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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 ProdcutID
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

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020	08/19/2020	Added new DataIDs (0x0154 to 0x016A) Added FTSpark B ProductID

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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)
ProductID	*DataFieldID*	*MessageID*

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

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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.

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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).

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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						

.
.
.

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.

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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)										

RUF: 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.

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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	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
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)

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Reserved	-----	0x0960	0x0960	FuelTech EGT-4 CAN (model D)
Reserved	-----	0x0980	0x0980	RFU
Reserved	-----	0x09A0	0x09A0	RFU
Reserved	-----	0x09C0	0x09C0	RFU
Reserved	-----	0x09E0	0x09E0	RFU

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

(0x0280 << 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

- **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

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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, 0x601, e 0x602 – 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

The MeasureIDs transmitted in each message are:

MessageID	Measure 1		Measure 2		Measure 3		Measure 4	
	Measure ID	Description	Measure ID	Description	Measure ID	Description	Measure ID	Description
0x600	0x0002	TPS	0x0004	MAP	0x0006	Air temperature	0x0008	Engine temperature
0x601	0x000A	Oil pressure	0x000C	Fuel pressure	0x000E	Water pressure	0x0022	Gear

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0x602	0x004E 0x004F	Exhaust O2	0x0084	ECU RPM	0x0118	Oil temperature	0x011A	PitLimit Switch

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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 Batery 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	ƛ	0.001	WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0026 0x0027	0x0013	Cylinder 1 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0028 0x0029	0x0014	Cylinder 2 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz

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0x002A 0x002B	0x0015	Cylinder 3 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x002C 0x002D	0x0016	Cylinder 4 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x002E 0x002F	0x0017	Cylinder 5 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0030 0x0031	0x0018	Cylinder 6 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0032 0x0033	0x0019	Cylinder 7 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0034 0x0035	0x001A	Cylinder 8 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0036 0x0037	0x001B	Cylinder 9 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0038 0x0039	0x001C	Cylinder 10 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003A 0x003B	0x001D	Cylinder 11 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003C 0x003D	0x001E	Cylinder 12 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x003E 0x003F	0x001F	Cylinder 13 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0040 0x0041	0x0020	Cylinder 14 O2	ƛ	0.001	PowerFT ECU 100Hz WBO2 Nano 100Hz WBO2 Slim 100Hz Alcohol O2 100Hz
0x0042 0x0043	0x0021	Cylinder 15 O2	ƛ	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
0x00A2	0x0051	ECU Average O2	ƛ	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	Internal use only
0x00EC	0x0076	Two step button state	-	Note 7	Internal use only
0x00EE	0x0077	Three step button state	-	Note 7	Internal use only
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	Internal use only
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	Internal use only
0x0100	0x0080	Generic PWM output increase button state	-	Note 7	Internal use only
0x0102	0x0081	Gear upshift button state	-	Note 7	Internal use only
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	Internal use only
0x0116	0x008B	Intercooler temperature	°C	0.1	Internal use only
0x0118	0x008C	Oil temperature	°C	0.1	Internal use only
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	Internal use only
0x013A	0x009D	Generic Input: button 2	-	Note 7	Internal use only
0x013C	0x009E	Generic Input: button 3	-	Note 7	Internal use only
0x013E	0x009F	Generic Input: button 4	-	Note 7	Internal use only
0x0140	0x00A0	Generic Input: button 5	-	Note 7	Internal use only
0x0142	0x00A1	Generic Input: button 6	-	Note 7	Internal use only
0x0144	0x00A2	Generic Input: button 7	-	Note 7	Internal use only
0x0146	0x00A3	Generic Input: button 8	-	Note 7	Internal use only
0x0224	0x0112	Left turn signal	-	Note 7	Internal use only
0x0226	0x0113	Right turn signal	-	Note 7	Internal use only
0x0228	0x0114	Low beam	-	Note 7	Internal use only
0x022A	0x0115	High beam	-	Note 7	Internal use only
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	Batery 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/Nigth 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
0x02D4	0x016A	Avaliable			
	...				
0xFFFE 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.

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 ethanol
Value 3: AFR methanol
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 cicle).
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

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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

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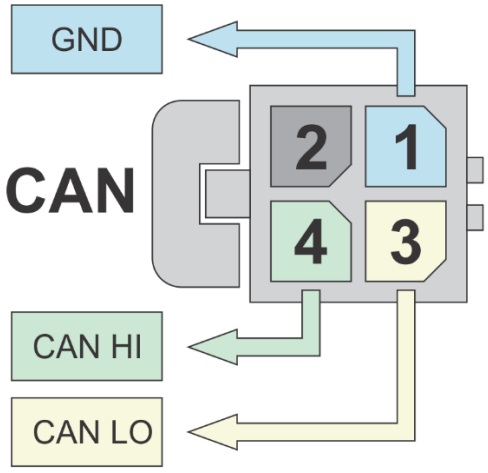
Connector Pinout

- PowerFT ECUs



Frontal view of the connector on the back of the ECU

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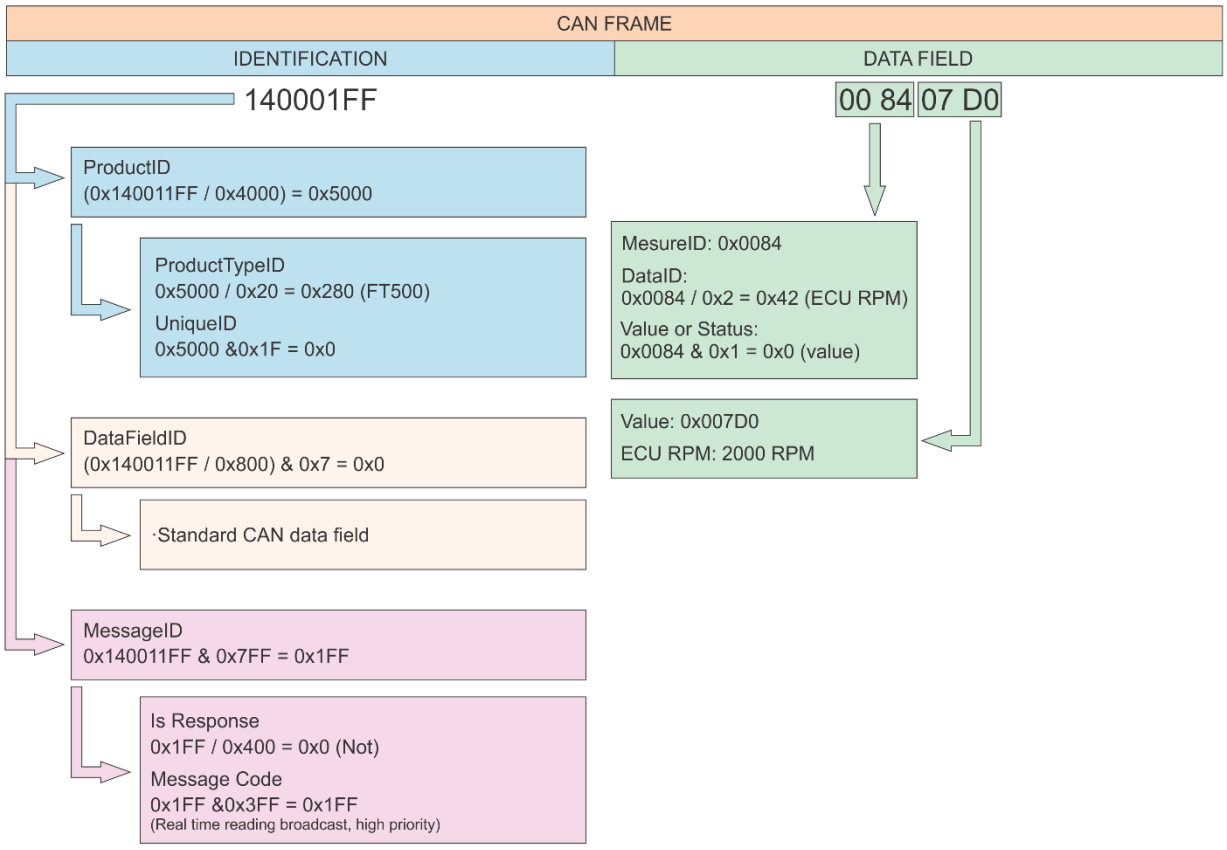
Examples

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



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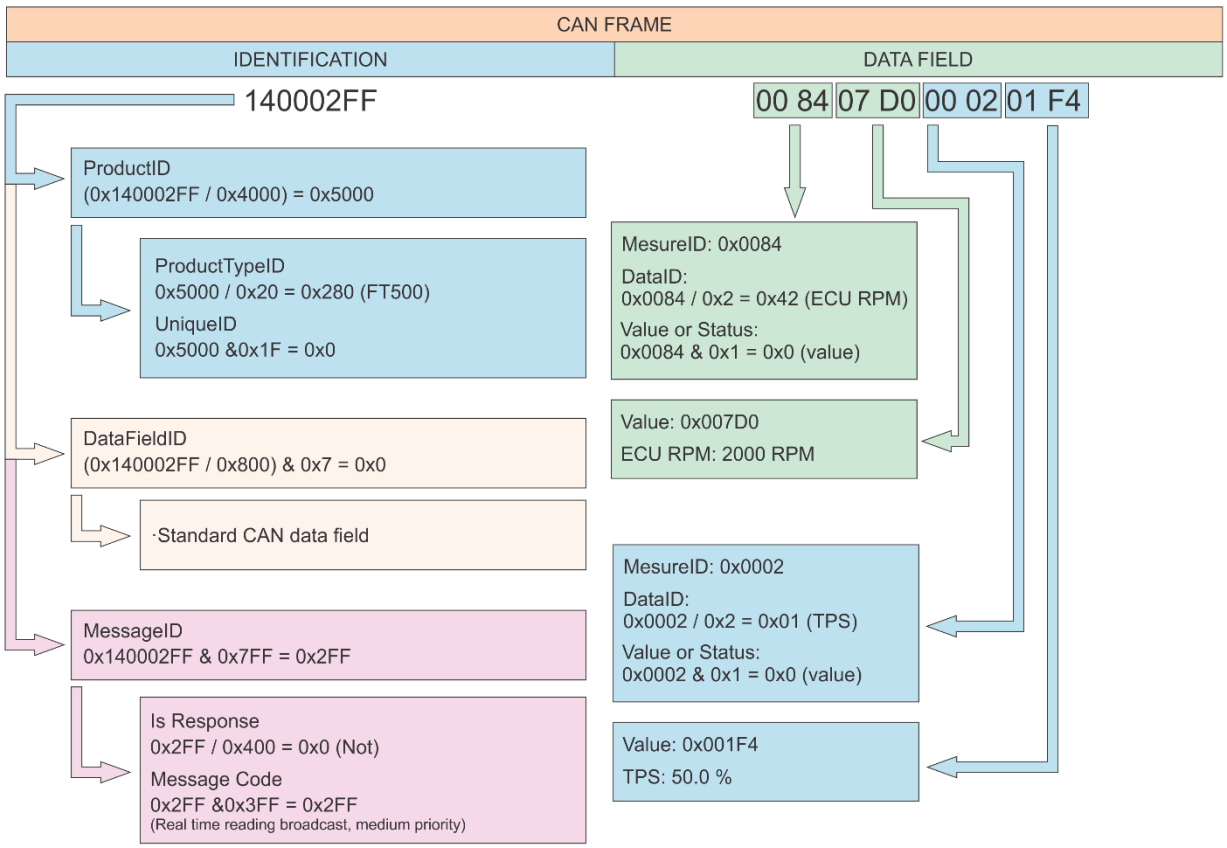
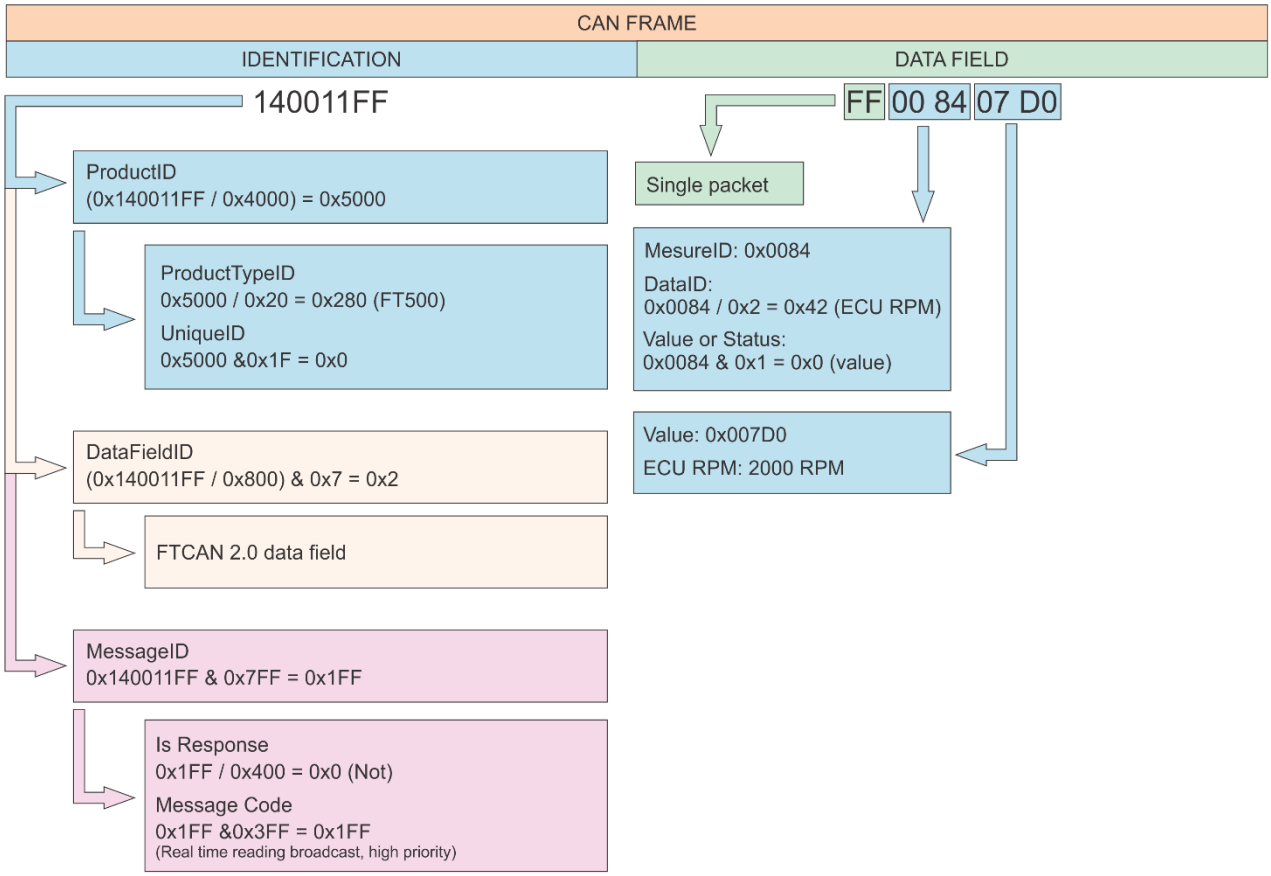
Example 2: Standard CAN layout – Single packet with RPM and TPS values



Example 3: FTCAN layout - Single packet with RPM value



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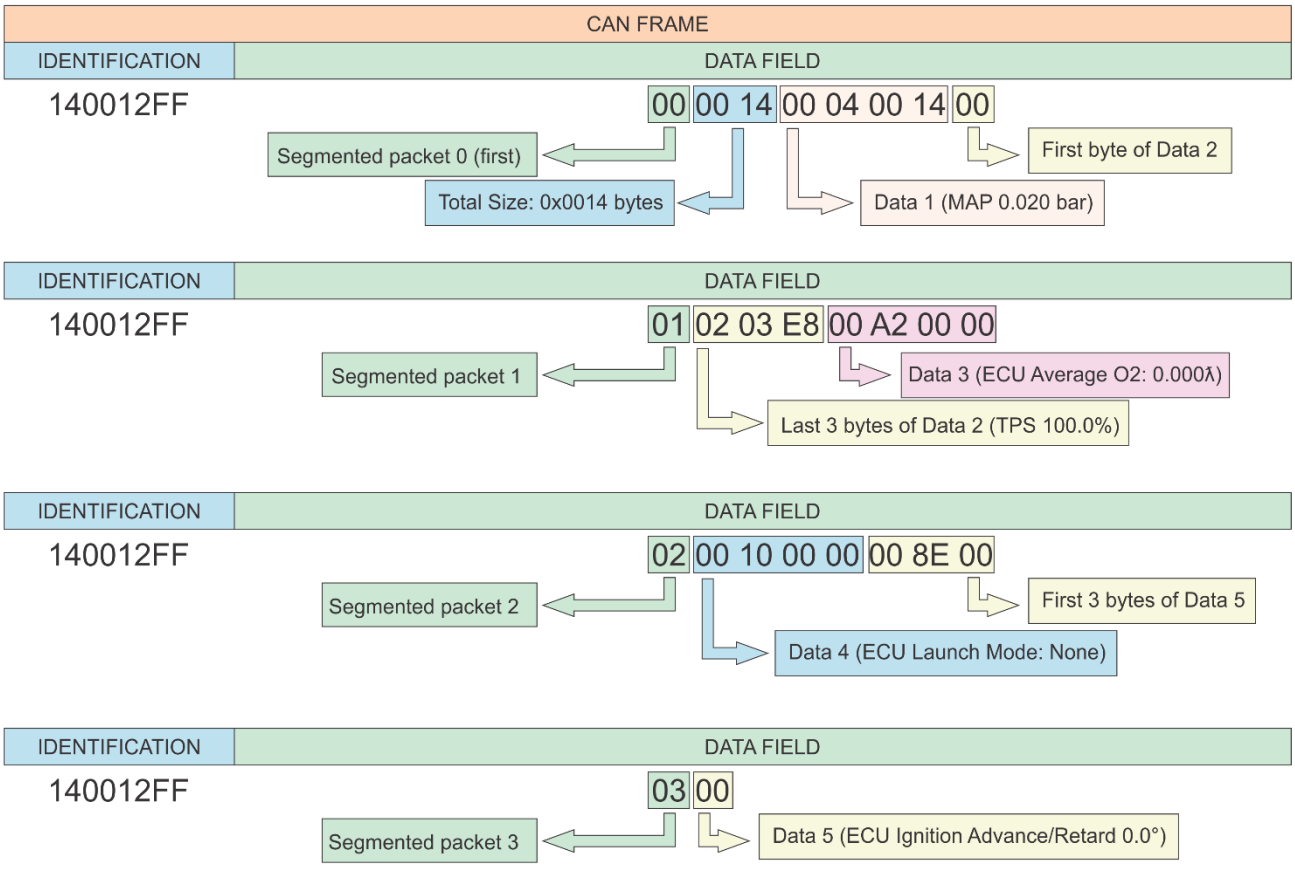
Example 4: FTCAN layout - Multiple packets with 5 different values



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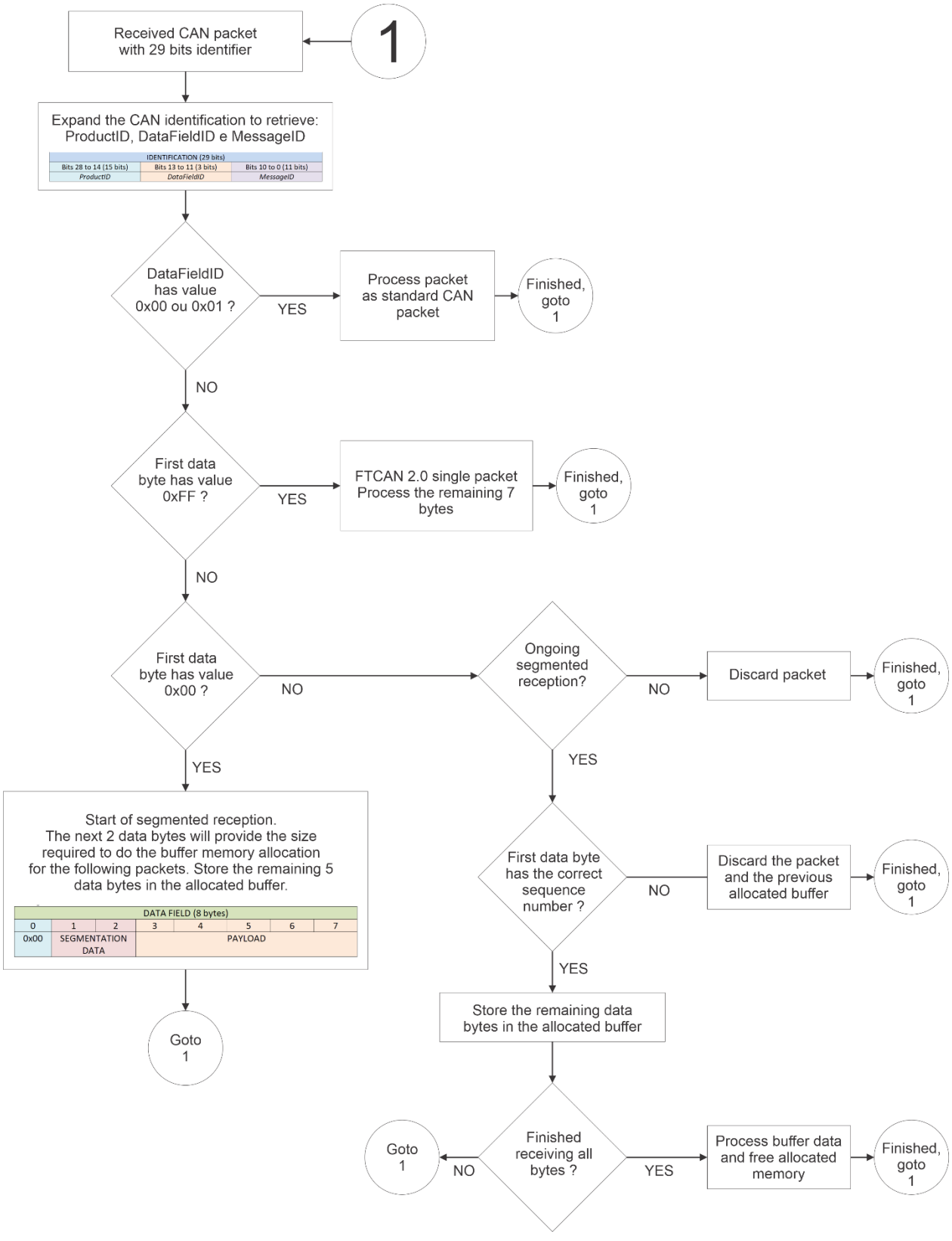
FTCAN2.0 segmented packet flowchart



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