

IQ Home Sensor Protocol Documentation

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1. Compatible device list

The sensor is a battery powered measurement tool designed to use in sensor networks controlled by Fast Response Commands (FRC). The protocol is based on major DPA version 3.

1.1. IQRF DPA informations

RF Network	IQRF
IQRF OS	4.03D
IQRF DPA	4.11
IQRF RF Mode	LP (Low Power)
Default RF Channel	Assigned at bonding time

HWPID																
15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	
Product code								Hardware revision				1	1	1	1	

HWPIDver																
15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	
Year of build date						Month of build date				Day of build date						

1.2. Compatible devices

Next table shows the devices which implement protocol described in this document. The table contains the Product code, the product name and the measurable values.

Code	Product name	T [°C]	rH [%]	CO ₂ [ppm]
SN-T-02	Temperature sensor	✓		
SN-TH-02	Temperature and Relative Humidity Sensor	✓	✓	
SN-THC-02	CO ₂ + Temperature and Relative Humidity Sensor	✓	✓	✓
SI-T-02	Industrial Temperature Sensor	✓		
SI-TH-02	Industrial Temperature and Relative Humidity Sensor	✓	✓	

1.3. Measurement procedure

The temperature, relative humidity and CO₂ concentration measurements are made in background. The measurement starts after reset or after module wakes up from sleep and automatically repeats the measurements in every 12 seconds in background. The measurement do not blocks the RF communication process. The sensor response immediately to peripheral request and to fast response commands, does not need additional conversion time.

If the node get a data request before the first measurement is finished the node response with sensor error. Recommended minimum waiting time between module wake up and the first data request 1 sec.

2. Read measured values

PNUM	PCMD
0x30	0x00

The command is usable to collect 16 bit wide representable physical measurable ambient quantities like ambient temperature in °C, Relative Humidity in %, CO₂ concentration in ppm, VOC concentration in ppm, air pressure, etc....

2.1. Request

The request does not contain any PDATA information.

Request			
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]
NADR	0x30	0x00	0x15AF or 0xFFFF

2.2. Response

The addressed node response with all measured ambient data information in PDATA.

Response						
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA [4, 7 or 10B]
NADR	0x30	0x80	0x15AF	0x00	?	Measured values

2.2.1. PDATA structure of the response

Response PDATA array contains 1 byte long status register and set of 3 byte long measured value entries.

PDATA										
1. byte	2. byte	3. byte	4. byte	5. byte	6. byte	7. byte	8. byte	9. byte	10. byte	11. ... 46. byte
Status reg.	Type	Value		Type	Value		Type	Value		More Type and Value pairs

Example:

- If sensor can measure only one quantity (for example: temperature value), than the sensor response with 1 byte status register and 3 byte long measured value entry in PDATA array.
- If sensor can measure one Temperature and one Relative Humidity value, than the sensor response with 1 byte status register and 6 byte long measured value entry list in PDATA array.

2.2.2. Structure of status register (1 byte)

Next table shows the **bit** structure of Status register byte.

Status Register Byte								
7. bit	6. bit	5. bit	4. bit	3. bit	2. bit	1. bit	0. bit	
Battery Low	F.U.	F.U.	F.U.	Number of measured values				

Meanings of bit fields:

- Battery Low
 - 0 = Appropriate battery state
 - 1 = The battery starts to run out
- F.U.
 - Unimplemented, reserved for future use.
- Number of measured values
 - Number of upcoming measured values entries.

2.2.3. Structure of measured value entry (3 byte)

Measured value entry contains:

- 1st byte: Data type (1st byte)
- 2nd byte: Low byte of measured value
- 3rd byte: High byte of measured value

Next table shows the Structure of one measured value entry:

Data block of one Measured value		
1. byte	2. byte	3. byte
Type	Value (low byte) [0-7 bit]	Value (high byte) [8-15 bit]

2.2.3.1. Structure of Data Type Byte

Data type byte describes the meaning of the following data value.

Next table shows the data type **bit** structure.

Data Type Byte							
7. bit	6. bit	5. bit	4. bit	3. bit	2. bit	1. bit	0. bit
F.U.					Type of measured quantity		

Meanings of bit fields:

- F.U.
 - Unimplemented, reserved for future use.
- Type of measured quantity
 - like Temperature, Relative Humidity, CO2, etc... Next table shows the exact type of measured quantities

Type of measured quantity	
Representation number	Measured quantity
0x00	Reserved (status register response @ FRC)
0x01	Temperature
0x02	Relative Humidity
0x03	CO ₂ concentration
0x04 - 0x0F	Reserved

2.2.4. Data value

Data value is a 16 bit wide signed binary data represented in two's complement.

Measured Data Value																
15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	
SIGN	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	

- Minimum representable value = -32764 (0x8004)
- Maximum representable value = +32767 (0x7FFF)
- Resolution = 1
- Error code = 0x8000 (Sensor error)
- Restricted values = 0x8001, 0x8002, 0x8003

2.2.5. Exact meaning of data values

Next table shows the exact meaning of data values based on measured quantity.*

Measured quantity	Data representation number	Unit	Response value Calculation	Resolution	Minimum value	Maximum value
Temperature	0x01	°C	T [°C] = Data value / 16	0.0625 °C	-2047.75 °C	+2047.9375 °C
Relative Humidity	0x02	%	rH [%] = Data value / 16	0.0625 %	-2047.75 %	+2047.9375 %
CO ₂ concentration	0x03	ppm	CO ₂ [ppm] = Data value	1 ppm	-32764 ppm	+32767 ppm

*At sensor error the response value equal with 0x8000.

2.2.6. PDATA response examples

Example: The sensor can measure temperature only. The measured Temperature is 25.5 °C. Battery state is ok.

PDATA			
1. byte	2. byte	3. byte	4. byte
0x01	0x01	0x98	0x01

- 1. byte = 0x01 - Battery state is ok, Number of measured values: 1
- 2. Byte = 0x01 - Next value is temperature value
- 3. - 4. Byte = 0x0198 -> 25.5 °C. (0x0198 = 408 -> 408/16= 25.5)

Example: The sensor can measure temperature only. The sensor detected sensor error.

PDATA			
1. byte	2. byte	3. byte	4. byte
0x01	0x01	0x00	0x80

- 1. byte = 0x01 - Battery state is ok, Number of measured values: 1
- 2. Byte = 0x01 - Next value is temperature value
- 3. - 4. Byte = 0x8000 -> Sensor error

Example: The sensor can measure temperature only. The measured Temperature is -12.25 °C. Battery state is low.

PDATA			
1. byte	2. byte	3. byte	4. byte
0x81	0x01	0x3C	0xFF

- 1. byte = 0x81 - Battery state is low (MSB bit equal with 1), Number of measured values: 1
- 2. Byte = 0x01 - Next value is temperature value
- 3. - 4. Byte = 0xFF3C -> -12.25 °C. (-(0x10000 - 0xFF3C) = -196 -> -196/16= 12.25)

Example: The sensor can measure temperature, relative humidity and CO₂ concentrate. The measured Temperature is 45 °C, Relative Humidity is 62.25%, the CO₂ concentrate is 925 ppm.

PDATA									
1. byte	2. byte	3. byte	4. byte	5. byte	6. byte	7. byte	8. byte	9. byte	10. byte
0x03	0x01	0xD0	0x02	0x02	0xE4	0x03	0x03	0x9D	0x03

- 1. byte = 0x03 - Battery state is ok, Number of measured values: 3
- 2. Byte = 0x01 - Next value is temperature value
- 3. - 4. Byte = 0x02D0 -> 45 °C. (0x02D0 = 720 -> 720/16= 45)
- 5. Byte = 0x02 - Next value is relative humidity
- 6. - 7. Byte = 0x03E4 -> 62.25%. (0x03E4 = 996 -> 996/16= 62.25)
- 8. Byte = 0x01 - Next value is temperature value
- 9. - 10. Byte = 0x039D -> 925 ppm. (0x039D = 925)

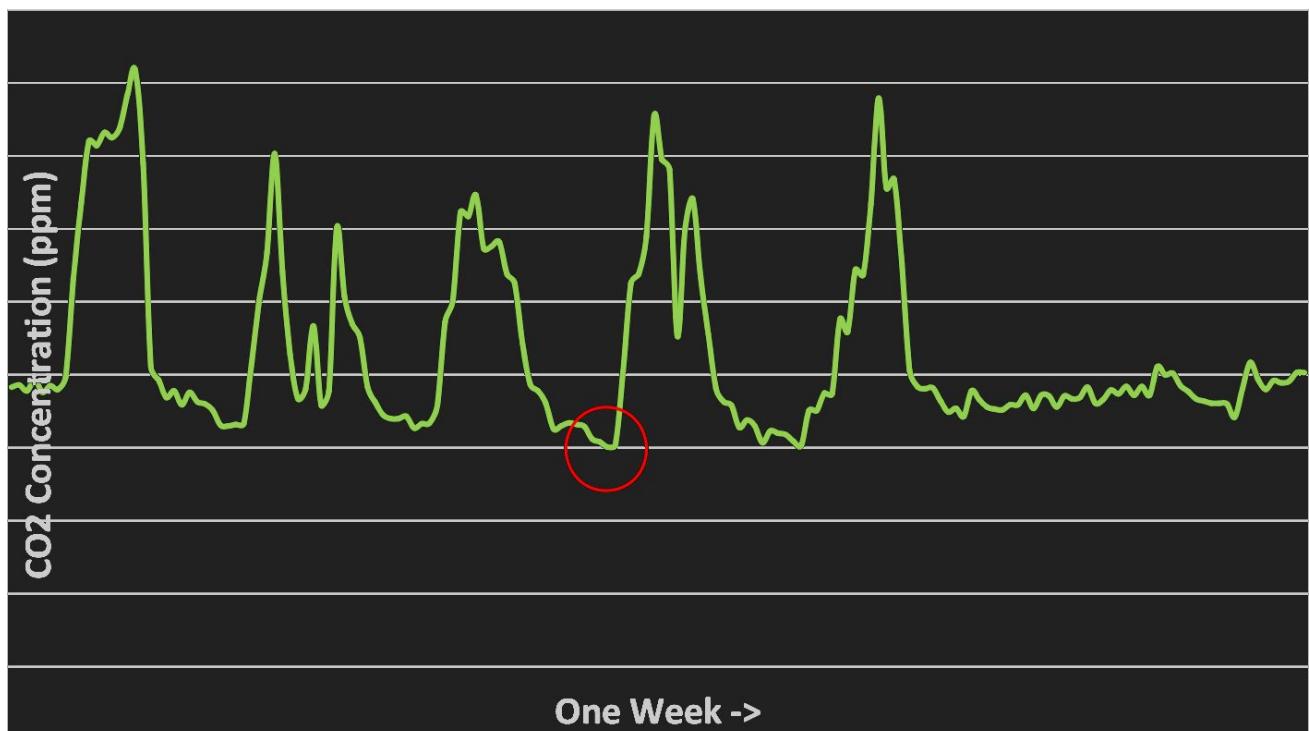
3. Auto calibration - CO₂

CO₂ sensor modules are fully calibrated prior to shipping from the factory. Over time, the zero point of the sensor needs to be calibrated to maintain the long term stability of the sensor. In many applications, this can happen automatically using the built in auto-calibration function.

This technique can be used in situations in which sensors will be exposed to typical background levels (400-450ppm) at least once during the auto-calibration period. For example, many buildings will drop quickly to background CO₂ levels when unoccupied overnight or at weekends. The auto-calibration function uses the information gathered at these periods to recalibrate.

The sensor has a zero calibration option designed to allow users to implement a network centralized auto calibration routine.

This recording from a sensor shows a typical one week recording in an office environment. The auto-calibration function uses the low point (circled) and uses it to recalibrate the zero point.



3.1. Environmental Requirements for Auto-calibration

Exposure to Fresh Air

The sensor must 'see' fresh air at least once during the auto-calibration period. You do not need to know when the fresh air will be sensed, just that it will be sensed at some point during the period.

Continuously Powered

The auto-calibration information is deleted when the sensor is switched off. This ensures that each installation is unaffected by any previous history of the sensor. For auto-calibration to function, it must be power on for the whole of the auto-calibration period.

Auto Calibration Interval

Autocalibration depends from current sensor usage. The minimum recommended auto calibration interval is one or two weeks at generally usage.

3.2. Implementing auto-calibration

The sensor has a zero calibration option designed to allow users to implement network centralized auto calibration routine. To implement auto-calibration the user have to implement these steps:

- First, select a calibration period. The choice of period should be long enough to ensure exposure to fresh air, so should usually be no less than one week.
- Next, select the value of background CO₂ expected. The recommended default minimum value is 400ppm, but it could be different based on current usage.
- The sensor automatically records the lowest CO₂ value from power-up or from last auto-calibration command. The user don't need to care about it.
- Finally, send the auto-calibration DPA command after a period of time to correct the minimum measured CO₂ value to value sent in command parameter. The command can be sent
 - Directly with direct node addressing;
 - With broadcast addressing (Node address = 0xFF);
 - With acknowledged broadcast FRC command (More information: [IQRF DPA Framework - Technical Guide](#)).

Note that this command can only be used once on a set of historic readings. The command automatically erases the recorded minimum value stored in the sensor. The next calibration command have to be sent at end of the new calibration period.

3.3. Auto-Calibration Command

PNUM	PCMD
0x30	0x0F

3.3.1. Request

The request contains 3 byte PDATA information.

Request						
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	PDATA 1. byte	PDATA 2. byte	PDATA 3. byte
NADR	0x30	0x0F	0x15AF or 0xFFFF	Type (0x03)	Calibration value (low byte) [0-7 bit]	Calibration value (high byte) [8-15 bit]

- First byte is the type of the calibration value. Current protocol implements only CO₂ calibration (Type have to be equal with 0x03)
- Second and third byte is the new calibration (minimum) value. The numerical representation of the calibration value is equal with data value representation described in chapter [Data value](#).

3.3.2. Response

The addressed node response with minimum measured CO₂ value from last calibration command or from last power-up.

Response								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2. byte	PDATA 3. byte
NADR	0x30	0x8F	0x15AF	0x00	?	Type (0x03)	Min. Value (low byte) [0-7 bit]	Min. Value (high byte) [8-15 bit]

- First byte is the type of the minimum value. Current protocol implements only CO₂ calibration (Type will equal with 0x03)
- Second and third byte is the minimum measured CO₂ value from last calibration command or from last power-up. The numerical representation of the minimum measured CO₂ value is equal with data value representation described in chapter [Data value](#).

3.4. Auto-Calibration examples

Example #1:

For example, if the lowest reading measured of Node #1 over 3 weeks was 415ppm, and the user wants to correct that to read 400ppm, the user have to send DPA command with value: 400ppm.
400 ppm = 0x0190

Request						
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	PDATA 1. byte	PDATA 2. byte	PDATA 3. byte
0x0001 (NADR)	0x30	0x0F	0x15AF	0x03 (Type)	0x90 (low byte of the calibration value)	0x01 (high byte of the calibration value)

The response contains the measured minimum value. Minimum measured value was 415 ppm. 415 ppm = 0x019F

Response								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2. byte	PDATA 3. byte
0x0001 (NADR)	0x30	0x8F	0x15AF	0x00	?	0x03 (Type)	0x9F Min. Value (low byte) [0-7 bit]	0x01 Min. Value (high byte) [8-15 bit]

Example #2:

To make half a month periodic whole network auto-calibration the user has to send an auto-calibration broadcast message every 14 days. For example, if user wants to correct the minimum measured value to 400ppm, the user have to send broadcast DPA message with value: 435ppm. 435 ppm = 0x01B3

Request						
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	PDATA 1. byte	PDATA 2. byte	PDATA 3. byte
0x00FF Broadcast	0x30	0x0F	0x15AF	0x03 (Type)	0xB3 (low byte of the calibration value)	0x01 (high byte of the calibration value)

The broadcast DPA message does not have any response message.

4. Read product information

PNUM	PCMD
0x3E	0x00

The command is usable to get basic information about the product.

4.1. Request

The request does not contain any PDATA information.

Request			
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]
NADR	0x3E	0x00	0x15AF or 0xFFFF

4.2. Response

The addressed node response with all basic product information.

Response						
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA [16B]
NADR	0x3E	0x80	0x15AF	0x00	?	Product information

4.2.1. PDATA structure of the response

Response PDATA array contains 20 byte long product information string.

PDATA										
1. byte - 15. byte						16. byte	17. byte	18. byte	19. byte	20. byte
Product String						Hardware revision				

- Product Code = Main product code of the product stored in ASCII characters.
- Hardware revision = Internal information about the hardware revision.

5. FRC - 1 Byte long sensor data collection

PNUM	PCMD	FRC command
0x0D	0x00 or 0x02	0xDF

This FRC command is used to collect measured sensor values in 1 byte wide representation format. All measured quantities have to have 1 byte wide FRC representation format. The data collection can be done

- with normal FRC (PCMD=0x00) command
- and with selective FRC (PCMD=0x02) command.

More information about FRC command can be found in [IQRF DPA Framework - Technical Guide](#).

Maximum numbers of sensors

- Maximum 63 sensors can send response to one data collection request.

5.1. Request

Next table shows the structure of request FRC command.

Request								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	FRC Command	User data 1. byte	User data 2. byte	User data 3. byte	User data 4. byte
0x0000 Coordinator	0x0D	0x00	0xFFFF	0xDF	0x30 Ambient sensor	Data type identifier	Sleep time (low byte)	Sleep time (high byte)

- At FRC Commands the addressable node have to be coordinator (0x00).
- 1st byte of PDATA = FRC Command.
0xDF: 1 Byte wide sensor data collection.
- 2nd byte of PDATA = 1st user data byte.
0x30: Ambient sensor mode
- 3rd byte of PDATA = 2nd user data byte.
Data type byte: equals with data type described in chapter [Structure of Data Type Byte](#).
- 4th and 5th byte of PDATA = 3rd and 4th user data byte.
Sleep time: If this parameter is bigger than zero and less than 0x8000 the nodes entries to deep sleep mode after FRC command. Sleep time = sleep value * 2.097 sec.
Minimum sleep time is: 2.097 sec
Maximum sleep time is: 32767 * 2.097 sec = 68712 sec (19 hour)
If Sleep time equal to zero or the MSB bit of sleep value is true then the device remains awake.
The sleep command is executed regardless the FRC command sub-parameter (1st user data byte) or the requested data type (2nd user data byte) is not implemented in sensor.

5.2. Response

Response							
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2... n. byte
0x0000 Coordinator	0x0D	0x80	?	0x00	?	Status	FRC Data

- Status:
Return code of the sendFRC IQRF OS function. See IQRF OS documentation for more information.
- FRC data:
Data collected from the nodes. Because the current version of DPA cannot transfer the whole FRC output buffer at once (currently only up to 55 bytes), the remaining bytes of the buffer can be read by the next described Extra result command. (More information: [IQRF DPA Framework - Technical Guide](#).)

5.2.1. Response values

All of the addressed node response with one byte response value. Collected bytes from each node (1-63) are stored in bytes 1-63 of the output buffer. Addressing of the output buffer is starting from zero. Zero as a node number is reserved for the coordinator, therefore the first byte of the output buffer is always zero.

The response value is equal with measured sensor information or contains status information.

5.2.1.1. Reserved FRC response values (status information)

- 0x00 => No response from node
- 0x01 => FRC command or sensor data type is not implemented
- 0x02 => Sensor error
- 0x03 => Reserved (default response value at status register query)

5.2.1.2. Normal FRC response values (measured sensor values)

Response value from 0x04 to 0xFF represents measured sensor value. Exact meaning of sensor value depends on the measured quantity requested by Data type byte in FRC request parameter.

Next table show the value calculation of 1 byte long FRC response sensor values.

Measured quantity	Data representation number	Unit	Response value Calculation	Resolution	Minimum value	Maximum value
Status Register	0x00	-	Upper four bit of Status register + 0x03	-	-	-
Temperature	0x01	°C	$T [^{\circ}\text{C}] = (\text{Data value} / 2) - 42$	0.5 °C	-40 °C	+85.5 °C
Relative Humidity	0x02	%	$rH [\%] = (\text{Data value} / 2) - 2$	0.5 %	0 %	+125.5 %
CO ₂ concentration	0x03	ppm	$\text{CO}_2 [\text{ppm}] = (10 * \text{Data value}) + 350$	10 ppm	390 ppm*	2900 ppm

* The minimum level of atmospheric carbon dioxide is higher than 400 ppm. ([More info](#))

6. FRC - 2 Byte long sensor data collection

PNUM	PCMD	FRC command
0x0D	0x00 or 0x02	0xF7

This FRC command is used to collect measured sensor values in 2 byte wide representation format. All measured quantities have to have 2 byte wide FRC representation format. The data collection can be done

- with normal FRC (PCMD=0x00) command
- and with selective FRC (PCMD=0x02) command.

More information about FRC command can be found in [IQRF DPA Framework - Technical Guide](#).

Maximum numbers of sensors

- Maximum 31 sensor can send response to one data collection request.

6.1. Request

Next table shows the structure of request FRC command.

Request								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	FRC Command	User data 1. byte	User data 2. byte	User data 3. byte	User data 4. byte
0x0000 Coordinator	0x0D	0x00	0xFFFF	0xF7	0x30 Ambient sensor	Data type identifier	Sleep time (low byte)	Sleep time (high byte)

The format of 2 byte long FRC request user data equals to 1 byte long FRC request user data format. The exact meaning of user data array described in chapter [FRC - 1 Byte long sensor data collection - Request](#).

6.2. Response

Response							
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2... n. byte
0x0000 Coordinator	0x0D	0x80	?	0x00	?	Status	FRC Data

The basic format of 2 byte long FRC response to 1 byte long FRC response format. The basic information about the Status register and FRC Data is described in chapter [FRC - 1 Byte long sensor data collection - Response](#).

6.2.1. Response values

All of the addressed node response with two byte response value. Collected byte pairs from each node (1-31) are stored in bytes 2-63 of the output buffer. Addressing of the output buffer is starting from zero. Zero as a node number is reserved for the coordinator, therefore the first two byte of the output buffer is always zero. The lower index of the byte pair contains the low significant byte information (low byte), the higher index of the byte pair contains the most significant byte information (high byte).

The response value is equal with measured sensor information or contains status information.

6.2.1.1. Reserved FRC response values (status information)

- 0x0000 => No response from node
- 0x0001 => FRC command or sensor data type is not implemented
- 0x0002 => Sensor error
- 0x0003 => Reserved (default response value at status register query)

6.2.1.2. Normal FRC response values (measured sensor values)

Response value from 0x0004 to 0xFFFF represents measured sensor value. Exact meaning of sensor value depends on the measured quantity requested by Data type byte in FRC request parameter.

The response values are equal with response values described in chapter [Exact meaning of data values](#) except if the calculated value is between zero and four. In such cases the FRC response values equal with calculated value + 0x8000.

Next table show the value calculation of 2 byte long FRC response sensor values.

Measured quantity	Data representation number	Unit	Response value Calculation	Resolution	Minimum value	Maximum value
Status Register	0x00	-	Upper four bit of Status register + 0x03	-	-	-
Temperature*	0x01	°C	T [°C] = Data value / 16	0.0625 °C	-2047.75 °C	+2047.9375 °C
Relative Humidity*	0x02	%	rH [%] = Data value / 16	0.0625 %	-2047.75 %	+2047.9375 %
CO ₂ concentration*	0x03	ppm	CO ₂ [ppm] = Data value	1 ppm	-32764 ppm	+32767 ppm

*The response values of 2 byte wide FRC queries have four representation exception:

- If the calculated response value equals with 0x0000 the FRC response value is 0x8000.
- If the calculated response value equals with 0x0001 the FRC response value is 0x8001.
- If the calculated response value equals with 0x0002 the FRC response value is 0x8002.
- If the calculated response value equals with 0x0003 the FRC response value is 0x8003.

7. FRC - 4 Byte long sensor data collection

PNUM	PCMD	FRC command
0x0D	0x00 or 0x02	0xFE

This FRC command is used to collect **all measured sensor values** in 1 byte wide representation format. All measured quantities have to have 1 byte wide FRC representation format. The data collection can be done

- with normal FRC (PCMD=0x00) command
- and with selective FRC (PCMD=0x02) command.

More information about FRC command can be found in [IQRF DPA Framework - Technical Guide](#).

Maximum numbers of sensors

- Maximum 15 sensor can send response to one data collection request.

7.1. Request

Next table shows the structure of request FRC command.

Request								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	FRC Command	User data 1. byte	User data 2. byte	User data 3. byte	User data 4. byte
0x0000 Coordinator	0x0D	0x00	0xFFFF	0xFE	0x30 Ambient sensor	Don't care	Sleep time (low byte)	Sleep time (high byte)

The format of 4 byte long FRC request user data equals to 1 byte long FRC request user data format. Only one difference between 4 byte and 1 byte long FRC request user data format is in 2nd user data byte. The 2nd user data byte value is don't care at 4 byte long FRC request. The exact meaning of user data array described in chapter [FRC - 1 Byte long sensor data collection - Request](#).

7.2. Response

Response								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2... n. byte	
0x0000 Coordinator	0x0D	0x80	?	0x00	?	Status	FRC Data	

All sensor in collection will respond with maximum of 3 measured sensor data value. The meaning of the 1st, 2nd and 3rd measured data byte is described by Data description byte. The representation

of each measured value byte equals with 1 byte long FRC response format. More information: [FRC - 1 Byte long sensor data collection - Response](#).

Response from one sensor (4 byte)			
0. byte LSB	1. byte	2. byte	3. byte MSB
1 st measured value	2 nd measured value	3 th measured value	Data description byte

Next table shows the **bit** structure of Data description byte.

Data description byte							
7. bit	6. bit	5. bit	4. bit	3. bit	2. bit	1. bit	0. bit
Battery Low	F.U.	F.U.	F.U.	F.U.	CO ₂	Relative humidity	Temperature

Meanings of bit fields:

- Battery Low
 - 0 = Appropriate battery state
 - 1 = The battery starts to run out
- F.U.
 - Unimplemented, reserved for future use.
- Measured values
 - If temperature equals with one, than the 1st measured value is Temperature.
 - If Relative humidity equals with one, than the 2nd measured value is Relative humidity.
 - If CO₂ equals with one, than the 3th measured value is Carbon dioxide.

The basic format of 2 byte long FRC response to 1 byte long FRC response format. The basic information about the Status register and FRC Data is described in chapter [FRC - 1 Byte long sensor data collection - Response](#).

8. FRC - 1 Byte long product code

PNUM	PCMD	FRC command
0x0D	0x00 or 0x02	0xDE

This FRC command is used to collect product code information of IQ Home's products.

Maximum numbers of devices

- Maximum 63 device can send response to one data collection request.

8.1. Request

Next table shows the structure of request FRC command.

Request								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	FRC Command	User data 1. byte	User data 2. byte	User data 3. byte	User data 4. byte
0x0000 Coordinator	0x0D	0x00	0xFFFF	0xDE	Don't care	Don't care	Don't care	Don't care

- At FRC Commands the addressable node have to be coordinator (0x00).
- 1st byte of PDATA = FRC Command.
0xDE: 1 Byte product code collection

8.2. Response

Response							
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2... n. byte
0x0000 Coordinator	0x0D	0x80	?	0x00	?	Status	FRC Data

- Status:
Return code of the sendFRC IQRF OS function. See IQRF OS documentation for more information.
- FRC data:
Data collected from the nodes. Because the current version of DPA cannot transfer the whole FRC output buffer at once (currently only up to 55 bytes), the remaining bytes of the buffer can be read by the next described Extra result command. (More information: [IQRF DPA Framework - Technical Guide](#).)

8.2.1. Response - Product codes

Product	Value
SN-T-02*	4
SN-T-02/24*	5
SN-TH-02	6
SN-TH-02/24*	7
SN-THC-02	8
SN-THC-02/24*	9
SN-THV-02*	10
SN-THV-02/24*	11
SI-T-02	16
SI-T-02/24*	17
SI-TH-02	18
SI-TH-02/24*	19
SI-THV-02*	20
SI-THV-02/24*	21
SN-THC-03*	32
SN-THC-03/24*	33

* These products are not released, these product code has been reserved for future use.

9. FRC - 2 Bit long RF mode

PNUM	PCMD	FRC command
0x0D	0x00 or 0x02	0x7E

This FRC command is used to collect current RF mode information of IQ Home's products.

Maximum numbers of devices

- Maximum 239 device can send response to one data collection request.

9.1. Request

Next table shows the structure of request FRC command.

Request								
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	FRC Command	User data 1. byte	User data 2. byte	User data 3. byte	User data 4. byte
0x0000 Coordinator	0x0D	0x00	0xFFFF	0x7E	Don't care	Don't care	Don't care	Don't care

- At FRC Commands the addressable node have to be coordinator (0x00).
- 1st byte of PDATA = FRC Command.
0x7E: 2 bit RF Mode collection

9.2. Response

Response							
NADR [2B]	PNUM [1B]	PCMD [1B]	HWPID [2B]	ErrN [1B]	DpaValue [1B]	PDATA 1. byte	PDATA 2... n. byte
0x0000 Coordinator	0x0D	0x80	?	0x00	?	Status	FRC Data

- Status:
Return code of the sendFRC IQRF OS function. See IQRF OS documentation for more information.
- FRC data:
Data collected from the nodes. Because the current version of DPA cannot transfer the whole FRC output buffer at once (currently only up to 55 bytes), the remaining bytes of the buffer can be read by the next described Extra result command. (More information: [IQRF DPA Framework - Technical Guide](#).)

9.2.1. Response - RF Mode

RF communication mode	Value
Fast communication mode* - IQRF RF Mode: STD - Routing on	1
Extreme Low Power communication mode* - IQRF RF Mode: LP - Routing off	2
Low Power communication mode - IQRF RF Mode: LP - Routing on	3

** These RF Modes are not used at the moment, these values have been reserved for future use.*

10. Release Notes

Property	Value
Protocol version	3.0.xx
IQRF OS version	4.03D
IQRF DPA version	4.11
Date of release	07/11/2019
Notes	<ul style="list-style-type: none"> • New DPA and OS version adapted. • 16 bit FRC command value has been modified from 0xFF to 0xF7. • FRC - 4 Byte long sensor data collection (0xFE) has been added. • Response length of Read product information command (PNUM=0x3E) has been extended to 20 byte. • FRC - 1 Byte long product code (0xDE) has been added. • FRC - 2 Bit long RF mode (0x7E) has been added. <p>Caution: Devices with protocol version 3.0 are not RF compatible with 2.0</p>

Property	Value
Protocol version	2.0.xx
IQRF OS version	4.02D
IQRF DPA version	3.02
Date of release	02/06/2018
Notes	Sleep calculation is modified. - MSB bit check is added.

Property	Value
Protocol version	2.0.xx
IQRF OS version	4.02D

IQRF DPA version	3.02
Date of release	11/05/2018
Notes	Device list has been modified Bonding documentation moved to product datasheet

Property	Value
Protocol version	2.0.xx
IQRF OS version	4.00D
IQRF DPA version	3.00
Date of release	25/07/2017
Notes	First revision of IQ Home sensor protocol version 2.