CHIPREG EPC
User Manual
V1.2

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1 Abbrevations and Acronyms

0d Number	: decimal format	
0x Number	: hexadecimal format	
0b Number	: binary format	
Uint8	: unsigned integer of 8 bit	(0d0..0d255)
Uint16	: unsigned integer of 16 bit	(0d0..0d65535)
Uint32	: unsigned integer of 32 bit	(0d0..0d4294967295)
Int8	: signed integer of 8 bit	(0d-128..0d127)
Int16	: signed integer of 16 bit	(0d-32768..0d32767)
Int32	: signed integer of 32 bit	(0d-2147483648..0d2147483647)

Float32: single precision floating point (IEEE754)

NVM : Non volatile memory

2 Purpose

This document is the reference for the user who wants to run the Chipreg EPC either in Analog or in Digital mode.

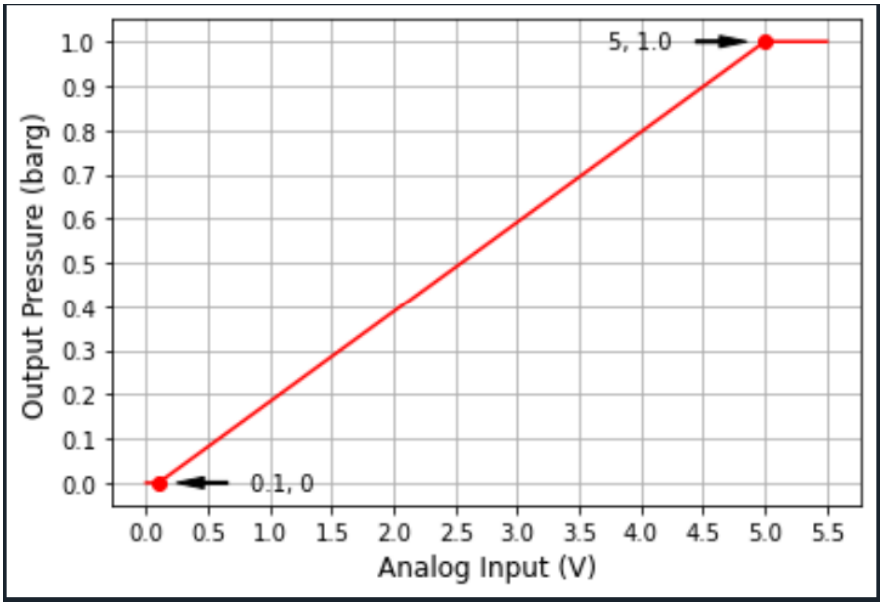
3 Analog I/O

3.1 Analog Input

The Analog Input Voltage applied at the 'Analog Pressure Setpoint' pin is the regulated pressure represented between 0 and 5 V:

Analog Input Voltage (V)	Regulated Pressure (barg)
0 →0.1	0
5	Full Scale

Here is an example for EPC 1barg.:



3.2 Analog Output

The Analog Output Voltage at the 'Analog Pressure Setpoint' pin is the regulated Pressure represented between 0 and 5 V:

Regulated Pressure (barg)	Analog Output Voltage (V)
0	0.1
Full Scale	5

4 Digital Communication

4.1 RS485 Peripheral setings

The settings are the following:

- Baud rate 115200 max
- Data 8 bits
- Parity none
- Data bits 8
- Stop bits 1
- Handshaking none
- Level EIA232/EIA485

4.2 Command Structure

The serial line uses characters to send / receive 8 bits (1 octet or 1 byte) packets. For numbers all values must be specified in hex format. Thus, each octet needs 2 characters. A command operation integrates two phases: send and receive with always the same structure.

Device Address	: 2 char default address is 'FF'
Command Code	: 6 char
Data	: n char
CRC16 Code	: 4 char

After sending a command (master) the Chipreg EPC (slave) must reply in accordance with the same following format:

Command Send (from Master)

Device		Command						Data				CRC16			
A0	A1	'-'	'>'	C0	C1	C2	C3	D0	D1	D2	Dn	R0	R1	R2	R3

Command Receive (from Slave)

Device		Command						Data				CRC16			
A0	A1	'-'	'>'	C0	C1	C2	C3	D0	D1	D2	Dn	R0	R1	R2	R3

Notice
For numbers (always in hex format) the letters (a, b, c, d, e and f can be written either in uppercase or lowercase). However, for text, the system is case-sensitive.

Example:
The user requests a pressure read with the command ‘SPRR’

Command Send (from Master)

Device		Command						CRC16			
‘0’	‘1’	‘-‘	‘>’	‘S’	‘P’	‘R’	‘R’	‘a’	‘c’	‘e’	‘1’

- The device address is 0x01 → ‘01’
- The command is composed of 2+4 letters →’->SPRR’
- No Data to send → void
- The CRC16 code of the whole character string ’01->SPRR’ is 0xace1 → ’ace1’

Command Receive (from Slave)

Device		Command						Data				CRC16			
‘0’	‘1’	‘-‘	‘>’	‘S’	‘P’	‘R’	‘R’	‘0’	‘0’	‘0’	‘7’	‘c’	‘4’	‘a’	‘c’

- The device number is always 0x01 → ‘01’
- The command is composed of 2+4 letters → ‘->SPRR’
- The returned data from the Chipreg EPC is a 16 bits number of 0x0007 → ’0007’
- The CRC16 code of the whole character string ’01->SPRR0007’ is 0xc4ac→ ‘c4ac’

In the case where a number is bigger than 8 bits (16 or 32 bits), we must split that number in several octets. An example where the 16 bits number 0d15893 must be write on the serial line:

0d15893 = 0x3e15 = 0b00111110 00010101
MSByte = 0x3e
LSByte = 0x15

Thus, we need 4 chars:
char0 = ‘3’
char1 = ‘e’
char2 = ‘1’
char3 = ‘5’

For reading operation MSByte and LSByte must be merged together to find the original number. The MSByte must be multiplied by 2^8 (shifted to the left 8 times) and added to LSByte.
We receive through the serial line 4 chars:

char0 = ‘3’
char1 = ‘e’
char2 = ‘1’
char3 = ‘5’

We convert it in 2 bytes:

MSByte = 0x3e
LSByte = 0x15

Number = (MSBytes << 8) + LSByte = 0x3E00 + 0x15 = 0x3E15 = 0d15893

4.3 CRC16 Computation

The CRC16 computation (checksum) is performed in accordance with the following algorithm:

```
//     Crc16 Modbus Checksum computation.
// Note              -
// *charData  Array of characters.
// uint8Nbr          Numbers of characters to receive.
// uint16Crc16       Output value.
uint16_t Crc16ModBusComputation (char* charData, uint8_t uint8Nbr)
{
       uint16_t                    uint16Crc16 = 0xFFFF;
       uint8_t                     uint8Position;
       uint8_t                     uint8Shift;

       for (uint8Position = 0; uint8Position < uint8Nbr;uint8Position++)
       {
              uint16Crc16 ^= (uint16_t)charData[uint8Position];

              for (uint8Shift = 8; uint8Shift != 0; uint8Shift--)
              {
                     if ((uint16Crc16 & 0x0001) != 0)
                     {
                            uint16Crc16 >>= 1;
                            uint16Crc16 ^= 0xA001;
                     }
                     else uint16Crc16 >>= 1;
              }
       }
       return uint16Crc16;
}
```

The Master can avoid the CRC16 computation replacing it by the character string ‘XXXX’.

Example:
The user requests a pressure read with the command ‘SPRR’ avoiding the CRC16 computation.

Command Send (from Master)

Device		Command						CRC16			
‘0’	‘1’	‘-‘	‘>’	‘S’	‘P’	‘R’	‘R’	‘X’	‘X’	‘X’	‘X’

- The device number is always 0x01 → ‘01’
- The command is composed of 2+ 4 letters → ‘->SPRR’
- No Data to send → void
- Instead of CRC16 code, the user can use ‘XXXX’ (capital letters) → ’XXXX’

4.4 Commands Access

Command	Type	Command	Type
PRSR	U	IDER	U
PRSW	U	IDEW	FPW/M
SPRR	U	DADR	U
PSIR	U	DADW	U/M
PSIW	U/M	BDRR	U
CTRR	U	BDRW	U/M
CTRW	U	UPPR	U
CTLR	U	UPPW	U/M
CTLW	U/M	NMSR	F
FWVR	U	NMSW	FPW/M
DPSW	U	NMWM	U
DPSR	U	SYRN	U
RVCR	U		
SVCR	U		
AOSR	U		
AOSW	U		
DPSR	U		
DPSW	U		
SISR	U		
SISW	U/M		
SYRN	U		
RASR	F		
SASR	U		
RDUR	F		
RDUW	F		
SDUR	U		
SDUW	U		
RDPR	U		
RAOR	F		
CALR	F		
CALW	FPW/M		

U : User (customer) oriented command
F : Factory oriented command (but available for user)
FPW : Need factory password (no access for user)
M : Written data storable in the non-volatile memory

4.5 Non Volatile Memory

Some user-oriented commands allow to store values in NVM :

- CTLW
- SISW
- DADW
- BDRW
- UPPW
- PSIW

Important

- To store the written values in NVM, the user must perform the command: NMWM (write data in NVM and automatic system reset).

- The written values will be immediately activated before NMWM command. This is true for the following commands:

  CTLW
  SISW
  UPPW
  PSIW

- The written values will be activated after NMWM command. This is true for the following commands:

  DADW
  BDRW

5 Commands Description

5.1 Pressure Setpoint Read: PRSR

Name
PRSR

Purpose
Read the last pressure setpoint written

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Pressure Setpoint	Uint16	0x0000 (0d0)	0x2710 (0d10000)	0..3	1)

1) See section 'Computation of the digital I/O data': Pressure

Example

Command Send

Device		Command							CRC16		
'f'	'f'	'-'	'>'	'P'	'R'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'P'	'R'	'S'	'R'	'0'	'7'	'd'	'0'				

- The pressure setpoint read is 0x07d0 (0d2000).

5.2 Pressure Setpoint Write: PRSW

Name
PRSW

Purpose
Write the pressure setpoint.

Data Send (char) : 4
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Pressure Setpoint	Uint16	0x0000 (0d0000)	0x1388 or 0x2710 (0d5000 or 0d10000)*	0..3	1)

*if EPC supports negative pressure then the valeur maximal will be 0d5000

1) See section 'Computation of the digital I/O data': Pressure

Data Receive

void

Example

Command Send

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'P'	'R'	'S'	'W'	'0'	'f'	'a'	'0'	'X	'X'	'X'	'X'

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'P'	'R'	'S'	'W'				

- The pressure setpoint written is 0x0fa0 (0d4000)

5.3 Control Read : CTRR

Name
CTRR

Purpose
Read the control configuration.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Control	Uint8	0x00 (0d0)	0x03 (0d3)	0..1	1)

1) 0x00 : No Control
0x01 : Standard Mode
0x02 : Polarity Mode
0x03 : Pwm

Example

Command Send

Device		Command							CRC16		
'f'	'f'	'-'	'>'	'C'	'T'	'R'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'R'	'R'	'0'	'2'				

- The control configuration read is 0x02 (0d2).

5.4 Control Write : CTRW

Name
CTRW

Purpose
Write the control configuration. After a 'CTRW', the CTLW must rewrite.

Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Control	Uint8	0x00 (0d0)	0x03 (0d3)	0..1	1)

1) 0x00 : No Control
0x01 : Standard Mode
0x02 : Polarity Mode
0x03 : Pwm

Data Receive

void

Example

Command Send

Device		Command							Data		CRC16		
'f'	'f'	'-'	'>'	'C'	'T'	'R'	'W'	'0'	'2'	'X'	'X'	'X'	'X'

Command Receive

Device		Command							CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'R'	'W'	'a'	'e'	'6'	'4'	

- The control configuration written is 0x02 (0d2)

5.5 Controller Read : CTLR

Name
CTLR

Purpose
Read the controller configuration.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Controller	Uint8	0x00 (0d0)	0x07 (0d7)	0..1	1)

1) 0x00 : No Controller
0x01 : PID Preset 1, small volume
0x02 : PID Preset 2, medium volume
0x03 : PID Preset 3, large volume
0x04 : PID User
0x05 : PWM Valve 1
0x06 : PWM Valve 2
0x07 : PWM Valve 1 & 2

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'L'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data	CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'L'	'R'	'0'	'2'				

- The controller configuration read is 0x02 (0d2).

5.6 Controller Write : CTLW

Name
CTLW

Purpose
Write the controller configuration.

Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Controller	Uint8	0x00 (0d0)	0x07 (0d7)	0..1	1)

1) 0x00 : No Controller
0x01 : PID Preset 1, small volume
0x02 : PID Preset 2, medium volume
0x03 : PID Preset 3, large volume
0x04 : PID User
0x05 : PWM Valve 1
0x06 : PWM Valve 2
0x07 : PWM Valve 1 & 2

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'L'	'W'	'0'	'2'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'C'	'T'	'L'	'W'				

- The controller configuration written is 0x02 (0d2)

5.7 Scaled Pressure Read: SPRR

Name
SPRR

Purpose
Read the scaled pressure

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Scaled Pressure	Uint16	0x0000 (0d0)	0x7FFF (0d37767)	0..3	1)

1) See section 'Computation of the digital I/O data': Pressure

Example

Command Send

Device		Command							CRC16		
'f'	'f'	'-'	'>'	'S'	'P'	'R'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'S'	'P'	'R'	'R'	'0'	'f'	'9'	'f'				

- The scaled Pressure read is 0x0f9f (0d3999).

5.8 User Pid Parameters Read: UPPR

Name
UPPR

Purpose
Read the user Pid parameters for pressure control.

Data Send (char) : 0
Data Receive (char) : 24

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Pressure User P	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	0..7	1)
Pressure User I	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	8..15	1)
Pressure User D	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	16..23	1)

1) See section ‘Computation of the digital I/O data’

Example

Command Send

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘U’	‘P’	‘P’	‘R’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						Data				
‘f’	‘f’	‘-‘	‘>’	‘U’	‘P’	‘P’	‘R’	See below				

- Data is: 0x3dcccccd3d75c28f00000000 (that means 0x3dcccccd, 0x3d75c28f and 0x00000000). In accordance with IEEE754 → P = 0.1, I = 0.06, D = 0

5.9 User Pid Parameters Write: UPPW

Name
UPPW

Purpose
Write the user Pid parameters for pressure control.

Data Send (char) : 24
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Pressure User P	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	0..7	1)
Pressure User I	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	8..15	1)
Pressure User D	Float32	0x00000000 (0d1.17..E-38)	0xFFFFFFFF (0d3.40..E38)	16..23	1)

1) See section 'Computation of the digital I/O data'

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16		
'f'	'f'	'-'	'>'	'U'	'P'	'P'	'W'	See below	'X'	'X'	'X'	'X'

- Data is: 0x3de147ae3d4ccccd00000000 (that means 0x3de147ae, 0x3d4ccccd and 0x00000000). In accordance with IEEE754 → P = 0.11, I = 0.05, D = 0

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'U'	'P'	'P'	'W'				

5.10 Device Address

This function provides the MFC's device address.

5.10.1 IMI FAS protocol DADR

Name
DADR

Purpose
Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Device Address	Uint8	0x00 (0d0)	0xFF* (0d255)	0..1	1)

1) See Annex for details.

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'D'	'A'	'D'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'D'	'A'	'D'	'R'	'0'	'1'				

- The device address read is 0x01 (0d1).

***Please Note:**
The address 255 (equivalent to 0xFF) is exclusively reserved for broadcasting purposes. It is strongly advised not to assign the slave device this address. In cases where you are uncertain about the device's address, you have the option to employ it for sending your request.

5.11 Device Address Write

This function could be used to change the MFC's device address.

5.11.1 IMI FAS protocol DADW

Name
DADW

Purpose
Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Device Address	Uint8	0x00 (0d0)	0xFF* (0d255)	0..1	1)

1) See Annex for details.

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'D'	'A'	'D'	'W'	'0'	'2'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'D'	'A'	'D'	'W'				

- The address device written is 0x02 (0d2)

***Please Note:**
The address 255 (equivalent to 0xFF) is exclusively reserved for broadcasting purposes. It is strongly advised not to assign the slave device this address. In cases where you are uncertain about the device's address, you have the option to employ it for sending your request.

5.12 Read Fw version : FWVR

Name
FWVR

Purpose
Read the fw version from the non volatile memory.

Data Send (char) : 0
Data Receive (char) : 9

Data Send

void

Data Receive

Parameter	Type
Fw version read	char

Example

Command Send

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘F’	‘W’	‘V’	‘R’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						Data				
‘f’	‘f’	‘-‘	‘>’	‘F’	‘W’	‘V’	‘R’	Fw version string				CRC16

Fw version string:”01.06.02A”

5.13 Baud Rate Read

This function could be used to read the chipreg's baudrate.

5.13.1 IMI FAS protocol BDRR

Name
BDRR

Purpose
Read the baud rate value

Data Send (char) : 0
Data Receive (char) : 8

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Baud Rate	Uint32	0x00000000 (0d)	0x0001C200 (0d115200)	0..7	1)

1) Available values are: 9600, 14400, 19200, 28800, 38400, 56000, 57600 and 115200

Example

Command Send

Device		Command					CRC16				
'f'	'f'	'-'	'>'	'B'	'D'	'R'	'R'	'X	'X'	'X'	'X'

Command Receive

Device		Command						Data	CRC16			
'f'	'f'	'-'	'>'	'B'	'D'	'R'	'R'	See below				

- Data is: 0x0001c200 (0d115200)

5.14 Raw Adc Setpoint Read: RASR

Name
RASR

Purpose
Read a raw data from the setpoint ADC

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Raw Adc Setpoint	Uint16	0x0000 (0d)	0x0FFF (0d4095)	0..3	1)

1) See section 'Computation of the digital I/O data'

Example

Command Send

Device		Command							CRC16		
'f'	'f'	'-'	'>'	'R'	'A'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'R'	'A'	'S'	'R'	'0'	'0'	'0'	'0'				

- The raw data read is 0x0000 (0d0).

5.15 Scaled Adc Setpoint Read: SASR

Name
SASR

Purpose
Read the analog Input setpoint

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Scaled Adc Setpoint	Uint16	0x0000 (0d0)	0x0FFF (0d4095)	0..3	1)

1) See section 'Computation of the digital I/O data'

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'S'	'A'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'S'	'A'	'S'	'R'	'0'	'0'	'0'	'0'				

- The analog input setpoint read is 0x0000 (0d0).

5.16 Baud Rate Write

This function could be used to set the chipreg's baudrate.

5.16.1 IMI FAS protocol BDRW

Name
BDRW

Purpose
Write the baud rate value.

Data Send (char) : 8
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Baud Rate	Uint32	0x00000000 (0d0)	0 x0001C200 (0d115200)	0..7	1)

1) Available values are: 9600, 14400, 19200, 28800, 38400, 56000, 57600 and 115200

Data Receive

void

Example

Command Send

Device		Command						Data	CRC16			
'f'	'f'	'-'	'>'	'B'	'D'	'R'	'W'	See below	'X'	'X'	'X'	'X'

- Data is: 0x0001c200 (0d115200)

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'B'	'D'	'R'	'W'				

5.16.2 IMI FAS protocol PSIR

Name
PSIR
Purpose
Read the pressure sign. If your EPC has been configured to work with negative pressure then the sign will be 2 if not it should be 1 for working positive pressure.
For polarity and PWM mode (respectively mode 2 and mode 3), the sign is ignored by the system.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Sign of pressure	Uint8	0x01	0x02	0..1	1 = positive 2 = negative

Example

Command Send

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘P’	‘S’	‘I’	‘R’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						Data		CRC16			
‘f’	‘f’	‘-‘	‘>’	‘P’	‘S’	‘I’	‘R’	‘0’	’2’				

5.16.1 IMI FAS protocol PSIW

Name
PSIW
Purpose
Please indicate the pressure setting. If you prefer to operate under negative pressure in mode 1, please send '2' to EPC. By default, an EPC configured to recognize negative pressure treats it as positive pressure unless specified otherwise.
The

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Sign of pressure	Uint8	0x01	0x02	0..1	1 = positive 2 = negative

Example

Command Send

Device		Command						Data		CRC16			
‘f’	‘f’	‘-‘	‘>’	‘P’	‘S’	‘I’	‘W’	‘0’	‘2’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘P’	‘S’	‘I’	‘W’				

5.17 Calibration Read : CALR

Name
CALR

Purpose
Read calibration data

Data Send (char) : 0
Data Receive (char) : 208

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Calibration Data				0..207	1)

1) See Annex for details.

5.18 Calibration Write : CALW

Name
CALW

Purpose
Write calibration data

Data Send (char) : 208
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Calibration Data				0..207	1)

1) See Annex for details.

Data Receive

void

5.19 Identification Read : IDER

Name
IDER

Purpose
Read identification data

Data Send (char) : 0
Data Receive (char) : 153

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Part Number	Char			0..152	1)

1) See Annex for details.

5.20 Identification Write : IDEW

Name
IDEW

Purpose
Write identification data

Data Send (char) : 153
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Part Number	Char			0..152	1)

1) See Annex for details.

Data Receive

void

5.21 Non-Volatile Memory Status Read: NMSR

Name
NMSR

Purpose
Read the status of the non-volatile memory.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Non-Volatile Memory Status	Uint8	0x00 (0d0)	0x01 (0d1)	0..1	1)

1) 0x00 : Nvm Incomplete
0x01 : Nvm Complete

Example

Command Send

Device		Command							CRC16		
'f'	'f'	'-'	'>'	'N'	'M'	'S'	'R'	'5'	'6'	'7'	'6'

Command Receive

Device		Command						Data		CRC16			
'0'	'1'	'-'	'>'	'N'	'M'	'S'	'R'	'0'	'1'	'8'	'a'	'7'	'3'

- The non-volatile memory status read is 0x01 (0d1).

5.22 Non-Volatile Memory Status Write

This function could be used to configure the Non-Valatile Memory Status as Incomplete(0), Complete for IMI FAS protocol(1) or Complete for Modbus RTU protocol(2).

Name
NMSW

Purpose
Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Non-Volatile Memory Status	Uint8	0x00 (0d0)	0x02 (0d2)	0..1	1)

1) 0x00 : Nvm Incomplete
0x01 : Nvm Complete
0x02 : Nvm Complete Modbus* (Until now there is no official firmware version supports this parameter.)

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'N'	'M'	'S'	'W'	'0'	'1'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'N'	'M'	'S'	'W'				

- The non-volatile memory status written is 0x01 (0d1).

5.23 Non-Volatile Memory Write Memory: NMWM

Name
NMWM

Purpose
Perform a non-volatile memory write (the control CTR must be disabled)

Data Send (char) : 0
Data Receive (char) : 0

Data Send

void

Data Receive

void

Example

Command Send

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘N’	‘M’	‘W’	‘M’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘N’	‘M’	‘W’	‘M’				

5.24 Setpoint Input Selection Read

This function could be used to get the setpoint input type.

5.24.1 IMI FAS protocol SISR

Name
SISR

Purpose
Read the setpoint input selection.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Setpoint Input Selection	Uint8	0x00 (0d0)	0x02 (0d3)	0..1	1) 2)

1) 0x00 : No Setpoint Input
   0x01 : Adc (analog)
   0x02 : RS232 (digital)

2) Analog Input option only for the Pressure control.
   (valve current and drive pwm setpoint through the serial communication only)

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'S'	'I'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'S'	'I'	'S'	'R'	'0'	'1'				

- The setpoint input selection read is 0x01 (0d1).

5.24.2 Modbus RTU protocol to get the setpoint input type

Until now there is no official firmware version supports this function.

Fct code	Address	Size	Range
Read Holding register (3)	0x1F00	16bits	0 – 2

Example:

Address = 0xFF

Request : FF 03 1F 00 00 01 96 00

Response : FF 03 02 00 02 10 51

5.25 Setpoint Input Selection Write

This function could be used to select the setpoint input type.

5.25.1 IMI FAS protocol SISW

Name
SISW

Purpose
Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Setpoint Input Selection	Uint8	0x00 (0d0)	0x02 (0d2)	0..1	1) 2)

1) 0x00 : No Setpoint Input
   0x01 : Adc (analog)
   0x02 : Digital (through the serial communication)

2) Analog Input option only for the pressure control.
   (valve current and drive pwm must be set with commands)

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16			
‘f’	‘f’	‘-’	‘>’	‘S’	‘I’	‘S’	‘W’	‘0’	‘1’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘S’	‘I’	‘S’	‘W’				

- The setpoint input selection written is 0x01 (0d1)

5.25.2 Modbus RTU protocol to select the setpoint input type

Until now there is no official firmware version supports this function.

Fct code	Address	Size	Range
Write Single Holding Register (6)	0x1F00	16bits	0 – 2

Example:
Address = 0xEA, value = 2
Request : EA 06 E0 01 00 02 79 10
Response : EA 06 E0 01 00 02 79 10

5.26 System Reset :

This function could be used to made a HW reset.

5.26.1 IMI FAS protocol SYRN

Name
SYRN

Purpose
Perform a soft reset of device.

Data Send (char) : 0
Data Receive (char) : 0

Data Send

void

Data Receive

void

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'S'	'Y'	'R'	'N'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'S'	'Y'	'R'	'N'				

5.26.2 Modbus RTU protocol to make a HW reset:

Fct code	Address	Size	Range
Write Single Coil (5)	0x2500	16bits	x

Example:
Address = 0xEA, value = 1
Request : EB 05 25 00 00 00 D0 0C
Response : -- *System is restarting then no response*

5.27 Raw Adc Setpoint Read: RASR

Name
RASR

Purpose
Read a raw data from the setpoint ADC

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Raw Adc Setpoint	Uint16	0x0000 (0d)	0x0FFF (0d4095)	0..3	1)

2) See section 'Computation of the digital I/O data'

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'R'	'A'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data				CRC16			
'f'	'f'	'-'	'>'	'R'	'A'	'S'	'R'	'0'	'0'	'0'	'0'				

- The raw data read is 0x0000 (0d0).

5.28 Scaled Adc Setpoint Read: SASR

Name
SASR

Purpose
Read the analog Input setpoint

Data Send (char) : 0
Data Receive (char) : 4

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Scaled Adc Setpoint	Uint16	0x0000 (0d0)	0x0FFF (0d4095)	0..3	1)

2) See section 'Computation of the digital I/O data'

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'S'	'A'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command					Data				CRC16			
'f'	'f'	'-'	'>'	'S'	'A'	'S'	'R'	'0'	'0'	'0'	'0'				

- The analog input setpoint read is 0x0000 (0d0).

5.29 Identification Read : IDER

Name
IDER

Purpose
Read identification data

Data Send (char) : 0
Data Receive (char) : 153

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Part Number	Char			0..152	1)

2) See Annex for details.

5.30 Identification Write : IDEW

Name
IDEW

Purpose
Write identification data

Data Send (char) : 153
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Part Number	Char			0..152	1)

2) See Annex for details.

Data Receive

void

5.31 Analog Output Selection Read: AOSR

Name
AOSR

Purpose
Read the analog output selection.

Data Send (char) : 0
Data Receive (char) : 2

Data Send

void

Data Receive

Parameter	Type	Min	Max	Char	Notice
Analog Output Selection	Uint8	0x00 (0d0)	0x03 (0d3)	0..1	1)

1) 0x00 : No Analog Out
0x01 : Valve Current 1
0x02 : Pressure
0x03 : Scaled User
0x04 : Raw User
0x05 : Valve Current 2

Example

Command Send

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'A'	'O'	'S'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data		CRC16			
'f'	'f'	'-'	'>'	'A'	'O'	'S'	'R'	'0'	'2'				

- The analog output selection read is 0x02 (0d2).

5.32 Analog Output Selection Write: AOSW

Name
AOSW

Purpose
Write the analog output selection.

Data Send (char) : 2
Data Receive (char) : 0

Data Send

Parameter	Type	Min	Max	Char	Notice
Analog Output Selection	Uint8	0x00 (0d0)	0x03 (0d3)	0..1	1) 2)

1) 0x00 : No Analog Out
   0x01 : Valve Current 1
   0x02 : Pressure
   0x03 : Scaled User
   0x04 : Raw User
   0x05 : Valve Current 2

2) For ‘User’ mode see command ‘SDUW’ and ‘RDUW’

Data Receive

void

Example

Command Send

Device		Command						Data		CRC16			
‘f’	‘f’	‘-‘	‘>’	‘A’	‘O’	‘S’	‘W’	‘0’	‘2’	‘X’	‘X’	‘X’	‘X’

Command Receive

Device		Command						CRC16			
‘f’	‘f’	‘-‘	‘>’	‘A’	‘O’	‘S’	‘W’				

- The analog output selection written is 0x02 (0d2)

5.33 Drive Pwm Setpoint Write: DPSW

Name
DPSW

Purpose
Write the drive pwm setpoint to the intlet or exhaust valve.

Data Send (char) : 6
Data Receive (char) : 0

Data Send

Parameter_1 : Valve	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint16	1	2	0..1	

Parameter_2 : PWM	Type	Min	Max	Char	Notice
Raw Drive Pwm	Uint16	0x0000 (0d)	0x0F9F (0d3999)	0..3	

Data Receive

void

Example

Command Send : write 0x0123 to valve 1 (inlet valve)

Device		Command						Par_1		Par_2				CRC16			
'f'	'f'	'-'	'>'	'D'	'P'	'S'	'W'	'0'	'1'	'0'	'1'	'2'	'3'	'X'	'X'	'X'	'X'

5.34 Drive Pwm Setpoint Read: DPSR

Name
DPSR

Purpose
Read back the pwm that has been set by the “DPSW” command.

Data Send (char) : 2
Data Receive (char) : 6

Data Send

Parameter: Valve	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint8	1	2	0..1	

Data Receive

Data_1	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint8	1	2	0..1	

Data_2	Type	Min	Max	Char	Notice
Raw Drive Pwm	Uint16	0x0000 (0d)	0x0F9F (0d3999)	0..3	

Example

Command Send : read back the pwm value that has been set to the valve 1 (inlet valve)

Device		Command						Par		CRC16			
‘f’	‘f’	‘-‘	‘>’	‘D’	‘P’	‘S’	‘R’	‘0’	‘1’	‘X’	‘X’	‘X’	‘X’

*01 for inlet valve, 02 for exhaust valve

Command Receive

Device		Command						Data_1		Data_2				CRC16			
‘f’	‘f’	‘-‘	‘>’	‘D’	‘P’	‘S’	‘R’	‘0’	‘1’	‘0’	‘1’	‘2’	‘3’	‘E’	‘5’	‘1’	‘8’

- The raw data read is 0x0123.

5.35 Raw Drive Pwm Read : RDPR

Name
RDPR

Purpose
Read the raw drive pwm.

Data Send (char) : 2
Data Receive (char) : 6

Data Send

Parameter: Valve	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint8	1	2	0..1	

Data Receive

Data_1	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint8	1	2	0..1	

Data_2	Type	Min	Max	Char	Notice
Raw Drive Pwm	Uint16	0x0000 (0d)	0x0F9F (0d3999)	0..3	

Example

Command Send : read valve 1 (inlet valve)

Device		Command						Par		CRC16			
'F'	'F'	'-'	'>'	'R'	'D'	'P'	'R'	'0'	'1'	'X'	'X'	'X'	'X'

*01 for inlet valve, 02 for exhaust valve

Command Receive

Device		Command						Data_1		Data_2				CRC16			
'f'	'f'	'-'	'>'	'R'	'D'	'P'	'R'	'0'	'1'	'0'	'0'	'0'	'0'	'5'	'B'	'0'	'8'

- The raw data read is 0000 (0d0).

5.36 Raw Drive Pwm Read : EDPR

Name
EDPR

Purpose
Read the raw drive pwm for intlet and exhaust valve.

Data Send (char) : 0
Data Receive (char) : 12

Data Send
--

Data Receive

Data_1/3	Type	Min	Max	Char	Notice
Valve type (Inlet = 1, Exhaust = 2)	Uint8	1	2	0..1	

Data_2/4	Type	Min	Max	Char	Notice
Raw Drive Pwm	Uint16	0x0000 (0d)	0x0F9F (0d3999)	0..3	

Example

Command Send : read valve 1 (inlet valve)

Device		Command						CRC16			
'f'	'f'	'-'	'>'	'E'	'D'	'P'	'R'	'X'	'X'	'X'	'X'

Command Receive

Device		Command						Data_1		Data_2				Data_3		Data_4				CRC16			
'f'	'f'	'-'	'>'	'E'	'D'	'P'	'R'	'0'	'1'	'0'	'0'	'0'	'0'	'0'	'2'	'0'	'2'	'3'	'0'				

6 Computation of the Digital I/O data

6.1 Pressure

The relationship linking the pressure to its digital value is:

$$Pressure = \frac{Pressure\ FS \cdot Digital\ Value}{Digital\ FS}$$

Pressure	current pressure	barg
Pressure Full Scale	EPC range	barg
Digital value	current digital value	counts
Digital Full Scale	5000(+-1barg) or 10000	counts

Example1

The device is a 5 barg EPC. To send a setpoint of 2.3 barg, the command PRSW (Pressure Setpoint Write) is used. Thus, the digital value to send is:

$$Digital\ value = \frac{2.3 \cdot 10000}{5} = 4600\ counts$$

Example2

The device is a 5 barg EPC. After sending the SPRR command (Scaled Pressure Read) the returned value is 5432. Thus, the current pressure is:

$$Pressure = \frac{5 \cdot 5432}{10000} = 2.716\ barg$$

A special case is for ±1 barg EPC where the Digital Full Scale is ±5000 counts. Here below some examples:

Example3

The device is a ±1 barg EPC. To send a setpoint of -0.4 barg, the command PRSW (Pressure Setpoint Write) is used. Thus, the digital value to send is:

$$Digital\ value = \frac{-0.4 \cdot 5000}{1} = -2000\ counts$$

That value must be sent in hex format (see chapter 4.2) using the “Two’s Complement” method. In the present case -2000 is 0xF830.

Example4

The device is a ±1 barg EPC. After sending the SPRR command (Scaled Pressure Read) the returned value is 2500. Thus, the current pressure is:

$$Pressure = \frac{1 \cdot 2500}{5000} = 0.5\ barg$$

6.1 Valves current

The current's raw value from the inlet and exhaust valve could be read using the RVCR. The raw values coming out from the embedded ADC used during calibration process in production.

6.2 Drive Pwm

The raw data represents the **register value of the PWM duty cycle of the power drive supplying the valve**.

Command	Type of Data
DPSR	Raw
DPSW	Raw
RDPR	Raw
EDPR	Raw

$$Duty\ Cycle = \frac{Raw\ Data}{Digital\ FS} \cdot 100$$

Duty Cycle	%
Raw Data	command digital value
Digital Full Scale	4000

Example

After sending the RDPR command (Raw Drive Pwm Read) the returned value is 2500. Thus, the duty cycle is:

$$Duty\ Cyle = \frac{2500}{4000} \cdot 100 = 62.5\%$$

6.3 Adc Setpoint

There are two types of ADC setpoint data: raw and scaled. The raw data is the raw values coming out from the embedded ADC used during calibration process in production. The scaled data are the raw values after conversion, it represents **the pressure setpoint of the analog input**.

Command	Type of Data
RASR	Raw (only use for production mode)
SASR	Scaled

$$Preesure\ Setpoint = \frac{Pressure\ FS \cdot Scaled\ Data}{Digital\ FS}$$

Pressure Setpoint	barg	standard conditions 20°C
Pressure Full Scale	barg	standard conditions 20°C
Scaled Data	command digital value	
Digital Full Scale	4095	

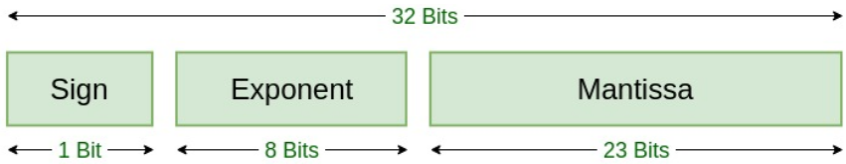
Example

The device is a 10 ls/min MFC. After sending the SASR command (Scaled Adc Setpoint Read) the returned value is 2000. Thus, the mass flow setpoint is:

$$Mass\ Flow\ Setpoint = \frac{10 \cdot 2000}{4095} = 4.884\ ls/min$$

6.4 User Pid Parameters

The **Pressure User PID** allow to customize the Pid controller for pressure control (if needed). By default, PID values are already stored in NVM. For fine tuning, it is recommended to start from these values. The format value is a float32 (single precision) type following the standard IEEE 754. For R/W operation the value must be encoded/decoded on 32 bit for the communication frame. Any programming language allows to perform this common task.



Single Precision IEEE 754 Floating Point Standard

Example

Number to Encode	Single Precision Representation
0.1	0x3dcccccd

Single Precision Representation	Decoded Number
0x3d75c28f	0.06

7 Troubleshooting

Following a master command, if an error occurs during communication, the device sends back an error code, designed by 'ERRN' describing the type of error with the following structure:

Command Receive

Device		Command						Data		CRC16			
A0	A1	'-'	'>'	'E'	'R'	'R'	'N'	D0	D1	R0	R1	R2	R3

Data Receive

Parameter	Type	Min	Max	Char	Notice
Communication Error	Uint8	0x00 (0d0)	0x09 (0d9)	0..1	1)

1) 0x01 : Reserved
   0x02 : Reserved
   0x03 : Error CRC16 (the computation of the CRC16 is incorrect)
   0x04 : Error Integrity (number in hex format has an incorrect character: g, h, i…)
   0x05 : Error Range (the range of a number is out of bounds)
   0x06 : Reserved
   0x07 : Error Password (wrong factory password)
   0x08 : Error Control Disable (operation not possible, because control disabled)
   0x09 : Error Control Enable (operation not possible, because control enabled)

Important
For any master command the device must reply, except when the following errors happen:

- The specified device address is not found on the communication bus.
- The command doesn't exist for the specified device Address.
- If the communication frame takes more than 1 sec (from the start to the end) to be transmitted.

8 Scripts

8.1 Default State

The default address of the Chipreg EPC is 0xFF and the daud rate is set at 115200 bps. After switching on (or System Reset) the device default state is the following:

- CTRR : 0x02 (Standard Mode)
- CTLR : 0x01 (PID Preset 1)

In Chipreg EPC final version, the default state values can be set by the user.

8.1 Calibration Data Description

Parameter	Type	Char	Notice	
floatNvmScaledAdcSetpointSlope	Uint32	0..7	Float32	
floatNvmScaledAdcSetpointOffset	Uint32	8..15	Float32	
floatNvmRawDac1Slope	Uint32	16..23	Float32	
floatNvmRawDac1Offset	Uint32	24..31	Float32	
int16NvmScaledAdcSetpointThreshold	Uint16	32..35		
int16NvmScaledAdcSetpointRange	Uint16	36..39		
uint32NvmMaxPressureOut	Uint32	40..47		
uint32NvmMinPressureOut	Uint32	48..55		
uint32NvmMaxPressure	Uint32	56..63		
int32NvmMinPressure	Uint32	64..71		
uint32NvmLimitPressure	Uint32	72..79		
uint32NvmMaxTemperatureOut	Uint32	80..87		
uint32NvmMinTemperatureOut	Uint32	87..94		
uint32NvmMaxTemperature	Uint32	95..87		
uint32NvmMinTemperature	Uint32	88..95		
int16NvmMaxScaledPressure	Uint16	96..99		
int16NvmMaxScaledTemperature	Uint16	100..103		
uint8NvmSetpointInputSelection	Uint8	104..105		
uint8NvmControlType	Uint8	106..107		
uint8NvmControllerType	Uint8	108..109		
uint8NvmAnalogOutputDac1Selection	Uint8	109..110		
uint8NvmPressureSign	Uint8	111..112		
floatNvmCtrlPressurePreset1Pid[0]	Uint32	113..120	Float32	
floatNvmCtrlPressurePreset1Pid[1]	Uint32	121..128	Float32	
floatNvmCtrlPressurePreset1Pid[2]	Uint32	129..136	Float32	
floatNvmCtrlPressurePreset2Pid[0]	Uint32	137..144	Float32	
floatNvmCtrlPressurePreset2Pid[1]	Uint32	145..152	Float32	
floatNvmCtrlPressurePreset2Pid[2]	Uint32	153..160	Float32	
floatNvmCtrlPressurePreset3Pid[0]	Uint32	161..168	Float32	
floatNvmCtrlPressurePreset3Pid[1]	Uint32	169..176	Float32	
floatNvmCtrlPressurePreset3Pid[2]	Uint32	177..184	Float32	
floatNvmCtrlPressureUserPid [0]	Uint32	185..192	Float32	
floatNvmCtrlPressureUserPid [1]	Uint32	193..200	Float32	
floatNvmCtrlPressureUserPid [2]	Uint32	201..208	Float32	
int16NvmCtrlBoostParameter	Uint16	209..212		
uint8NvmDeviceAddress	Uint8	213..214		
uint8NvmRs485Impedance	Uint8	215..216		
uint32NvmBaudRate	Uint32	217..224		

8.2 Identification Data Description

Parameter	Type	Min	Max	Char	Notice	Offset Register Modbus
Part Number	Char			0..12	13	
Suffix	Char			13..20	8	
Description	Char			21..52	32	
Serial Number	Char			53..74	22	
SW Version	Char			75..83	9	
HW Version	Char			84..92	9	
Calibration Date	Char			93..106	1) 14	

1)

		Example
Format	: YYYYMMDDHHMMSS	20190221153623
Year	: YYYY	2019
Month	: MM	02
Day	: DD	21
Hour	: HH	15
Minute	: MM	36
Second	: SS	23

8.3 Device Address

The default address is 0xFF. If the user changes the device address (from 0x00 to 0xFE), 0xFF can still be used as rescue address. It is important to underline that the default address can't be used when several devices are connected on the same serial line (RS485).

To change the default address, the user must connect individually each device on the communication bus and follow the scenario in 'Scripts' chapter.