DATAEAGLE 7050 / 2730 Compact – Commissioning

Connection with DATAEAGLE X-treme IO module

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1. About this document

   This document describes the coupling of DATAEAGLE X-treme IO module(s) to a DATAEAGLE 7050 / 2730 Compact device.

2. Basic settings

   The basic and connection settings of the DATAEAGLE X-treme IO are configured on the DA-TAEAGLE Compact 2730 / or 7050 via the DATAEAGLE Wizard Software tool.
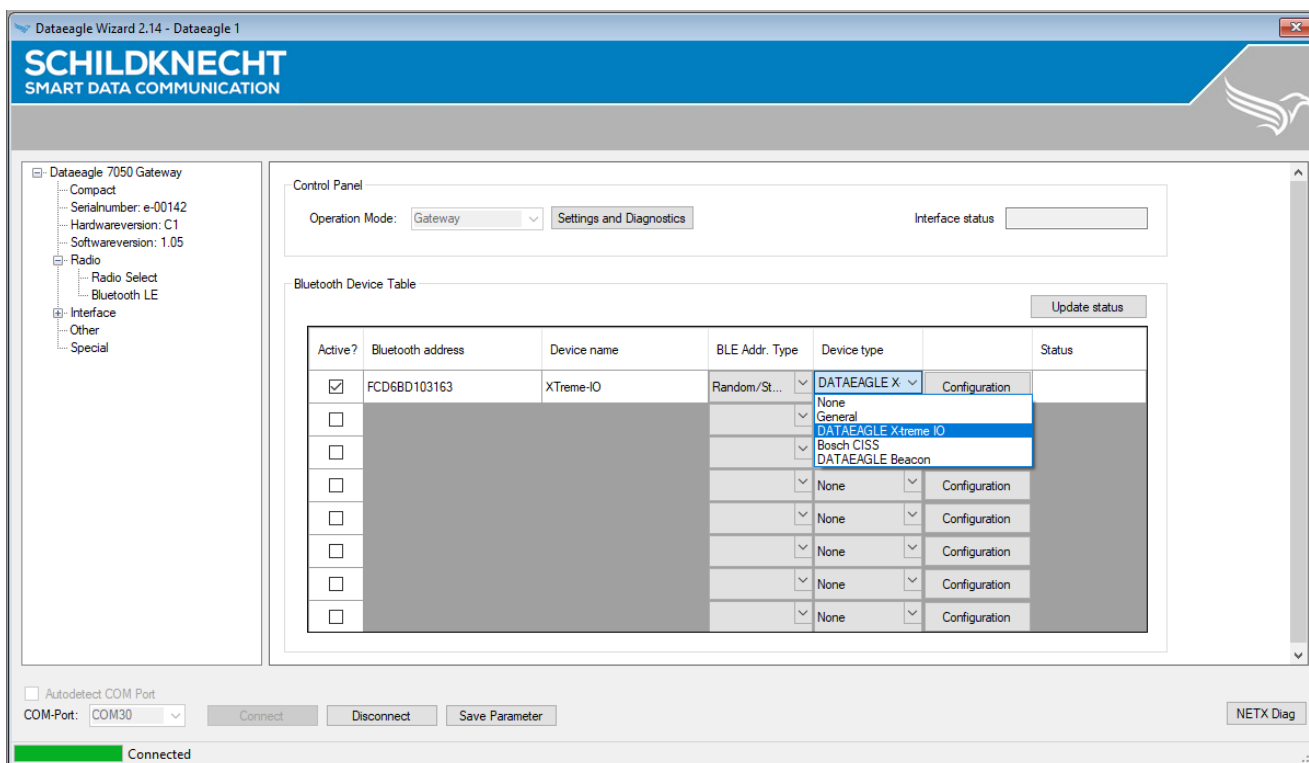

Figure 1: Basic settings of X-treme IO (See Table 1)

Table 1: Basic settings of X-treme IO

Active ?	BLE device active / not active
Bluetooth Address	Bluetooth MAC address of the BLE device
Device name	Name of the BLE device. Only required if the connection is established via a scan operation.
BLE Addr. Type	Address type of the BLE participant. Select "Random/Static" for DATAEAGLE X-treme IO modules
Device type	Device type of the BLE device as preconfiguration (template) of the data settings of the BLE device. Select the "DATAEAGLE X-treme IO" device type for coupling a DATAEAGLE X-treme IO.

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Since the X-treme IO module is available in different variants, the variant type must also be selected via the "Configuration" button (see Figure 2). A brief description of the different variants can be found in Table 2.
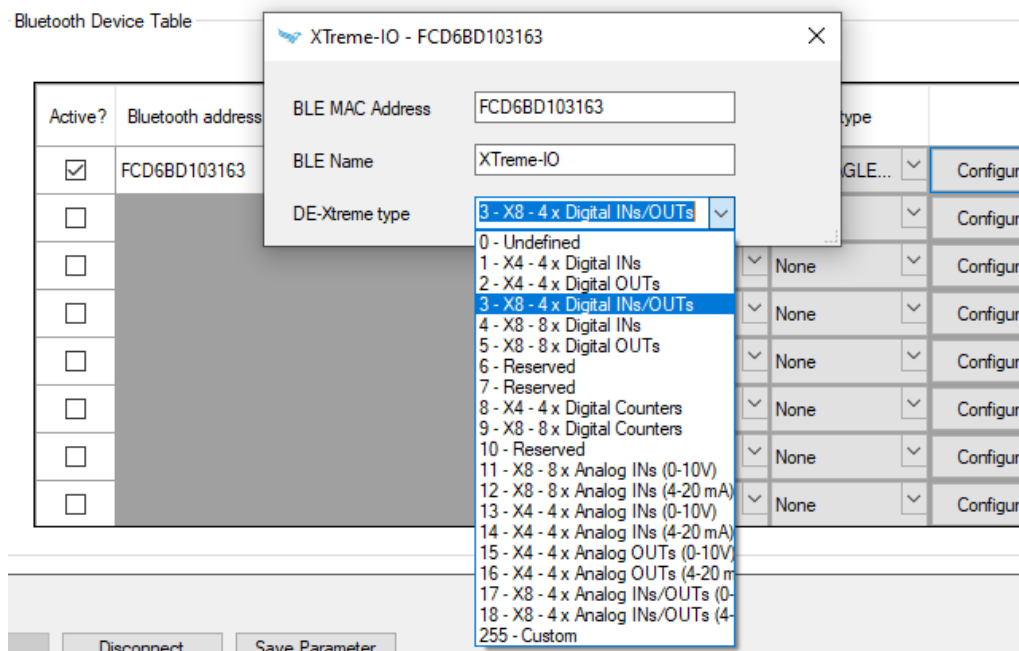

Figure 2: DATAEAGLE X-treme IO type configuration

Table 2: Description of X-treme IO module variants

Nr.	description
0	Undefined
1	X4 – 4 x Digital INs
2	X4 – 4 x Digital OUTs
3	X8 – 4 x Digital INs/OUTs
4	X8 - 8 x Digital INs
5	X8 - 8 x Digital OUTs
6	Reserved
7	Reserved
8	X4 - 4 x Digital Counters
9	X8 - 8 x Digital Counters

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10	Reserved
11	X8 - 8 x Analog INs (0-10V)
12	X8 - 8 x Analog INs (4-20 mA)
13	X4 - 4 x Analog INs (0-10V)
14	X4 - 4 x Analog INs (4-20 mA)
15	X4 - 4 x Analog OUTs (0-10V)
16	X4 - 4 x Analog OUTs (4-20 mA)
17	X8 - 4 x Analog INs/OUTs (0-10V)
18	X8 - 4 x Analog INs/OUTs (4-20mA)
255	Custom

!!! ATTENTION !!!
➔ A maximum of eight BLE devices or X-treme IO modules can be configured in the DATAEA-GLE Compact 7050 / 2730 gateway.
➔ After completing the configuration, the DATAEAGLE Compact 2730 / 7050 device must be restarted to apply the settings.

3. Data processing

After successful configuration, the DATAEAGLE Compact 2730 / 7050 gateway will establish the Bluetooth connection to the DATAEAGLE X-treme IO and exchange the IO signals. The IO data is then exchanged with the PLC via the fieldbus interface and/or transferred to the DA-TAEAGLE Cloud Portal, depending on the device variant ordered. These two variants are described in more detail below.

3.1. Data coupling via field bus

!!! ATTENTION!!!
➔ Depending on the PLC and fieldbus system, different data structures are created for the data exchange via the fieldbus interface. This can result in memory gaps. It must be ensured that the transmitted data is transferred without gaps on the fieldbus interface.

➔ Depending on the PLC and fieldbus system, data structures are transferred in a different byte order. It must be ensured that the byte sequence corresponds to this document.

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3.1.1.   Basic data structure

The basic structure for the send and receive data that is exchanged with the PLC via the fieldbus interface is independent of which Bluetooth station has been configured.

3.1.1.1.   Send data structure

Table 3 describes the structure of the data transmitted from the PLC to the DATAEA-GLE Compact 7050 / 2730. The format of the "SEND DATA" depends on the Bluetooth participant (e.g. DATAEAGLE X-treme IO variant).

Table 3: Basic structure send data from PLC

Name	Datatype	Description
ORDER_NUMBER	BYTE	Order counter
TARGET_ADDRESS	BYTE	Destination address of the BLE device
REQUESTED_BYTES	BYTE	Number of requested bytes
SENT_BYTES	BYTE	Number of bytes sent
MAIN_COMMAND	BYTE	Main Command
SPECIAL_COMMAND	BYTE	Special command
SEND DATA	-----	BLE device data

Via "MAIN_COMMAND" and "SPECIAL_COMMAND" different functions/commands can be triggered between the DATAEAGLE Comapct 2730 / 7050 and the connected Bluetooth device. These functions are described in table 4 and 5.

!!! ATTENTION !!!
Functions that are triggered via "MAIN_COMMAND" and "SPECIAL_COMMAND" are only accepted by DATAEAGLE Compact 2730 / 7050 as a new function if the job counter also increases.

Table 4: Possible commands to the DATAEAGLE

Name	Coding	Description
Empty Command	0x08	Empty command - useful to trigger data exchange between PLC and DATAEAGLE.
Read Command	0x06	Reads all configured read characteristics from the BLE device
Write Command	0x05	Writes all configured write characteristics to the BLE device

By setting or resetting the individual bits in the "SPECIAL_COMMAND" byte, special functions can be activated or deactivated on the DATAEAGLE X-treme IO module (see Table 5).

Table 5: Bit coding for SPECIAL_COMMAND

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Failsafe off	OC-monitoring	Blink test	0	Reserved (0)			

The Failsafe off bit activates or deactivates the function that the outputs of the DA-TAEAGLE X-treme IO are not reset to 0 if the radio link is interrupted.
If the bit is not set, all outputs are set to 0 if the radio connection is interrupted.

The OC-monitoring bit activates or deactivates the function that the DATAEAGLE X-treme IO monitors the order counter. If this is no longer increased by the PLC, then the DATAEAGLE X-treme IO also switches the outputs to 0.
If the bit is not set, the order counter is not evaluated.

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3.1.1.2. Receive data structure

Table 6 describes the structure for the receive data that is read from the DATAEAGLE Compact 2730 / 7050 by the PLC via the fieldbus interface. The format of the "RECEIVE DATA" depends on the Bluetooth device (e.g. DATAEAGLE X-treme IO variant).

Table 6: Basic structure received data in PLC

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
SOURCE_ADDRESS	BYTE	Destination address of the BLE device
RECEIVED_BYTES	BYTE	Number of requested bytes
SEND_BYTES	BYTE	Number of bytes sent
DEVICE_IDX	BYTE	Device Index (same as SOURCE_ADDRESS)
BLE_STATUS	BYTE	Status of the BLE device
BLE_RSSI	DINT	RSSI value of the existing BLE connection.
RECEIVE DATA	-----	Data of the BLE device

The byte "BLE_STATUS" reports the current state of the BLE connection. Table 7 describes the possible BLE states

Table 7: Possible values for the BLE state

Name	Kodierung	Description
None	0x00	
Error	0x01	Error.
Inactive	0x02	Device is not activated
First Boot	0x03	
Idle	0x04	
Test	0x05	
Init	0x06	

Scan	0x07	Scanning process running
Reset	0x08	
Data	0x09	Interface data traffic running
Disconnected	0x0A	Device disconnected
Disconnecting	0x0B	Device disconnecting
Found	0x0C	Device found
Not found	0x0D	Device not found
Active	0x0E	Interface active
Connecting	0x0F	Connection is established
Init Pairing	0x10	Pairing is initialized
Pair Code	0x11	Pair code is transmitted
Preparing	0x12	
Configuring	0x13	Notifications are activated
Startup	0x14	Startup commands are executed
Receiving	0x15	Data is read by the participant.
Sending	0x16	Data is transferred to the device
Command/Transceiving	0x17	Connection successful and device now accepts commands

3.1.2. DATAEAGLE X-treme IO transmit and receive data

The length and format of the send and receive data depends on the configured DA-TAEAGLE X-treme IO variant. These are described below.

3.1.2.1. Digital IO modules

The data structure described here applies to the following DATAEAGLE X-treme IO variants:
➔ 1: 4x Digital IN
➔ 2: 4x Digital OUT
➔ 3: 4x Digital IN/OUT
➔ 4: 8x Digital IN
➔ 5: 8x Digital OUT
➔ 6: 8x Digital IN/OUT

Send Data: PLC ➔ DATAEAGLE Compact

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
TARGET_ADDRESS	BYTE	Destination address of the BLE device
REQUESTED_BYTES	BYTE	Number of requested bytes
SENT_BYTES	BYTE	Number of bytes sent
MAIN_COMMAND	BYTE	Main Command
SPECIAL_COMMAND	BYTE	Special command
DIGITAL OUT	UINT	Digital Outputs

Description of MAIN_COMMAND and SPECIAL_COMMAND can be found in chapter 3.1.1.1.

Receive data: DATAEAGLE Compact ➔ PLC

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
SOURCE_ADDRESS	BYTE	Destination address of the BLE device
RECEIVED_BYTES	BYTE	Number of requested bytes
SEND_BYTES	BYTE	Number of bytes sent

DEVICE_IDX	BYTE	Device Index (same as SOURCE_ADDRESS)
BLE_STATUS	BYTE	Status of the BLE device
BLE_RSSI	DINT	RSSI value of the existing BLE connection.
DIGITAL IN	UINT	Digital Inputs

3.1.2.2. Digital counter

The data structure described here applies to the following DATAEAGLE X-treme IO variants:
➔ 8: 4x Digital Counters
➔ 9: 4x Digital Counters

Send Data: PLC ➔ DATAEAGLE Compact

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
TARGET_ADDRESS	BYTE	Destination address of the BLE device
REQUESTED_BYTES	BYTE	Number of requested bytes
SENT_BYTES	BYTE	Number of bytes sent
MAIN_COMMAND	BYTE	Main Command
SPECIAL_COMMAND	BYTE	Special command
COUNTER_1_COMMAND	UINT	Command for counter 1
COUNTER_2_COMMAND	UINT	Command for counter 2
COUNTER_3_COMMAND	UINT	Command for counter 3
COUNTER_4_COMMAND	UINT	Command for counter 4

COUNTER_5_COMMAND	UINT	Command for counter 5
COUNTER_6_COMMAND	UINT	Command for counter 6
COUNTER_7_COMMAND	UINT	Command for counter 7
COUNTER_8_COMMAND	UINT	Command for counter 8

Each counter on a module can be set with start values and further functions can be executed. The bit coding for "Command counter" is described in table 8.

Table 8: Bit coding counter command

Bit 15	Bit 14	Bit 13	…………	Bit 0
Counter-Sync	Counter stop	Start value for the counter		

Receive data: DATAEAGLE Compact → PLC

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
SOURCE_ADDRESS	BYTE	Destination address of the BLE device
RECEIVED_BYTES	BYTE	Number of requested bytes
SEND_BYTES	BYTE	Number of bytes sent
DEVICE_IDX	BYTE	Device Index (same as SOURCE_ADDRESS)
BLE_STATUS	BYTE	Status of the BLE device
BLE_RSSI	DINT	RSSI value of the existing BLE connection.
DIGITAL IN	UINT	Digital Inputs
COUNTER_1_STATUS	UINT	State for counter 1
COUNTER_2_STATUS	UINT	State for counter 2
COUNTER_3_STATUS	UINT	State for counter 3
COUNTER_4_STATUS	UINT	State for counter 4
COUNTER_5_STATUS	UINT	State for counter 5
COUNTER_6_STATUS	UINT	State for counter 6
COUNTER_7_STATUS	UINT	State for counter 7
COUNTER_8_STATUS	UINT	State for counter 8

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The status for each counter contains not only the current counter value but also the activation and synchronization state. The bit coding for "COUN-TER_x_STATUS" is described in table 9.

Bit 15	Bit 14	Bit 13	………..	Bit 0
0 = no Sync. 1 = Synchronized	0 = activ, 1= stop	Current counter value		

!!! ATTENTION !!!
➔ To determine only the current counter value, an AND operation (0x3FFF) must be made with the counter status.

$$Counter\ value = (counter\ status)\ AND\ (0x3FFF)$$

➔ The counter continues to count actively even if the Bluetooth connection is interrupted. If a counter overflow takes place during this time (8192 counts), then the synchronization bit (BIT 15) is reset.

3.1.2.3.   Analog modules

The data structure described here applies to the following DATAEAGLE X-treme IO variants:
➔ 11: 8x Analog IN (0 – 10V)
➔ 12: 8x Analog IN (4 - 20mA)
➔ 13: 4x Analog IN (0 – 10V)
➔ 14: 4x Analog IN (4 - 20mA)
➔ 15: 4x Analog OUT (0 – 10V)
➔ 16: 4x Analog OUT (4 - 20mA)
➔ 17: 4x Analog IN / OUT (0 – 10V)
➔ 18: 4x Analog IN / OUT (4 - 20mA)

Send Data: PLC → DATAEAGLE Compact

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
TARGET_ADDRESS	BYTE	Destination address of the BLE device
REQUESTED_BYTES	BYTE	Number of requested bytes
SENT_BYTES	BYTE	Number of bytes sent
MAIN_COMMAND	BYTE	Main Command
SPECIAL_COMMAND	BYTE	Special command
ANALOG_OUT_1	UINT	Value for analog output 1
ANALOG_OUT_2	UINT	Value for analog output 2
ANALOG_OUT_3	UINT	Value for analog output 3
ANALOG_OUT_4	UINT	Value for analog output 4

The analog values set by the PLC must be converted from the voltage or current values (0-10V or 4-20 mA).

For a 0 - 10V module the following formula applies:

$$Value_{Out} = \frac{Value_{volt} \times 32767}{10}$$

For a 4 - 20mA module the following formula applies:

$$Value_{Out} = \frac{(Value_{mA} - 4) \times 32767}{10}$$

Receive data: DATAEAGLE Compact → PLC

Name	Data type	Description
ORDER_NUMBER	BYTE	Order counter
SOURCE_ADDRESS	BYTE	Destination address of the BLE device
RECEIVED_BYTES	BYTE	Number of requested bytes

SEND_BYTES	BYTE	Number of bytes sent
DEVICE_IDX	BYTE	Device Index (same as SOURCE_ADDRESS)
BLE_STATUS	BYTE	Status of the BLE device
BLE_RSSI	DINT	RSSI value of the existing BLE connection.
ANALOG_IN_1	UINT	Value for analog input 1
ANALOG_IN_2	UINT	Value for analog input 2
ANALOG_IN_3	UINT	Value for analog input 3
ANALOG_IN_4	UINT	Value for analog input 4
ANALOG_IN_5	UINT	Value for analog input 5
ANALOG_IN_6	UINT	Value for analog input 6
ANALOG_IN_7	UINT	Value for analog input 7
ANALOG_IN_8	UINT	Value for analog input 8

The received analog values must be converted by the PLC into the respective voltage or current values (0-10V or 4-20 mA).

For a 0 - 10V module the following formula applies:

$$Value_{volt} = \frac{Value_{IN} \times 10}{32767}$$

For a 4 - 20mA module the following formula applies:

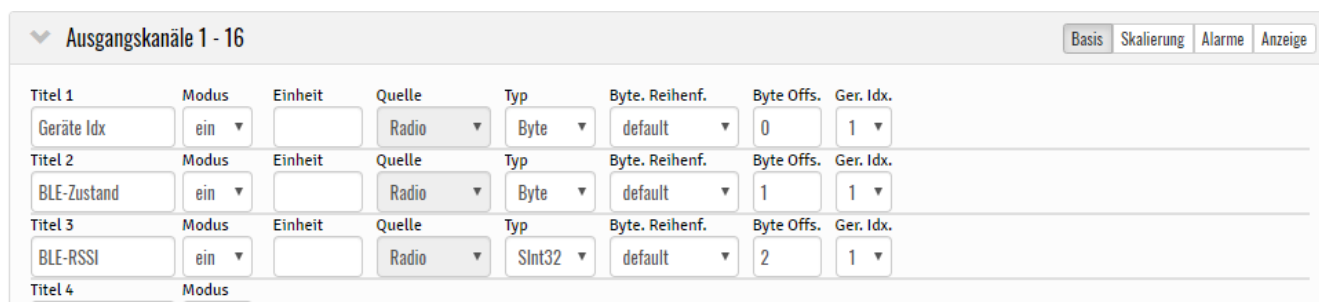$$Value_{mA} = 4 + \frac{Value_{IN} \times 16}{32767}$$

3.2.   Data connection to the cloud

If the DATAEAGLE Compact 2730 7 7050 also has a cloud interface, the data from the DA-TAEAGLE X-treme IO modules can be displayed in the DATAEAGLE portal.

In the DATAEAGLE portal, this data can be configured via the output channels of the DATAEAGLE Compact 2730 / 7050. See exemplary in figure 3.

Figure 3: Output channels for BLE data

Name	Byteoffset	Data type	Description
DEVICE_IDX	0	BYTE	Device Index
BLE_STATUS	1	BYTE	Status of the BLE device
BLE_RSSI	2	DINT	RSSI value of the existing BLE connection.
DATA	6	-----	Data of the BLE device

The structure of the DATA block from byte offset (6) has the same structure as the respective DATAEAGLE X-treme IO variant. To be found in this document from 3.1.2.