ECU 100Hz
0x008E	0x0047	ECU Ignition Advance/Retard	°	0.1	PowerFT ECU 1KHz
0x0090	0x0048	2-Step Signal	-	Note 7	PowerFT ECU 1KHz Gear Controller 1KHz
0x0092	0x0049	3-Step Signal	-	Note 7	PowerFT ECU 100Hz
0x0094	0x004A	Burnout Signal	-	Note 7	PowerFT ECU 100Hz
0x0096	0x004B	ECU Cut	%	1	PowerFT ECU 100Hz
0x0098	0x004C	ECU Air Conditioning	-	Note 7	PowerFT ECU 100Hz
0x009A	0x004D	ECU Eletro Fan	-	Note 7	PowerFT ECU 100Hz
0x009C	0x004E	GEAR Cut	%	1	Gear Controller 500Hz
0x009E	0x004F	GEAR Retard	°	0.1	Gear Controller 500Hz
0x00A0	0x0050	GEAR Sensor Voltage	Volts	0.001	Gear Controller 100Hz PowerFT ECU 100Hz
0x00A2	0x0051	ECU Average O2	λ	0.001	PowerFT ECU 100Hz
0x00A4	0x0052	External Ignition output 1 discharge time	uS	1	FTSPARK 50Hz
0x00A6	0x0053	External Ignition output 2 discharge time	uS	1	FTSPARK 50Hz
0x00A8	0x0054	External Ignition output 3 discharge time	uS	1	FTSPARK 50Hz
0x00AA	0x0055	External Ignition output 4 discharge time	uS	1	FTSPARK 50Hz
0x00AC	0x0056	External Ignition output 5 discharge time	uS	1	FTSPARK 50Hz
0x00AE	0x0057	External Ignition output 6 discharge time	uS	1	FTSPARK 50Hz
0x00B0	0x0058	External Ignition output 7 discharge time	uS	1	FTSPARK 50Hz
0x00B2	0x0059	External Ignition output 8 discharge time	uS	1	FTSPARK 50Hz
0x00B4	0x005A	External Ignition output 9 discharge time	uS	1	FTSPARK 50Hz
0x00B6	0x005B	External Ignition output 10 discharge time	uS	1	FTSPARK 50Hz
0x00B8	0x005C	External Ignition output 11 discharge time	uS	1	FTSPARK 50Hz
0x00BA	0x005D	External Ignition output 12 discharge time	uS	1	FTSPARK 50Hz
0x00BC	0x005E	External Ignition output 13 discharge time	uS	1	FTSPARK 50Hz
0x00BE	0x005F	External Ignition output 14 discharge time	uS	1	FTSPARK 50Hz
0x00C0	0x0060	External Ignition output 15 discharge time	uS	1	FTSPARK 50Hz
0x00C2	0x0061	External Ignition output 16 discharge time	uS	1	FTSPARK 50Hz
0x00C4	0x0062	External Ignition Power Supply	V	.001	FTSPARK 50Hz
0x00C6	0x0063	External Ignition Power Supply Drop	V	.001	FTSPARK 50Hz
0x00C8	0x0064	External Ignition Power Level	mJ	1	FTSPARK 50Hz
0x00CA	0x0065	External Ignition Temperature	°C	0.1	FTSPARK 50Hz
0x00CC	0x0066	External Ignition Capacitor 1 charge	V	0.1	FTSPARK 50Hz



0x00CE	0x0067	External Ignition Capacitor 2 charge	V	0.1	FTSPARK 50Hz
0x00D0	0x0068	External Ignition Capacitor 3 charge	V	0.1	FTSPARK 50Hz
0x00D2	0x0069	External Ignition Capacitor 4 charge	V	0.1	FTSPARK 50Hz
0x00D4	0x006A	External Ignition Capacitor 1 charge time	uS	1	FTSPARK 50Hz
0x00D6	0x006B	External Ignition Capacitor 2 charge time	uS	1	FTSPARK 50Hz
0x00D8	0x006C	External Ignition Capacitor 3 charge time	uS	1	FTSPARK 50Hz
0x00DA	0x006D	External Ignition Capacitor 4 charge time	uS	1	FTSPARK 50Hz
0x00DC	0x006E	External Ignition Error code	-	Note 8	FTSPARK 25Hz
0x00DE	0x006F	External Ignition no load outputs	-	Note 9	FTSPARK 25Hz
0x00E0	0x0070	External Ignition partial discharge outputs	-	Note 9	FTSPARK 25Hz
0x00E2	0x0071	External Ignition damaged outputs	-	Note 9	FTSPARK 25Hz
0x00E4	0x0072	External Ignition disabled outputs	-	Note 9	FTSPARK 25Hz
0x00E6	0x0073	External Ignition operation status	-	Note 10	FTSPARK 25Hz
0x00E8	0x0074	Power level config for external ignition	mJ	1	PowerFT ECU 10Hz
0x00EA	0x0075	Air conditioning button state	-	Note 7	PowerFT ECU 10Hz
0x00EC	0x0076	Two step button state	-	Note 7	PowerFT ECU 10Hz
0x00EE	0x0077	Three step button state	-	Note 7	PowerFT ECU 10Hz
0x00F0	0x0078	Transbreak button state	-	Note 7	Internal use only
0x00F2	0x0079	Burnout button state	-	Note 7	Internal use only
0x00F4	0x007A	ProNitrous button state	-	Note 7	Internal use only
0x00F6	0x007B	Progressive Nitrous #1 button state	-	Note 7	Internal use only
0x00F8	0x007C	Datalogger button state	-	Note 7	PowerFT ECU 10Hz
0x00FA	0x007D	Day/Night button state	-	Note 7	Internal use only
0x00FC	0x007E	Dashboard button state	-	Note 7	Internal use only
0x00FE	0x007F	Engine start button state	-	Note 7	PowerFT ECU 10Hz
0x0100	0x0080	Generic PWM output increase button state	-	Note 7	Internal use only
0x0102	0x0081	Gear upshift button state	-	Note 7	PowerFT ECU 10Hz
0x0104	0x0082	Boost controller increase button state	-	Note 7	Internal use only
0x0106	0x0083	Gear reset button state	-	Note 7	Internal use only
0x0108	0x0084	Adjust change button	-	Note 7	Internal use only
0x010A	0x0085	Adjust 1 button	-	Note 7	Internal use only
0x010C	0x0086	Adjust 2 button	-	Note 7	Internal use only
0x010E	0x0087	Adjust 3 button	-	Note 7	Internal use only
0x0110	0x0088	Adjust 4 button	-	Note 7	Internal use only
0x0112	0x0089	Adjust 5 button	-	Note 7	Internal use only
0x0114	0x008A	Transmission temperature	°C	0.1	PowerFT ECU 10Hz
0x0116	0x008B	Intercooler temperature	°C	0.1	Internal use only
0x0118	0x008C	Oil temperature	°C	0.1	PowerFT ECU 10Hz
0x011A	0x008D	PitLimit Switch/Button	-	Note 7	Internal use only
0x011C	0x008E	Active Traction Control: enable switch	-	Note 7	Internal use only
0x011E	0x008F	Active Traction Control: table 1 button	-	Note 7	Internal use only
0x0120	0x0090	Active Traction Control: table 2 button	-	Note 7	Internal use only
0x0122	0x0091	Active Traction Control: table 3 button	-	Note 7	Internal use only
0x0124	0x0092	Active Traction Control: table 4 button	-	Note 7	Internal use only



0x0126	0x0093	Active Traction Control: table 5 button	-	Note 7	Internal use only
0x0128	0x0094	Active Traction Control: table 6 button	-	Note 7	Internal use only
0x012A	0x0095	Active Traction Control: next table button	-	Note 7	Internal use only
0x012C	0x0096	Active Traction Control: previous table button	-	Note 7	Internal use only
0x012E	0x0097	Tire temperature: Front Left	°C	0.1	Internal use only
0x0130	0x0098	Tire temperature: Front Right	°C	0.1	Internal use only
0x0132	0x0099	Tire temperature: Rear Left	°C	0.1	Internal use only
0x0134	0x009A	Tire temperature: Rear Right	°C	0.1	Internal use only
0x0136	0x009B	Track temperature	°C	0.1	Internal use only
0x0138	0x009C	Generic Input: button 1	-	Note 7	PowerFT ECU 10Hz
0x013A	0x009D	Generic Input: button 2	-	Note 7	PowerFT ECU 10Hz
0x013C	0x009E	Generic Input: button 3	-	Note 7	PowerFT ECU 10Hz
0x013E	0x009F	Generic Input: button 4	-	Note 7	PowerFT ECU 10Hz
0x0140	0x00A0	Generic Input: button 5	-	Note 7	PowerFT ECU 10Hz
0x0142	0x00A1	Generic Input: button 6	-	Note 7	PowerFT ECU 10Hz
0x0144	0x00A2	Generic Input: button 7	-	Note 7	PowerFT ECU 10Hz
0x0146	0x00A3	Generic Input: button 8	-	Note 7	PowerFT ECU 10Hz
0x0224	0x0112	Left turn signal	-	Note 7	PowerFT ECU 10Hz
0x0226	0x0113	Right turn signal	-	Note 7	PowerFT ECU 10Hz
0x0228	0x0114	Low beam	-	Note 7	PowerFT ECU 10Hz
0x022A	0x0115	High beam	-	Note 7	PowerFT ECU 10Hz
0x022C	0x0116	External Ignition Switch voltage	V	0.001	FTSPARK 25Hz
0x022E	0x0117	External Ignition CPU supply voltage	V	0.001	FTSPARK 25Hz
0x0230	0x0118	External Ignition CPU temperature	°C	0.1	FTSPARK 25Hz
0x0232	0x0119	External Ignition operation time	S	0.1	FTSPARK 10Hz
0x0234	0x011A	MFI external switch	-	Note 7	Internal use only
0x0236	0x011B	Progressive Nitrous #2 button state	-	Note 7	Internal use only
0x0238	0x011C	Gear Reverse button	-	Note 7	Internal use only
0x023A	0x011D	Gear Drive button	-	Note 7	Internal use only
0x023C	0x011E	Blip signal	-	Note 7	Internal use only
0x023E	0x011F	Bank A Injector 1 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0240	0x0120	Bank A Injector 2 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0242	0x0121	Bank A Injector 3 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0244	0x0122	Bank A Injector 4 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0246	0x0123	Bank A Injector 5 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0248	0x0124	Bank A Injector 6 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x024A	0x0125	Bank A Injector 7 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x024C	0x0126	Bank A Injector 8 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x024E	0x0127	Bank A Injector 9 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0250	0x0128	Bank A Injector 10 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0252	0x0129	Bank A Injector 11 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0254	0x012A	Bank A Injector 12 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0256	0x012B	Bank B Injector 1 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0258	0x012C	Bank B Injector 2 Duty cycle	%	0.1	PowerFT ECU 10Hz

0x025A	0x012D	Bank B Injector 3 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x025C	0x012E	Bank B Injector 4 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x025E	0x012F	Bank B Injector 5 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0260	0x0130	Bank B Injector 6 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0262	0x0131	Bank B Injector 7 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0264	0x0132	Bank B Injector 8 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0266	0x0133	Bank B Injector 9 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x0268	0x0134	Bank B Injector 10 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x026A	0x0135	Bank B Injector 11 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x026C	0x0136	Bank B Injector 12 Duty cycle	%	0.1	PowerFT ECU 10Hz
0x026E	0x0137	Gear downshift button state	-	Note 7	Internal use only
0x0270	0x0138	EV Battery temperature	°C	0.1	PowerFT ECU 10Hz
0x0272	0x0139	EV Battery Voltage	V	1	PowerFT ECU 10Hz
0x0274	0x013A	EV Battery Current	A	1	PowerFT ECU 10Hz
0x0276	0x013B	EV Battery Charge	%	1	PowerFT ECU 10Hz
0x0278	0x013C	EV Motor 1 RPM	RPM	1	PowerFT ECU 10Hz
0x027A	0x013D	EV Motor 1 Current	A	1	PowerFT ECU 10Hz
0x027C	0x013E	EV Motor 1 Voltage	V	1	PowerFT ECU 10Hz
0x027E	0x013F	EV Motor 1 Torque	%	1	PowerFT ECU 10Hz
0x0280	0x0140	EV Motor 1 Temperature	°C	0.1	PowerFT ECU 10Hz
0x0282	0x0141	EV Motor 2 RPM	RPM	1	PowerFT ECU 10Hz
0x0284	0x0142	EV Motor 2 Current	A	1	PowerFT ECU 10Hz
0x0286	0x0143	EV Motor 2 Voltage	V	1	PowerFT ECU 10Hz
0x0288	0x0144	EV Motor 2 Torque	%	1	PowerFT ECU 10Hz
0x028A	0x0145	EV Motor 2 Temperature	°C	0.1	PowerFT ECU 10Hz
0x028C	0x0146	EV Inverter 1 Temperature	°C	0.1	PowerFT ECU 10Hz
0x028E	0x0147	EV Inverter 2 Temperature	°C	0.1	PowerFT ECU 10Hz
0x0290	0x0148	Park button	-	Note 7	Internal use only
0x0292	0x0149	Neutral button	-	Note 7	Internal use only
0x0294	0x014A	Self Dial	S	0.001	PowerFT ECU 0.5Hz
0x0296	0x014B	Opponent Dial	S	0.001	Internal use only
0x0298	0x014C	Bump up button	-	Note 7	Internal use only
0x029A	0x014D	Bump down button	-	Note 7	Internal use only
0x029C	0x014E	Super bump button	-	Note 7	Internal use only
0x029E	0x014F	Multi-function button	-	Note 7	Internal use only
0x02A0	0x0150	Total Fuel Flow	L/min	0.01	PowerFT ECU 10Hz
0x02A2	0x0151	Brake pressure	Bar	0.001	PowerFT ECU 10Hz
0x02A4	0x0152	Generic outputs state	-	Note 9	PowerFT ECU 10Hz
0x02A6	0x0153	Day/Night state		Note 12	PowerFT ECU 10Hz
0x02A8	0x0154	External Ignition Power Supply – B	V	.001	FTSPARK 50Hz
0x02AA	0x0155	External Ignition Power Supply Drop - B	V	.001	FTSPARK 50Hz
0x02AC	0x0156	External Ignition Power Level – B	mJ	1	FTSPARK 50Hz
0x02AE	0x0157	External Ignition Temperature - B	°C	0.1	FTSPARK 50Hz
0x02B0	0x0158	External Ignition Capacitor 1 charge - B	V	0.1	FTSPARK 50Hz

0x02B2	0x0159	External Ignition Capacitor 2 charge – B	V	0.1	FTSPARK 50Hz
0x02B4	0x015A	External Ignition Capacitor 3 charge – B	V	0.1	FTSPARK 50Hz
0x02B6	0x015B	External Ignition Capacitor 4 charge – B	V	0.1	FTSPARK 50Hz
0x02B8	0x015C	External Ignition Capacitor 1 charge time – B	uS	1	FTSPARK 50Hz
0x02BA	0x015D	External Ignition Capacitor 2 charge time – B	uS	1	FTSPARK 50Hz
0x02BC	0x015E	External Ignition Capacitor 3 charge time – B	uS	1	FTSPARK 50Hz
0x02BE	0x015F	External Ignition Capacitor 4 charge time - B	uS	1	FTSPARK 50Hz
0x02C0	0x0160	External Ignition Error code – B	-	Note 8	FTSPARK 25Hz
0x02C2	0x0161	External Ignition no load outputs – B	-	Note 9	FTSPARK 25Hz
0x02C4	0x0162	External Ignition partial discharge outputs – B	-	Note 9	FTSPARK 25Hz
0x02C6	0x0163	External Ignition damaged outputs – B	-	Note 9	FTSPARK 25Hz
0x02C8	0x0164	External Ignition disabled outputs – B	-	Note 9	FTSPARK 25Hz
0x02CA	0x0165	External Ignition operation status – B	-	Note 10	FTSPARK 25Hz
0x02CC	0x0166	External Ignition Switch voltage – B	V	0.001	FTSPARK 25Hz
0x02CE	0x0167	External Ignition CPU supply voltage – B	V	0.001	FTSPARK 25Hz
0x02D0	0x0168	External Ignition CPU temperature – B	°C	0.1	FTSPARK 25Hz
0x02D2	0x0169	External Ignition operation time – B	S	0.1	FTSPARK 10Hz
0x02E0	0x0170	Ride Height	-	-	PowerFT ECU 10Hz
0x02E2	0x0171	Shock Sensor FR (Front Right)	-	0.001	PowerFT ECU 10Hz
0x02E4	0x0172	Shock Sensor FL (Front Left)	-	0.001	PowerFT ECU 10Hz
0x02E6	0x0173	Shock Sensor RR (Rear Right)	-	0.001	PowerFT ECU 10Hz
0x02E8	0x0174	Shock Sensor RL (Rear Left)	-	0.001	PowerFT ECU 10Hz
0x02EA	0x0175	TwoStep Clutch Button	-	Note 1	PowerFT ECU 10Hz
0x02EC	0x0176	Brake Switch	-	Note 7	PowerFT ECU 10Hz
0x02EE	0x0177	Back Pressure	Bar	0.001	PowerFT ECU 10Hz
0x02F0	0x0178	DiffCtrl_SelPosition_1	-	-	PowerFT ECU 10Hz
0x02F2	0x0179	DiffCtrl_SelPosition_2	-	-	PowerFT ECU 10Hz
0x02F4	0x017A	DiffCtrl_EngPosition_1	-	-	PowerFT ECU 10Hz
0x02F6	0x017B	DiffCtrl_EngPosition_2	-	-	PowerFT ECU 10Hz
0x02F8	0x017C	DiffCtrl_EngPosition_3	-	-	PowerFT ECU 10Hz
0x02FA	0x017D	Yaw Rate	-	-	PowerFT ECU 10Hz
0x02FC	0x017E	Actual Gear Pulse	-	-	Internal use only
0x02FE	0x017F	Clutch Pressure	Bar	0.001	Internal use only
0x0300	0x0180	Nitro Pressure	Bar	-	PowerFT ECU 10Hz
0x0302	0x0181	Nitro Pressure 2	Bar	-	PowerFT ECU 10Hz
0x0304	0x0182	Transmission Pressure	Bar	0.001	PowerFT ECU 10Hz
0x0306	0x0183	Westgate Pressure Input	-	-	PowerFT ECU 10Hz
0x0308	0x0184	Pan Vaccun	-	-	PowerFT ECU 10Hz
0x030A	0x0185	Torque Convert Pressure	-	-	PowerFT ECU 10Hz
0x030C	0x0186	Lambda Narrow	-	Note 3	PowerFT ECU 10Hz
0x030E	0x0187	Boost 1 RPM	RPM	-	PowerFT ECU 10Hz
0x0310	0x0188	Boost 2 RPM	RPM	-	PowerFT ECU 10Hz
0x0312	0x0189	Inputshaft RPM	RPM	-	PowerFT ECU 10Hz
0x0314	0x018A	Input Expander Bat	V	-	PowerFT ECU 10Hz

0x0316	0x018B	Input Expander Sensor 5V	V	-	PowerFT ECU 10Hz
0x0318	0x018C	Input Expander Temperature	°C	-	PowerFT ECU 10Hz
0x031A	0x018D	Input Expander Status	-	-	PowerFT ECU 10Hz
0x031C	0x018E	P2P Switch	-	-	PowerFT ECU 10Hz
0x031E	0x018F	Westgate 2 BoostP Button	-	-	PowerFT ECU 10Hz
0x0320	0x0190	Westgate 2 Pressure Input	-	-	PowerFT ECU 10Hz
0x0322	0x0191	ALS Button Input	-	-	PowerFT ECU 10Hz
0x0324	0x0192	Interlock Input	-	-	PowerFT ECU 10Hz
0x0326	0x0193	Upshift Request	-	-	PowerFT ECU 10Hz
0x0328	0x0194	Upshift Validated	-	-	PowerFT ECU 10Hz
0x032A	0x0195	Downshift Request	-	-	PowerFT ECU 10Hz
0x032C	0x0196	Downshift Validated	-	-	PowerFT ECU 10Hz
0x032E	0x0197	Flow Pump A	-	-	PowerFT ECU 10Hz
0x0330	0x0198	Flow Pump B	-	-	PowerFT ECU 10Hz
0x0332	0x0199	Flow Return A	-	-	PowerFT ECU 10Hz
0x0334	0x019A	Flow Return B	-	-	PowerFT ECU 10Hz
0x0336	0x019B	EGate 1 Temperature	°C	-	PowerFT ECU 10Hz
0x0338	0x019C	EGate 2 Temperature	°C	-	PowerFT ECU 10Hz
0x033A	0x019D	EGate BoostP Button	-	-	PowerFT ECU 10Hz
0x033C	0x019E	Peak and Hold Status M1	-	-	FT_PnH Pro
0x033E	0x019F	Peak and Hold Status M2	-	-	FT_PnH Pro
0x0340	0x01A0	Peak and Hold Driver 1 Status M1	-	-	FT_PnH Pro
0x0342	0x01A1	Peak and Hold Driver 2 Status M1	-	-	FT_PnH Pro
0x0344	0x01A2	Peak and Hold Driver 3 Status M1	-	-	FT_PnH Pro
0x0346	0x01A3	Peak and Hold Driver 4 Status M1	-	-	FT_PnH Pro
0x0348	0x01A4	Peak and Hold Driver 5 Status M1	-	-	FT_PnH Pro
0x034A	0x01A5	Peak and Hold Driver 6 Status M1	-	-	FT_PnH Pro
0x034C	0x01A6	Peak and Hold Driver 7 Status M1	-	-	FT_PnH Pro
0x034E	0x01A7	Peak and Hold Driver 8 Status M1	-	-	FT_PnH Pro
0x0350	0x01A8	Peak and Hold Driver 1 Status M2	-	-	FT_PnH Pro
0x0352	0x01A9	Peak and Hold Driver 2 Status M2	-	-	FT_PnH Pro
0x0354	0x01AA	Peak and Hold Driver 3 Status M2	-	-	FT_PnH Pro
0x0356	0x01AB	Peak and Hold Driver 4 Status M2	-	-	FT_PnH Pro
0x0358	0x01AC	Peak and Hold Driver 5 Status M2	-	-	FT_PnH Pro
0x035A	0x01AD	Peak and Hold Driver 6 Status M2	-	-	FT_PnH Pro
0x035C	0x01AE	Peak and Hold Driver 7 Status M2	-	-	FT_PnH Pro
0x035E	0x01AF	Peak and Hold Driver 8 Status M2	-	-	FT_PnH Pro
0x0360	0x01B0	RPM CAN	RPM	-	PowerFT ECU 10Hz
0x0362	0x01B1	Lockup On Button	-	-	PowerFT ECU 10Hz
0x0364	0x01B2	Lockup Off Button	-	-	PowerFT ECU 10Hz
0x0366	0x01B3	Fuel Total Consumption	L	-	PowerFT ECU 10Hz
0x0368	0x01B4	Fuel Total Consumption Reset Button	-	-	PowerFT ECU 10Hz
0x036A	0x01B5	Bracket Pre Staging Button	-	-	PowerFT ECU 10Hz
0x036C	0x01B6	Throttle Stop Bump Down Button	-	-	PowerFT ECU 10Hz

0x036E	0x01B7	Throttle Stop Bump Up Button	-	-	PowerFT ECU 10Hz
0x0370	0x01B8	Throttle Stop Super Bump Button	-	-	PowerFT ECU 10Hz
0x0386	0x01C3	EV Battery DCL	A	1	PowerFT ECU 10Hz
0x0388	0x01C4	EV Battery CCL	A	1	PowerFT ECU 10Hz
0x038A	0x01C5	EV Battery Lowest Cell Voltage	V	1	PowerFT ECU 10Hz
0x038C	0x01C6	EV Battery Highest Cell Voltage	V	1	PowerFT ECU 10Hz
0x038E	0x01C7	EV Battery Lowest Cell Temperature	°C	0.1	PowerFT ECU 10Hz
0x0390	0x01C8	EV Battery Highest Cell Temperature	°C	0.1	PowerFT ECU 10Hz
0x0408	0x0204	EV Torque Target	%	1	PowerFT ECU 10Hz
0x040A	0x0205	EV Regen Target	%	1	PowerFT ECU 10Hz
0x046A	0x0235	Tire pressure 1	Bar	0.001	TPMS reader
0x046C	0x0236	Tire pressure 2	Bar	0.001	TPMS reader
0x046E	0x0237	Tire pressure 3	Bar	0.001	TPMS reader
0x0470	0x0238	Tire pressure 4	Bar	0.001	TPMS reader
0x0472	0x0239	Tire pressure 5	Bar	0.001	TPMS reader
0x0474	0x023A	Tire pressure 6	Bar	0.001	TPMS reader
0x0476	0x023B	Tire pressure 7	Bar	0.001	TPMS reader
0x0478	0x023C	Tire pressure 8	Bar	0.001	TPMS reader
0x047A	0x023D	Tire pressure 9	Bar	0.001	TPMS reader
0x047C	0x023E	Tire pressure 10	Bar	0.001	TPMS reader
0x047E	0x023F	Tire pressure 11	Bar	0.001	TPMS reader
0x0480	0x0240	Tire pressure 12	Bar	0.001	TPMS reader
0x0482	0x0241	Tire temperature 1	°C	0.1	TPMS reader
0x0484	0x0242	Tire temperature 2	°C	0.1	TPMS reader
0x0486	0x0243	Tire temperature 3	°C	0.1	TPMS reader
0x0488	0x0244	Tire temperature 4	°C	0.1	TPMS reader
0x048A	0x0245	Tire temperature 5	°C	0.1	TPMS reader
0x048C	0x0246	Tire temperature 6	°C	0.1	TPMS reader
0x048E	0x0247	Tire temperature 7	°C	0.1	TPMS reader
0x0490	0x0248	Tire temperature 8	°C	0.1	TPMS reader
0x0492	0x0249	Tire temperature 9	°C	0.1	TPMS reader
0x0494	0x024A	Tire temperature 10	°C	0.1	TPMS reader
0x0496	0x024B	Tire temperature 11	°C	0.1	TPMS reader
0x0498	0x024C	Tire temperature 12	°C	0.1	TPMS reader
0xFFFF 0xFFFF	0x7FFF	Last DataID			

*Only one of the possible sources is allowed to broadcast a specific DataID on the network. If one or more sources are broadcasting the same DataID a network conflict state is raised.*

**\*The broadcast transmission rate may vary when the ECU is under high RPM**

### **Note 1**

Value 0: None (running)

Value 1: Burnout

Value 2: Burnout Spool (Burnout and 2-Step)

Value 3: 3-Step

Value 4: 2-Step

### **Note 2**

Value -2: Park

Value -1: Reverse

Value 0: Neutral

Value 1: First gear

Value 2: Second gear

Value 3: Third gear

Value 4: Fourth gear

Value 5: Fifth gear

Value 6: Sixth gear

Value 7: Seventh gear

Value 8: Eighth gear

Value 9: Ninth gear

Value 10: Tenth gear

### **Note 3**

Value 0: Undefined

Value 1: Lambda

Value 2: AFR methanol

Value 3: AFR ethanol

Value 4: AFR gasoline

Value 0xFF: Undefined

### **Note 4**

Value 0: Km/h

Value 1: Mph

### **Note 5**

Value 0: bar

Value 1: PSI

Value 2: KPa

### **Note 6**

Value 0: °C

Value 1: °F

### **Note 7**

Value 0: Off

Value 1: On

### **Note 8**

Bit 0: Unknown pulse width received by the FT Ignition Bus.

Bit 1: Incorrect ignition order in semi-sequential operation.

Bit 2: Over voltage in the high voltage bus. (external ignition disabled until next power cycle).

Bit 3: Under voltage in the output drivers power supply. (external ignition disabled while condition exists).

Bit 4: Charge circuit unable to charge capacitors.

Bit 5: Power supply under voltage.

Bit 6: 12V switch under voltage.

### **Note 9**

Bit 0: Output 1

Bit 1: Output 2

Bit 2: Output 3

Bit 3: Output 4

Bit 4: Output 5

Bit 5: Output 6

Bit 6: Output 7

Bit 7: Output 8

Bit 8: Output 9

Bit 9: Output 10

Bit 10: Output 11

Bit 11: Output 12

Bit 12: Output 13

Bit 13: Output 14

Bit 14: Output 15

Bit 15: Output 16

### **Note 10**



Bit 0: Internal use

Bit 1: Internal use

Bit 2: High power mode enabled

**Note 11**

Incremental counter of errors in the respective cylinder

**Note 12**

Value 0: Day

Value 1: Nigth



## Simplified packets

In addition to the standard packets the FTCAN 2.0 can also be used in conjunction with simplified broadcast packets. This simplified broadcast packets have a fixed and defined data structure and are only broadcasted by the ECUs. The following table shows the simplified packets:

ID (FT500)	ID (FT600/550/450)	Bytes							
		1	2	3	4	5	6	7	8
0x14000600	0x14080600	TPS		MAP		Air Temperature		Engine Temperature	
0x14000601	0x14080601	Oil Pressure		Fuel Pressure		Water Pressure		Gear	
0x14000602	0x14080602	Exhaust O2		RPM		Oil Temperature		Pit Limit	
0x14000603	0x14080603	Wheel Speed FR		Wheel Speed FL		Wheel Speed RR		Wheel Speed RL	
0x14000604	0x14080604	Traction Ctrl - Slip		Traction Ctrl - Retard		Traction Ctrl - Cut		Heading	
0x14000605	0x14080605	Shock Sensor FR		Shock Sensor FL		Shock Sensor RR		Shock Sensor RL	
0x14000606	0x14080606	G-force (accel)		G-force (lateral)		Yaw-rate (frontal)		Yaw-rate (lateral)	
0x14000607	0x14080607	Lambda Correction		Fuel Flow Total		Inj Time Bank A		Inj Time Bank B	
0x14000608	0x14080608	Oil Temperature		Transmission Temperature		Fuel Consumption		Brake Pressure	

The data format, unit and multipliers are the same used in the standard packets.

## Simplified packets - EGT-4

### Temperature data format and conversion

- Channel temperature values are transmitted as signed 16 bits in big-endian byte order.
- Temperature resolution: 0.125°C / bit
- Data conversion:
  - Temperature value (°C) = Channel bytes \* 0.125
  - Maximum temperature: 1000°C (0x1F40 on channel bytes)
  - Minimum temperature: -50°C (0xFE70 on channel bytes)
  - Examples:
    - 1°C equals value 8 (0x0008)
    - 500°C equals value 4000 (0x0FA0)
    - -10°C equals value -80 (0xFFB0)
- When an error is detected on a channel (eg. thermocouple disconnected) the EGT-4 will broadcast a reading of 1050°C (0x20D0).

ID (EGT-4)		Bytes							
		0	1	2	3	4	5	6	7
Model A	0x02400000	Channel 1		Channel 2		Channel 3		Channel 4	
Model B	0x02480000								
Model C	0x02500000								
Model D	0x02580000								

## Simplified packets – SwitchPanel

ID: 0x12200320 – SW-8 Button State

ID: 0x12200321 – SW-8 Button Color

ID: 0x12218320 – SW-8 mini Button State

ID: 0x12218321 – SW-8 mini Button Color

ID: 0x12210320 – SW-5 mini Button State

ID: 0x12210321 – SW-5 mini Button Color

ID: 0x12208320 – SW-5 mini Button State

ID: 0x12208321 – SW-5 mini Button Color

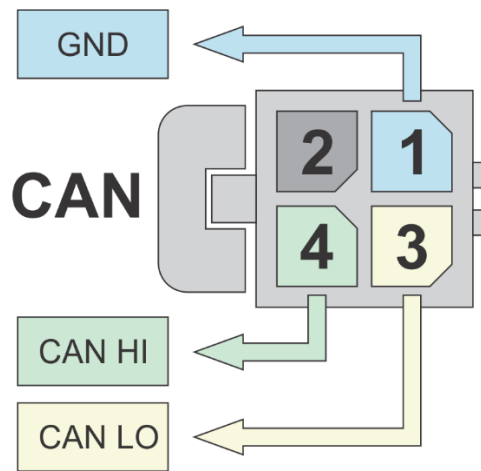
Length: 8 Bytes

Messages transmitted by the switchpanel every 250 ms or on change (50 ms minimum)

- Byte 0 (of 7): 0xFF
- Byte 1: 0xFF
- Byte 2 o Bit 0: Button 1 State (0 = not pressed, 1 = pressed)
  - Bit 1: Button 2 State
  - Bit 2: Button 3 State
  - Bit 3: Button 4 State
  - Bit 4 for Bit 7: Set to 0, not used
- Byte 3 o Bit 0: Button 5 State (0 = not pressed, 1 = pressed)
  - Bit 1: Button 6 State
  - Bit 2: Button 7 State
  - Bit 3: Button 8 State
  - Bit 4 for Bit 7: Set to 0, not used
- Byte 4: 0x00
- Byte 5: 0x00
- Byte 6: 0x00
- Byte 7: 0x00

## Connector Pinout

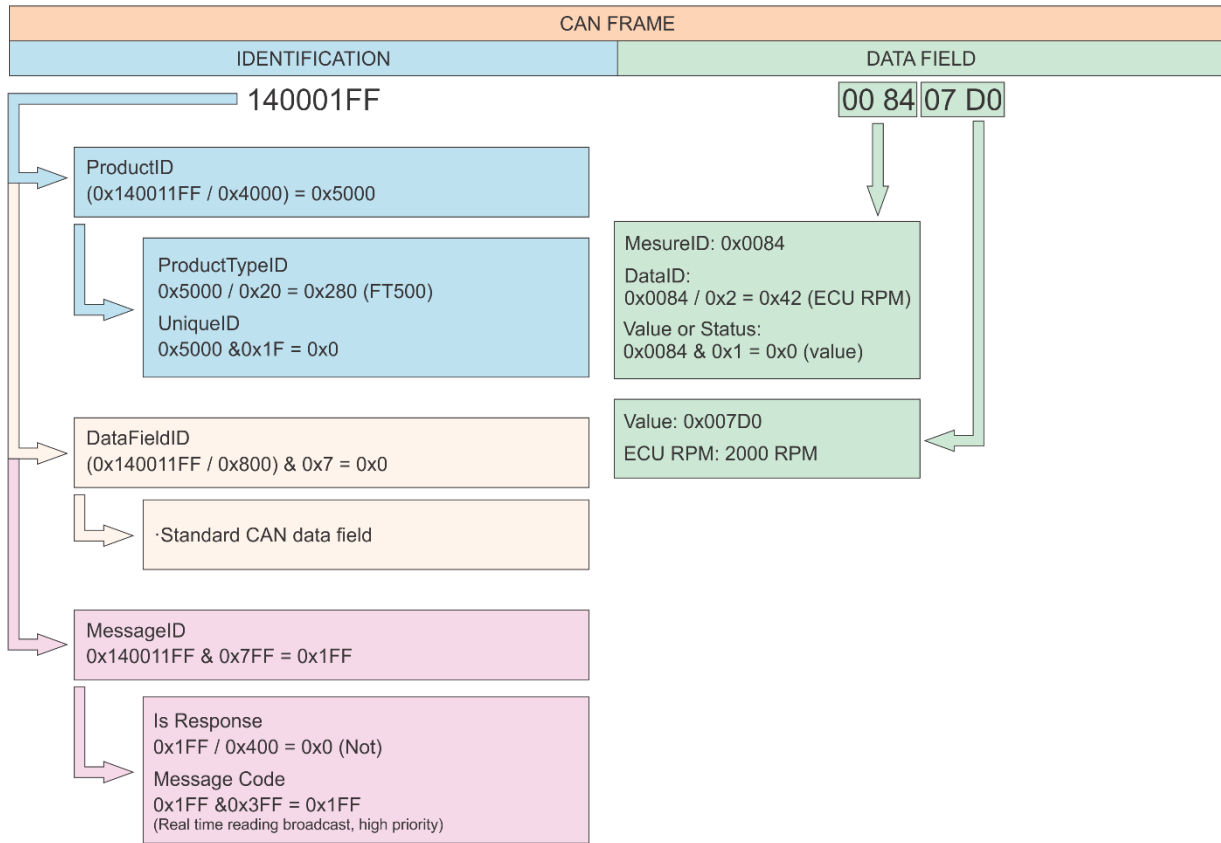
- PowerFT ECUs



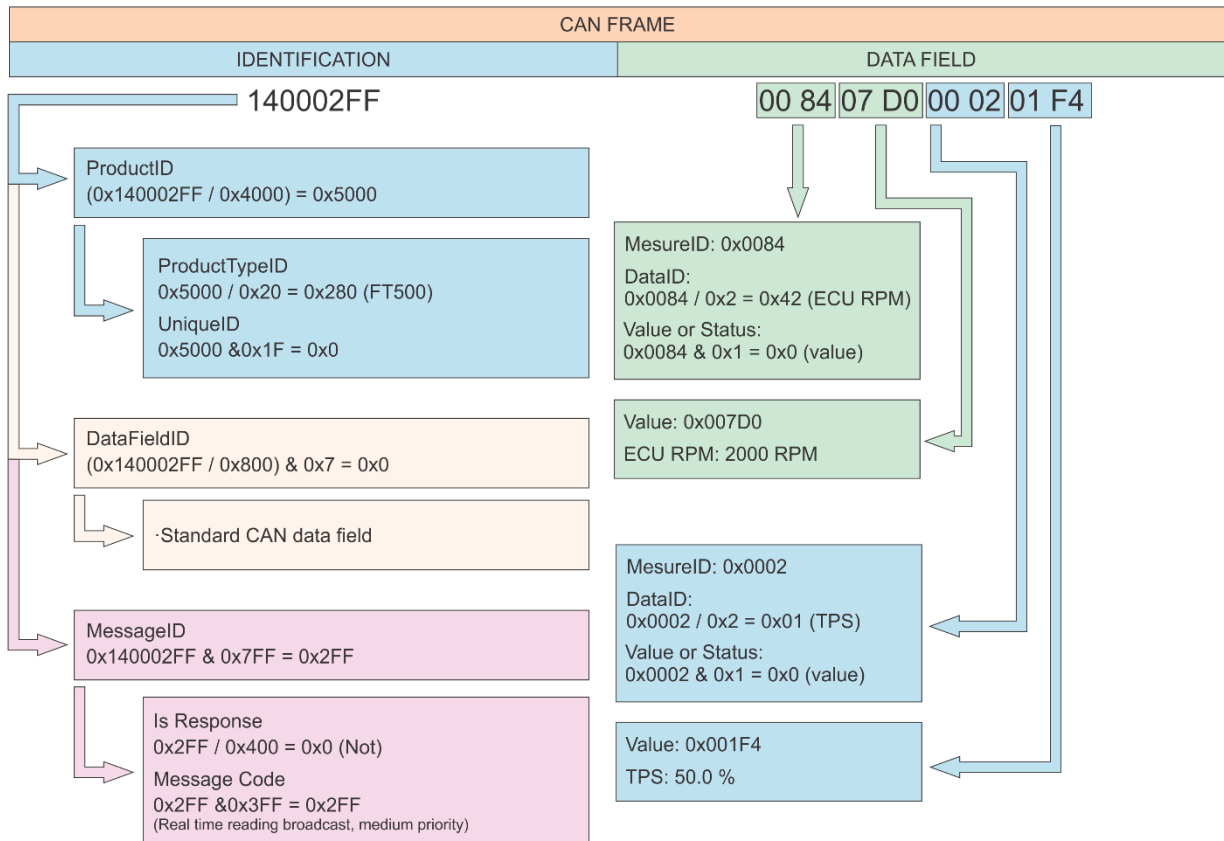
Frontal view of the connector on the back of the ECU

## Examples

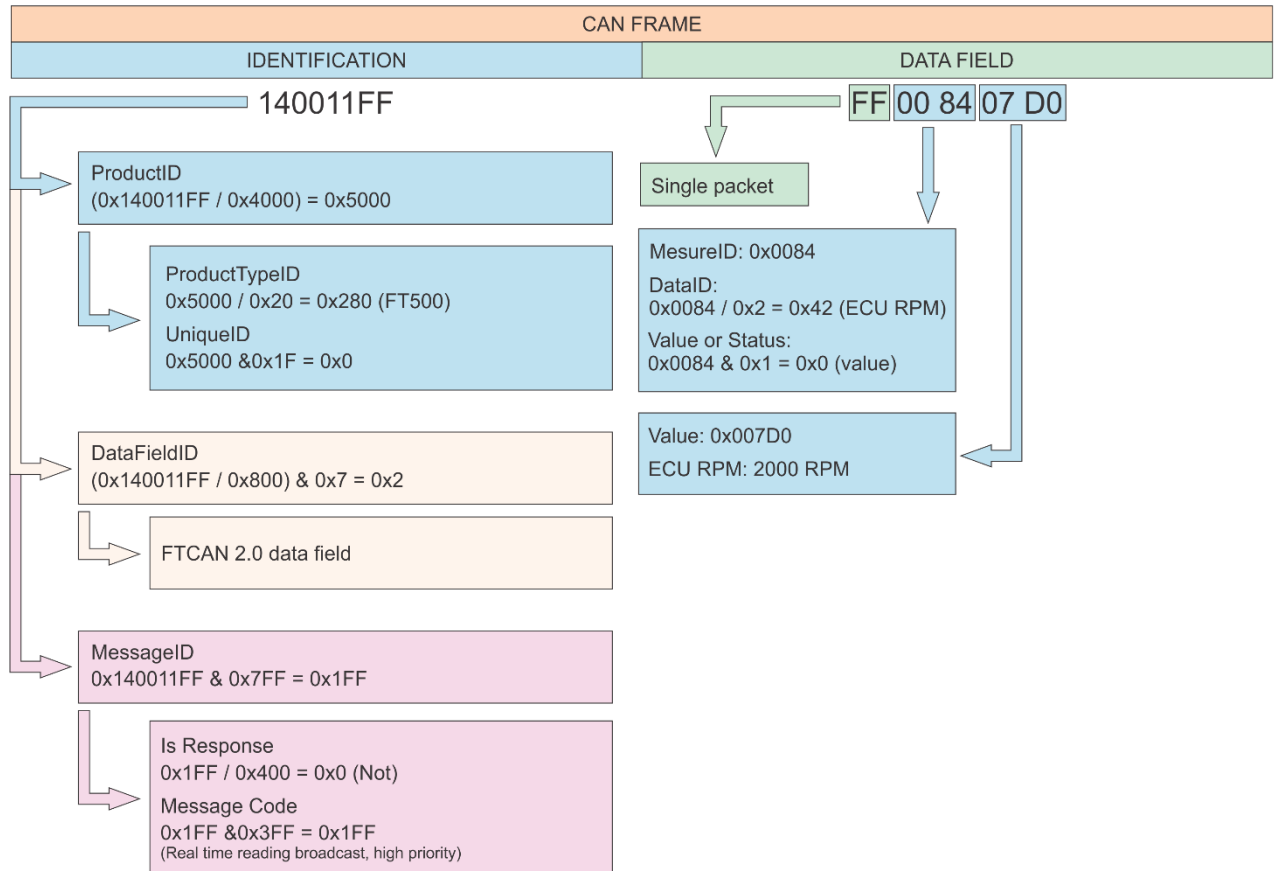
### Example 1: Standard CAN layout – Single packet with RPM value



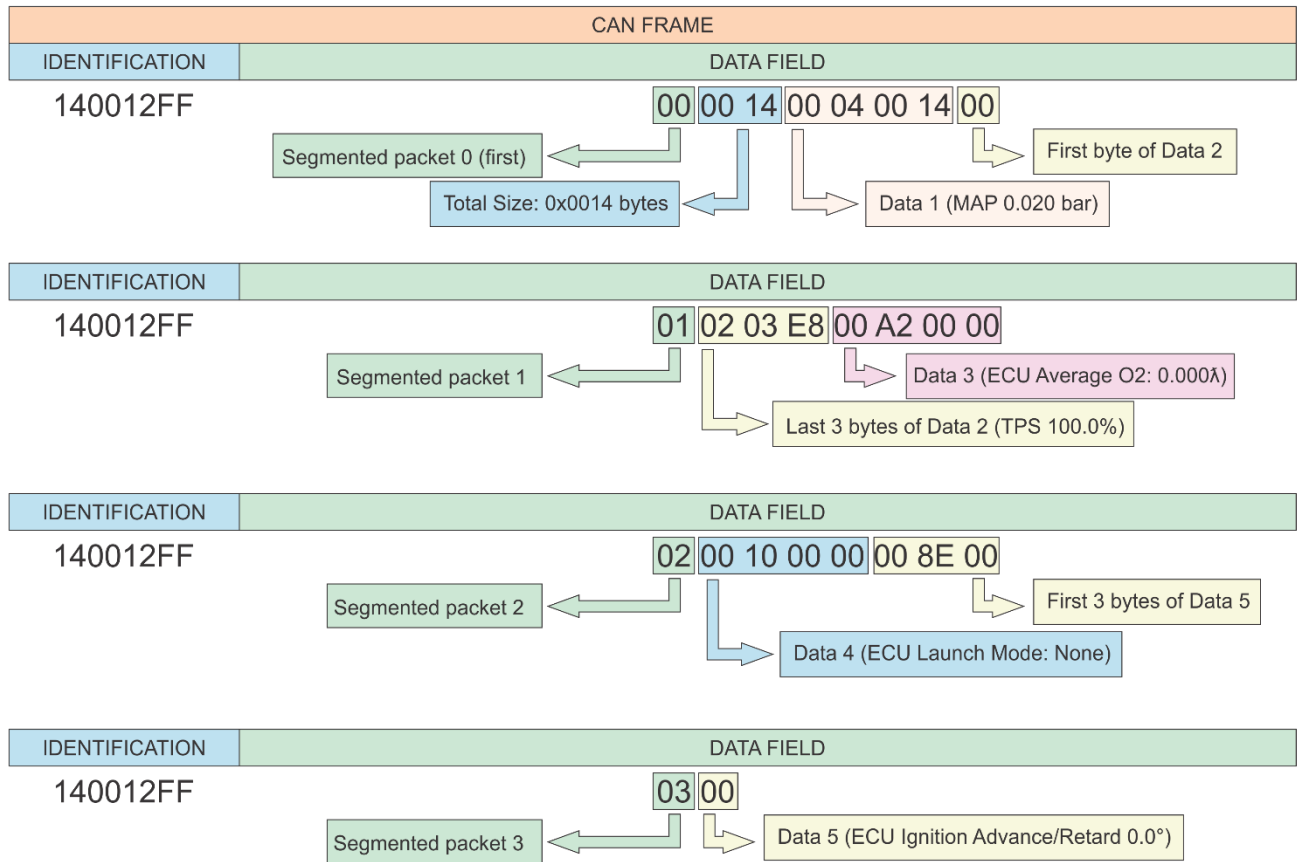
## Example 2: Standard CAN layout – Single packet with RPM and TPS values



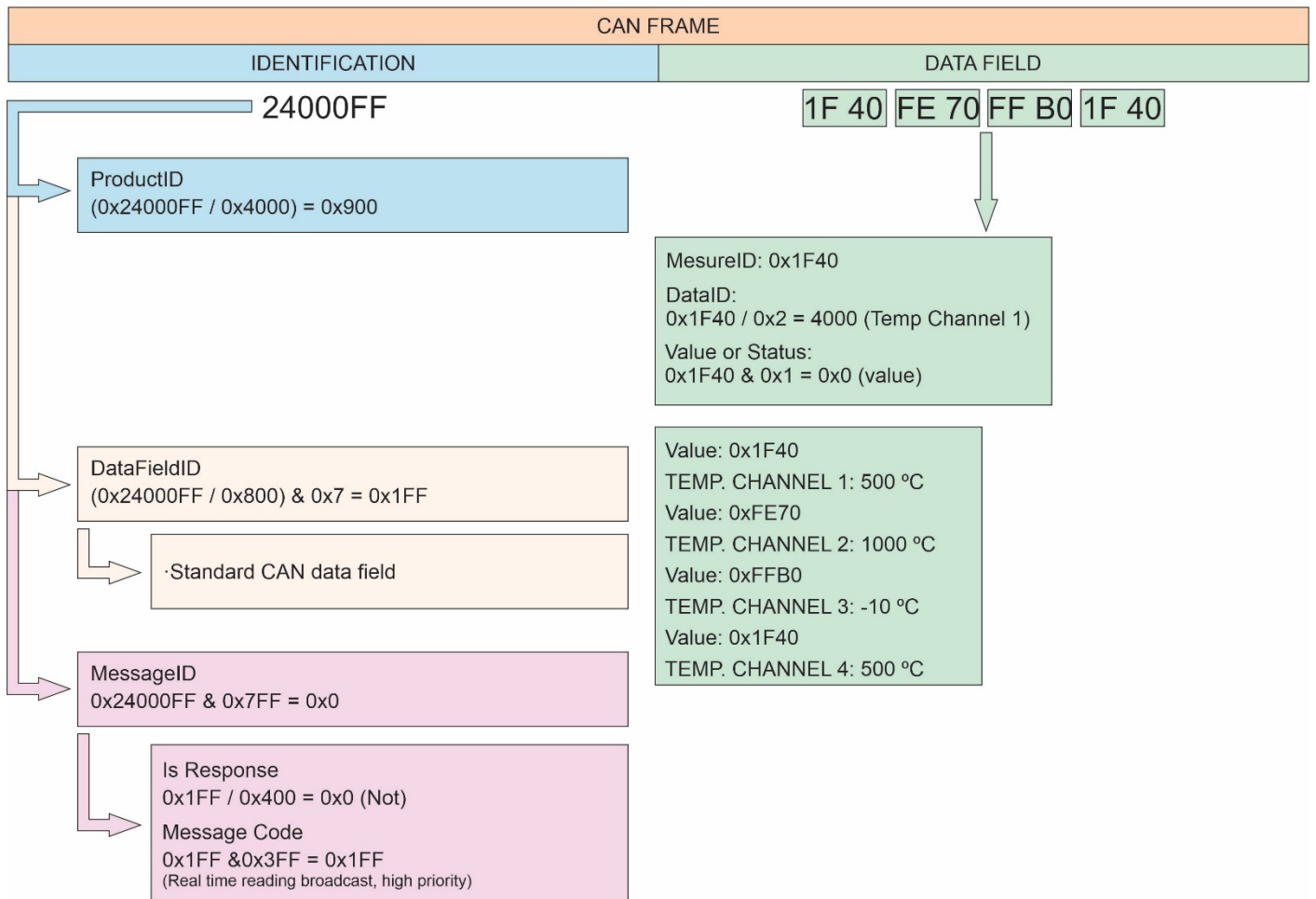
## Example 3: FTCAN layout - Single packet with RPM value



## Example 4: FTCAN layout - Multiple packets with 5 different values



## Example 5: FTCAN layout EGT-4 - Single packet with Temperature value





## FTCAN2.0 segmented packet flowchart

