

IQ² Development

Complete Hardware and Software example for DEVICE STACK integration

To simplify IQ² Device stack integration into Customers device, a complete example (hardware and software) is available:

1. Hardware
 - a. Hardware is based on “MAXIM IO-LINK RTD TEMP SENSOR (MAXREFDES42#)” Device.



- b. IO-Link device transceiver: Maxim MAX14821EWA
 - c. Main microcontroller: Renesas RL78/G1A (R5F10E8EALA)
2. Software
 - a. Device stack
 - b. Application:
 - i. Hardware configuration
 - ii. Timers
 - iii. IO Link device configuration
 1. Device identification and IO Link parameters configuration
 2. Process Data In
 3. Parameters manager (include block parametrization)
 4. Data storage
 5. Event Dispatcher
 6. **IO-Link BLOB Transfer & Firmware Update**

Revision History:

Reviton	Changes	Author
1.1.2.1	Add possibility to force execute Bootloader at startup.	Svitlychnyi
1.1.2.3	Enable required IO-Link parameters in bootloader mode Add delay before switch from application to bootloader and vice versa, to give a possibility to answer for a command	Svitlychnyi
1.1.3.3	Add firmware update emulation mode	Svitlychnyi
1.1.3.3	Fix link to bootloader update	Svitlychnyi
1.1.3.3	Fix link to bootloader update emulation file	Svitlychnyi
1.1.3.5	Fix min cycle time	

MAXREFDES42 is a temperature sensor with IO-Link communication and can be used as reference for hardware and software design.

Latest document:

https://download.iq2-development.de/Releases/MAXREFDES42/doc/MAXREFDES42_example.pdf

IODD:

Device ID 901 (firmware update will be emulated):

<https://download.iq2-development.de/Releases/MAXREFDES42/IODD/IQ2Dev-MAXREFDES42-20190707-IODD1.1.zip>

Device ID 902 (firmware will be really replaced):

<https://download.iq2-development.de/Releases/MAXREFDES42/IODD/IQ2Dev-MAXREFDES42F-20190707-IODD1.1.zip>

It used:

Application mode:

- 6,8 ms min cycle time
- 2 bytes on-request data
- 2 byte for ProcessDataIn / 0 byte ProcessDataOut

Bootloader mode:

- 26,4 ms min cycle time
- 2 bytes on-request data
- 0 byte for ProcessDataIn / 0 byte ProcessDataOut

Process data In consists 16-bit integer temperature raw value

Parameter	Device
▼ Process Data	
▼ ProcessDataIn	
ambient temperature process value »	8 861

Parameters:

- Device Access lock (included in data storage)

- Application tag (included in data storage)
- Detailed device status (dynamic parameters)
- Ambient temperature Switch point light level (included in data storage), index="256"
- Ambient temperature Switch point Hysteresis (included in data storage), index="257"
- Ambient temperature (in °C) (dynamic variable), index="267"
- Ambient temperature (in °F) (dynamic variable), index="268"

▼ Identification		
Vendor Text	IQ2 Development. The IO-Link specialists	
Product Name	MAXREFDES42	
Product ID	MAXREFDES42	
Product Text	IO-Link Temperature Sensor reference design	
Firmware Version	V1.0.1.4	
▼ Device Access Locks		
Parameter (write) Access Lock	false	<input type="checkbox"/> Write
Data Storage Lock	false	<input type="checkbox"/> Write
Local Parameterization Lock	false	<input type="checkbox"/> Write
Local User Interface Lock	false	<input type="checkbox"/> Write
Vendor Name	IQ2 Development	
Application Specific Tag	***	<input type="text" value="32 bytes maximal (UTF8)"/> Write
Error Count	0	
Device Status	0 (Device is OK)	
▶ Detailed Device Status		
▼ Parameters		
Ambient temperature Switch point light level »	9 148	<input type="text" value="0 .. 65 535"/> Write
Ambient temperature Switch point Hysteresis »	32	<input type="text" value="0 .. 65 535"/> Write
▼ Observation		
Ambient temperature (in °F) »	68	
Ambient temperature (in °C) »	20	

Commands:

- Restore Factory settings
- Boot In Application Mode – restart device and firmware will be started in normal mode, command 0xC8
- Boot In Bootloader Mode – device will be restarted and IO-Link bootloader mode is active, command 0xC9

▼ Diagnosis	
Standard Command	Tech-in ambient temperature switch-point level description
Standard Command	Restore Factory Settings
Standard Command	Boot In Application Mode
Standard Command	Boot In Bootloader Mode

BLOB:

- Id=-4096, reading 64 byte data
- Id=4096, writing 64 byte data

▼ Binary Large Objects - BLOB (Profile)

Transfer channels

Read: Calibration values (read)

Write: Calibration values (write)

Data buffer

```
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F
```

Length: 64 octets

Firmware update:

Emulation Mode:

Emulation mode was added started from version 1.1.3.3.

Device ID in emulation mode: 901

It gives a possibility to test Firmware Update and Bootloader Update (or BLOB transfer) without a risk to damage a device. When emulation mode is enabled, the data transfer and state machine is the same, no Firmware will be modified.

Firmware update emulation mode use special prepared firmware files, which give a possibility to control transferred data and raise an error, if data is not correct.

Switching between emulation mode and real mode is done by IO-Link system command:

Index = 202: enable emulation mode (default)

Index = 203: disable emulation mode

If iqPDCT software are used, they can be found in Diagnosis menu

Standard Command		Firmware update will be emulated
Standard Command		Firmware update will be not emulated

The current status of emulation mode can be checked in parameter "Bit status", index=260

Bit 0: Data Storage upload flag

Bit 1: Emulation mode (0 – enabled, 1 – disable)

Firmware update file, if emulation mode is active:

https://download.iq2-development.de/Releases/MAXREFDES42/FW%20Update/IQ2%20Development-V1.1.3.0EMULATE_MAXREFDES42-20190307-IOLFW1.0.iolfw

File for bootloader update:

https://download.iq2-development.de/Releases/MAXREFDES42/FW%20Update/fw_bootloader_emu.bin

if device is running in bootloader mode and emulation mode is active, display will show "BTE" (bootloader emulation), see picture.



Real Mode:



Device ID in real mode: 902

- show temperature in Celsius

https://download.iq2-development.de/Releases/MAXREFDES42/FW Update/IQ2Dev-MAXREFDES42_C_V1.1.3.5-20190707-IOLFW1.0.iolfw

- show temperature in Fahrenheit

https://download.iq2-development.de/Releases/MAXREFDES42/FW Update/IQ2Dev-MAXREFDES42_F_V1.1.3.5-20190707-IOLFW1.0.iolfw

When device is running in application mode, the temperature is shown:	When device is running in application mode, the "BOOT" word is shown:
	

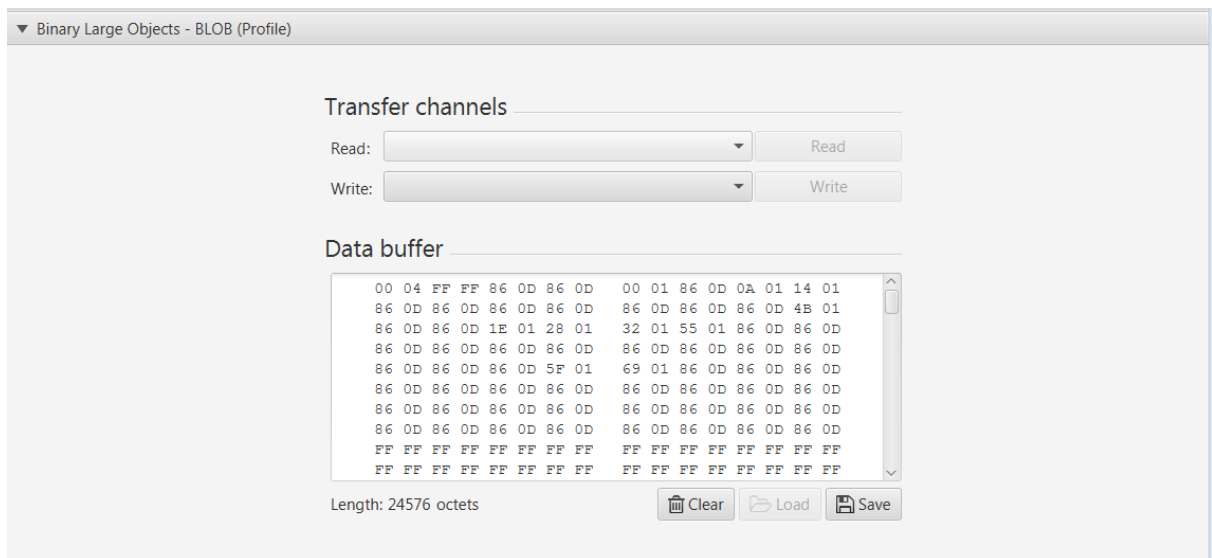
Bootloader update:

WARNING!!! – don not run bootloader update with version low then 1.1.1.0

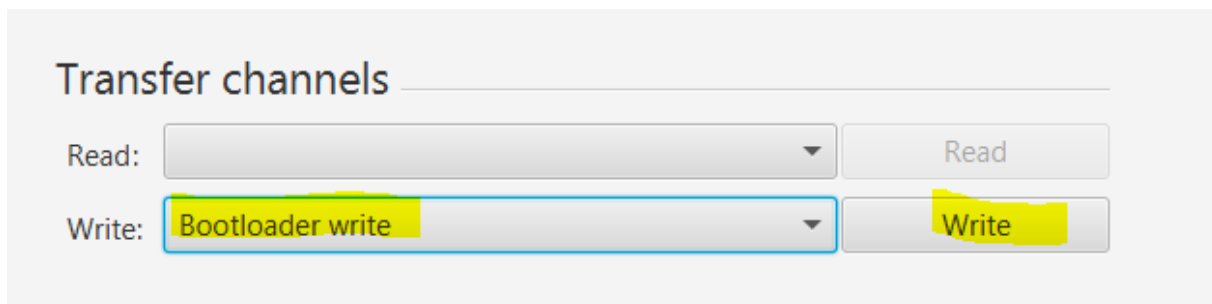
Bootloader update is implemented through BLOB transfer, index: 5000 (dec)

Bootloader file can be downloaded from here: https://download.iq2-development.de/Releases/MAXREFDES42/FW/iqmaxrefdes42_boot.bin

For bootloader update open tab “Binary Large Object” in iqPDCT application and load the bootloader file



Select “Bootloader write” in Write Transfer channel and press write



After Blob data transfer the bootloader will be updated

If some error during process was happen, do not power cycle the device, because it will not boot, just try once more

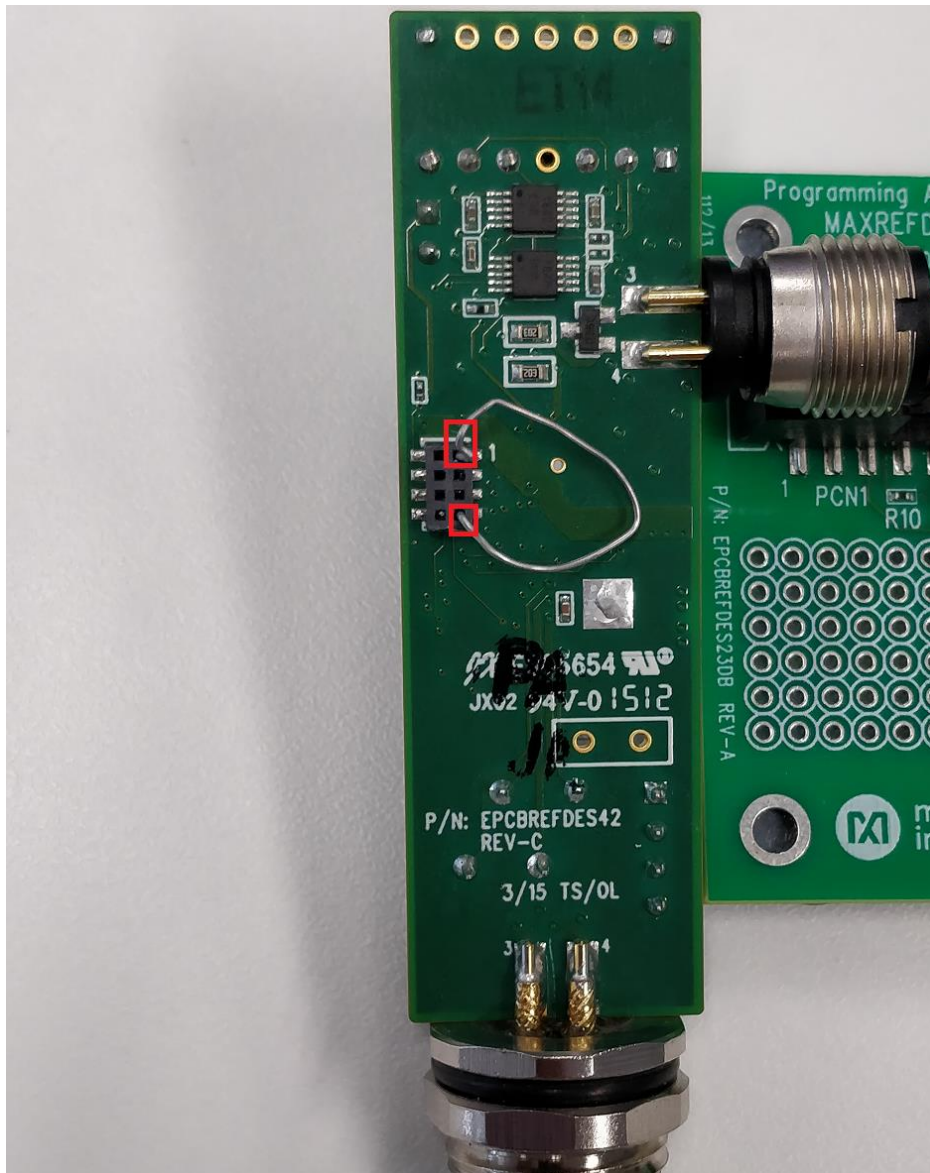
Force enter bootloader:

WARNING!!! – don not execute force enter bootloader with version lower than 1.1.2.1. It can damage a board.

If User application has not been updated correctly – it is possible to forcibly start Bootloader.

Steps should be exactly, as described:

1. Disconnect MAXREFDES42 board from Master
2. Connect pins 1 and 7 on CN2 connector



3. Connect board to the Master

4. Without Master disconnect remove connection from pins 1 and 7
5. The board should show, it works in Bootloader mode (Led screen should show "BOOT")

Troubleshooting

If display message is "----", it means, that device run in application mode, but the temperature sensor is not detected. This happen, if sensor disconnected from connector. To fix this, the sensor should be reconnected (just extract it and put it again into the slot, pins 2 and 3):

