EnOcean Serial Protocol 3 (ESP3)

V1.50

June 3th 2020

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1 EnOcean Serial Protocol 3 (ESP3)

REVISION HISTORY

The following major modifications and improvements have been made to the first version of this document:

No.	Major Changes	Date	Who	Reviewer
1.0	First Version			
1.1	Corrections, added uses cases			
1.2	Added small correction in CMD_SA_LEARNDEVICE command.			
1.2	Reworked improved protocol			
1.3	Removed SMACK comments – rework needed			
1.4	Document Reviewed, performance measurements moved to EO3000I_API			
1.5	Added PacketType = 3			
1.6	Added types and defined commands			
1.7	New terms and definitions; extended description	2010-08-31	ap, op, jh	
1.8	Modifications	2010-09-07	ap, op	
1.9	Extracted from system spec document, removed internal info	2010-09-15	ASt	
1.10	1st review	2010-09-28	op	
1.11	2nd review (notes ap, mf)	2010-10-11	op	
1.12	Minor modifications	2010-10-27	nm, op	
1.13	Minor modifications	2010-11-03	nm, op	
1.14	New event: CO_READY	2010-12-10	op	
1.15	New optional data in CO_RD_IDBASE	2011-02-28	wh,ap	
1.16	Corrected wrong CRC8D in CO_WR_RESET example Changed the REMOTE_MAN_COMMAND	2011-06-14	jh	
1.17	Examples added for CO_WR_FILTER_ADD	2011-08-02	mho, wh	
1.18	Fixed CO_RD_FILTER description	2012-03-16	jh	
1.19	Common commands for secure devices added; minor modifications	2012-12-15	ap	
1.20	Added CO_WR_MODE, type RADIO_ADVANCED to support advanced protocol	2013-01-06	jh	
1.21	Minor editorial changes	2013-02-12	ap	
1.22	Added type RADIO_MESSAGE, CO_RD_SECURE_DEVICE, CO_RD_NUM_SECURE_DEVICES. Updated types table	2013-03-04	ap	
1.23	Fixed typos . Updated security commands, added commands: CO_WR_SECUREDEVICE_ADD_PSK, CO_WR_SECUREDEVICE_SENDTEACHIN, CO_WR_TEMPORARY_RLC_WINDOW	2013-08-19	jh	
1.24	Added CO_RD_SECUREDEVICE_PSK	2013-10-14	jh	
1.25	Modifications in filter and repeater common commands to enable filtered repeating functionality	2014-02-24	ap	
1.26	Changed description of SA_RD_LEARNEDCLIENTS response, enhanced secure ESP 3 messages	2014-05-06	mhs	

1.27	CO_WR_SECURE_DEVICE_ADD: Added optional byte defining if it is a PTM. Added CO_RD_DUTYCYCLE_LIMIT and CO_DUTYCYCLE_LIMIT.Remote management examples corrected. Many typos corrected. Renamed "Advanced Protocol" to ERP2.	2014-07-30	ap	
1.28	Return code RET_LOCK_SET added.		ap	
1.29	Reference to 2.4 Commands added. CO_SET_BAUDRATE and new supported higher baudrates added	2015-10-16	tm	
1.30	CO_GET_FREQUENCY_INFO, CO_GET_STEPCODE and 2.4 documentation added	2016-03-22	tm	
1.31	New smart ack commands added, formatting updated	2016-07-18	tm	
1.32	Added Config Commands	2016-10-25	fg	
1.33	CO_READY extended by mode CO_WR_REMAN_CODE added	2016-12-21	ap	
1.34	CO_WR_STARTUP_DELAY defined	2017-02-08	mf	
1.35	Packet Type 32 Packet Type 33 added	2017-03-17	rs	TM
1.36	CO_SET_REMAN_REPEATED CO_GET_REMAN_REPEATED	2017-05-09	tm	
1.37	Modification of the CO_RD_STEPCODE	2017-10-17	mf	
1.38	Modification of the CO_EVENT_SECUREDEVICES	2017-12-06	mf	
1.39	Modification of Security Level inside of RADIO_PACKET_ERP1 Added Security Level to RADIO_PACKET_ERP2 and Message Updated CO_EVENT_SECUREDEVICES	2017-12-11	tm	mh
1.40	Redundant ESP3 command Code 40 CO_WR_SECUREDEVICE_CLEAR_LIST deleted. Packet 11 CONFIG_COMMAND codes deleted. Adding commands 36 to 51 missing in the list of common commands codes	2017-12-11	at	mh
1.41	The ESP3 CO_WR_SECUREDEVICE_DEL contains a new optional data value = 0x03 that allows deleting the whole contains from all link tables.	2018-01-21	mf	mh
1.42	Changing the current description of CO 48 and CO 49 for a proper one	2018-01-22	at	mh
1.43	Added option for EEPROM reading and writing (CO_RD_MEM, CO_RD_MEM_ADDRESS and CO_WR_MEM).	2018-01-29	mf	mh
1.44	Commands for RD and WR RORG deleted Packet Type 32 and 33 not included for this version	2018-03-06	at	
1.45	Table 57,58 and 59 adding option 0x00000000 as ID to delete broadcast device and Optional Data Direction	2018-05-07	at	
1.46	Description for Tables 4 and 10 updated, Code 07 description corrected, Code 25,26 and 27 Security Level information updated. Missing description for responses added. Formatting checked	2018-05-29	at	mh
1.47	CO_WR_FILTER_DEL addition of syntax in-line with Filter Add. CO_RD_FILTER response, destination ID added. ID Base change restriction documented now in product user manuals.	2018-09-4	at	mh

1.48	CO_WR_DATETIME,CO_RD_DATETIME, CO_WR_RLC_SAVE_PERIOD, Adding 2 new security commands to replace the old ones. The new ones allows to use 32 bit RLC CO_WR_SECUREDEVICEV2_ADD CO_RD_SECUREDEVICEV2_BY_INDEX	2019-03-26	tm,rs,mh, at	
1.49	Updated introductory text; Update CO_WR_SLEEP wake on UART; Update subtelegram offset formula; Added references CO_WR_SECUREDEVICEV2_ADD; Deprecated CO_WR_SECUREDEVICE_ADD; Updated SubTelNum on type 1 packets; General improvements to descriptions.	2019-07-01	mk,dv	
1.50	Added the CO_WR_RSSITESTMODE and CO_RD_RSSITESTMODE Added CO_TX_DONE, CO_LRN_MODE_DISABLED events ADDED CO_EVENT_SECURE_DEVICES subevent for device added and RLC sync ADDED the COMMAND_ACCEPTED and logic for long operations	2020-06-03	tm,dv	

Published by EnOcean GmbH, Kolpingring 18a, 82041 Oberhaching, Germany
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1.1 Terms & Abbreviations

Term / Abbr.	Description
µC	Microcontroller (external)
API	Application Programming Interface
APP	Application
BIST	Built-in self-test
CRC8	Cyclic redundancy check (CRC) or polynomial code checksum; CRC-8 = 9 bits polynomial lengths
CRC8D	CRC8 for Group 'Data' (incl. Optional Data)
CRC8H	CRC8 for Group 'Header'
Data	Payload of ESP3 packet
EEP	EnOcean Equipment Profile
ERP1, ERP2	EnOcean Radio Protocol. There are versions 1 and 2.
ESP3	EnOcean Serial Protocol V3
Field	Identifier of Data subset / element
Group	Part of ESP3 packet (header, data, optional data)
Host	ESP3 communication device
LSB	Least significant bit
Mailbox	Message filing of the Postmaster for each Smart Ack Sensor/Client
MSB	Most significant bit
Offset	Byte position pointer of packet
Packet	ESP3 data unit
Packet Type	Type of ESP3 Packet (Command, Event, Radio, ...)
PM	Postmaster
Postmaster	Includes multiple mailboxes for each Smart Ack Sensor/Client
R-ORG	Unique identification of radio telegram types
R-ORG_EN	Addressed version of 'R-ORG' (EN = encapsulation)
RS-232	Telecommunication standard for serial binary single-ended data and control signals
RSSI	Received signal strength indication (dBm)
Smart Ack	EnOcean standard for energy-optimized bidirectional transmission
Subtelegram	Smallest unit of data in radio transmission, using orthogonal structure
Sync Byte	Identifier for ESP3 packet start
UART	Universal Asynchronous Receiver Transmitter

1.2 Introduction

This document specifies the EnOcean Serial Protocol 3.0 (ESP3).

ESP3 defines a serial communication protocol between host systems such as microcontrollers, gateways or PCs and EnOcean radio transceiver modules. ESP3 communication is based on a 3-wire UART connection (Rx, Tx, GND) using software handshake and full-duplex communication similar to an RS-232 serial interface.

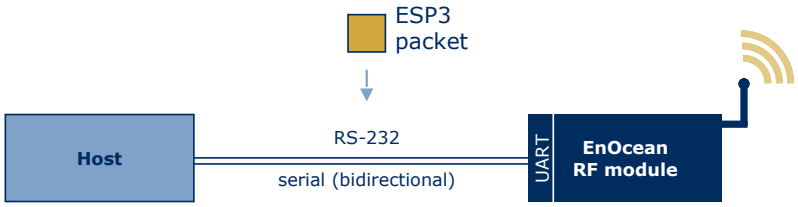

Figure 1

ESP3 enhances the previous ESP2 protocol by adding future-proof structures and extending the data content. New functional properties in ESP3 are:

- Reporting of the received radio signal strength and number of the received subtelegrams
- Higher throughput due to a significantly higher baud rate
- Improved data security and consistency by CRC8 Data verification
- More reliable ESP3 packet detection within the serial byte stream
- Option for backwards-compatible future extensions using the "Optional Data" feature

The ESP2/3 differences in summary:

	ESP 2.0	ESP 3.0
Subtelegram count	--	•
Receive signal strength (RSSI)	--	•
Upward compatible with 'Optional Data'	--	•
Data verification	Checksum	CRC8
UART Synchronization (packet detection)	2 bytes	6 bytes
Max. number of ESP packet types	8	256
Types of data	Radio, Command	Any type of data
Max. size of transferred data	28 bytes	65535 bytes
Communication speed	9600 baud	**57600 baud** 115200 baud 230400 baud 460800 baud

Table 1

1.3 ESP3 packet structure

ESP3 is a point-to-point protocol using a packet data structure. It consists of three distinct groups:

- Header
  The header group provides all required information to parse the ESP3 packet, specifically:
  - Data Length (number of bytes of the group Data)
  - Optional Length (number of bytes of the group Optional Data)
  - Packet Type (RADIO, RESPONSE, EVENT, COMMAND ...)

- Data
  The data group contains the mandatory data of an ESP3 packet. The format of this field will not change for a given ESP3 packet type (e.g. a specific ESP3 command) to ensure backwards compatibility.

- Optional Data
  The optional data group can be used to extend an existing ESP3 packet.

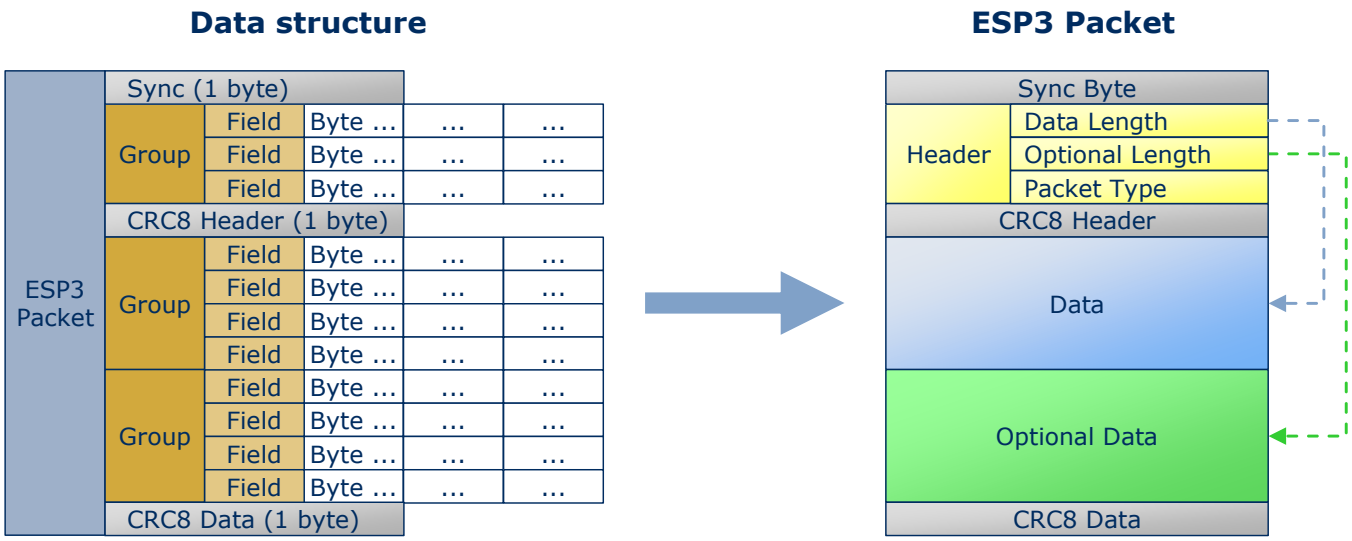

Figure 2

In addition, the following items are used to enable proper packet handling:
- Sync.-Byte (start)
- CRC8 for Header
- CRC8 for Data (incl. Optional Data)

The resulting overall packet structure is shown below.

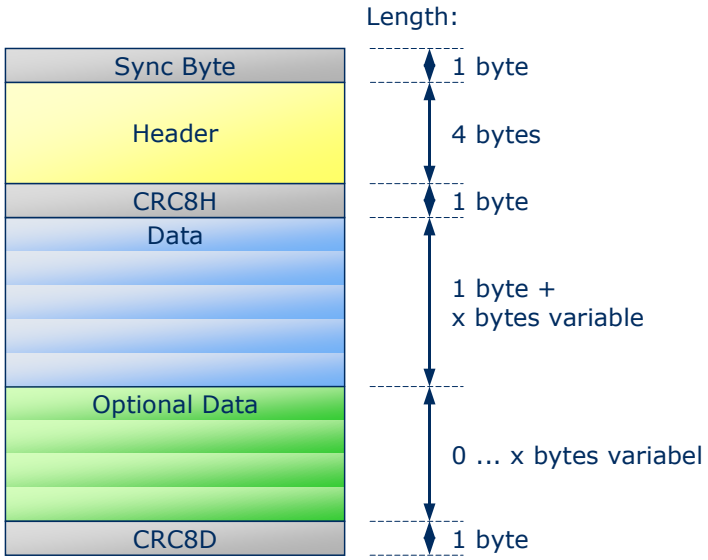

Figure 3

1.4 Maintaining compatibility

The ESP3 protocol is defined as a specific structure of Sync.-Byte, Header & CRC8. This basic structure is maintained across all versions of this protocol.

Packet types and packet content (e.g. commands) will be extended as the protocol matures, but care has to be taken to maintain compatibility between different protocol versions.

For a given type of packet (e.g. a specific ESP3 command) the content of the DATA group may not be changed in future implementations to ensure compatibility. Required modifications may only be implemented via the OPTIONAL_DATA group. Legacy products that are unfamiliar with such extension can ignore the content of the OPTIONAL_DATA group thus ensuring backwards compatibility of such feature extension

If modification via OPTIONAL_DATA does not meet the implementation needs, then a new packet (e.g. a new ESP3 command) shall be defined.

Legacy products will react as to new or modified ESP3 packets follows:

- Unknown packet types are confirmed with the RESPONSE message 'not supported' and will not be processed further.
- New fields in the Optional Data section of an existing packet type will be ignored; a RESPONSE message will not be sent.
- It is allowed to skip bytes (not transfer them) from optional fields when they are located at the end of the optional field.

1.5 UART parameters

UART communication used by ESP3 uses the following parameters:

- 8 data bits
- No parity bit
- One start bit (logical 0)
- One stop bit (logical 1)
- Line idle (≙neutral) is logical 1 (standard).

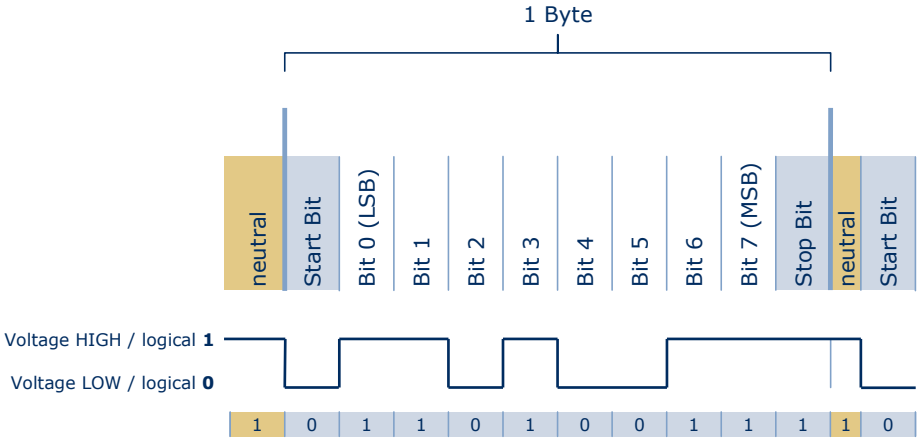

Figure 4

1.6 UART synchronization (start of packet detection)

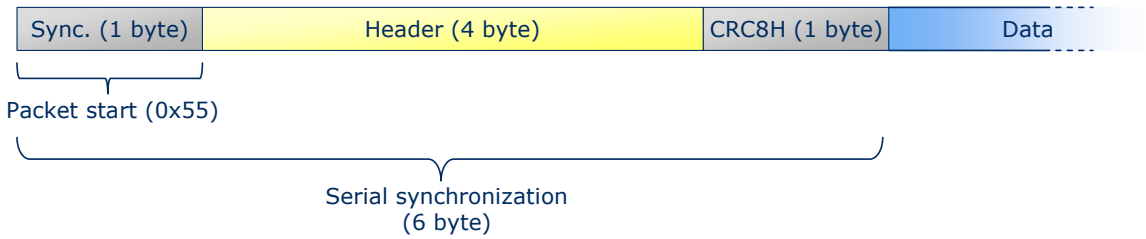

Figure 5

The start of an ESP3 packet is indicated by a Sync Byte with the value 0x55. Once such Sync Byte is identified, the subsequent 4 byte header is compared with the corresponding CRC8H value to verify that this indeed is the start of an ESP3 packet.

If the CRC8H value matches the 4 byte header then the start of the ESP3 packet has detected properly and the subsequent data will be passed.

If the CRC8H value does not match the 4 byte header then the value 0x55 does not correspond to a Sync Byte indicating the start of an ESP3 packet and the decoding logic will wait for the next occurrence of 0x55 within the data stream.

The chapter 3.4 shows an example for a feasible implementation.

1.7 Packet format

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	Serial synchronization byte; always set to 0x55
Header	1	2	Data Length	0xnnnn	Specifies how many bytes in DATA must be interpreted
	3	1	Optional Length	0xnn	Specifies how many bytes in OPTIONAL_DATA must be interpreted
	4	1	Packet Type	0xnn	Specifies the packet type of DATA, respectively OPTIONAL_DATA
-	5	1	CRC8H	0xnn	CRC8 Header byte; calculated checksum for bytes: DATA_LENGTH, OPTIONAL_LENGTH and TYPE
Data	6	x	... ...	... ...	Contains the actual data payload with topics: - RawData (e.g. 1:1 radio telegram) - Function codes + optional parameters - Return codes + optional parameters - Event codes x = variable length of DATA / byte number
Optional Data	6+x	y	... ...	... ...	Contains additional data that extends the field DATA; y = variable length of OPTIONAL_DATA
-	6+x+y	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 2

1.8 Packet types

Depending on the field [Packet Type] a different kind of packet is transmitted.

Type No.	Value hex	Name	Description
0	0x00	---	Reserved
1	0x01	RADIO_ERP1	Radio telegram
2	0x02	RESPONSE	Response to any packet
3	0x03	RADIO_SUB_TEL	Radio subtelegram
4	0x04	EVENT	Event message
5	0x05	COMMON_COMMAND	Common command
6	0x06	SMART_ACK_COMMAND	Smart Acknowledge command
7	0x07	REMOTE_MAN_COMMAND	Remote management command
8	0x08	---	Reserved for EnOcean
9	0x09	RADIO_MESSAGE	Radio message
10	0x0A	RADIO_ERP2	ERP2 protocol radio telegram
11	0x0B	CONFIG_COMMAND	RESERVED
12	0x0C	COMMAND_ACCEPTED	For long operations, informs the host the command is accepted
13-15	0x0D ... 0F	---	Reserved for EnOcean
16	0x10	RADIO_802_15_4	802_15_4_RAW Packet
17	0x11	COMMAND_2_4	2.4 GHz Command
18 ... 127	0x12 ... 0x1F	---	Reserved for EnOcean

128...255	0x80 ... FF	available	MSC and messages

Table 3

1.9 Direction of packet types

The function and the properties of a packet type determine the direction of the ESP3 data traffic, and whether a RESPONSE message is required or not.

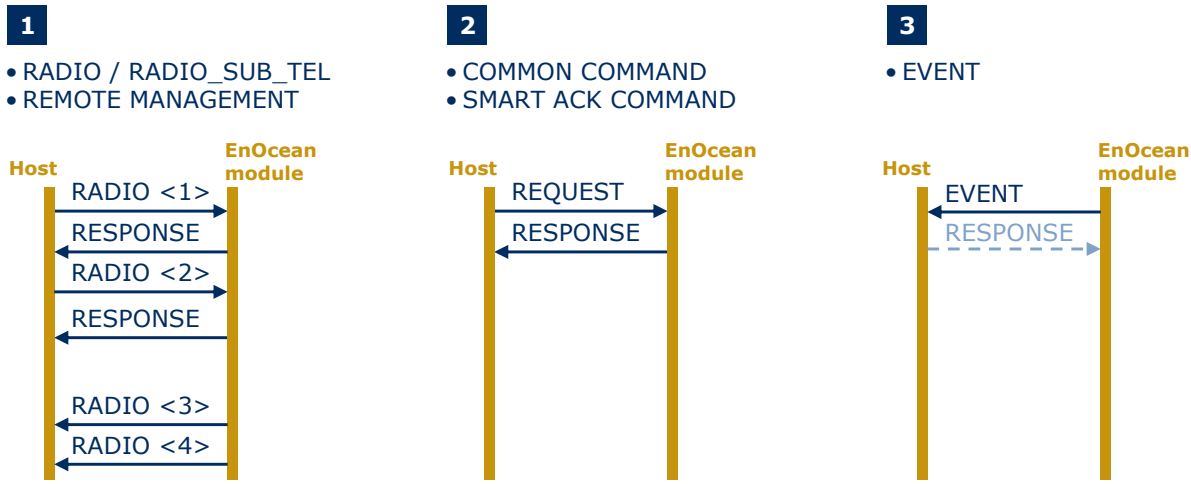

Figure 6

Case 1: ESP3 packets of the type RADIO_ERP1, RADIO_SUB_TEL or REMOTE_MAN are bidirectional, that is, after sending a packet (host -> module) it is mandatory to wait for the RESPONSE message, to confirm the telegram has been processed and will subsequently be transmitted.

After receiving (module -> host) a packet no RESPONSE is required (see RADIO_ERP1 no. <3> and <4>).

Case 2: Only a host sends a ESP3 COMMAND (COMMON, SMART ACK) to an EnOcean module. Each REQUEST is answered with a RESPONSE message (OK, error, etc.). The reverse direction module-to-host is not possible.

Case 3: Only an EnOcean module sends an EVENT to a host. The type of the EVENT defines whether a RESPONSE message is required or not.

1.10 ESP3 timeout

An ESP3 packet timeout occurs when the time between characters exceeds 100ms.

If the answer time between REQUEST/EVENT and RESPONSE/COMMAND_ACCPETD exceeds 500ms a timeout is occurs as well.

If an operation needs longer or an unknown amount of time to execute, the EnOcean module can send a COMMAND_ACCEPTED packet instead of a response, to inform the host that it will perform the requested operation. When the operation is finished executing the EnOcean module will send a standard RESPONSE. The EnOcean module

may not respond to additional requests while performing the previously requested operation.

2 ESP3 Command Description

2.1 Packet Type 1: RADIO_ERP1

2.1.1 Packet structure

The ERP1 radio telegram (raw data) is embedded into the ESP3 packet.
The actual user data (variable length) is a subset of the radio telegram.

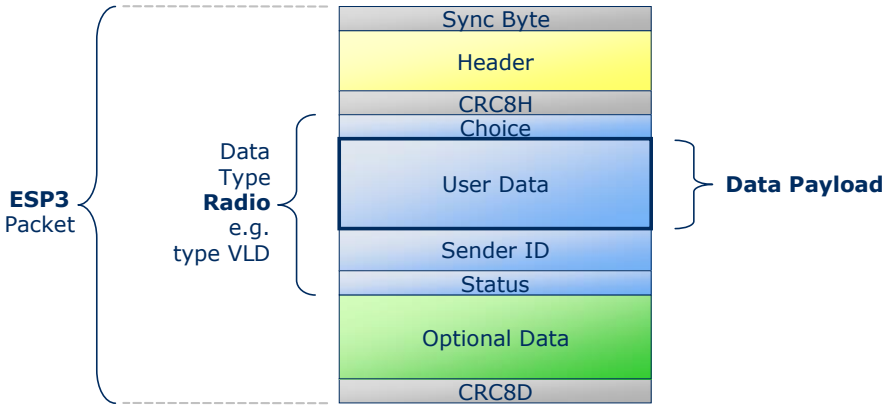

Figure 7

The following structure is applicable to all types of radio telegrams:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	Variable length of radio telegram
	3	1	Optional Length	0x07	7 fields fixed
	4	1	Packet Type	0x01	RADIO_ERP1 = 1
-	5	1	CRC8H	0xnn	
Data	6	x	... ...	... ...	Radio telegram without checksum/CRC x = variable length / size
Optional Data	6+x	1	SubTelNum	0xnn	Number of subtelegram; Send: 3 / receive: 0
	7+x	4	Destination ID	0xnnnnnnnn	Broadcast transmission: FF FF FF FF Addressed transmission (ADT): Destination ID (= address)
	11+x	1	dBm	0xnn	Send case: FF Receive case: best RSSI value of all received subtelegrams (value decimal without minus)
	12+x		Security Level	0x0n	Send Case: Will be ignored (Security is selected by link table entries) Receive case: 0 = telegram not processed 1 = Obsolete (old security concept) 2 = Telegram decrypted

					3 = Telegram authenticated 4 = Telegram decrypted + authenticated
-	13+x	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 4

When receiving a telegram, no RESPONSE has to be sent. When sending a telegram, a RESPOND has to be expected. In this case, the following **RESPONSE** message gives the return codes:

00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
05 RET_LOCK_SET

When there is no additional data included that have to be described, the standard RESPONSE structure is used as detailed in chapter 2.2.3

Note:

- Security: When sending an Addressed Radio Packet (ADT Telegram) the used security features will be determined by the Secure Link Table. Security level field in ESP3 will not have any influence in the send case.
  If the destination address has been configured in the outbound table, the preconfigured security features will be used.
  If the destination address is not included in the outbound link table, then Security Level 0x00 (no encryption/authentication) will be used.

Radio variants (examples)

Out of the numerous variants of the RADIO_ERP1 packet, described in other documents, only a few examples are described here.

RADIO (VLD)

Group	Offset	Size	Field	Value hex	Description
Data	6	1	R-ORG	0xD2	Radio type VLD = D2
	7	x	User Data	0xnn...0xnn	**1 ... 14** byte data payload
	7+x	4	Sender ID	0xnnnnnnnn	Unique device sender ID
	11+x	1	Status	0xnn	Telegram control bits – used in case of repeating, switch telegram encapsulation, checksum type identification

Table 5

RADIO (ADT) Addressing Destination Telegram

Group	Offset	Size	Field	Value hex	Description
Data	6	1	R-ORG	0xA6	Radio type, e.g. ADT = A6, 4BS = 0xA5
	7	x	User Data	0xnn...0xnn	**1 ... 9** byte data payload
	7+x	4	Sender ID	0xnnnnnnnn	Unique device sender ID
	11+x	1	Status	0xnn	Telegram control bits – used in case of repeating, switch telegram encapsulation, checksum type identification
Optional Data	6+x	1	SubTelNum	0xnn	Number of sub telegram; Send: 3 / receive: 1 ... y
	7+x	4	Destination ID	0xnnnnnnnn	Addressed transmission (ADT): Destination ID (= address)
	11+x	1	dBm	0xnn	Send case: FF Receive case: best RSSI value of all received subtelegrams (value decimal without minus)
	12+x	1	Security Level	0x0n	Send Case: Will be ignored Receive case: 0 = telegram not processed 1 = Obsolete (old security concept) 2 = Telegram decrypted 3 = Telegram authenticated 4 = Telegram decrypted + authenticated

Table 6

RADIO (4BS) / EEP profile 07-02-14

Group	Offset	Size	Field	Value hex	Description
Data	6	1	R-ORG	0xA5	Radio type 4BS
	7	1	Data Byte 3	0x00	Unused in this EEP profile
	8	1	Data Byte 2	0x00	Unused in this EEP profile
	9	1	Data Byte 1	0xnn	Temperature value 255 ... 0
	10	1	Data Byte 0	0b0000**n**000	DB_0.BIT 3 = Learn Bit Normal mode = 1 / Teach In = 0
	11	4	Sender ID	0xnnnnnnnn	Unique device sender ID
	15	1	Status	0xnn	Telegram control bits – used in case of repeating, switch telegram encapsulation, checksum type identification

Table 7

2.2 Packet Type 2: RESPONSE

2.2.1 Packet structure

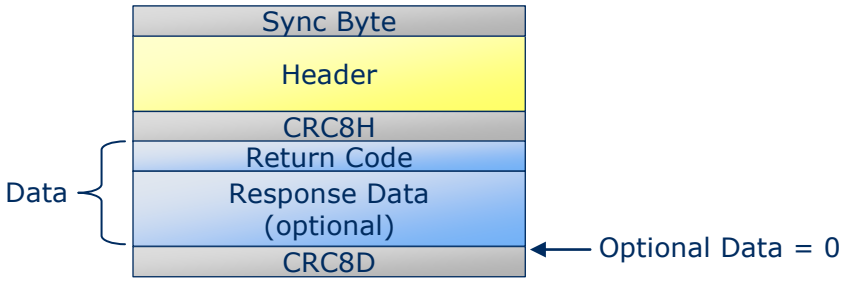

Figure 8

The properties of the preceding command and the re-delivered return-code determine whether optional response data are included, or only the return code itself.

2.2.2 List of Return Codes

Code	Name	Description
00	RET_OK	No error.
01	RET_ERROR	There is an error occurred.
02	RET_NOT_SUPPORTED	The functionality is not supported by that implementation.
03	RET_WRONG_PARAM	There was a wrong parameter in the command.
04	RET_OPERATION_DENIED	Example: memory access denied (code-protected).
05	RET_LOCK_SET	Duty cycle lock.
06	RET_BUFFER_TO_SMALL	The internal ESP3 buffer of the device is too small, to handle this telegram.
07	RET_NO_FREE_BUFFER	Currently all internal buffers are used.
> 128	---	Return codes greater than 0x80 are used for commands with special return information, not commonly in use.

Table 8

2.2.3 Standard Response Structure

Example of standard RESOPNSE with RET_OK (without response data)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	Data = 1 byte
	3	1	Optional Length	0x00	Optional Data = 0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK
-	7	1	CRC8D	0xnn	

Table 9

Specific variants of the response messages are described in the chapter of the command.

2.3 Packet Type 3: RADIO_SUB_TEL

This ESP3 packet type is functionality internal to EnOcean; it is applied for e.g. diagnosis or statistics. The packet design corresponds to the type RADIO_ERP1. The content of the OPTIONAL_DATA is altered slightly.

Group	Offset	Size	Field	Value hex	Description	
-	0	1	Sync. Byte	0x55		
Header	1	2	Data Length	0xnnnn	Variable length of radio subtelegram	
	3	1	Optional Length	0xnn	9 + x + 3*s bytes x = variable length radio subtelegram s = number of subtelegram	
	4	1	Packet Type	0x03	RADIO_SUB_TEL = 3	
-	5	1	CRC8H	0xnn		
Data	6	x	... ...	... ...	Radio telegram without checksum/CRC x = variable length / size	
Optional Data	6+x	1	SubTelNum	0xnn	actual sequence number of subtelegrams (1 ... y); Repeated telegrams will be added	
	7+x	4	Destination ID	0xnnnnnnnn	Broadcast transmission: FF FF FF FF Addressed transmission (ADT): Destination ID (= address)	
	11+x	1	dBm	0xnn	Send case: FF Receive case: best RSSI value of all received subtelegrams (value decimal without minus)	
	12+x	1	Security Level	0x0n	Send Case: Will be ignored (Security is selected by link table entries) Receive case: 0 = telegram not processed 1 = Obsolete (old security concept) 2 = Telegram decrypted 3 = Telegram authenticated 4 = Telegram decrypted + authenticated	
	13+x	2	TimeStamp	0xnnnn	Timestamp of 1st subtelegram is the system timer tick [ms] (2 byte lower address)	
	15+x+3*s	1	Tick SubTel	0xnn	Relative time [ms] of each subtelegram in relation to the TimeStamp	s
	16+x+3*s	1	dBm SubTel	0xnn	RSSI value of each subtelegram	
	17+x+3*s	1	Status SubTel	0xnn	Telegram control bits of each subtelegram – used in case of repeating, switch telegram encapsulation, checksum type identification	
-	18+x+ (SubTelNum-1)*3	1	CRC8D	0xnn		

Table 10

Where ***s*** is the index of an individual subtelegram starting at zero and ***SubTelNum*** is the total number of subtelegrams received. Every received subtelegram will contain the following fields in order: ***Tick SubTel***, ***dBm SubTel*** and ***Status SubTel***.

When receiving a telegram, no RESPONSE has to be sent. When sending a telegram, a RESPOND has to be expected. In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
05 RET_LOCK_SET
When there is no additional data included that have to be described, the standard RESPONSE structure is used as detailed in chapter 2.2.3

2.4 Packet Type 4: EVENT

2.4.1 Structure

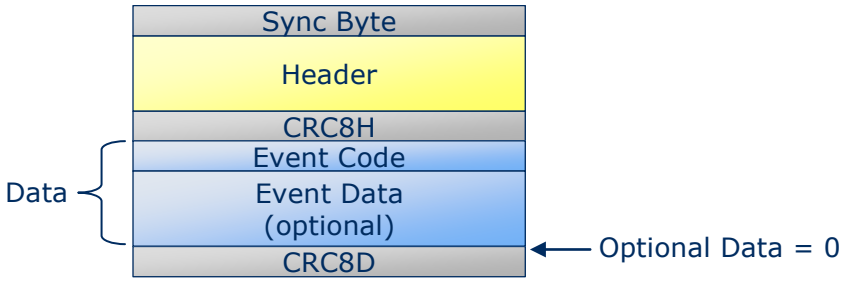

Figure 9

An EVENT is primarily a confirmation for processes and procedures, incl. specific data content. Event codes 0x01 and 0x02 expect a response in the form of a response packet. The responses will not receive an acknowledgement from the EnOcean device.

2.4.2 List of EVENT Codes

Code	Name	Description
01	SA_RECLAIM_NOT_SUCCESSFUL	Informs the external host about an unsuccessful reclaim by a Smart Ack. client
02	SA_CONFIRM_LEARN	Request to the external host about how to handle a received learn-in / learn-out of a Smart Ack. client
03	SA_LEARN_ACK	Response to the Smart Ack. client about the result of its Smart Acknowledge learn request
04	CO_READY	Inform the external about the readiness for operation
05	CO_EVENT_SECUREDEVICES	Informs the external host about an event in relation to security processing
06	CO_DUTYCYCLE_LIMIT	Informs the external host about reaching the duty cycle limit
07	CO_TRANSMIT_FAILED	Informs the external host about not being able to send a telegram.
08	CO _TX_DONE	Informs that all TX operations are done
09	CO_LRN_MODE_DISABLED	Informs that the learn mode has time-out.

Table 11

2.4.3 Code 01: SA_RECLAIM_NOT_SUCCESSFUL

Function: Informs about an unsuccessful Smart Acknowledge client reclaim.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x01	SA_RECLAIM_NOT_SUCCESSFUL = 1
-	7	1	CRC8D	0xnn	

Table 12

Following described **RESPONSE** applies to return codes:
00: RET_OK
01: RET_ERROR
02: RET_NOT_SUPPORTED
03: RET_WRONG_PARAM

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0xnn	00, 01, 02, 03
-	7	1	CRC8D	0xnn	

Table 13

2.4.4 Code 02: SA_CONFIRM_LEARN

Function: Request to external host to determine how to handle the received learn request.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0011	17 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x02	SA_CONFIRM_LEARN = 2
	7	1	Priority of the postmaster candidate	0xnn	Already post master 0b xxxx 1xxx Place for mailbox 0b xxxx x1xx Good RSSI 0b xxxx xx1x Local 0b xxxx xxx1
	8	1	2^2 ... 2^0: Manufacturer ID 2^7 ... 2^3: Res.	0b00000nnn	nnn = Most significant 3 bits of the Manufacturer ID 00000 = reserved
	9	1	Manufacturer ID	0xnn	Least significant bits of the Manufact. ID
	10	3	EEP	0xnnnnnn	Code of used EEP profile
	13	1	RSSI	0xnn	Signal strength; Send case: FF Receive case: actual RSSI
	14	4	Postmaster Candidate ID	0xnnnnnnnn	Device ID of the Post master candidate
	18	4	Smart Ack ClientID	0xnnnnnnnn	This sensor would be Learn IN
	22	1	Hop Count	0xnn	Numbers of repeater hop
-	23	1	CRC8D	0xnn	

Table 14

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0004	4 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	2	Response time	0xnnnn	Response time for Smart Ack Client in ms in which the external host can prepare the data and send it to the postmaster. Only relevant if Confirm code is Learn IN
	9	1	Confirm code	0xnn	0x00 Learn IN 0x11 Discard Learn IN, EEP not accepted 0x12 Discard Learn IN, PM has no place for further mailbox 0x13 Discard Learn IN, Controller has no place for new sensor 0x14 Discard Learn IN, RSSI was not good enough 0x20 Learn OUT 0xFF Function not supported

-	10	1	CRC8D	0xnn	

Table 15

For **RESPONSE** with return codes: 01 RET_ERROR, 02 RET_NOT_SUPPORTED, 03 RET_WRONG_PARAM is the structure described by the chapter: 2.2.3

2.4.5 Code 03: SA_LEARN_ACK

Function: Informs Smart Acknowledge client about the result of a previous sent learn request.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0004	4 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x03	SA_LEARN_ACK = 3
	7	2	Response time	0xnnnn	Response time for Smart Ack Client in ms in which the controller can prepare the data and send it to the postmaster. Only relevant if Confirm code is Learn IN
	9	1	Confirm code	0xnn	0x00 Learn IN 0x11 Discard Learn IN, EEP not accepted 0x12 Discard Learn IN, PM has no place for further MB 0x13 Discard Learn IN, Controller has no place for new sensor 0x14 Discard Learn IN, RSSI was not good enough 0x20 Learn OUT
-	10	1	CRC8D	0xnn	

Table 16

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included, that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.4.6 Code 04: CO_READY

Function: Informs external host about the readiness for operation.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	1 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x04	CO_READY = 4
	7	1	Wakeup Cause	0xnn	**00** = Voltage supply drop or indicates that VDD > VON **01** = Reset caused by usage of the reset pin (is set also after downloading the program with the programmer) **02** = Watchdog timer counter reached the timer period **03** = Flywheel timer counter reached the timer period **04** = Parity error **05** = HW Parity error in the Internal or External Memory **06** = A memory request from the CPU core does not correspond to any valid memory location. This error may be caused by a S/W malfunction. **07** = Wake-up pin 0 activated **08** = Wake-up pin 1 activated **09** = Unknown reset source – reset reason couldn't be detected **10** = UART Wake up
Optional Data	8	1	Mode	0xnn	**00** = Standard Security **01** = Extended Security
-	8	1	CRC8D	0xnn	

Table 17

This EVENT does not require any RESPONSE message.

2.4.7 Code 05: CO_EVENT_SECUREDEVICES

Function: Informs external host about events regarding security processing

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x05	CO_EVENT_SECUREDEVICES = 5
	7	1	Event Cause	0xnn	**00** = Teach-in failed because no more space available in secure link table. **01** = Reserved. **02** = Resynchronization attempt with wrong private key. **03** = Configured count of telegrams with wrong CMAC received. **04** = Teach-In failed. Telegram corrupted. **05** = PSK Teach-In failed. No PSK is set for the device. **06** = Teach-In failed. Trying to teach-in without Pre-Shared Key even if the PSK is set for the device. **07** = CMAC or RLC not correct **08** = Standard Telegram from device in secure link table. **09** = Teach-In successful. **0x0A**= Received valid RLC sync via Teach-In **0x0B..0xFF** = Reserved.
	8	4	Device ID	0xnnnnnnnn	Device ID
-	12	1	CRC8D	0xnn	

Table 18

This EVENT does not require any RESPONSE message.

2.4.8 Code 06: CO_DUTYCYCLE_LIMIT

Function: Informs external host about duty cycle limit

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x06	CO_DUTYCYCLE_LIMIT = 6
	7	1	Event Cause	0xnn	**00** = Duty cycle limit not yet reached It is possible to send telegrams **01** = Duty cycle limit reached It is not possible to send telegrams **02...0xFF** = reserved
-	8	1	CRC8D	0xnn	

Table 19

This EVENT does not require any RESPONSE message.

2.4.9 Code 07: CO_TRANSMIT_FAILED

Function: Informs the external host that the device was not able to send a telegram or that it did not receive an acknowledge for a transmitted telegram

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x07	CO_TRANSMIT_FAILED = 7
	7	1	Event Cause	0xnn	**00** = CSMA failed, channel not free **01** = No Acknowledge received, telegram was transmitted, but no ack received. **02...0xFF** = reserved
-	8	1	CRC8D	0xnn	

Table 20

This EVENT does not require any RESPONSE message.

2.4.10 Code 08: CO_TX_DONE

Function: Informs the external host that the device has finished all transmissions.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	

Data	6	1	Event Code	0x08	CO_TX_DONE = 8
-	7	1	CRC8D	0xnn	

Table 21

This EVENT does not require any RESPONSE message.

2.4.11 Code 09 CO_LRN_MODE_DISABLED

Function: Informs the external host that the learn mode has been disabled due to time-out.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x04	EVENT = 4
-	5	1	CRC8H	0xnn	
Data	6	1	Event Code	0x09	CO_LRN_MODE_DISABLED = 9
-	7	1	CRC8D	0xnn	

Table 22

This EVENT does not require any RESPONSE message.

2.5 Packet Type 5: COMMON_COMMAND

2.5.1 Structure

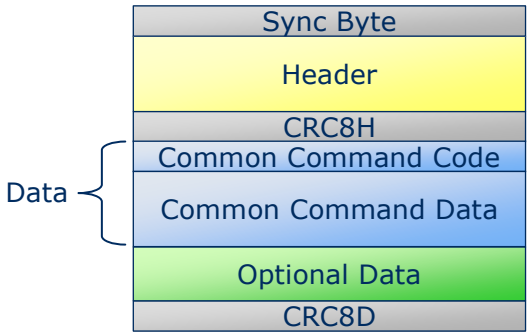

Figure 10

2.5.2 List of COMMON_COMMAND Codes

Code	Function Name	Description
01	CO_WR_SLEEP	Enter energy saving mode
02	CO_WR_RESET	Reset the device
03	CO_RD_VERSION	Read the device version information
04	CO_RD_SYS_LOG	Read system log
05	CO_WR_SYS_LOG	Reset system log
06	CO_WR_BIST	Perform Self Test
07	CO_WR_IDBASE	Set ID range base address
08	CO_RD_IDBASE	Read ID range base address
09	CO_WR_REPEATER	Set Repeater Level
10	CO_RD_REPEATER	Read Repeater Level
11	CO_WR_FILTER_ADD	Add filter to filter list
12	CO_WR_FILTER_DEL	Delete a specific filter from filter list
13	CO_WR_FILTER_DEL_ALL	Delete all filters from filter list
14	CO_WR_FILTER_ENABLE	Enable / disable filter list
15	CO_RD_FILTER	Read filters from filter list
16	CO_WR_WAIT_MATURITY	Wait until the end of telegram maturity time before received radio telegrams will be forwarded to the external host
17	CO_WR_SUBTEL	Enable / Disable transmission of additional subtelegram info to the external host
18	CO_WR_MEM	Write data to device memory
19	CO_RD_MEM	Read data from device memory
20	CO_RD_MEM_ADDRESS	Read address and length of the configuration area and the Smart Ack Table
21	CO_RD_SECURITY	DEPRECATED Read own security information (level, key)
22	CO_WR_SECURITY	DEPRECATED Write own security information (level, key)
23	CO_WR_LEARNMODE	Enable / disable learn mode
24	CO_RD_LEARNMODE	Read learn mode status
25	CO_WR_SECUREDEVICE_ADD	DEPRECATED Add a secure device
26	CO_WR_SECUREDEVICE_DEL	Delete a secure device from the link table
27	CO_RD_SECUREDEVICE_ BY_INDEX	DEPRECATED Read secure device by index
28	CO_WR_MODE	Set the gateway transceiver mode

29	CO_RD_NUMSECUREDEVICES	Read number of secure devices in the secure link table
30	CO_RD_SECUREDEVICE_ BY_ID	Read information about a specific secure device from the secure link table using the device ID
31	CO_WR_SECUREDEVICE_ ADD_PSK	Add Pre-shared key for inbound secure device
32	CO_WR_SECUREDEVICE_ SENDTEACHIN	Send Secure Teach-In message
33	CO_WR_TEMPORARY_RLC_ WINDOW	Set a temporary rolling-code window for every taught-in device
34	CO_RD_SECUREDEVICE_PSK	Read PSK
35	CO_RD_DUTYCYCLE_LIMIT	Read the status of the duty cycle limit monitor
36	CO_SET_BAUDRATE	Set the baud rate used to communicate with the external host
37	CO_GET_FREQUENCY_INFO	Read the radio frequency and protocol supported by the device
38	Reserved	
39	CO_GET_STEPCODE	Read Hardware Step code and Revision of the Device
40	Reserved	
41	Reserved	
42	Reserved	
43	Reserved	
44	Reserved	
45	Reserved	
46	CO_WR_REMAN_CODE	Set the security code to unlock Remote Management functionality via radio
47	CO_WR_STARTUP_DELAY	Set the startup delay (time from power up until start of operation)
48	CO_WR_REMAN_REPEATING	Select if REMAN telegrams originating from this module can be repeated
49	CO_RD_REMAN_REPEATING	Check if REMAN telegrams originating from this module can be repeated
50	CO_SET_NOISETHRESHOLD	Set the RSSI noise threshold level for telegram reception
51	CO_GET_NOISETHRESHOLD	Read the RSSI noise threshold level for telegram reception
52	Reserved	
53	Reserved	
54	CO_WR_RLC_SAVE_PERIOD	Set the period in which outgoing RLCs are saved to the EEPROM
55	CO_WR_RLC_LEGACY_MODE	Activate the legacy RLC security mode allowing roll-over and using the RLC acceptance window for 24bit explicit RLC
56	CO_WR_SECUREDEVICEV2_ADD	Add secure device to secure link table
57	CO_RD_SECUREDEVICEV2_BY_IND EX	Read secure device from secure link table using the table index
58	CO_WR_RSSITEST_MODE	Control the state of the RSSI-Test mode.
59	CO_RD_RSSITEST_MODE	Read the state of the RSSI-Test Mode.
60	CO_WR_SECUREDEVICE_MAINTEN ANCEKEY	Add the maintenance key information into the secure link table.
61	CO_RD_SECUREDEVICE_MAINTEN ANCEKEY	Read by index the maintenance key information from the secure link table.
62	CO_WR_TRANSPARENT_MODE	Control the state of the transparent mode.
63	CO_RD_TRANSPARENT_MODE	Read the state of the transparent mode.
64	CO_WR_TX_ONLY_MODE	Control the state of the TX only mode.

65	CO_RD_TX_ONLY_MODE	Read the state of the TX only mode.

Table 23

2.5.3 Code 01: CO_WR_SLEEP

Function: Request to enter energy saving mode

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x01	CO_WR_SLEEP = 1
	7	4	Deep sleep period	0x00nnnnnn	0x00000000 Wake by UART Not supported on all devices 0x00000001 … 0x00FFFFFF Duration of sleep in 10 ms units (maximum value ~ 46h) After waking up, the module generates an internal hardware reset
-	11	1	CRC8D	0xnn	

Table 24

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.4 Code 02: CO_WR_RESET

Function: Request to reset the device

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x02	CO_WR_RESET = 2
-	7	1	CRC8D	0xnn	

Table 25

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.5 Code 03: CO_RD_VERSION

Function: Read device SW version / HW version, chip-ID, etc.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x03	CO_RD_VERSION = 3
-	7	1	CRC8D	0xnn	

Table 26

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0021	33 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	4	APP version	0xnnnnnnnn	Application Byte 1: Main version Byte 2: Beta version Byte 3: Alpha version Byte 4: Build
	11	4	API version	0xnnnnnnnn	Application Programming Interface Byte 1: Main version Byte 2: Beta version Byte 3: Alpha version Byte 4: Build
	15	4	Chip ID	0xnnnnnnnn	Unique ID
	19	4	Chip Version	0xnnnnnnnn	Reserved for internal use
	23	16	App. description	char. ASCII	8 bit ASCII / 16 characters; Null-terminated string
-	39	1	CRC8D	0xnn	

Table 27

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter 2.2.3

2.5.6 Code 04: CO_RD_SYS_LOG

Function: Read System Log

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x04	CO_RD_SYS_LOG = 4
-	7	1	CRC8D	0xnn	

Table 28

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	1+x bytes
	3	1	Optional Length	0xnn	y bytes
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	x	API Log entry 000 API Log entry 001 API Log entry 002	0xnn 0xnn 0xnn	Log entry 000 - xxx in DATA: Log counter of API
Optional Data	7+x	y	APP Log entry 000 APP Log entry 001 APP Log entry 002	0xnn 0xnn 0xnn	Log entry 000 - xxx in OPTIONAL_DATA: Log counter of APP
-	7+x+y	1	CRC8D	0xnn	

Table 29

After a reset, the counters starts with FF and decrement with each new EVENT down to 00 and will stopped. With a reset command the counter starts again with FF.

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter 2.2.3

2.5.7 Code 05: CO_WR_SYS_LOG

Function: Reset System Log

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x05	CO_WR_SYS_LOG = 5
-	7	1	CRC8D	0xnn	

Table 30

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.8 Code 06: CO_WR_BIST

Function: Perform Built-in-self-test

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x06	CO_WR_BIST = 6
-	7	1	CRC8D	0xnn	

Table 31

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	BIST result	0xnn	BIST OK = 0, BIST failed = other value
-	8	1	CRC8D	0xnn	

Table 32

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter 2.2.3

2.5.9 Code 07: CO_WR_IDBASE

Function: Write ID range base number.

IMPORTANT: On TCM 3xx / TCM 4xx devices, this function can only be used 10 times to change the base ID. There is no possibility to reset this constraint. Also power off/on will not allow more than 10 changes!

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x07	CO_WR_IDBASE = 7
	7	4	Base ID	0xFFnnnnnn	Range between 0xFF800000 and 0xFFFFFF80
-	11	1	CRC8D	0xnn	

Table 33

RESPONSE:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0xnn	RET_OK = 0x00 RET_NOT_SUPPORTED = 0x02 MEMORY_ERROR = 0x82 The memory write process failed BASEID_OUT_OF_RANGE = 0x90 BASEID_MAX_REACHED = 0x91 BaseID has already been changed 10 times, no more changes are allowed
-	7	1	CRC8D	0xnn	

Table 34

2.5.10 Code 08: CO_RD_IDBASE

Function: Read start address of Base ID range

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x08	CO_RD_IDBASE = 8
-	7	1	CRC8D	0xnn	

Table 35

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	4	Base ID	0xFFnnnnnn	Start address of Base ID Range (between 0xFF800000 and 0xFFFFFF80)
Optional Data	8	1	Remaining write cycles for Base ID	0xnn	Remaining write cycles for Base ID If this value is 0xFF, there is no limit for writing cycles.
-	9	1	CRC8D	0xnn	

Table 36

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter 2.2.3

2.5.11 Code 09: CO_WR_REPEATER

Function: Set Repeater Mode and Repeater Level

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x09	CO_WR_REPEATER = 09
	7	1	REP_ENABLE	0x00…0x02	Repeater mode 0x00: OFF (Do not repeat telegrams) 0x01: ON (Repeat all telegrams) 0x02: SELECTIVE (Use filter list)
	8	1	REP_LEVEL	0x00…0x02	Repeater level 0x00: OFF (use if REP_ENABLE = 0x00) 0x01: 1-level repeating (when enabled) 0x02: 2-level repeating (when enabled)
-	9	1	CRC8D	0xnn	

Table 37

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.12 Code 10: CO_RD_REPEATER

Function: Read Repeater Mode

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0A	CO_RD_REPEATER = 10
-	7	1	CRC8D	0xnn	

Table 38

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	REP_ENABLE	0x00…0x02	Repeater mode 0x00: OFF (Do not repeat telegrams) 0x01: ON (Repeat all telegrams) 0x02: SELECTIVE (Use filter list)
	8	1	REP_LEVEL	0x00…0x02	Repeater level 0x00: OFF (use if REP_ENABLE = 0x00) 0x01: 1-level repeating (when enabled) 0x02: 2-level repeating (when enabled)
-	9	1	CRC8D	0xnn	

Table 39

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter: 2.2.3

2.5.13 Code 11: CO_WR_FILTER_ADD

Function: Add filter to receiver filter list

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0007	7 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0B	CO_WR_FILTER_ADD = 11
	7	1	Filter criterium	0x00…0x03	Filter criterium to be used 0x00: Source address 0x01: Telegram type (R-ORG) 0x02: Minimum signal strength (dBm) 0x03: Destination address
	8	4	Filter value	0xnnnnnnnn	Value to compare filter criterium against - Source address - R-ORG - Signal strength (interpreted as negative dBm, e.g. 85 -> -85 dBm) - Destination address
	12	1	Filter action	0x00 0x80 0x40 0xC0	0x00: Drop received telegram 0x80: Forward received telegram 0x40: Do not repeat received telegram 0xC0: Repeat received telegram
-	13	1	CRC8D	0xnn	

Table 40

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
01 RET_ERROR (memory space full)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter: 2.2.3

Additional information on filters
Filters allow selecting only specific received telegrams for forwarding to the external host or for repeating (in case the repeater mode is set to SELECTIVE).

Both positive logic (forward / repeat specific telegrams) and negative logic (do not forward / repeat specific telegrams) are supported. For instance, it is possible to forward only telegrams originating from a specific device. Alternatively, it is possible not to repeat telegrams above a certain received signal strength (i.e. do not repeat telegrams originating from nearby senders).

More than one condition (filter) can be specified. If several filters are specified, then they can be combined either as logic OR (at least one filter condition must be true) or as a logic AND (all filter conditions must to be true).

Some examples for filters:

//Drop telegrams from a specified ID
Filter_type = 0x0 (ID)
Filter_value = 0x12345678 (device source ID)
Filter_kind = 0x00 (Drop received telegram)

//Drop all telegrams except that from a specified ID
Filter_type = 0x00 (ID)
Filter_value = 0x12345678 (device source ID)
Filter_kind = 0x80 (Forward received telegram)

//Drop telegrams of a specific type (R-ORG)
Filter_type = 0x01 (R-ORG)
Filter_value = 0xA5 (4BS Telegram Type)
Filter_kind = 0x00 (Drop received telegram)

//Forward only telegrams of a specific type (R-ORG)
Filter_type = 0x01 (R-ORG)
Filter_value = 0xA5 (4BS)
Filter_kind = 0x80 (Forward received telegram)

//Drop telegrams below a minimum signal strength of -70dBm
Filter_type = 0x02 (Minimum signal strength)
Filter_value = 0x00000046 (dec 70)
Filter_kind = 0x00 (Drop received telegram)

//Repeat only telegrams from the specified sender ID (in SELECTIVE repeater mode)
Filter_type = 0x00 (ID)
Filter_value = 0x12345678 (device source ID)
Filter_kind = 0xC0 (Repeat received Telegram)

//Do not repeat telegrams of a certain type (in SELECTIVE repeater mode)
Filter_type = 0x01 (R-ORG)
Filter_value = 0xA5 (4BS)
Filter_kind = 0x40 (Do not repeat received telegram)

// Do not repeat signals stronger than -70dBm (in SELECTIVE repeater mode)
Filter_type = 0x02 (dBm)
Filter_value = 0x00000046 (dec 70)
Filter_kind = 0xC0 (Repeat received Telegram)

2.5.14 Code 12: CO_WR_FILTER_DEL

Function: Delete a specific filter from filter list.
Latest syntax (in line with CO_WR_FILTER_ADD):

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0007	7 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0C	CO_WR_FILTER_DEL = 12
	7	1	Filter type	0x00…0x03	Filter criterium to be used 0x00: Source address 0x01: Telegram type (R-ORG) 0x02: Minimum signal strength (dBm) 0x03: Destination address
	8	4	Filter value	0xnnnnnnnn	Value to compare filter criterium against - Source address - R-ORG - Signal strength (interpreted as negative dBm, e.g. 85 -> -85 dBm) - Destination address
	9	1	Filter kind	0x00 0x80 0x40 0xC0	0x00: Drop received telegram 0x80: Forward received telegram 0x40: Do not repeat received telegram 0xC0: Repeat received telegram
-	12	1	CRC8D	0xnn	

Table 41

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
01 RET_ERROR
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter: 2.2.3

Previous command syntax (backward compatible):

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0C	CO_WR_FILTER_DEL = 12
	7	1	Filter type	0x00…0x03	Device source ID = 0, R-ORG = 1, dBm = 2, destination ID = 3
	8	4	Filter value	0xnnnnnnnn	Value of filter function 'compare': - device source or destination ID - R-ORG - dBm value RSSI of radio telegram (unsigned, but interpreted as negative dBm value)
-	12	1	CRC8D	0xnn	

Table 42

2.5.15 Code 13: CO_WR_FILTER_DEL_ALL

Function: Delete all filters from filter list

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0D	CO_WR_FILTER_DEL = 13
-	7	1	CRC8D	0xnn	

Table 43

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
Since no additional data are included which require description the standard RESPONSE structure is detailed in chapter: 2.2.3

2.5.16 Code 14: CO_WR_FILTER_ENABLE

Function: Enable / disable the configure filters

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0E	CO_WR_FILTER_ENABLE = 14
	7	1	Filter ON/OFF	0x00 0x01	0x00: Filter disable (OFF) 0x01: Filter enable (ON)
	8	1	Filter Operator	0x00 0x01 0x08 0x09	0x00: OR combination of all filters 0x01: AND combination of all filters 0x08: OR combination for receive filters AND combination for repeat filters 0x09: AND combination for receive filters OR combination for repeat filters
-	9	1	CRC8D	0xnn	

Table 44

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter: 2.2.3

2.5.17 Code 15: CO_RD_FILTER

Function: Read all configured filters

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x0F	CO_RD_FILTER = 15
-	7	1	CRC8D	0xnn	

Table 45

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description	
-	0	1	Sync. Byte	0x55		
Header	1	2	Data Length	0xnnnn	1 + 5*f bytes (f = number of filters)	
	3	1	Optional Length	0x00	0 byte	
	4	1	Packet Type	0x02	RESPONSE = 2	
-	5	1	CRC8H	0xnn		
Data	6	1	Return Code	0x00	RET_OK = 0	
	7+5*f	1	Filter type	0xnn	Device ID = 0, R-ORG = 1, dBm = 2 Destination ID = 3	**f**
	8+5*f	4	Filter value	0xnnnnnnnn	Value of filter function 'compare': - device ID - R-ORG - RSSI of radio telegram in dBm	
-	12+5*f	1	CRC8D	0xnn		

Table 46

Every supplied filter has the group **f** with fields in the order: filter type, filter value.

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED is the standard structure described in the chapter 2.2.3

2.5.18 Code 16: CO_WR_WAIT_MATURITY

Function: Waiting until the end of the telegram maturity time before received radio telegrams will forwarded to the external host.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x10	CO_WR_WAIT_MATURITY = 16
	7	1	Wait End Maturity	0xnn	0x00: Received telegrams are forwarded to the external host immediately. 0x01: Received telegrams are forwarded to the external host after the maturity time elapsed.
-	8	1	CRC8D	0xnn	

Table 47

In this case, the following **RESPONSE** gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.19 Code 17: CO_WR_SUBTEL

Function: Enable / disable additional subtelegram info to be provided to the external host

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x11	CO_WR_SUBTEL = 17
	7	1	Enable	0xnn	0x00: Disable 0x01: Enable
-	8	1	CRC8D	0xnn	

Table 48

In this case, the following **RESPONSE** gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.20 Code 18: CO_WR_MEM

Function: Write data to memory (only supported on TCM 3xx / TCM 4xx platforms)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	6 + x bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x12	CO_WR_MEM = 18
	7	1	Memory type	0xnn	Flash: 0x00 RAM 0: 0x01 data RAM: 0x02 idata RAM: 0x03 xdata RAM: 0x04 EEPROM: 0x05
	8	4	Memory address	0xnnnnnnnn	Start address to write
	12	x	Memory data	0xnn ... 0xnn	Data content to write ... ...
-	12+x	1	CRC8D	0xnn	

Table 49

In this case, the following **RESPONSE** gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (address outside range of values)
04 RET_OPERATION_DENIED (memory access denied / code-protected)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.21 Code 19: CO_RD_MEM

Function: Read data from memory (only supported on TCM 3xx / TCM 4xx platforms)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnn08	8 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x13	CO_RD_MEM = 19
	7	1	Memory type	0xnn	Flash: 0x00 RAM 0: 0x01 data RAM: 0x02 idata RAM: 0x03 xdata RAM: 0x04 EEPROM: 0x05
	8	4	Memory address	0xnnnnnnnn	Start address to read
	12	2	Data lenght	0xnnnn	Length to be read
-	14	1	CRC8D	0xnn	

Table 50

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	1 + x bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	x	Memory data	0xnn ... 0xnn	Of read memory contents ... ...
-	7+x	1	CRC8D	0xnn	

Table 51

For **RESPONSE** with return codes:
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (address outside range of values)
04 RET_OPERATION_DENIED (memory access denied / code-protected)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.22 Code 20: CO_RD_MEM_ADDRESS

Function: Read start address and length of the configuration area and the Smart Ack table (only supported on TCM 3xx / TCM 4xx platforms).

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x14	CO_RD_MEM_ADDRESS = 20
	7	1	Memory area	0xnn	Config area: 0 Smart Ack table: 1 System error log: 2
-	8	1	CRC8D	0xnn	

Table 52

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x000A	10 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Memory type	0xnn	Flash: 0x00 RAM 0: 0x01 data RAM: 0x02 idata RAM: 0x03 xdata RAM: 0x04 EEPROM: 0x05
	8	4	Memory address	0xnnnnnnnn	Start address of config area / Smart Ack table / system error log
	12	4	Memory length	0xnnnnnnnn	Data length of config area / Smart Ack table / system error log
-	16	1	CRC8D	0xnn	

Table 53

For **RESPONSE** with return codes:
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
04 RET_OPERATION_DENIED (memory access denied / code-protected)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.23 Code 21: DEPRECATED CO_RD_SECURITY

Function: Read security information (level, keys). This function does not support the actual security concept and should not be used any more.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x15	CO_RD_SECURITY = 21
-	7	1	CRC8D	0xnn	

Table 54

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x000A	10 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	SEC LEVEL	0x0n	Type no. of encryption
	8	4	KEY	0xnnnnnnnn	Security key
	12	4	Rolling Code	0x00000000	Reserved
-	16	1	CRC8D	0xnn	

Table 55

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.24 Code 22: DEPRECATED CO_WR_SECURITY

Function: Write security information (level, keys). This function does not support the actual security concept and should not be used any more.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x000A	10 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x16	CO_WR_SECURITY = 22
	7	1	SEC LEVEL	0x0n	Type no. of encryption
	8	4	KEY	0xnnnnnnnn	Security key
	12	4	Rolling Code	0x00000000	Reserved
-	16	1	CRC8D	0xnn	

Table 56

In this case, the following **RESPONSE** gives the return codes:
00 RET_OK
01 RET_ERROR
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.25 Code 23: CO_WR_LEARNMODE

Function: Enables or disable learn mode

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x17	CO_WR_LEARNMODE = 23
	7	1	Enable	0x0n	Start Learn mode = 1 End Learn mode = 0
	8	4	Timeout	0xnnnnnnnn	Time-Out for the learn mode in ms. When time is 0 then default period of 60’000 ms is used
Optional Data	12	1	Channel	0xnn	0..0xFD: Channel No. absolute 0xFE: Previous channel relative 0xFF: Next channel relative
-	-	1	CRC8D	0xnn	

Table 57

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.26 Code 24: CO_RD_LEARNMODE

Function: Read the learn-mode status

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x18	CO_RD_LEARNMODE = 24
-	7	1	CRC8D	0xnn	

Table 58

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Enable	0x0n	Learn mode not active = 0 Learn mode active = 1
Optional Data	8	1	Channel	0xnn	0..0xFD: Channel No. absolute 0xFE: not used 0xFF: not used
-	-	1	CRC8D	0xnn	

Table 59

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.27 Code 25: DEPRECATED CO_WR_SECUREDEVICE_ADD

Function: Add entry for a secure device to the secure link table. It is possible to add only one or more rocker with this function. For newer devices (e.g. TCM 515), users should use

Code 56: CO_WR_SECUREDEVICEV2_ADD, as this command supports 32bit RLC and uses 1 byte for the Teach Info (as defined in the Security Spec).

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0019	25 bytes
	3	1	Optional Length	0x02	2 bytes
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x19	CO_WR_SECUREDEVICE_ADD = 25
	7	1	SLF	0xnn	Security Level Format
	8	4	ID	0xnnnnnnnn	Device ID
	12	16	Private key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes private key of the device
	28	3	Rolling code	0xnnnnnn	If a 16 bit rolling code is defined in SLF, the MSB is undefined
Optional Data	31	1	Direction	0xnn	Add device security information to: 0x00 = Inbound table (default), ID = Source ID 0x01 = Outbound table, ID = Destination ID 0x01 = Outbound table, ID = own ID or 0x00000000 Secure broadcast 0x02 = Outbound broadcast table, ID = Source ID (can be ChipID or one of BaseIDs) 0x03..0xFF = not used
	32	1	PTM Sender	0xnn	0x00: Not a PTM sender 0x01: PTM sender 0x02..0xFF: Not Used.
	33	1	Teach-Info	0x0n	Secure device Teach-In info
-	-	1	CRC8D	0xnn	

Table 60

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (memory space full)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (added device known, but private key wrong)
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.28 Code 26: CO_WR_SECUREDEVICE_DEL

Function: Delete secure device from controller. It is only possible to delete ALL rockers of a secure device. If there was a Pre-Shared Key entry specified for that device, then it will be removed as well.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1A	CO_WR_SECUREDEVICE_DEL = 26
	7	4	ID	0xnnnnnnnn	Device ID. Using 0xFFFFFFFF will delete all devices (supported only by some devices, refer to user manual for further details).
Optional Data	8	1	Direction	0xnn	Remove secure device from: 0x00: Inbound table (default) 0x01: Outbound table 0x02: Outbound broadcast table 0x03: Erase ID in both inbound and outbound table 0x04..0xFF: Not used
-	-	1	CRC8D	0xnn	

Table 61

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.29 Code 27: DEPRECATED CO_RD_SECUREDEVICE_BY_INDEX

Function: Read secure device by index, will be replaced by Code 57: CO_RD_SECUREDEVICEV2_BY_INDEX

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1B	CO_RD_SECUREDEVICE = 27
	7	1	Index	0x00…0xFE	Index of secure device to read, starting with 0…254
Optional Data	8	1	Direction	0xnn	Read device security information from: 0x00 = Inbound table (default) 0x01 = Outbound table, 0x02 = Outbound broadcast table 0x03..0xFF = not used
-	9	1	CRC8D	0xnn	

Table 62

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	SLF	0xnn	Security Level Format
	8	4	ID	0xnnnnnnnn	Device ID
Optional Data	12	16	Private Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes private key of the device
	28	3	Rolling Code	0xnnnnnn	If a 16 bit rolling code is defined in SLF, the MSB is undefined
	31	16	PSK	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes pre-shared key of the device. (when not present it will be set to 0x00)
	47	1	Teach-In info	0x0n	Teach-In info of the secure device
-	47	1	CRC8D	0xnn	

Table 63

For **RESPONSE** with return code:
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

Note: If PSK was not set, it will be not included in the packet. If in the future response will be extended, all bytes of non-existing PSK will be set to 0x00.

2.5.30 Code 28: CO_WR_MODE

Function: Sets the transceiver mode

There are two modes available:

- Compatible mode (ERP1)
  Transceiver uses Packet Type 1 to transmit and receive radio telegrams

- Advanced mode (ERP2)
  Transceiver uses Packet Type 10 to transmit and receive radio telegrams

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1C	CO_WR_MODE = 28
	6	1	Mode	0xnn	0x00 – Compatible mode (default) - ERP1 0x01 – Advanced mode - ERP2
-	7	1	CRC8D	0xnn	

Table 64

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.31 Code 29: CO_RD_NUMSECUREDEVICES

Function: Read number of taught-in secure devices

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00...0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1D	CO_RD_NUMSECUREDEVICES = 29
Optional Data	7	1	Direction	0xnn	0x00: Inbound table (default) 0x01: Outbound table 0x02: Outbound broadcast table 0x03: Total number of link table entries 0x04…0x0FF: Not used
-	8	1	CRC8D	0xnn	

Table 65

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Number	0xnn	Number of entries in the table(s)
-	8	1	CRC8D	0xnn	

Table 66

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.32 Code 30: CO_RD_SECUREDEVICE_BY_ID

Function: Read index of secure device entry by device ID

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00...0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1E	CO_RD_SECUREDEVICE_BY_ID= 30
	7	4	ID	0xnnnnnnnn	Device ID
Optional Data	11	1	Direction	0xnn	0x00: Inbound table (default) 0x01: Outbound table 0x02: Outbound broadcast table 0x03: Maintenance Link 04..0xFF: Not used
-	12	1	CRC8D	0xnn	

Table 67

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00...0x01	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	SLF	0xnn	Security Level Format
Optional Data	8	1	Index	0x00…0xFE	Index of secure device in the devices table, starting with 0…254
-	9	1	CRC8D	0xnn	

Table 68

For **RESPONSE** with return code:
01 RET_ERROR (device not in the list)
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.33 Code 31: CO_WR_SECUREDEVICE_ADD_PSK

Function: Add Pre-shared key for inbound secure device.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0015	21 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x1F	CO_WR_SECUREDEVICE_ADD_PSK = 31
	8	4	ID	0xnnnnnnnn	Device ID
	12	16	Pre-Shared Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes pre-shared key of the device
-	-	1	CRC8D	0xnn	

Table 69

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (memory space full)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (added device known, but private key wrong)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.34 Code 32: CO_WR_SECUREDEVICE_SENDTEACHIN

Function: Send a secure teach-in message. It is required that the outbound secure link table contains an entry for the device. Use CO_WR_SECUREDEVICE_ADD / CO_WR_SECUREDEVICEV2_ADD to add the device to the outbound link table.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00...0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x20	CO_WR_SECUREDEVICE_SENDTEACHIN = 32
	8	4	ID	0xnnnnnnnn	Device ID
Optional Data	8	1	TeachInInfo	0xnn	Teach-In Info
-	-	1	CRC8D	0xnn	

Table 70

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (error in sending TeachIn)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (link table empty, device not found)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.35 Code 33: CO_WR_TEMPORARY_RLC_WINDOW

Function: Set a temporary rolling-code window for every taught-in device. If a telegram from a taught-in secure telegram is received then the RLC window for this device will be reset to the standard value (128).

This function is intended for the case where the receiver did not receive secure telegrams for an extended period of time e.g. due to power loss. Using this command enables RLC re-synchronization over a wider window under such conditions:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x21	CO_WR_TEMPORARY_RLC_WINDOW=33
	7	1	Enable	0xnn	0x00: Disable temporary RLC window RLC window = 128 will be used 0x01: Enable temporary RLC window Use RLC Window size
	8	4	RLC Window	0xnnnnnnnn	Temporary RLC window size
-	-	1	CRC8D	0xnn	

Table 71

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (zero is not allowed as temporary rolling code window)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.36 Code 34: CO_RD_SECUREDEVICE_PSK

Function: Read Pre-shared key for inbound secure device or for the module itself.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x22	CO_RD_SECUREDEVICE_PSK = 34
	8	4	ID	0xnnnnnnnn	Device ID 0x00000000: will return the module PSK other ID: will return inbound device PSK
-	-	1	CRC8D	0xnn	

Table 72

In this case, the following **RESPONSE** message gives only the return codes:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0011	17 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	16	PSK	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16-bytes Pre-Shared Key
-	12	1	CRC8D	0xnn	

Table 73

01 RET_ERROR (no PSK assigned to the ID)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (added device known, but private key wrong)
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.37 Code 35: CO_RD_DUTYCYCLE_LIMIT

Function: Read current status of duty cycle supervisor (for 868 MHz ASK products)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x23	CO_RD_DUTYCYCLE_LIMIT = 35
-	-	1	CRC8D	0xnn	

Table 74

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0008	8 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Available duty cycle	0..0x64	Total load of available 1% duty cycle from 0..100%
	8	1	Slots	0xnn	Total number of duty cycle slots
	9	2	Slot period	0xnnnn	Period of one slot in seconds
	11	2	Actual slot left	0xnnnn	Time left in actual slot in seconds
	13	1	Load after actual	0..0x64	Load available when period ends from 0..100%
-	14	1	CRC8D	0xnn	

Table 75

02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.38 Code 36: CO_SET_BAUDRATE

Function: Modifies the baud rate of the ESP3 interface to the external host (standard start up baud rate is 57600). Only supported by TCM 515 devices.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x24	CO_SET_BAUDRATE = 36
	7	1	BAUDRATE	0xnn	0 = 57600 BAUD 1 = 115200 BAUD 2 = 230400 BAUD 3 = 460800 BAUD
-	-	1	CRC8D	0xnn	

Table 76

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

Note:

- The response is send with the current Baud rate settings. If the baud rate can be modified as requested then the response is subsequently send again with the new baud rate

2.5.39 Code 37: CO_GET_FREQUENCY_INFO

Function: Read frequency and protocol used by the transceiver

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x25	CO_GET_FREQUENCY_INFO = 37
-	7	1	CRC8D	0xnn	

Table 77

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Frequency	0xnn	0x00 315Mhz 0x01 868.3Mhz 0x02 902.875Mhz 0x03 925 Mhz 0x04 928 Mhz 0x20 2.4 Ghz
	8	1	Protocol	0xnn	0x00 ERP1 0x01 ERP2 0x10 802.15.4 0x30 Long Range
-	9	1	CRC8D	0xnn	

Table 78

02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.40 Code 38: Reserved

Reserved for future use.

2.5.41 Code 39: CO_GET_STEPCODE

Function: Read Hardware Step code and Revision of the Device.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x27	CO_GET_STEPCODE = 39
-	7	1	CRC8D	0xnn	

Table 79

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Step code	0xnn	e.g. 0xDA ,0xCA …
	8	1	Status code	0xnn	e.g. 0x01, 0x02 …
-	9	1	CRC8D	0xnn	

Table 80

02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.42 Code 40 - 45: Reserved

Reserved for future use.

2.5.43 Code 46: CO_WR_REMAN_CODE

Function: Set the security code required to unlock Remote Management functionality by radio.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x2E	CO_WR_REMAN_CODE= 46
	7	4	Secure Code	0xnnnnnnnn	Secure code for unlocking device
-	11	1	CRC8D	0xnn	

Table 81

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (Hardware Error)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.44 Code 47: CO_WR_STARTUP_DELAY

Function: Set the startup delay (time between power up and enabling the receiver)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x2F	CO_WR_STARTUP_DELAY = 47
Data	7	1	Startup Delay	0xnn	Startup delay as multiple of 10 ms
-	8	1	CRC8D	0xnn	

Table 82

Start-up Delay = 1 → Start delay = 10ms
Start-up Delay = 90 → Start delay = 900ms

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (Hardware Error)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.45 Code 48: CO_WR_REMAN_REPEATING

Function: Select if REMAN telegrams originating from this transceiver can be repeated

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x30	CO_WR_REMAN_REPEATING = 48
Data	7	1	Reman Repeating	0xnn	0x00: Reman telegrams will not be repeated (Status =0x8F) 0x01: Reman answers will be repeated (Status =0x80)
-	8	1	CRC8D	0xnn	

Table 83

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.46 Code 49: CO_RD_REMAN_REPEATING

Function: Check if the REMAN telegrams originating from this module can be repeated.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x31	CO_RD_REMAN_REPEATING = 49
-	7	1	CRC8D	0xnn	

Table 84

In this case, the following **RESPONSE** message gives only the return codes:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Reman Repeating	0xnn	0x00: Reman telegrams will not be repeated (Status =0x8F) 0x01: Reman answers will be repeated (Status =0x80)
-	8	1	CRC8D	0xnn	

Table 85

02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.47 Code 50: CO_SET_NOISETHRESHOLD

Function: Sets the RSSI noise rejection threshold level for telegram reception. Received Signals below this threshold will be filtered out.

Group	Offset	Size	Field	Value hex	Description
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x32	CO_SET_NOISETHRESHOLD = 50
	7	4	RSSI Level	0xnn	Minimum RSSI Level for data telegrams (positive offset from the theoretical noise minimum of -146 dBm)
-	11	1	CRC8D	0xnn	

Table 8386

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (Hardware Error)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.48 Code 51: CO_GET_NOISETHRESHOLD

Function: Read the RSSI noise threshold level for telegram detection.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x33	CO_GET_NOISETHRESHOLD = 51
-	7	1	CRC8D	0xnn	

Table 87

In this case, the following **RESPONSE** message gives only the return codes:00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	RSSI Level		Minimum RSSI Level for data telegrams (positive offset from the theoretical noise minimum of -146 dBm)
-	8	1	CRC8D	0xnn	

Table 88

02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.49 Code 54: CO_WR_RLC_SAVE_PERIOD

Function: Select how frequently the rolling codes in the outbound secure link table will be saved to the EEPROM.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x36	CO_WR_RLC_SAVE_PERIOD = 54
Data	7	1	Save Period	0xnn	0x00: All RLC in the outbound secure link table will be saved immediately 0x01..0xFF: RLC are saved every n times
-	8	1	CRC8D	0xnn	

Table 89

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.50 Code 55: CO_WR_RLC_LEGACY_MODE

Function: Enable / disable the legacy RLC processing mode for 24 bit RLC.

If legacy mode is enabled, then RLC roll-over is allowed, but all RLCs must be within an RLC window of 128. If legacy mode is disabled, then RLC roll-over is now allowed and no RLC window is used.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x37	CO_WR_RLC_LEGACY_MODE = 55
Data	7	1	Legacy Mode	0xnn	0x00: Default value 0x01: 24Bit RLC explicit mode with roll-over is allowed.
-	8	1	CRC8D	0xnn	

Table 90

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, standard RESPONSE structure is detailed in chapter 2.2.3

2.5.51 Code 56: CO_WR_SECUREDEVICEV2_ADD

Function: Add device to a secure link table. New version allows for 32 bit RLC.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0018	27 bytes
	3	1	Optional Length	0x01	1 bytes
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x38	CO_WR_SECUREDEVICE2_ADD = 56
	7	1	SLF	0xnn	Security Level Format
	8	4	ID	0xnnnnnnnn	Device ID
	12	16	Private Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes private key of the device
	28	4	Rolling Code	0xnnnnnnnn	If a 24/16 bit rolling code is defined in SLF, the MSBs are undefined
	32	1	Teach-Info	0xnn	Full SEC_TEACH_INFO, like defined in the security SPEC
Optional Data	31	1	Direction	0xnn	0x00: Inbound table (default), ID = Source ID 0x01: Outbound table, ID = Destination ID 0x01: Outbound table, ID = own ID or 0x00000000 0x02: Outbound broadcast table, ID = Source ID (can be ChipID or one of BaseIDs) 0x03..0xFF = not used
-	48	1	CRC8D	0xnn	

Table 91

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (memory space full)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (added device known, but private key wrong)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.52 Code 57: CO_RD_SECUREDEVICEV2_BY_INDEX

Function: Read device from secure link table by index. New version allows for 32 bit RLC.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x39	CO_RD_SECUREDEVICE = 57
	7	1	Index	0x00…0xFE	Index of secure device to read, starting with 0…254
Optional Data	8	1	Direction	0xnn	Read device security information from: 0x00: Inbound table (default) 0x01: Outbound table, 0x02: Outbound broadcast table 0x03..0xFF: not used
-	9	1	CRC8D	0xnn	

Table 92

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0018	27 bytes
	3	1	Optional Length	0x10	16 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	SLF	0xnn	Security Level Format
	8	4	ID	0xnnnnnnnn	Device ID
	12	16	Private Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes private key of the device
	28	4	Rolling Code	0xnnnnnnnn	If a 24/16 bit rolling code is defined in SLF, the MSBs are undefined
	32	1	Teach-Info	0xnn	Full SEC_TEACH_INFO, like defined in the security SPEC
Optional Data	31	16	PSK	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 bytes pre-shared key of the device. (when not present it will be set to 0x00)
-	47	1	CRC8D	0xnn	

Table 93

For **RESPONSE** with return code:
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

Note: If PSK was not set, it will be not included in the packet. If in the future response will be extended, all bytes of non-existing PSK will be set to 0x00.

2.5.53 Code 58: CO_WR_RSSITEST_MODE

Function: This command enables/disables the RSSI Test Mode. The device will send a RX Channel Quality Signal Telegram (MID: 0x0A) for every non-filtered telegram.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0004	4 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3A	CO_WR_RSSITEST_MODE = 58
	7	1	RSSI Test Mode	0xnn	0x00: Disable the RSSI Test Mode 0x01: Enable the RSSI Test Mode
	8	2	Timeout	0xnnnnn	Timeout for the RSSI Test Mode in seconds. If 0 is used, no timeout will be set (device will reset after POR).
-	12	1	CRC8D	0xnn	

Table 94

For **RESPONSE** with return code:
00: RET_OK
01 RET_ERROR
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.54 Code 59: CO_RD_RSSITEST_MODE

Function: This command reads if the RSSI Test Mode. The device will send a Channel Quality Signal Telegram (MID: 0x0A) for every non-filtered telegram.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3B	CO_RD_RSSITEST_MODE = 59
-	7	1	CRC8D	0xnn	

Table 95

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	16 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	RSSI Test Mode	0xnn	0x00: RSSI Test Mode is disabled 0x01: RSSI Test Mode is enabled

-	8	1	CRC8D	0xnn	

Table 96

For **RESPONSE** with return code:
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.55 Code 60: CO_WR_SECUREDEVICE_MAINTENANCEKEY

Function: Add a maintenance key for one device to the secure link table. This command will automatically create an outbound and inbound RLC entry. If the device receives a Remote Command Package via ESP3, it will automatically encrypt it using the maintenance key pair. It will also decrypt the responses using the same key pair.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0018	22 bytes
	3	1	Optional Length	0x00	0 bytes
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3C	CO_WR_SECUREDEVICE_MAINTENANCEKEY = 60
	7	4	ID	0xnnnnnnnn	Device ID
	11	16	Maintenance Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 byte maintenance AES key of the device
	27	1	Maintenance Key Number	0xnn	1-15. This is the key the device will use for maintenance messages. Only one key pair is supported for a device.
-	28	1	CRC8D	0xnn	

Table 97

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (memory space full)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM (added device known, but private key wrong)

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.56 Code 61: CO_RD_SECUREDEVICE_MAINTENANCEKEY

Function: Read maintenance info from secure link table by index.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	-
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3D	CO_RD_SECUREDEVICE_MAINTENANCEKEY = 61
	7	1	Index	0x00…0xFE	Index of secure device to read, starting with 0…254
-	9	1	CRC8D	0xnn	

Table 98

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0018	27 bytes
	3	1	Optional Length	0x0	
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	4	ID	0xnnnnnnnn	Device ID
	11	16	Private Key	0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn 0xnnnnnnnn	16 byte private key of the device
	27			0xnn	Key Number
	28	4	Inbound Rolling Code	0xnnnnnnnn	Current inbound RLC (last received one)
	32	4	Outbound Rolling Code	0xnnnnnnnn	Current outbound RLC
-	36	1	CRC8D	0xnn	

Table 99

For **RESPONSE** with return code:
01 RET_ERROR (device not in list)
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.57 Code 62: CO_WR_TRANSPARENT_MODE

Function: This command enables/disables transparent mode. In general it disables chaining, encryption and remote management functions and will forward all received telegrams into the ESP3 interface without any processing applied.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0004	2 bytes
	3	1	Optional Length	0x00	0 byte

	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3E	CO_WR_TRANSPARENT_MODE = 62
	7	1	Transparent Mode	0xnn	0x00: Disable Transparent Mode 0x01: Enable Transparent Mode
-	8	1	CRC8D	0xnn	

Table 100

For **RESPONSE** with return code:
00: RET_OK
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.58 Code 63: CO_RD_TRANSPARENT_MODE

Function: This command reads the transparent mode state.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x3F	CO_RD_TRANSPARENT_MODE = 63
-	7	1	CRC8D	0xnn	

Table 101

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	16 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Transparent Mode	0xnn	0x00: Transparent mode is disabled 0x01: Transparent mode is enabled
-	8	1	CRC8D	0xnn	

Table 102

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.59 Code 64: CO_WR_TX_ONLY_MODE

Function: This command enables/disables the TX only mode. If enabled, RX functionality will be disabled.

When in TX only mode, the device will send an event (CO_TX_DONE) when all subtelegrams have been transmitted.
If auto-sleep is on, the device will go into a sleep-mode and needs to be waken up again via UART or through other methods (see device user manual for further details).
If auto-sleep is off, the device will continue operating and the receiver will remain off.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0004	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x40	CO_WR_TX_ONLY_MODE = 64
	7	1	TX Only Mode	0xnn	0x00: TX only OFF 0x01: TX only ON (no auto-sleep) 0x02: TX only ON with auto-sleep
-	8	1	CRC8D	0xnn	

Table 103

For **RESPONSE** with return code:
00: RET_OK
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.5.60 Code 65: CO_RD_TX_ONLY_MODE

Function: This command reads the current state of TX only mode.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 bytes
	3	1	Optional Length	0x00	1 byte
	4	1	Packet Type	0x05	COMMON_COMMAND = 5
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x41	CO_RD_TX_ONLY_MODE = 65
-	7	1	CRC8D	0xnn	

Table 104

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	16 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	TX Only Mode	0xnn	0x00: TX only OFF 0x01: TX only ON (no auto-sleep) 0x02: TX only ON with auto-sleep
-	8	1	CRC8D	0xnn	

Table 105

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6 Packet Type 6: SMART_ACK_COMMAND

2.6.1 Structure

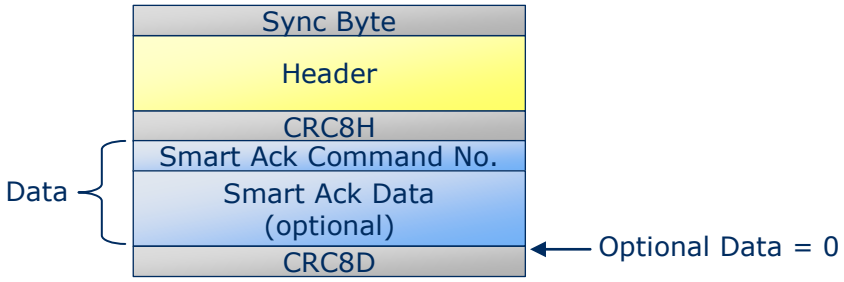

Figure 11

In the current version of ESP3 the packet type SMART_ACK_COMMAND carries no Optional Data.

2.6.2 List of SMART ACK Codes

Code	Function Name	Description
01	SA_WR_LEARNMODE	Set/Reset Smart Ack learn mode
02	SA_RD_LEARNMODE	Get Smart Ack learn mode state
03	SA_WR_LEARNCONFIRM	Used for Smart Ack to add or delete a mailbox of a client
04	SA_WR_CLIENTLEARNRQ	Send Smart Ack Learn request (Client)
05	SA_WR_RESET	Send reset command to a Smart Ack client
06	SA_RD_LEARNEDCLIENTS	Get Smart Ack learned sensors / mailboxes
07	SA_WR_RECLAIMS	Set number of reclaim attempts
08	SA_WR_POSTMASTER	Activate/Deactivate Post master functionality

Table 106

2.6.3 Code 01: SA_WR_LEARNMODE

Function: Enable or disable learn mode of the Smart Acknowledge controller.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0007	7 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x01	SA_WR_LEARNMODE = 1
	7	1	Enable	0x0n	0x0: End Learn mode 0x01: Start Learn mode
	8	1	Extended	0x0n	0x00: Simple Learn mode 0x01: Advanced Learn mode 0x02: Advanced Learn mode select Rep.
	9	4	Timeout	0xnnnnnnnn	Time-out for the learn mode in ms. When time is 0 then default period of 60’000 ms is used
-	13	1	CRC8D	0xnn	

Table 107

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.4 Code 02: SA_RD_LEARNMODE

Function: Read the learn mode status of the Smart Acknowledge controller.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x02	SA_RD_LEARNMODE = 2
-	7	1	CRC8D	0xnn	

Table 108

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0003	3 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	Enable	0x0n	Learn mode not active = 0 Learn mode active = 1
	8	1	Extended	0x0n	0x00: Simple Learn mode 0x01: Advanced Learn mode 0x02: Advanced Learn mode, select repeater
-	9	1	CRC8D	0xnn	

Table 109

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.5 Code 03: SA_WR_LEARNCONFIRM

Function: Send Smart Acknowledge learn answer to modify mailbox at Post Master.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x000C	12 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x03	SA_WR_LEARNCONFIRM = 3
	7	2	Response time	0xnnnn	Response time for sensor in ms in which the controller can prepare the data and send it to the postmaster. Only relevant, if learn return code is Learn IN.
	9	1	Confirm code	0xnn	0x00: Learn IN 0x20: Learn OUT
	10	4	Postmaster Candidate ID	0xnnnnnnnn	Device ID of the used Post Master
	14	4	Smart Ack Client ID	0xnnnnnnnn	Device ID of the learned IN/OUT Smart Ack client.
-	18	1	CRC8D	0xnn	

Table 110

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.6 Code 04: SA_WR_CLIENTLEARNRQ

Function: Sends Smart Acknowledge Learn Request telegram to the Smart Acknowledge controller. This function can only be used in a Smart Acknowledge client.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0006	6 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x04	SA_WR_ CLIENTLEARNRQ = 4
	7	1	2^2 ... 2^0: Manufacturer ID 2^7 ... 2^3: Reserved	0b11111nnn	nnn = Most significant 3 bits of the Manufacturer ID 11111 = reserved / default values
	8	1	Manufacturer ID	0xnn	Least significant bits of the Manufacturer ID
	9	3	EEP	0xnnnnnn	EEP of the Smart Ack client, who wants to Teach IN.
-	12	1	CRC8D	0xnn	

Table 111

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.7 Code 05: SA_WR_RESET

Function: Send reset request to Smart Acknowledge client.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0005	5 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x05	SA_WR_ RESET = 5
	7	4	Smart Ack Client ID	0xnnnnnnnn	Device ID of the Smart Ack client
-	11	1	CRC8D	0xnn	

Table 112

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.8 Code 06: SA_RD_LEARNEDCLIENTS

Read mailbox information at the Smart Acknowledge controller to determine status of learned-in Smart Acknowledge clients.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x06	SA_RD_ LEARNEDCLIENTS = 6
-	7	1	CRC8D	0xnn	

Table 113

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description	
-	0	1	Sync. Byte	0x55		
Header	1	2	Data Length	0xnnnn	1 + 9*c bytes (c = number of clients)	
	3	1	Optional Length	0x00	0 byte	
	4	1	Packet Type	0x02	RESPONSE = 2	
-	5	1	CRC8H	0xnn		
Data	6	1	Return Code	0x00	RET_OK = 0	
	7	4	Smart Ack Client ID	0xnnnnnnnn	Device ID of the Smart Ack client	**c**
	7 +4*c	4	Controller ID	0xnnnnnnnn	Controller ID dedicated Smart Ack client	
	7 +8*c	1	Mailbox index	0xnn	Internal counter of Post Master (0x00 ... 0x0E)	
-	7 +9*c	1	CRC8D	0xnn		

Table 114

Every learned Smart Acknowledge client has the group **c** with fields in the order: Controller ID, Smart Acknowledge client ID, Mailbox index (c = also number of clients / multiplier to calculate the offset).

For **RESPONSE** with return code:
02 RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.9 Code 07: SA_WR_RECLAIMS

Function: Set the amount of reclaim tries in the Smart Acknowledge client.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x07	SA_WR_RECLAIMS = 7
	7	1	Reclaim count	0xnn	Presetting for the number of required reclaim tries
-	8	1	CRC8D	0xnn	

Table 115

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.10 Code 08: SA_WR_POSTMASTER

Function: Enable / disable postmaster functionality at the Smart Acknowledge controller

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x08	SA_WR_POSTMASTER = 8
	7	1	Mailbox count	0xnn	Amount of mailboxes available, 0 = disable post master functionality; Maximum 28 mailboxes can be created. The upper limit is device dependent and may be smaller.
-	8	1	CRC8D	0xnn	

Table 116

In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.6.11 Code 09: SA_RD_MAILBOX STATUS

Read mailbox status for a specific Smart Acknowledge client.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0009	9 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x09	SA_RD_ MAILBOXSTATUS = 9
	7	4	Smart Ack Client ID	0xnnnnnnnn	Device ID of the Smart Ack Client
	11	4	Controller ID	0xnnnnnnnn	Controller ID dedicated Smart Ack Client
-	15	1	CRC8D	0xnn	

Table 117

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x02	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0x00	RET_OK = 0
	7	1	MailBox status	0xnn	0 = mailbox is empty 1 = mailbox is full 2 = mailbox does not exists.
-	8	1	CRC8D	0xnn	

Table 118

2.6.12 Code 10: SA_DEL_MAILBOX

Delete mailbox for a certain Smart Acknowledge client.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0009	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x06	SMART_ACK_COMMAND = 6
-	5	1	CRC8H	0xnn	
Data	6	1	SMART_ACK Code	0x0A	SA_DEL_MAILBOX = 10
	7	4	Smart Ack Client ID	0xnnnnnnnn	Device ID of the Smart Ack Client
	11	4	Controller ID	0xnnnnnnnn	Controller ID dedicated Smart Ack Client
-	15	1	CRC8D	0xnn	

Table 119

In this case, the following **RESPONSE** message gives only the return codes:
00 RET_OK
01 RET_ERROR (mailbox does not exist)
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.7 Packet Type 7: REMOTE_MAN_COMMAND

2.7.1 Structure

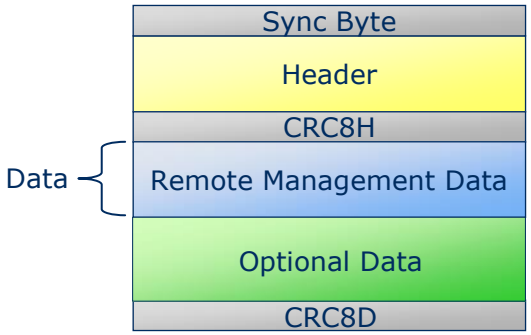

Figure 12

This section describes the remote management command structure. This structure is applied for the send as well as the receive case.

2.7.2 Description

Function: Remote Management send or receive message.

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	4 + x bytes
	3	1	Optional Length	0x0A	10 bytes
	4	1	Packet Type	0x07	REMOTE_MAN_COMMAND = 7
-	5	1	CRC8H	0xnn	
Data	6	2	Function No.	0x0nnn	Range: 0x0000 ... 0x0FFF
	8	2	Manufacturer ID	0x0nnn	Range: 0x0000 ... 0x07FF
	10	x	Message data	...	N bytes
Optional Data	10+x	4	Destination ID	0xnnnnnnnn	Destination ID Broadcast ID: FF FF FF FF
	14+x	4	Source ID	0xnnnnnnnn	Receive case: Source ID of the sender Send case: 0x00000000
	18+x	1	dBm	0xnn	Send case: 0xFF Receive case: Best RSSI value of all received sub telegrams (only if wait for maturity is set to true!) (value decimal without minus)
	19+x	1	Send With Delay	0x0n	0x00: No random delay (default) 0x01: First message has to be sent with random delay. When replying to a broadcast message this field must be set to 1, otherwise to 0
-	20+x	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 120

The receive case has no RESPONSE.

The send case has the following **RESPONSE** with the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.8 Packet Type 9: RADIO_MESSAGE

2.8.1.1 Packet structure

The radio message (payload data without any radio telegram contents) is embedded into the ESP3 packet.

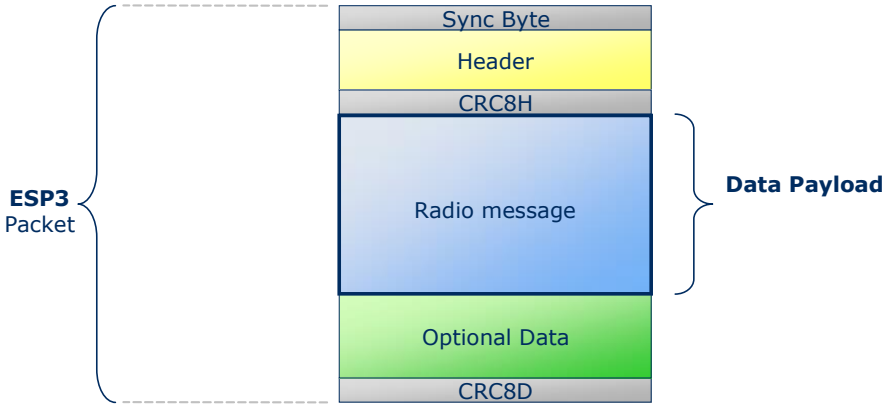

Figure 13

The following structure is applicable to all types of radio messages:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	Variable length of message
	3	1	Optional Length	0x09	Optional Data = 9 bytes
	4	1	Packet Type	0x09	RADIO_MESSAGE = 9
-	5	1	CRC8H	0xnn	
Data	6	1	Message RORG	0xnn	RORG
Data	7	x	Message Data	...	Message Data Content
Optional Data	7+x	4	Destination ID	0xnnnnnnnn	Destination ID Broadcast ID: FF FF FF FF
	11+x	4	Source ID	0xnnnnnnnn	Receive case: Source ID of the sender Send case: 0x00000000
	15+x	1	dBm	0xnn	Send case: 0xFF Receive case: Best RSSI value of all received sub telegrams (value decimal without minus) (only if wait for maturity is set to true!)
	16+x	1	Security Level	0x0n	Send Case: Will be ignored (Security is selected by link table entries) Receive case: 0 = telegram unencrypted 1 = Obsolete (old security concept) 2 = Telegram encrypted 3 = Telegram authenticated 4 = Telegram encrypted + authenticated
-	13+x	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 121

When receiving a message, no RESPONSE has to be sent. When sending a message, a RESPOND has to be expected. In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
05 RET_LOCK_SET
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.9 Packet Type 10: RADIO_ERP2

2.9.1 Packet structure

The ERP2 radio protocol telegram (raw data without LEN) is embedded into the ESP3 packet.

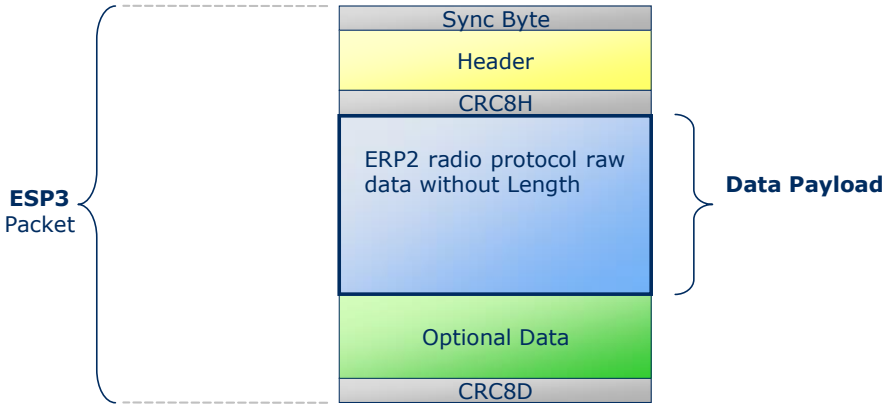

Figure 14

The following structure is applicable to all types of radio telegrams:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	Variable length of radio telegram
	3	1	Optional Length	0x02	2 fields fixed
	4	1	Packet Type	0x0A	RADIO_ERP2 = 10
-	5	1	CRC8H	0xnn	
Data	6	x	Raw data	... ...	ERP2 radio protocol telegram without the first Length byte. For sending the ERP2 protocol CRC8 byte can be set to any value. x = Data Length
Optional Data	6+x	1	SubTelNum	0xnn	Number of sub telegram; Send: 3 / receive: 1 ... y
	7+x	1	dBm	0xnn	Send case: FF Receive case: best RSSI value of all received sub telegrams (value decimal without minus) (only if wait for maturity is set to true!)
	8+x	1	Security Level	0x0n	Send Case: Will be ignored (Security is selected by link table entries) Receive case: 0 = telegram unencrypted 1 = Obsolete (old security concept) 2 = Telegram encrypted 3 = Telegram authenticated 4 = Telegram encrypted + authenticated
-	8+x	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 122

When receiving a telegram, no RESPONSE has to be sent. When sending a telegram, a RESPOND has to be expected. In this case, the following **RESPONSE** message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
When there is no additional data included that have to be described, the standard RESPONSE structure is used as detailed in chapter 2.2.3

2.10 Packet Type 12: COMMAND ACCEPTED

2.10.1 Packet structure

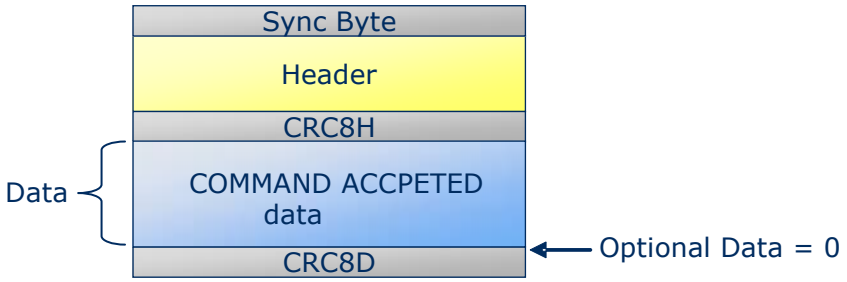

Figure 15

The command accepted packet will be transmitted after an ESP3 request has been received, but the answer will only become available after a time, which would exceed the ESP3 timeout. The normal response will be send after the operation has finished executing.

2.10.2 Command Accepted Structure

Example of standard RESOPNSE with RET_OK (without response data)

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	Data = 1 byte
	3	1	Optional Length	0x00	Optional Data = 0 byte
	4	1	Packet Type	0x0C	COMMAND_ACCEPTED = 12
-	5	1	CRC8H	0xnn	
Data	6	1	Blocking Operation	0xnn	0x00: Non-blocking operation, additional commands can be accepted while current command is executed 0x01: Blocking operation, Firmware will reject additional commands without response while current command is executed
	3	2	Estimated Operation Time ms	0xnnnn	0x0000 unknown 0x0001- 0xFFFF Estimated operation time in n ms. (1ms to 65535ms)
-	7	1	CRC8D	0xnn	

Table 123

2.11 Packet Type 16: RADIO_802_15_4 (802.15.4 Raw Packet)

This packet is sent from a transceiver to an external host after receiving a valid 802.15.4 frame. If the transceiver receives such a telegram, the packet will be send via the air interface.

2.11.1 Packet structure

The ESP3 packet encapsulates the whole 802.15.4 mac frame omitting the FCS.

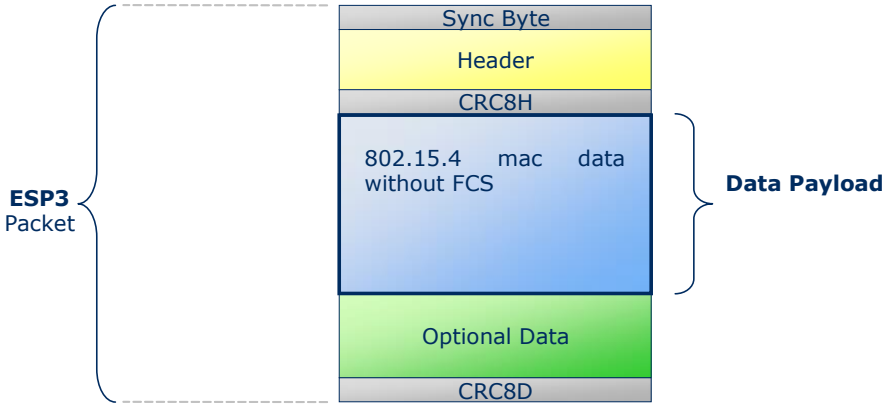

Figure 16 Packet Type 0x10

Octets: 2	1	0/2	0/2/8	0/2	0/2/8	0/5/6/10/14	variable	2
Frame Control	Sequence Number	Destination PAN Identifier	Destination Address	Source PAN Identifier	Source Address	Auxiliary Security Header	Frame Payload	FCS
		Addressing fields						
MHR							MAC Payload	MFR

Figure 17 Mac Data Format

The following structure is applicable:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0xnnnn	Variable length of radio telegram
	3	1	Optional Length	0x01	1 byte
	4	1	Packet Type	0x10	RADIO_802_15_4= 16
-	5	1	CRC8H	0xnn	
Data	6	x	Raw data	... ...	802.15.4 MHR+ mac payload without the FCS
Optional Data	6+x	1	RSSI	0xnn	Send case: don't care Receive case: - RSSI
-	8+x	1	CRC8D	0xnn	CRC8 Data byte; calculated checksum for whole byte groups: DATA and OPTIONAL_DATA

Table 124

When receiving a telegram, no RESPONSE has to be sent. When sending a telegram, a RESPOND has to be expected. In this case, the following RESPONSE message gives the return codes:
00 RET_OK
02 RET_NOT_SUPPORTED
03 RET_WRONG_PARAM
07 RET_NO_FREE_BUFFER

When no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.12 Packet Type 17: COMMAND_2_4

2.12.1 List of EnOcean 2.4 commands

Code	Command Name	Description
01	SET_CHANNEL	Sets IEEE 802.15.4 radio channel
02	GET_CHANNEL	Read the IEEE 802.15.4 radio channel

Table 125

2.12.2 Code 01: R802_WR_CHANNEL

Function: Set the IEEE 802.15.4 radio channel

The command structure is following:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x11	COMMAND_2_4 = 0x11
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x01	R802_WR_CHANNEL = 0x01
	7	1	Channel	11-26	The 802.15.4 channel to use
-	8	1	CRC8D	0xnn	

Table 126

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE = 2
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0xnn	00
-	7	1	CRC8D	0xnn	

Table 127

For **RESPONSE** with return code:
02: RET_NOT_SUPPORTED

Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

2.12.3 CODE 02: R802_RD_CHANNEL

Function: Get the device's current used channel

The command structure is following:

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0001	1 byte
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x11	COMMAND_2_4 = 0x11
-	5	1	CRC8H	0xnn	
Data	6	1	COMMAND Code	0x02	R820_RD_CHANNEL = 0x02
-	7	1	CRC8D	0xnn	

Table 128

Following described **RESPONSE** applies to return code:
00: RET_OK

Group	Offset	Size	Field	Value hex	Description
-	0	1	Sync. Byte	0x55	
Header	1	2	Data Length	0x0002	2 bytes
	3	1	Optional Length	0x00	0 byte
	4	1	Packet Type	0x02	RESPONSE_PACKET = 0x02
-	5	1	CRC8H	0xnn	
Data	6	1	Return Code	0	OK
	7	1	Channel	11..26	Used Channel
-	8	1	CRC8D	0xnn	

Table 129

For **RESPONSE** with return code:
02: RET_NOT_SUPPORTED
Since no additional data are included that have to be described, the standard RESPONSE structure is detailed in chapter 2.2.3

3 Appendix

3.1 ESP3 Data flow sequences

The following examples illustrate the ESP3 traffic. In particular the flow of the Smart Ack commands is more complex.

3.1.1 Client data request

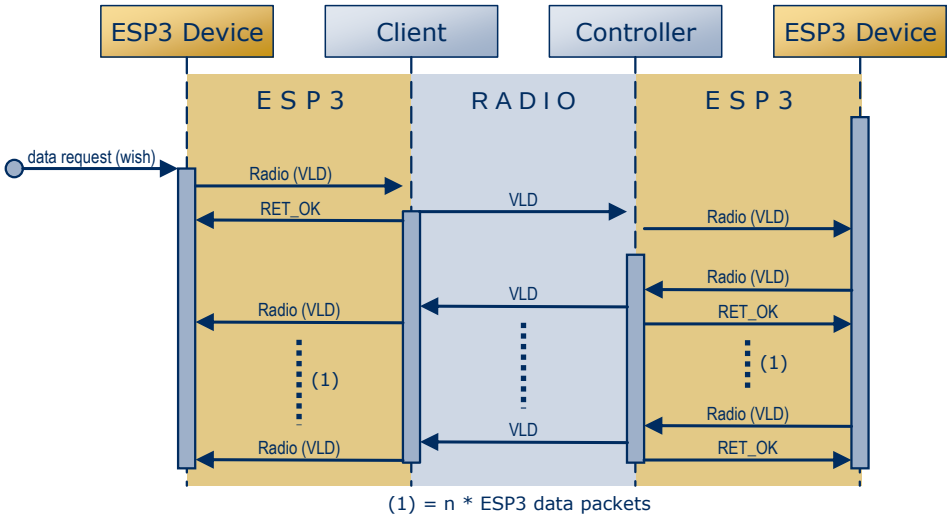

Figure 18

3.1.2 Teach IN via VLL

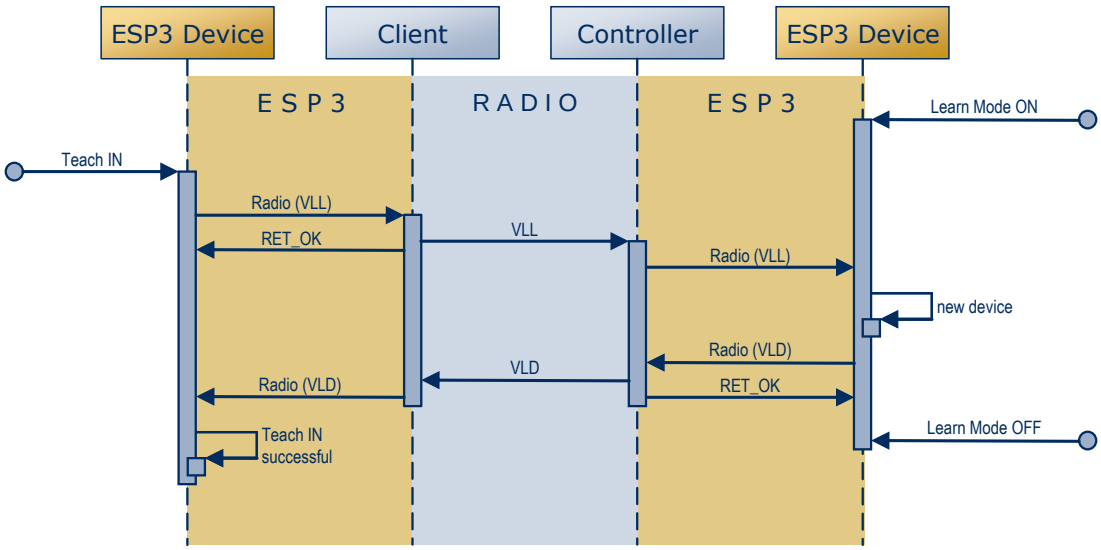

Figure 19

3.1.3 Teach IN via Smart Ack

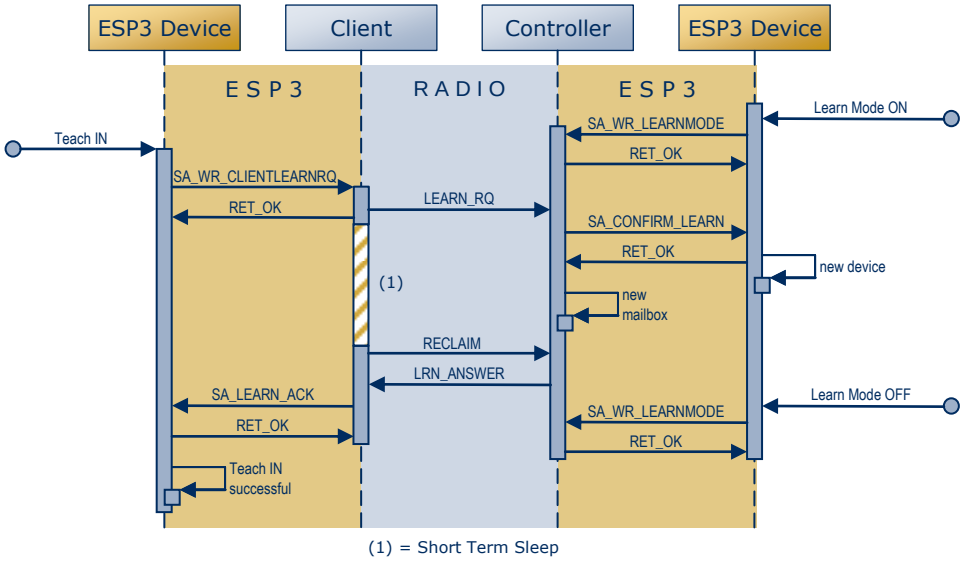

Figure 20

3.1.4 Teach IN via Smart Ack incl. repeater

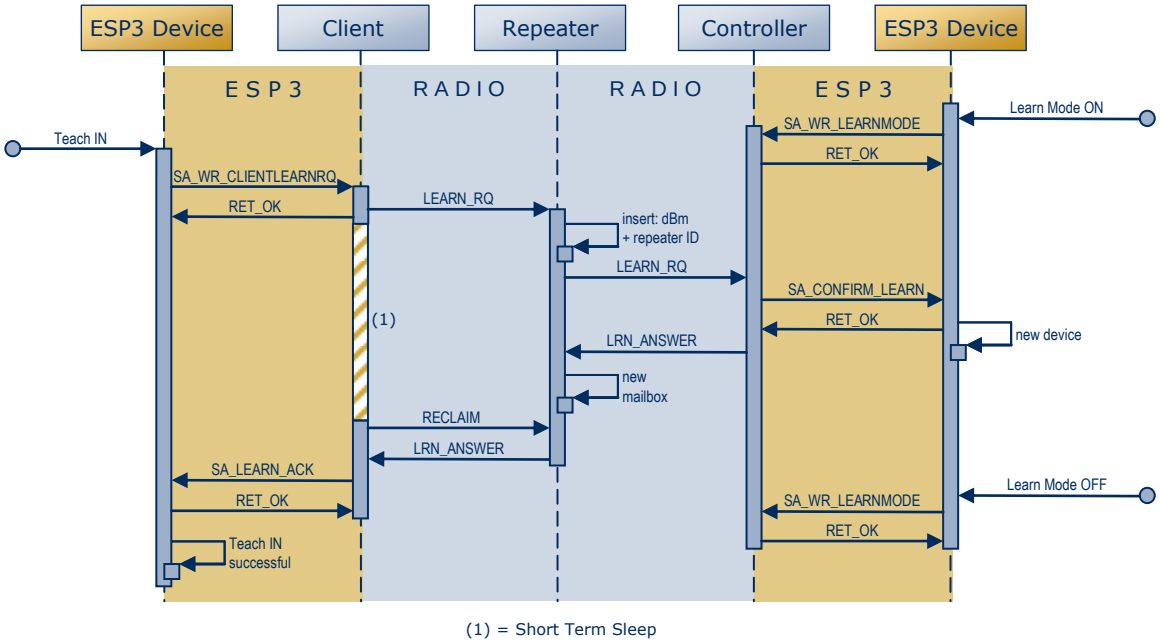

Figure 21

3.2 ESP3 telegram examples

3.2.1 Packet: Radio VLD

Sy	Header	CRC8	Data	Optional Data	CRC8
55	00 0F 07 01	2B	D2 DD DD DD DD DD DD DD DD DD 00 80 35 C4 00	03 FF FF FF FF 4D 00	36

3.2.2 Packet: CO_WR_SLEEP

Sy	Header	CRC8	Data	CRC8
55	00 05 00 05	DB	01 00 00 00 0A	54

Period = 10 (0x0A)

3.2.3 Packet: CO_WR_RESET

Sy	Header	CRC8	Data	CRC8
55	00 01 00 05	70	02	0E

3.2.4 Packet: CO_RD_IDBASE

Sy	Header	CRC8	Data	CRC8
55	00 01 00 05	70	08	38

Response RET_OK:

Sy	Header	CRC8	Data	CRC8
55	00 05 00 02	CE	00 FF 80 00 00	DA

3.2.5 Packet: REMOTE_MAN_COMMAND

Example dummy command:
Function = 0x0876
Manufacture = 0x07FF
Message data = 0x000102030405060708090a0b0c0d0e0f
DestinationID = Broadcast = 0xFFFFFFFF
SendWithDelay = 0

Sy	Header	CRC8	Data	
				Message data
55	00 14 0A 07	9E	08 76 07 FF	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

Optional Data	CRC8
FF FF FF FF 00 00 00 00 FF 00	86

Example QueryID:

Sy	Header	CRC8	Data	CRC8
55	00 04 00 07	BE	00 04 07 FF	33

3.3 CRC8 calculation

The polynomial **$G(x) = x^8 + x^2 + x^1 + x^0$** is used to generate the CRC8 table, needed for the CRC8 calculation. Following C code illustrates how the CRC8 value is calculated:

Implementation:

```
uint8 u8CRC8Table[256] = {
    0x00, 0x07, 0x0e, 0x09, 0x1c, 0x1b, 0x12, 0x15,
    0x38, 0x3f, 0x36, 0x31, 0x24, 0x23, 0x2a, 0x2d,
    0x70, 0x77, 0x7e, 0x79, 0x6c, 0x6b, 0x62, 0x65,
    0x48, 0x4f, 0x46, 0x41, 0x54, 0x53, 0x5a, 0x5d,
    0xe0, 0xe7, 0xee, 0xe9, 0xfc, 0xfb, 0xf2, 0xf5,
    0xd8, 0xdf, 0xd6, 0xd1, 0xc4, 0xc3, 0xca, 0xcd,
    0x90, 0x97, 0x9e, 0x99, 0x8c, 0x8b, 0x82, 0x85,
    0xa8, 0xaf, 0xa6, 0xa1, 0xb4, 0xb3, 0xba, 0xbd,
    0xc7, 0xc0, 0xc9, 0xce, 0xdb, 0xdc, 0xd5, 0xd2,
    0xff, 0xf8, 0xf1, 0xf6, 0xe3, 0xe4, 0xed, 0xea,
    0xb7, 0xb0, 0xb9, 0xbe, 0xab, 0xac, 0xa5, 0xa2,
    0x8f, 0x88, 0x81, 0x86, 0x93, 0x94, 0x9d, 0x9a,
    0x27, 0x20, 0x29, 0x2e, 0x3b, 0x3c, 0x35, 0x32,
    0x1f, 0x18, 0x11, 0x16, 0x03, 0x04, 0x0d, 0x0a,
    0x57, 0x50, 0x59, 0x5e, 0x4b, 0x4c, 0x45, 0x42,
    0x6f, 0x68, 0x61, 0x66, 0x73, 0x74, 0x7d, 0x7a,
    0x89, 0x8e, 0x87, 0x80, 0x95, 0x92, 0x9b, 0x9c,
    0xb1, 0xb6, 0xbf, 0xb8, 0xad, 0xaa, 0xa3, 0xa4,
    0xf9, 0xfe, 0xf7, 0xf0, 0xe5, 0xe2, 0xeb, 0xec,
    0xc1, 0xc6, 0xcf, 0xc8, 0xdd, 0xda, 0xd3, 0xd4,
    0x69, 0x6e, 0x67, 0x60, 0x75, 0x72, 0x7b, 0x7c,
    0x51, 0x56, 0x5f, 0x58, 0x4d, 0x4a, 0x43, 0x44,
    0x19, 0x1e, 0x17, 0x10, 0x05, 0x02, 0x0b, 0x0c,
    0x21, 0x26, 0x2f, 0x28, 0x3d, 0x3a, 0x33, 0x34,
    0x4e, 0x49, 0x40, 0x47, 0x52, 0x55, 0x5c, 0x5b,
    0x76, 0x71, 0x78, 0x7f, 0x6A, 0x6d, 0x64, 0x63,
    0x3e, 0x39, 0x30, 0x37, 0x22, 0x25, 0x2c, 0x2b,
    0x06, 0x01, 0x08, 0x0f, 0x1a, 0x1d, 0x14, 0x13,
    0xae, 0xa9, 0xa0, 0xa7, 0xb2, 0xb5, 0xbc, 0xbb,
    0x96, 0x91, 0x98, 0x9f, 0x8a, 0x8D, 0x84, 0x83,
    0xde, 0xd9, 0xd0, 0xd7, 0xc2, 0xc5, 0xcc, 0xcb,
    0xe6, 0xe1, 0xe8, 0xef, 0xfa, 0xfd, 0xf4, 0xf3
    };

#define proccrc8(u8CRC, u8Data) (u8CRC8Table[u8CRC ^ u8Data])
```

Example:

```
u8CRC = 0;
for (i = 0 ; i < u16DataSize ; i++)
    u8CRC = proccrc8(u8CRC, u8Data[i]);
printf("CRC8 = %02X\n", u8CRC);
```

3.4 UART Synchronization (example c-code)

Please notice, that the example c-code in this chapter is written for big endian systems only. If you have a little endian system you have to make changes for proper functionality.

3.4.1 ESP3 Packet Structure

```
  //! Packet structure (ESP3)
    typedef struct
    {
        // Amount of raw data bytes to be received. The most significant byte is sent/received first
            uint16   u16DataLength;
        // Amount of optional data bytes to be received
            uint8    u8OptionLength;
        // Packe type code
            uint8    u8Type;
        // Data buffer: raw data + optional bytes
            uint8    *u8DataBuffer;
    } PACKET_SERIAL_TYPE;
```

3.4.2 Get ESP3 Packet

```
//! \file uart_getPacket.c

#include "EO3000I_API.h"
#include "proc.h"
#include "uart.h"
#include "time.h"

/*
ESP3 packet structure through the serial port.

Protocol bytes are generated and sent by the application

Sync = 0x55
CRC8H
CRC8D


    1             2               1          1          1      u16DataLen + u8OptionLen       1
+------+-----------------+--------------+----------+----------+-------------/------------+----------+
| 0x55 |     u16DataLen   |   u8OptionLen |  u8Type   |  CRC8H    |             DATAS          |   CRC8D   |
+------+-----------------+--------------+----------+----------+-------------/------------+----------+


DATAS structure:

                   u16DataLen                    u8OptionLen
+-------------------------------------------+----------------------+
|                   Data                    |     Optional         |
+-------------------------------------------+----------------------+
*/


RETURN_TYPE uart_getPacket(PACKET_SERIAL_TYPE *pPacket, uint16 u16BufferLength)
{
    //! uart_getPacket state machine states.
     typedef enum
     {
          //! Waiting for the synchronisation byte 0x55
          GET_SYNC_STATE=0,
          //! Copying the 4 after sync byte: raw data length (2 bytes), optional data length (1), type (1).
          GET_HEADER_STATE,
          //! Checking the header CRC8 checksum. Resynchronisation test is also done here
          CHECK_CRC8H_STATE,
          //! Copying the data and optional data bytes to the paquet buffer
          GET_DATA_STATE,
          //! Checking the info CRC8 checksum.
          CHECK_CRC8D_STATE,
```

```
} STATES_GET_PACKET;

//! UART received byte code
uint8  u8RxByte;
//! Checksum calculation
static uint8 u8CRC = 0;
//! Nr. of bytes received
static uint16 u16Count = 0;
//! State machine counter
static STATES_GET_PACKET u8State = GET_SYNC_STATE;
//! Timeout measurement
static uint8 u8TickCount = 0;
// Byte buffer pointing at the paquet address
uint8 *u8Raw = (uint8*)pPacket;
// Temporal variable
uint8    i;

// Check for timeout between two bytes
if (((uint8)ug32SystemTimer) - u8TickCount > SER_INTERBYTE_TIME_OUT)
{
     // Reset state machine to init state
     u8State = GET_SYNC_STATE;
}

// State machine goes on when a new byte is received
while (uart_getByte(&u8RxByte) == OK)
{
     // Tick count of last received byte
     u8TickCount = (uint8)ug32SystemTimer;

     // State machine to load incoming packet bytes
     switch(u8State)
     {
          // Waiting for packet sync byte 0x55
          case GET_SYNC_STATE:

               if (u8RxByte == SER_SYNCH_CODE)
               {
                    u8State = GET_HEADER_STATE;
                    u16Count = 0;
                    u8CRC   = 0;
               }

               break;


          // Read the header bytes
          case GET_HEADER_STATE:

               // Copy received data to buffer
               u8Raw[u16Count++] = u8RxByte;
               u8CRC = proc_crc8(u8CRC, u8RxByte);

               // All header bytes received?
               if(u16Count == SER_HEADER_NR_BYTES)
               {
                   u8State = CHECK_CRC8H_STATE;
               }

               break;


          // Check header checksum & try to resynchonise if error happened
          case CHECK_CRC8H_STATE:

               // Header CRC correct?
               if (u8CRC != u8RxByte)
               {
                    // No. Check if there is a sync byte (0x55) in the header
                    int a = -1;
                    for (i = 0 ; i < SER_HEADER_NR_BYTES ; i++)
                         if (u8Raw[i] == SER_SYNCH_CODE)
                         {
                              // indicates the next position to the sync byte found
                              a=i+1;
                              break;
                         };
```

```
            if ((a == -1) && (u8RxByte != SER_SYNCH_CODE))
            {
                // Header and CRC8H does not contain the sync code
                u8State = GET_SYNC_STATE;
                break;
            }
            else if((a == -1) && (u8RxByte == SER_SYNCH_CODE))
            {
                // Header does not have sync code but CRC8H does.
                // The sync code could be the beginning of a packet
                u8State = GET_HEADER_STATE;
                u16Count = 0;
                u8CRC    = 0;
                break;
            }

            // Header has a sync byte. It could be a new telegram.
            // Shift all bytes from the 0x55 code in the buffer.
            // Recalculate CRC8 for those bytes
            u8CRC = 0;
            for (i = 0 ; i < (SER_HEADER_NR_BYTES - a) ; i++)
            {
                u8Raw[i] = u8Raw[a+i];
                u8CRC = proc_crc8(u8CRC, u8Raw[i]);
            }
            u16Count = SER_HEADER_NR_BYTES - a;
            // u16Count = i; // Seems also valid and more intuitive than u16Count -= a;

            // Copy the just received byte to buffer
            u8Raw[u16Count++] = u8RxByte;
            u8CRC = proc_crc8(u8CRC, u8RxByte);

            if(u16Count < SER_HEADER_NR_BYTES)
            {
                u8State = GET_HEADER_STATE;
                break;
            }

            break;
        }

        // CRC8H correct. Length fields values valid?
        if((pPacket->u16DataLength + pPacket->u8OptionLength) == 0)
        {
            //No. Sync byte received?
            if((u8RxByte == SER_SYNCH_CODE))
            {
                //yes
                u8State = GET_HEADER_STATE;
                u16Count = 0;
                u8CRC    = 0;
                break;
            }

            // Packet with correct CRC8H but wrong length fields.
            u8State = GET_SYNC_STATE;
            return OUT_OF_RANGE;
        }

        // Correct header CRC8. Go to the reception of data.
        u8State = GET_DATA_STATE;
        u16Count = 0;
        u8CRC    = 0;

        break;


    // Copy the information bytes
    case GET_DATA_STATE:

        // Copy byte in the packet buffer only if the received bytes have enough room
        if(u16Count < u16BufferLength)
        {
            pPacket->u8DataBuffer[u16Count] = u8RxByte;
            u8CRC = proc_crc8(u8CRC, u8RxByte);
        }
```

```
                    // When all expected bytes received, go to calculate data checksum
                    if( ++u16Count == (pPacket->u16DataLength + pPacket->u8OptionLength) )
                    {
                         u8State = CHECK_CRC8D_STATE;
                    }

                    break;


               // Check the data CRC8
               case CHECK_CRC8D_STATE:

                    // In all cases the state returns to the first state: waiting for next sync byte
                    u8State = GET_SYNC_STATE;

                    // Received packet bigger than space to allocate bytes?
                    if (u16Count > u16BufferLength)  return OUT_OF_RANGE;

                    // Enough space to allocate packet. Equals last byte the calculated CRC8?
                    if (u8CRC == u8RxByte)       return OK;               // Correct packet received

                    // False CRC8.
                    // If the received byte equals sync code, then it could be sync byte for next paquet.
                    if((u8RxByte == SER_SYNCH_CODE))
                    {
                         u8State = GET_HEADER_STATE;
                         u16Count = 0;
                         u8CRC    = 0;
                    }

                    return NOT_VALID_CHKSUM;


               default:

                    // Yes. Go to the reception of info.
                   u8State = GET_SYNC_STATE;
                    break;
          }
     }

     return (u8State == GET_SYNC_STATE) ? NO_RX_TEL : NEW_RX_BYTE;
}
```

3.4.3 Send ESP3 Packet

```
//! \file uart_sendPacket.c


#include "EO3000I_API.h"
#include "proc.h"
#include "uart.h"

/*
ESP3 packet structure through the serial port.

Protocol bytes are generated and sent by the application

Sync = 0x55
CRC8H
CRC8D


    1              2                1           1           1      u16DataLen + u8OptionLen       1
+------+------------------+---------------+-----------+-----------+-------------/------------+-----------+
| 0x55 |     u16DataLen   |   u8OptionLen |  u8Type   |    CRC8H  |             DATAS          |   CRC8D   |
+------+------------------+---------------+-----------+-----------+-------------/------------+-----------+


DATAS structure:

                    u16DataLen                    u8OptionLen
+-----------------------------------------------+----------------------+
|                    Data                       |     Optional         |
+-----------------------------------------------+----------------------+

*/

RETURN_TYPE uart_sendPacket(PACKET_SERIAL_TYPE *pPacket)
{
     uint16 i;
     uint8  u8CRC;

     // When both length fields are 0, then this telegram is not allowed.
     if((pPacket->u16DataLength || pPacket->u8OptionLength) == 0)
     {
          return OUT_OF_RANGE;
     }
     // Sync
     while(uart_sendByte(0x55) != OK);

     // Header
     while(uart_sendBuffer((uint8*)pPacket, 4) != OK);

     // Header CRC
     u8CRC = 0;
     u8CRC = proc_crc8(u8CRC, ((uint8*)pPacket)[0]);
     u8CRC = proc_crc8(u8CRC, ((uint8*)pPacket)[1]);
     u8CRC = proc_crc8(u8CRC, ((uint8*)pPacket)[2]);
     u8CRC = proc_crc8(u8CRC, ((uint8*)pPacket)[3]);
     while(uart_sendByte(u8CRC) != OK);

     // Data
     u8CRC = 0;
     for (i = 0 ; i < (pPacket->u16DataLength + pPacket->u8OptionLength) ; i++)
     {
          u8CRC = proc_crc8(u8CRC, pPacket->u8DataBuffer[i]);
          while(uart_sendByte(pPacket->u8DataBuffer[i]) != OK);
     }

     // Data CRC
     while(uart_sendByte(u8CRC)!=OK);

     return OK;
}
```