

	TEXAS INSTRUMENTS Microreader II Reference Guide	
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Reference Guide

Low Frequency HDX Microreader II

RI-STU-MRD2

(Preliminary)

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1. References

11-06-21-027	Reference Guide S2000 Reader System Micro Reader RI-STU-MRD1
11-07-22-014	Datasheet TMS37157 PaLFI

2. Definitions

2.1 Abbreviations

AID	Animal Identification Code
BCC	Block Check Character
BLC	Bit Length Coding
BSP	Bit Sequence Protocol
CDC	Communication Device Class
DIL	Dual in Line
ECM	Easy Code Mode
EOF	End of Frame
FBCC	Frame Block Check Character
FSK	Frequency Shift Keying
HDX	Half Duplex
HDX+	Half Duplex Plus (TMS37190 Transponder)
LMP	Legacy Microreader Protocol
MCU	Micro Controller Unit
MPT	Multipage Transponder
MRD1	Microreader (RI-STU-MRD1)
PaLFI	Passive Low Frequency Interface
PCB	Printed Circuit Board
PPM	Pulse Position Modulation
PWM	Pulse Width Modulation
RFU	Reserved for Future Use
RO	Read Only (Transponder)
R/W	Read / Write (Transponder)
RX	Receive
SM	Setup Mode
SMD	Surface Mounted Device
SOF	Start of Frame
TX	Transmit

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3. Product Description

The Microreader II module comprises a complete low frequency HDX RFID reader designed to operate together with a 47 μ H low Q antenna.

It is available in two form-factors. One is mechanical and electrical compatible to the MRD1 reader in a DIL format with pins and the other is a smaller size SMD module.

Main features of the reader are:

- Supply voltage from 2.7V to 5.5V
- Serial port host interface with baud rates up to 115200 baud
- USB host interface fully compliant with USB 2.0 full speed Specifications
- Support of RO, R/W, MPT, HDX+ and PaLFI transponders
- Measurement of the transponders low bit frequency
- Automatic resonance frequency trimming for HDX+ transponder
- Two input and two output pins for user functions
- Save and restore of user settings
- Firmware update via serial port or USB

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3.1 SMD Module

3.1.1 Product Photo



Figure 1 : Pictures of the MRD2 SMD module

3.1.2 Product Dimensions

The module is designed as SMD module with single sided component placement. Overall height of the module is below **4mm**. The PCB itself has a thickness of **1mm**.

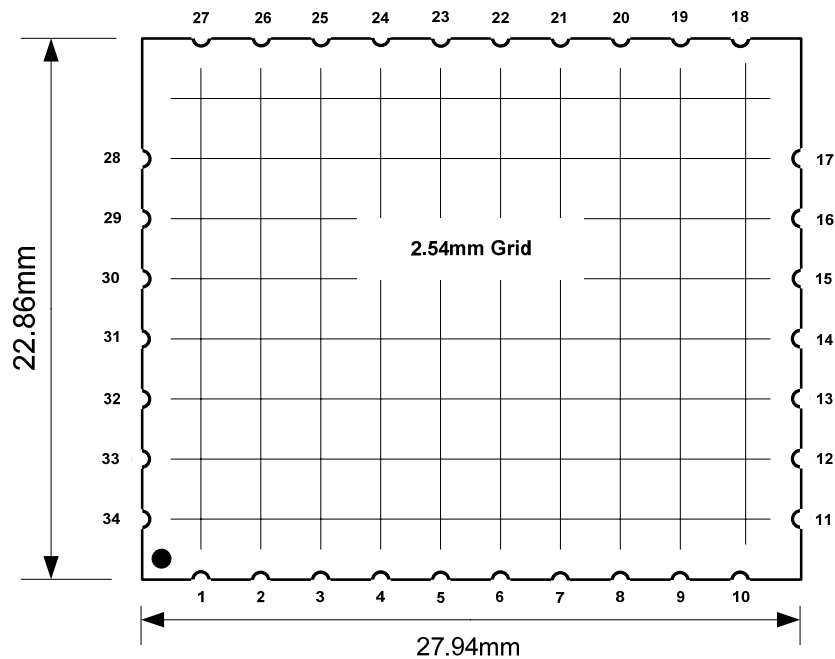


Figure 2 : Mechanical Dimensions, Top View MRD2 SMD module

3.1.3 Module Pin Configuration

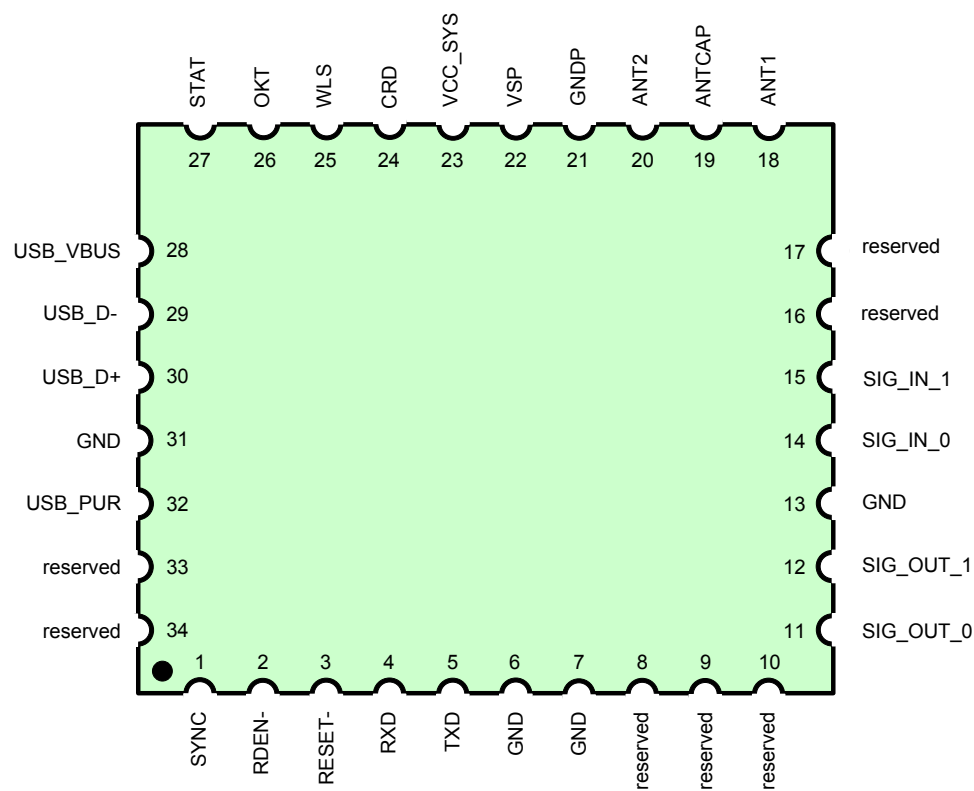


Figure 3 : Pin Configuration SMD Module

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3.1.4 Pin Functions

Pin	Pin Name	Func.	Description
1	SYNC	O	Output for wired synchronization (yellow LED)
2	RDEN-	I	Input for wired synchronization and single read trigger
3	RESET-	I	Reset of the Microreader (low active)
4	RXD	I	Receive Data signal input of serial interface
5	TXD	O	Transmit Data signal output of serial interface
6	GND		
7	GND		
8	reserved		(test pin; no user function)
9	reserved		
10	reserved		(test pin; no user function)
11	SIG_OUT_0	O	Programmable signal output 0
12	SIG_OUT_1	O	Programmable signal output 1
13	GND		
14	SIG_IN_0	I	Programmable signal input 0
15	SIG_IN_1	I	Programmable signal input 1
16	reserved		
17	reserved		
18	ANT1		Antenna terminal 1
19	ANTCAP		Antenna Capacitor terminal
20	ANT2		Antenna terminal 2
21	GNDP		Ground for output stage
22	VSP	P	Supply voltage output stage
23	VSL	P	
24	CRD	I	Input for continuous read mode
25	WLS	I	Input to switch wireless synchronization on
26	OKT	O	Output to show if a valid ID was read (green LED)
27	STAT	O	Output to show status of RF-transmitter control (red LED)
28	USB_VBUS	P	+5V from USB Port
29	USB_D-	B	USB Data
30	USB_D+	B	USB Data
31	GND		
32	USB_PUR	O	USB pullup resistor
33	reserved		(test pin; no user function)
34	reserved		(test pin; no user function)

Function: B = Bidir; I = Input; O = Output; P = Power;

Table 1 : Pin Functions SMD Module

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3.2 DIL Module

3.2.1 Product Photo



Figure 4 : MRD2 DIL module

3.2.2 Product Dimensions

(Dimensions shown of Microreader MRD1 – also valid for MRD2)

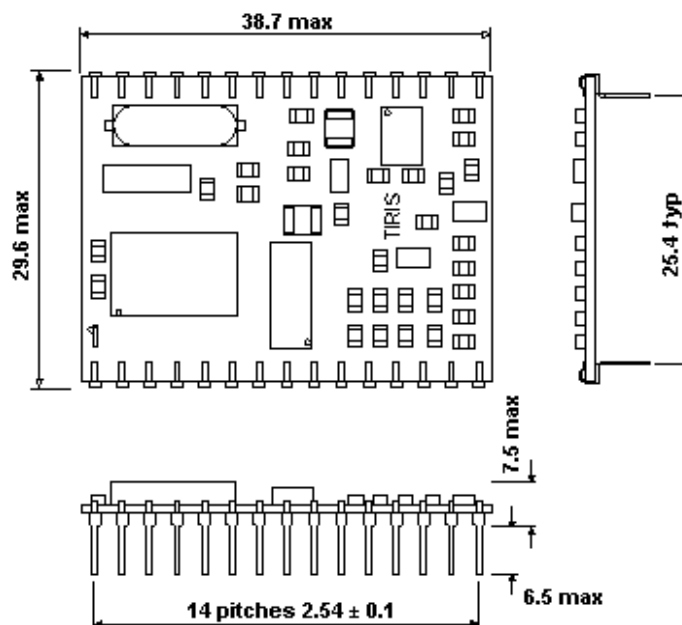


Figure 5 : Mechanical Dimensions MRD2 DIL module

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3.2.3 Pin Functions

Pin	Pin Name	Func.	Description
1	SYNC	O	Output for wired synchronization (yellow LED)
2	RDEN-	I	Input for wired synchronization and single read trigger
3	reserved		(test pin; no user function)
4	RESET-	I	Reset of the Microreader
5	RXD	I	Receive Data signal input of serial interface
6	TXD	O	Transmit Data signal output of serial interface
7	USB_D-	B	USB Data
8	USB_D+	B	USB Data
9	reserved		(test pin; no user function)
10	reserved		(test pin; no user function)
11	SIG_OUT_0	O	Programmable signal output 0
12	SIG_OUT_1	O	Programmable signal output 1
13	SIG_IN_0	I	Programmable signal input 0
14	SIG_IN_1	I	Programmable signal input 1
15	GND		
16	ANT1		Antenna terminal 1
17	ANTCAP		Antenna Capacitor terminal
18	reserved		do not connect
19	ANT2		Antenna terminal 2
20	reserved		do not connect
21	GNDP		Ground for output stage
22	VSP	P	Supply voltage output stage
23	USB_PUR	O	USB pullup resistor
24	VSL	P	
25	GND		
26	CRD	I	Input for continuous read mode
27	WLS	I	Input to switch wireless synchronization on
28	USB_VBUS	P	+5V from USB Port
29	OKT	O	Output to show if a valid ID was read (green LED)
30	STAT	O	Output to show status of RF-transmitter control (red LED)

Function: B = Bidir; I = Input; O = Output; P = Power;

Table 2: Pin Functions DIL Module

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3.3 Circuit Description

Main parts of the reader are the transmitter, receiver and the controller. In addition a voltage regulator and level shifters are implemented to maintain the specified wide supply range.

Generation of the transmit signal and demodulation of the receive signal is done by the controller as well as the handling of the two host interfaces, which are a serial port and a USB interface.

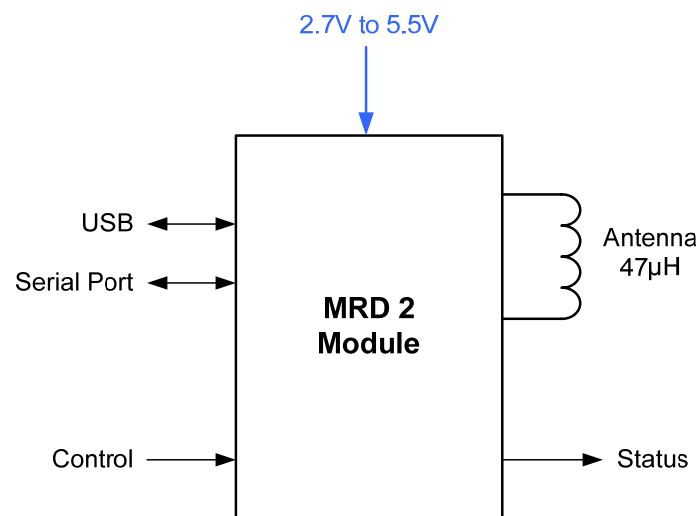


Figure 6 : Overview

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3.3.1 Transmit Stage

Main part of the transmit stage is a MOSFET half bridge circuit, which drives the antenna. The antenna is part of the resonance circuit L res, C res.

The antenna should have an inductance of $47\mu\text{H}$ and a quality factor Q of ~ 20 . With the reader build in C res of 30nF the resonance frequency is $\sim 134.2\text{kHz}$ and the quality factor of the system is ~ 10 .

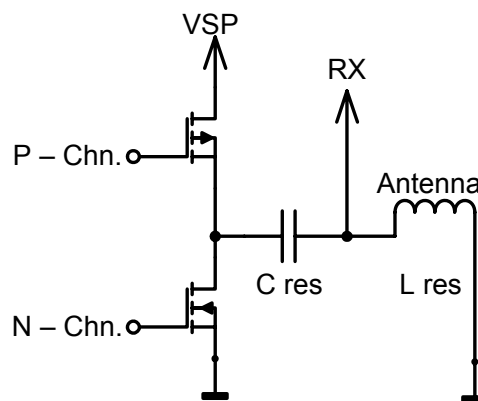


Figure 7 : TX-Stage Half Bridge Principle

3.3.2 Level Shifter

Over the complete supply voltage range of the module from 2.7V to 5.5V the output level of the digital output signals follows the supply voltage VSL. Although this module can work with low supply voltage the digital inputs are 5V tolerant. The digital outputs have a push/pull driver with at least $\pm 15\text{mA}$ output current.

3.3.3 Serial Port

Two signals build the serial interface between the reader and the controlling host. RXD is the serial port input and TXD the serial port output signals. No handshake signals are used. The logic level of these signals depends on the supply voltage VSL. The input RXD is 5V tolerant. For use as RS232 compatible port an external RS232 buffer is necessary. Factory default for the serial port parameters are 9600 baud 8N1 (8 data bits, no parity, 1 stop bit)

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3.3.4 USB Port

The USB host interface is fully compliant with the USB 2.0 full speed Specifications. Only a minimum of external components is necessary to connect the reader to a hosts USB port. These are ESD protection and termination of the datalines. In addition a diode for reverse supply protection and a blocking capacitor for the +5V VBUS are recommended.

The following schematic shows an example for the external USB circuitry.

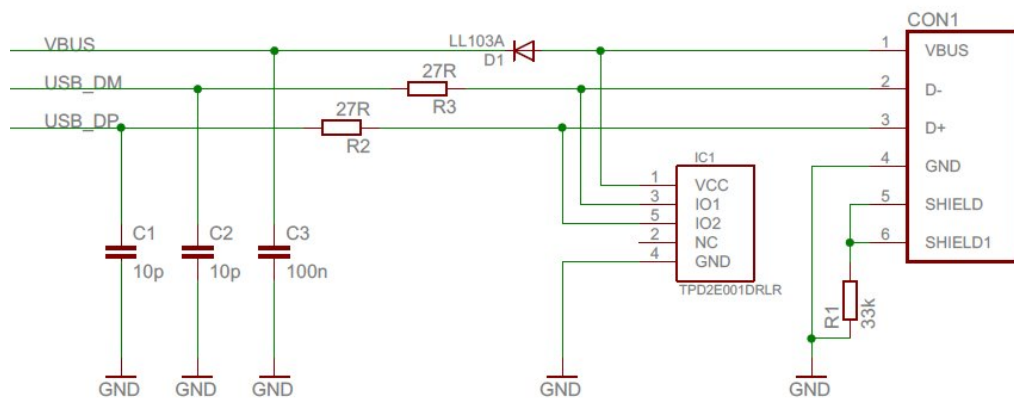


Figure 8 : External USB Port Components

The USB port is configured to show up as COM port at a Windows PC. When asked for a driver, at connection of the reader, browse to the MicroreaderII.INF file that is supplied with the reader (or available from TI support). The Windows Device Manager can give you information to which COM port the reader is configured.

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4. Communication between Host and Reader

Communication between host and reader is done either by the serial port or the USB port. Both ports can accept commands. No setup or switch between these ports is necessary. Response is sent to the port where the command comes from.

The USB port is configured as CDC (Communication Device Class). If connected to a PC, no special driver, but an INF file is required. If the port is installed by the host it is accessible as COM port.

Data transfer is done in a binary format. No ASCII characters interpretation is done. Due to this fact, the use of the ASCII Carriage Return (CR) or Line Feed (LF) for the command termination is not possible. The reader assumes a command as terminated if the number of bytes specified after the 0x01 start byte is received, or if for 10ms no new byte is received.

The Microreader is able to process different communication protocols. First of all it interprets the protocol defined for the current Microreader MRD1 with no restrictions. This protocol is referred to as **Legacy Microreader Protocol (LMP)**.

A full description of this protocol is found in the **RI-STU-MRD1 Reference Guide**. Based on this protocol, expansions are defined to support new functionality. These expansions are:

- **Bit Sequence Protocol**
allows to specify a transponder downlink at bit level
- **Easy Code Mode Protocol**
allows to specify a transponder downlink with a minimum of parameters based on the specification of the used device and the associated command
- **Setup Mode Protocol**
used to setup reader parameter or to handle functionality like the inventory process

4.1 Bit Sequence Protocol BSP

The Bit Sequence Protocol is similar to the Legacy Microreader Protocol LMP but has some enhancements. It can be used for transponders that are not implemented in the Easy Code Mode ECM or if special features are required. Using this protocol requires deep knowledge about the used transponder because the downlink to the transponder has to be defined bitwise. The response to a BSP command is the raw data received from the transponder including the Start-Byte but without the Pre-Bits.

4.1.1 BSP Command Format

Command

Start Byte	Length	CMD1	CMD2	CMD3	Power Burst 1
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5,6
0x01	0xXX	1XXX XXXX bin	1XXX XXXX bin	0XXX XXXX bin	0xXXXX

Power Burst 2	Number of TX Bits	Data	Number of RX Bytes	BCC
Byte 7,8	Byte 9	Byte 10...n	Byte n + 1	Byte n + 2
0xXXXX	0xXX	0xXX.....	0xXX	calculated

Figure 9: BSP Command Format (full)

- **Start Byte** is always 0x01
- The **Length** byte indicates the length in bytes of the following command and data fields.
- **CMD1 to CMD3** are command bytes that are used to configure the behavior of the downlink, like Power Bursts, Timing and so on.
Bit 8 of CMD1 and CMD2 must always be "1", Bit 8 of CMD3 must be "0".
- **Power Burst 1** this optional 16 bits value defines the length of the Power Burst 1 in millisecond. (max. 65 sec.)
- **Power Burst 2** this optional 16 bits value defines the length of the Power Burst 2 in millisecond. (max. 65 sec.)
- **Number of TX Bits** this value defines the length of the downlink to the transponder in bits. This value must be equal to or less than the number of data bits available in the **Data** section. If no **Data** is specified this field is omitted.
- The **Data** Field contains the data that is sent as downlink to the transponder. LSByte comes first. LSBit of LSByte will be transmitted first.
- **Number of RX Bytes** is the number of bytes that are expected from the transponder during the uplink. Count starts at the first bit of the Start Byte.
- The **BCC** Field is a one byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole command excluding the **Start-Byte**.

The fields: **Power Burst 1**, **Power Burst 2**, **Number of TX Bits** and **Data** are optional. The availability must correlate with the settings made in CMD1.

4.1.1.1 Command Bytes CMD1, CMD2, CMD3

Command bytes are used to configure the downlink protocol to the transponder. Here it can be specified if a power burst is needed or if data has to be send to the transponder as well as the duration of the power bursts and the used downlink timing. Finally special handling of the transmit mode, for instance if the carrier stays on after the data is transmitted, can be set.

CMD1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
"1"	Data	Power Burst 2	"0"	Power Burst 1	"0"	"0"	"0"

Figure 10: Command Byte CMD1

- Bit 3 - **Power Burst 1** has to be set if the command has a value for the duration of the Power Burst 1 specified. (Charge Burst)
- Bit 5 - **Power Burst 2** has to be set if the command has a value for the duration of the Power Burst 2 specified. (Program Burst)
- Bit 6 - **Data** indicates that the command contains a **Data** field an also the **Number of TX Bits** field.

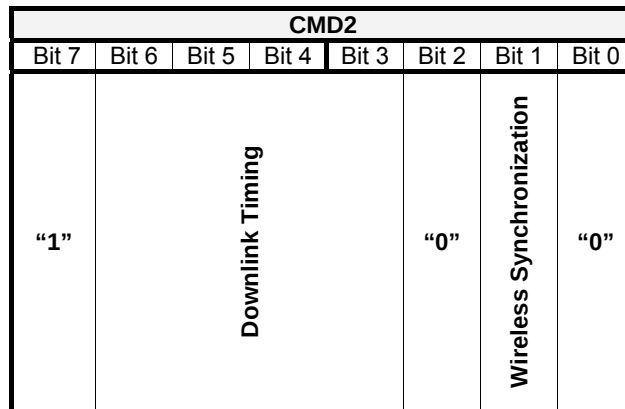


Figure 11: Command Byte CMD2

- Bit 1 – enables the **Wireless Synchronization**
- Bit 3-6 – **Downlink Timing** specifies the timing used for the downlink to the transponder. See the following table.

Downlink Timing	Bit 6	Bit 5	Bit 4	Bit 3
PWM (R/W & MPT)	0	0	0	0
PWM (Auto)	0	0	0	1
PPM	0	0	1	0
BLC (HDX+)	0	0	1	1
BLC (Auto) with SOF/EOF	0	1	0	0
BLC (Auto) with SOF without EOF	0	1	0	1
RFU	.	.	.	.

Table 3: CMD2 Downlink Timing Coding

CMD3							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
"0"	RFU	RFU	RFU (Immobilizer/ Passive Entry)		Send Ton first	Special TX Mode	

Figure 12: Command Byte CMD3

- Bit 0 and 1 **Special TX Mode** are used to set special behavior of the TX signal (carrier). See table below.
- Bit 2 **Send Ton first** reverses, if set, the timing specification of the downlink. One single bit of the downlink is composed of a time where the carrier is off (Toff) and a time where the carrier is on (Ton). Normally the carrier off (Toff) comes first. This can be changed to Ton first by setting this bit.

Mode	Bit 1	Bit 0
Normal	0	0
Keep TX on after downlink	0	1
Set TX on again after uplink was received	1	0
RFU	1	1

Table 4: Special TX Mode

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4.2 Easy Code Mode (ECM)

This protocol was implemented with the intention that user does not need deep knowledge of the device used. It should free the user from knowing all the timings, meanings of all bits and the sequence how they have to be send to, or how they have to be received from the transponder.

Only a minimum of information is necessary to construct an ECM reader command. This includes the device that is used in form of a device code, the command that should be send to the device and, if any, the parameters that belongs to the command. The reader's response will contain status information and also data, if data was requested with the command.

The raw structure of an ECM command is:

Device Code	Command	Parameters / Data
--------------------	----------------	--------------------------

The raw structure of an ECM response is:

Status Information	Data
---------------------------	-------------

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4.2.1 ECM Command Format

To fit into the Microreader's protocol structure, an ECM reader command needs additional byte fields. The following shows an ECM reader command in detail:

Start Byte	Length	CMD1	CMD2 Device Code	Device Command	Parameter, Data (optional)	BCC
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5...n	Byte 5 or Byte n + 1
0x01	0xXX	0x80	0xXX	0xXX	0xXX....	calculated

Table 6: ECM Command Format

- The **Start Byte** has a fix value of **0x01** and marks the beginning of the command.
- The **Length** byte indicates the length in bytes of the following command and data fields.
- **CMD1** has a value of **0x80** (single command)
- **CMD2** is the device code
- **Device Command**
- The presence of the **Parameter** and **Data** Field is optional and depends, as well as the number of bytes, on the device command.
- The **BCC** Field is a one byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole command excluding the **Start Byte**.

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4.2.1.1 ECM Device Codes

The table shows the implemented devices and their corresponding **Device Codes**.

Device	Device Type	Device Code (6 bits)
Read Only Transponder	TMS3719	0x00
Read Write Transponder	TMS37124	0x01
Multipage MPT 16/17	TMS3789	0x02
	TMS37159	
HDX+ RFU	TMS37190	0x03
		
PaLFI RFU	TMS37158	0x07
		
Raw Data of last Command		0x2F

Table 7: ECM Device Codes

The last Device Code is added for debug purpose. With this code (0x2F) the reader will not initiate a downlink to the transponder but will instead respond with the raw data received from the transponder at the last cycle.

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4.2.1.2 ECM Command Codes

Command Codes are divided into four groups:

- Read
- Program
- Lock and Protect
- Special

Command Codes and the Devices, for which these commands are valid, are shown in the following table.

Group	Command	Command Code	valid for Device				
			RO	R/W	MPT	HDX+	PaLFI
Read	Charge only Read	0x00	X	X	X	X	
	General Read	0x01			X	X	X
	Selective Read	0x02				X	
	Read Multi Block	0x03				X	
	Selective Read Multi Block	0x04				X	
	Read UID	0x05				X	
	Read Configuration	0x06				X	
							
Program	RFU	0x10					
	Program	0x11		X	X	X	X
	Selective Program	0x12				X	X
	Program Multi Blocks	0x13				X	
	Selective Prog. Multi Blocks	0x14				X	
	Program (CRC by Reader)	0x15		X	X		
	Write Configuration	0x16				X	
	Write AID (CRC by Reader)	0x17				X	
	Write TI R/W Transponder	0x18				X	
	Write C-Trim Value	0x19				X	
							
Lock And Protect	Lock	0x20			X	X	X
							
	Selective Lock	0x22				X	X
	Protect	0x23					X
	Selective Protect	0x24					X
							
Special	RFU	0x30					
	RFU	0x31					
	RFU	0x32					
	Battery Check	0x33					X
	Battery Charge	0x34					X
	MSP Access	0x35					X
	Successive Approx. C-Trim	0x36				X	

Table 8: ECM Command Codes Overview

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4.2.2 ECM Command Response Format

Response

Start Byte	Length	Status 1	Status 2	Data	BCC
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...n	Byte n + 1
0x01	0xXX	0xXX	0xXX.....	0xXX.....	calculated

- The **Start Byte** has a fix value of **0x01** and marks the beginning of the response.
- The **Length** byte indicates the length in bytes of the following status and data fields.
- **Status 1** and **Status 2** are used to show the status of the host to reader communication and the reader to transponder communication
- The presence of the **Data** Field is optional and depends, as well as the number of bytes, on the ECM command.
- The **BCC** Field is a one byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole response excluding the **Start Byte**.

4.2.2.1 Status Byte Format

The Status Bytes, Status 1 and Status 2, are used to show the status of the host to reader communication and the reader to transponder communication.

Bit 0 of Status 1 is used to distinguish between host to reader and reader to transponder. If **Bit 0 of Status 1** has a value of “1” host to reader protocol status is shown. In this case Status 2 has a value of 0x00.

Status Byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
“0”	“0”	“0”	“0”	Parameter Error	Unknown Device Code	Unknown Command Code	“1”

Status Byte 2							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
“0”	“0”	“0”	“0”	“0”	“0”	“0”	“0”

Table 9: Status Byte Definition for Host to Reader Protocol Status

- Bit 1 “**Unknown Command Code**” of Status 1 will be set to “1” if a Command code is send to the reader that is not defined.
- Bit 2 “**Unknown Device Code**” of Status 1 will be set to “1” if a Device code is send to the reader that is not defined.
- Bit 3 “**Parameter Error**” of Status 1 will be set to “1” if the length of the Parameter and Data field does not match with the Device / Command combination or if one of the Parameters is out of the allowed bounds.

If any of these errors occurred, no downlink is send to the transponder.
The response has the Length Byte set to “0x02” because no Data is responded.

If **Bit 0** of **Status 1** has a value of “0” reader to transponder protocol status is shown.

If no Error occurred or no status information is available, Status Bytes 1 and Status Byte 2 have a value of 0x00, which means the last command was executed successful. In the case that the Status Byte 1 has a value of 0x00 and Status Byte 2 has a value that is not equal 0x00, then Status Byte 2 shows not an error condition but only additional status information. This could be, if you read a page from a MPT transponder and get the status that the read page is a locked page which is not an error condition.

Status Byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Error shown in Status Byte 2	“0”	No Start Byte detected	Frame BCC Error	Data BCC (CRC) Error	Tag to Reader Protocol Error	Wrong Start Byte detected	“0”

Status Byte 2							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Raw Data follows	Command Groups			Error Codes			

Table 10: Status Byte Definition for Reader to Transponder Protocol Status

- Bit 1 of Status Byte 1 “**Wrong Start Byte detected**” will be set to “1” if a Start Byte is received by the reader that does not match the Device Code used in the reader command.

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- Bit 2 of Status Byte 1 “**Tag to Reader Communication Error**” is set to “1” if no or a wrong Stop Byte is received by the reader. This can happen if the received data is incomplete. The bit is also set if wrong trailing bits are received.
- Bit 3 of Status Byte 1 “**Data BCC (CRC) Error**” is set to “1” if the BCC (CRC) received from the transponder does not match with the transponder ID.
- Bit 4 of Status Byte 1 “**Frame BCC Error**” is set to “1” if the frame send by the transponder has a BCC error. Frame BCC are not available at all transponders. MPT and HDX+ can have a frame BCC
- Bit 5 of Status Byte 1 “No Start Byte Detected” is set to “1” if no valid Start Byte was detected.
- Bit 6 of Status Byte 1 is always “0”
- Bit 7 of Status Byte 1 indicates that Status Bytes 2 shows an error condition.

In error cases (Status Byte 1 not equal 0x00) no transponder data is responded. The ECM command with device code 0x2F can be used to get the received raw data.

The following Table shows the error coding in Status Byte 2.

Bit 7 of Status Byte 1 indicates if Status Byte 2 shows an error or if only additional status information is available (i.e. read of locked page).

The status information in Status Byte 2 is organized into two sections. The first section, bits 0 to 3 show the actual error code. Bits 4 to 6 indicate the command groups as Reader, Program, Lock and Special commands.

	Error		Command Groups			Error Codes				
	Status 1 Bit Nr.	Status Byte 2 Bit Number								
	7	7	6	5	4	3	2	1	0	
Description	7	7	6	5	4	3	2	1	0	Read
no Error	0	0	0	0	0	0	0	0	0	
Read locked page	0	0	0	0	0	0	0	0	1	
Page not available	1	0	0	0	0	0	0	1	0	
RFU		0	0	0	0					Program
Page is locked	1	0	0	0	1	0	0	0	1	
Page not available	1	0	0	0	1	0	0	1	0	
Programming not successful (or unreliable)	1	0	0	0	1	0	0	1	1	
Programming not successful (field strength to low)	1	0	0	0	1	0	1	0	0	
RFU		0	0	0	1					Lock & Protect
Page is locked	1	0	0	1	0	0	0	0	1	
Page not available	1	0	0	1	0	0	0	1	0	
Locking not successful (or unreliable)	1	0	0	1	0	0	0	1	1	
Locking not successful (field strength to low)	1	0	0	1	0	0	1	0	0	
RFU		0	0	1	0					Special
SPI Programming failed	1	0	0	1	1	0	0	0	1	
MSP Access execution failed	1	0	0	1	1	0	0	1	0	
RFU		0	0	1	1					
Raw Data received from Transponder will follow	0	1	X	X	X	X	X	X	X	
unknown	1	0	X	X	X	1	1	1	1	

Table 11 : Coding of Status Byte 2

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4.2.3 Device Commands Read Only Transponder RO

Devices	TMS3719
Device Code	0x00
Downlink Timing	<i>none</i>

4.2.3.1 Charge Only Read

Read Only Transponders support a single command the so called “Charge Only Read”. The response data contain a 16 bit checksum and a 64 bit ID.

Charge Only Read (Device Command 0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	00 hex
Device Command	1	4	00 hex
BCC	1	5	83 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
CRC	2	4,5	xxxx hex
ID	8	6-13	xxxxxxxxxxxxxxxx hex
BCC	1	14	calculated hex

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4.2.4 Device Commands Read Write Transponder R/W

Devices	TMS37124
Device Code	0x01
Downlink Timing	PWM (R/W & MPT)

Three different commands are supported for the R/W transponders which all have the same response format.

4.2.4.1 Charge Only Read

Charge Only Read (Device Command 0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	01 hex
Device Command	1	4	00 hex
BCC	1	5	82 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
CRC	2	4,5	xxxx hex
ID	8	6-13	xxxxxxxxxxxxxxxx hex
BCC	1	14	calculated hex

4.2.4.2 Program/Configuration

For the configuration an additional Keyword and Password is needed (see description of TMS37124 device)

Charge Only Read (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0F hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	01 hex
Device Command	1	4	11 hex
Keyword	1	5	xx hex
Password	1	6	xx hex
CRC	2	7,8	xxxx hex
ID	8	9-16	xxxxxxxxxxxxxxxx hex
BCC	1	17	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.4.1*).

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4.2.4.3 Program/Configuration; CRC calculated by Reader

For the configuration an additional Keyword and Password is needed (see description of TMS37124 device). The CRC for the ID will be calculated by the reader.

Charge Only Read (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0D hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	01 hex
Device Command	1	4	15 hex
Keyword	1	5	xx hex
Password	1	6	xx hex
ID	8	7-14	xxxxxxxxxxxxxxxx hex
BCC	1	15	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.4.1*).

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4.2.5 Device Commands Multipage Transponder MPT 16/17

Devices	TMS3789, TMS37159
Device Code	0x02
Downlink Timing	PWM (R/W & MPT)

Five different commands are supported for the MPT transponders,. All commands have the same response format.

4.2.5.1 Charge Only Read

The response to the “Charge Only Read” is different for the MPT16 and MPT17 transponders. The MPT16 transponder responds with the content of page 1 in the RO transponder format which has a Start Byte and a Stop Byte of 0x7E. The MPT17 transponder responds with the content of page 1 but in the MPT format with the “Read Address” instead of a fixed Stop Byte.

Charge Only Read (Device Command 0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	02 hex
Device Command	1	4	00 hex
BCC	1	5	81 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0D hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Data	10	4-13	xxxxxxxxxxxxxxxx hex
Read Address	1	14	xx hex
BCC	1	15	calculated hex

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4.2.5.2 General Read Page

This command reads one page with 80 bits of data from a MPT transponder.

General Read Page (Device Command 0x01)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	02 hex
Device Command	1	4	01 hex
Page Number	1	5	xx hex
BCC	1	6	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.5.1*).

4.2.5.3 Program Page

This command programs a page of a MPT transponder with 80 bits of data.

Program Page (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0E hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	02 hex
Device Command	1	4	11 hex
Page Number	1	5	xx hex
Write Data	10	6-15	xxxxxxxxxxxxxxxx hex
BCC	1	16	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.5.1*).

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4.2.5.4 Program Page 64 Bits; CRC calculated by Reader

This command programs one page of a MPT transponder with 80 bits of data. With the command 64 bits are specified and the reader adds 16 bits of CRC to the data.

Program Page; CRC by Reader (Device Command 0x15)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	02 hex
Device Command	1	4	15 hex
Page Number	1	5	xx hex
Write Data	8	6-13	xxxxxxxxxxxxxxxx hex
BCC	1	15	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.5.1*).

4.2.5.5 Lock Page

This command locks one page of a MPT transponder.

Lock Page (Device Command 0x20)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	02 hex
Device Command	1	4	20 hex
Page Number	1	5	xx hex
BCC	1	6	calculated hex

Response format is the same as for the “Charge Only Read” (*see 4.2.5.1*).

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4.2.6 Device Commands HDX+ Transponder

Devices	TMS37190
Device Code	0x03
Downlink Timing	BLC (HDX+)

17 different commands are defined for the HDX+ transponders. Due to the fact that various HDX+ derivatives exist some commands will work only with a specific transponder derivative.

4.2.6.1 Charge Only Read

The response to the “Charge Only Read” is the same as for a RO transponder.

Charge Only Read (Device Command 0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	00 hex
BCC	1	5	80 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
CRC	2	4,5	xxxx hex
ID	8	6-13	xxxxxxxxxxxxxxxx hex
BCC	1	14	calculated hex

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4.2.6.2 Read UID

The command reads the 48 bit UID of the transponder.

Read UID (Device Command 0x05)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	05 hex
BCC	1	5	85 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
UID	6	4-9	xxxxxxxxxx hex
BCC	1	10	calculated hex

4.2.6.3 General Read (Memory Read Single Block)

This command reads a 32 bits block from the transponders memory.

General Read (Single Block) (Device Command 0x01)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	01 hex
Block Number (0x00-0x0F)	1	5	xx hex
BCC	1	6	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Memory Data	4	4-7	xxxxxxx hex
BCC	1	8	calculated hex

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4.2.6.4 Selective Read (Memory Read Single Block Addressed)

This command reads a 32 bits block from the transponders memory if the specified UID matches the transponders UID.

Selective Read (Single Block Addressed) (Device Command 0x02)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0A hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	02 hex
UID	6	5-10	xxxxxxxxxxx hex
Block Number (0x00-0x0F)	1	11	xx hex
BCC	1	12	calculated hex

Response format is the same as for the “General Read (Memory Read Single Block)” command (*see 4.2.6.3*).

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4.2.6.5 Read Multi Block (Memory Read Two Blocks)

This command reads two 32 bits blocks from the transponders memory.

Read Multi Block (Device Command 0x03)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	03 hex
Start Block Number (0x00-0x0E)	1	5	xx hex
BCC	1	6	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Memory Data First Block	4	4-7	xxxxxxx hex
Memory Data Second Block	4	8-11	xxxxxxx hex
BCC	1	12	calculated hex

4.2.6.6 Selective Read Multi Block

This command reads two 32 bits block from the transponders memory if the specified UID matches the transponders UID.

Selective Read Multi Block (Device Command 0x04)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0A hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	04 hex
UID	6	5-10	xxxxxxxxxxx hex
Start Block Number (0x00-0x0E)	1	11	xx hex
BCC	1	12	calculated hex

Response format is the same as for the “Read Multi Block” command. (see 4.2.6.5).

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4.2.6.7 Program (Memory Write Single Block)

This command writes a 32 bits block to the transponders memory.

Program (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	11 hex
Block Number (0x00-0x0F)	1	5	xx hex
Write Data	4	6-9	xxxxxxx hex
BCC	1	10	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
BCC	1	4	calculated hex

4.2.6.8 Selective Program (Memory Write Single Block Addressed)

This command writes a 32 bits block to the transponders memory if the specified UID matches the transponders UID.

Selective Program (Device Command 0x12)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0E hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	12 hex
UID	6	5-10	xxxxxxxxxxx hex
Block Number (0x00-0x0F)	1	11	xx hex
Write Data	4	12-15	xxxxxxx hex
BCC	1	16	calculated hex

Response format is the same as for the “Program” command. (*see 4.2.6.7*)

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4.2.6.9 Program Multi Blocks (Memory Write two Blocks)

This command writes two 32 bits blocks to the transponders memory.

Program Multi Blocks (Device Command 0x13)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	13 hex
First Block Number (0x00-0x0E)	1	5	xx hex
Write Data First Block	4	6-9	xx hex
Write Data Second Block	4	10-13	xxxxxxx hex
BCC	1	14	calculated hex

Response format is the same as for the “Program” command. (*see 4.2.6.7*)

4.2.6.10 Selective Program Multi Blocks (Memory Write two Blocks Addressed)

This command writes two 32 bits blocks to the transponders memory if the specified UID matches the transponders UID.

Selective Program Multi Blocks (Device Command 0x14)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	12 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	14 hex
UID	6	5-10	xxxxxxxxxxx hex
First Block Number (0x00-0x0E)	1	11	xx hex
Write Data First Block	4	12-15	xxxxxxx hex
Write Data Second Block	4	16-19	xxxxxxx hex
BCC	1	20	calculated hex

Response format is the same as for the “Program” command. (*see 4.2.6.7*)

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4.2.6.11 Lock Block

This command locks a 32 bits block of the transponders memory.

Lock Block (Device Command 0x20)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	20 hex
Block Number (0x00-0x0F)	1	5	xx hex
BCC	1	6	calculated hex

Response format is the same as for the “Program” command. (*see 4.2.6.7*)

4.2.6.12 Selective Lock Block

This command locks a 32 bits block of the transponders memory if the specified UID matches the transponders UID.

Selective Lock Block (Device Command 0x22)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	12 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	22 hex
UID	6	5-10	xxxxxxxxxxx hex
Block Number (0x00-0x0F)	1	11	xx hex
BCC	1	12	calculated hex

Response format is the same as for the “Program” command. (*see 4.2.6.7*)

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4.2.6.13 Read Configuration

This command reads the configuration bytes “Config Byte 1” and “Config Byte 2” from the transponders memory.

Read Configuration (Device Command 0x06)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	06 hex
BCC	1	5	86 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Config Byte 1	1	4	xx hex
Config Byte 2	1	5	xx hex
BCC	1	6	calculated hex

4.2.6.14 Write Configuration

This command writes the configuration bytes “Config Byte 1” and “Config Byte 2” to the transponders memory.

Write Configuration (Device Command 0x16)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	05 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	16 hex
Config Byte 1	1	5	xx hex
Config Byte 2	1	6	xx hex
BCC	1	7	calculated hex

Response format is the same as for the “Read Configuration” command. (*see 4.2.6.13*)

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4.2.6.15 Write AID

This command writes the AID to the transponder. The CRC that belongs to this AID will be calculated by the reader and also written to the transponder.

Write AID (Device Command 0x17)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0B hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	17 hex
AID	8	5-12	xxxxxxxxxxxxxxxx hex
BCC	1	13	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
CRC	2	4,5	xxxx hex
AID	8	6-13	xxxxxxxxxxxxxxxx hex
BCC	1	14	calculated hex

4.2.6.16 Program C-Trim Switches

This command programs a 6 bit value to the transponders C-Trim switches for the trimming of the resonance frequency.

Program C-Trim Switches (Device Command 0x19)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	19 hex
Trim Value (0x00-0x3F)	1	5	xx hex
BCC	1	6	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Trim Value	1	5	xx hex
BCC	1	6	calculated hex

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4.2.6.17 Write TI R/W Transponder

This command programs a HDX+ transponder that is configured to be TI R/W transponder with 80 bits of data.

Program TI R/W Transponder (Device Command 0x18)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0D hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	03 hex
Device Command	1	4	18 hex
Write Data	10	5,14	xxxxxxxxxxxxxxxx hex
BCC	1	15	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0C hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Data	10	4-13	xxxxxxxxxxxxxxxx hex
BCC	1	14	calculated hex

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4.2.7 Device Commands PaLFI

Devices	TMS37157
Device Code	0x07
Downlink Timing	PWM (Auto)

4.2.7.1 General Read

This command reads a page with 6 bytes of data from the PaLFI memory. Valid page numbers are 1 to 3, 8 to 15 and 40 to 55.

General Read (Device Command 0x01)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	01 hex
Page Number (1-3, 8-15 ,40-55)	1	5	xx hex
BCC	1	6	calculated hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Data (see byte order below)	6	4-9	xxxxxxxxxxx hex
BCC	1	10	calculated hex

The following table describes the byte order of the response data.

Response Data Byte Order						
Page	5	4	3	2	1	0
1 - 3	SerialNr.	SerialNr.	SerialNr.	Manuf.	Data Page 2	Sel. Addr.
8 - 15	Data 4	Data 3	Data 2	Data 1	Data 0	Data Page 2
40 - 55	Data 4	Data 3	Data 2	Data 1	Data 0	Data Page 2

Note:

A read to the pages 1 to 3 will respond the same data for all three pages.

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4.2.7.2 Selective Read

This command reads a page with 6 bytes of data from the PaLFI memory when the specified **Selective Address** matches the **Selective Address** of the transponder (data in page 1).

Selective addressing is enabled when page 1 contains a value other than 0xFF.

Valid page numbers are 1 to 3.

Selective Read (Device Command 0x02)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	05 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	02 hex
Selective Address	1	5	xx hex
Page Number (1-3)	1	6	xx hex
BCC	1	7	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

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4.2.7.3 Program (Page 1 - 2)

This command writes a page with 1 byte of data to the PaLFI memory.

Valid page numbers are 1 and 2.

Page 1 contains the **Selective Address**. Any value other than 0xFF enables selective addressing. Page 2 contains 1 byte of user data.

Program (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	09 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	11 hex
Page Number (1,2)	1	5	xx hex
Data	1	6	xx hex
BCC	1	7	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

4.2.7.4 Program (8 - 15, 40 - 55)

This command writes a page with 5 bytes of data to the PaLFI memory.

Valid page numbers are 8 to 15 and 40 to 55.

Program (Device Command 0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	09 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	11 hex
Page Number (8-15, 40-55)	1	5	xx hex
Data	5	6-10	xxxxxxxxxx hex
BCC	1	11	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

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4.2.7.5 Selective Program (Page 1, 2)

This command writes a page with 1 byte of data to the PaLFI memory when the specified **Selective Address** matches the **Selective Address** of the transponder (data in page 1).

Selective addressing is enabled when page 1 contains a value other than 0xFF.

Valid page numbers are 1 and 2. (➔ Page 3 is factory locked)

Selective Program (Device Command 0x12)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0A hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	12 hex
Selective Address	1	5	xx hex
Page Number (1, 2)	1	6	xx hex
Data	1	7	xx hex
BCC	1	8	calculated hex

Response format is the same as for the “General Read” command. (see 4.2.7.1)

4.2.7.6 Selective Program (Page 8 – 15, 40 – 55)

This command writes a page with 5 bytes of data to the PaLFI memory when the specified **Selective Address** matches the **Selective Address** of the transponder (data in page 1).

Selective addressing is enabled when page 1 contains a value other than 0xFF.

Valid page numbers are 8 to 15 and 40 to 55 (➔ Page 3 is factory locked).

Selective Program (Device Command 0x12)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0A hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	12 hex
Selective Address	1	5	xx hex
Page Number (8 – 15, 40 – 55)	1	6	xx hex
Data	5	7-11	xxxxxxxxxx hex
BCC	1	12	calculated hex

Response format is the same as for the “General Read” command. (see 4.2.7.1)

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4.2.7.7 Lock

This command locks a page of the PaLFI memory.

Locked pages can not be programmed. The locking of a page is irreversible!

Valid page numbers are 1 to 2, 8 to 15 and 40 to 55 (➔ Page 3 is factory locked).

Lock (Device Command 0x20)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	20 hex
Page Number (1,2, 8-15, 40-55)	1	5	xx hex
BCC	1	12	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

4.2.7.8 Selective Lock

This command locks a page of the PaLFI memory if the specified **Selective Address** matches the **Selective Address** of the transponder (data in page 1).

Selective addressing is enabled when page 1 contains a value other than 0xFF.

Locked pages cannot be programmed. The locking of a page is irreversible!

Valid page numbers are 1 to 2, 8 to 15 and 40 to 55.

Selective Lock (Device Command 0x22)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	05 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	22 hex
Selective Address	1	5	xx hex
Page Number	1	6	xx hex
BCC	1	13	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

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4.2.7.9 Protect

This command protects a page of the PaLFI memory.

Protected pages can only be reprogrammed via SPI. The protection is irreversible!

Valid page numbers are 8 to 15 and 40 to 55.

Protect (Device Command 0x23)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	23 hex
Page Number (8-15, 40-55)	1	5	xx hex
BCC	1	12	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

4.2.7.10 Selective Protect

This command protects a page of the PaLFI memory if the specified **Selective Address** matches the **Selective Address** of the transponder (data in page 1).

Selective addressing is enabled when page 1 contains a value other than 0xFF.

Protected pages can only be reprogrammed via SPI. The protection is irreversible!

Valid page numbers are 8 to 15 and 40 to 55.

Selective Protect (Device Command 0x24)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	05 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	24 hex
Selective Address	1	5	xx hex
Page Number (8-15, 40-55)	1	6	xx hex
BCC	1	13	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

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4.2.7.11 MSP Access

This command starts a SPI cycle and sends 6 bytes of data to the device connected to the SPI interface. When the “MSP Access Time” is elapsed the data received at the SPI interface is send back to the reader. Set the “MSP Access Time” to 0x0000 if no response is expected.

MSP Access (Device Command 0x35)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0B hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	35 hex
Data	6	5-10	xxxxxxxxxxx hex
MSP Access Time [ms]	2	11,12	xxxx hex
BCC	1	13	calculated hex

Response format is the same as for the “General Read” command. (*see 4.2.7.1*)

4.2.7.12 Battery Check

This command gives information about the charge condition of the battery.

Battery Check (Device Command 0x33)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	33 hex
BCC	1	5	B0 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Data	1	4	xx hex
BCC	1	5	calculated hex

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4.2.7.13 Battery Charge

This command starts a charge of the battery.

The transponder will not respond to this command. Any following command that initiates a downlink to the device will stop the charge cycle.

Battery Charge (Device Command 0x34)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	07 hex
Device Command	1	4	34 hex
BCC	1	5	B7 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
BCC	1	4	calculated hex

4.2.7.14 Relation between PaLFI Read Address and MRII ECM Status Bytes

The TMS37157 device has a so called **Read Address** defined in the response protocol. This is a one byte value which contains in bit 7 to 2 the page address of the page that was address by the command. If no error occurs this is the address that was specified in the **Write Address** part of the command that was send to the transponder. The bits 1 and 0 are used to give status information about the last executed command.

The following table shows the relationship between this status information and the Status Byte 1 and 2 that is return by the reader when using the ECM protocol.

		Read Address		Error Status 1 Bit 7	Status Byte 2	Comment
Page Number	Command	Bit [7:2]	Bit [1:0]			
1 - 3	Read & Selective Read	> 0	00	0	0x00	read unlocked page
			01	1	0x0F	unknown
			10	0	0x01	read locked page
			11	1	0x0F	unknown
		= 0	00	1	0x0F	unknown
			01	1	0x0F	unknown
			10	1	0x0F	unknown
			11	1	0x0F	unknown
	Program & Selective Program	> 0	00	1	0x14	prog. not exec. fieldstrength too low
			01	0	0x00	done
			10	1	0x11	page is locked
			11	1	0x1F	unknown
		= 0	00	1	0x1F	unknown
			01	1	0x13	prog. possibly not reliable
			10	1	0x1F	unknown
			11	1	0x1F	unknown
	Lock & Selective Lock	> 0	00	1	0x24	lock not exec. fieldstrength too low
			01	1	0x2F	unknown
			10	0	0x21	done
			11	1	0x2F	unknown
		= 0	00	1	0x23	locking possible unreliable
			01	1	0x2F	unknown
			10	1	0x23	locking possible unreliable
			11	1	0x2F	unknown

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Page Number	Command	Bit [7:2]	Bit [1:0]	Error Status 1 Bit 7	Status Byte 2	Comment
8 - 15 and 40 - 55	Read	> 0	00	0	0x00	read unlocked page
			01	1	0x0F	unknown
			10	0	0x01	page is locked
			11	1	0x0F	unknown
		= 0	00	1	0x0F	unknown
			01	1	0x0F	unknown
			10	1	0x0F	unknown
			11	1	0x0F	unknown
	Program & Selective Program	> 0	00	1	0x14	prog. not exec. fieldstrength too low
			01	0	0x00	done
			10	1	0x11	page is locked
			11	1	0x1F	unknown
		= 0	00	1	0x1F	unknown
			01	1	0x13	prog. possibly not reliable
			10	1	0x1F	unknown
			11	1	0x1F	unknown
	Lock And Selective Lock	> 0	00	1	0x24	lock not exec. fieldstrength too low
			01	1	0x2F	unknown
			10	0	0x21	done
			11	1	0x2F	unknown
		= 0	00	1	0x23	locking possible unreliable
			01	1	0x2F	unknown
			10	1	0x23	locking possible unreliable
			11	1	0x2F	unknown
	Protect & Selective Protect	> 0	00	1	0x24	Protection not set, fieldstrength too low
			01	1	0x2F	unknown
			10	1	0x24	Protection not set, fieldstrength too low
			11	0	0x00	done
		= 0	00	1	0x2F	unknown
			01	1	0x2F	unknown
			10	1	0x2F	unknown
			11	1	0x23	protection set but possible not reliable

19	Battery Check	> 0	00	0	0x00	read unlocked page
			01	1	0x3F	unknown
			10	1	0x3F	unknown
			11	1	0x3F	unknown
		= 0	00	1	0x3F	unknown
			01	1	0x3F	unknown
			10	1	0x3F	unknown
			11	1	0x3F	unknown

31	MSP Access	> 0	00	1	0x31	SPI Programming failed
			01	0	0x3x	MSP Access execution ok
			10	1	0x3F	unknown
			11	1	0x3F	unknown
		= 0	00	1	0x32	MSP Access execution failed
			01	1	0x32	MSP Access execution failed
			10	1	0x3F	unknown
			11	1	0x3F	unknown

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4.2.7.15 Device Command Raw Data Response

Devices	all
Device Code	0x2F
Downlink Timing	not applicable

For debug purpose a special device code was defined. If this device code is used the reader responds with the raw data that was received from the transponder during the last command.

The length of the response depends on the number of bits received.

Raw Data Response (Device Command 0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	80 hex
Device Code (CMD2)	1	3	2F hex
<i>Don't care</i>	1	4	00 hex
BCC	1	5	AC hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	xx hex
Status 1	1	2	xx hex
Status 2	1	3	xx hex
Raw Data	n	4-n	xx.....xx hex
BCC	1	n + 1	calculated hex

The **Raw Data** contains the bit sequence receive from the transponder. Byte number 4 of the response, which is the first byte of the raw data, contains in bit 0 the first data bit receive from the transponder. This the first bit of the Start Byte.

The following table shows the bit sequence in the **Raw Data**.

Raw Data															
Byte Number 4								Byte Number 5							
7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8


 ▲ first bit received

Table 12 : Raw Data Bit Sequence

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4.3 Setup Mode

The current Microreader protocol specification has no setup mode defined. The new MRII protocol is extended with a setup mode to maintain the following functionality:

- get firmware / protocol version and hardware type
- get MSP430 serial number
- get and set timing parameter
- carrier on/off for field-strength measurements
- get last measured low bit frequency
- setup of serial port baud rate
- save to flash setting and restore to factory defaults
- automated determination of the C-Trim value
- initiation of the inventory process (normal and ISO)
- protocol specific settings

The MRD1 protocol defines Bit 0, Bit 1 = ‘11’ of the Command Field 1 as command for the MR to send the MR firmware version.

For the new Setup Mode the same command is used with the addition of Bit 7 = ‘1’ which is used to indicate that a second command byte follows. This results in a fix value of **0x83** for Command Field 1.

The new defined setup mode commands are specified within the Command Field 2.

Note:

*All values that are altered are temporary and will be lost after a reset or power down of the reader. Use the “**Save Settings**” command to permanently store the settings in the reader’s flash memory.*

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CMD2	Description	Influence on Protocol		
		LMP	BSP	ECM
0x00	Get firmware version			
0x01	Get protocol version			
0x02	Get hardware type			
0x03	Get serial number (from MSP)			
0x04	Get PWM timing		•	•
0x05	Set PWM timing		•	•
0x06	Get PWM (R/W & MPT) timing		•	•
0x07	Set PWM (R/W & MPT) timing		•	•
0x08	Get PPM timing		•	•
0x09	Set PPM timing		•	•
0x0A	Get BLC (HDX+) timing		•	•
0x0B	Set BLC (HDX+) timing		•	•
0x0C	Get BLC (Auto) timing		•	•
0x0D	Set BLC (Auto) timing		•	•
...	RFU (new timing specs)			
0x10	Set Duration Power Burst I (Charge)	• ¹⁾	• ¹⁾	•
0x11	Get Duration Power Burst I (Charge)			•
0x12	Set Duration Power Burst II (Program)	• ¹⁾	• ¹⁾	•
0x13	Get Duration Power Burst II (Program)			•
....	RFU			
0x20	Set downlink CRC in HDX+ protocol (on / off)			•
0x21	Set uplink CRC in HDX+ protocol (on / off)			•
0x23	Set check R/W Data CRC (on/off)			•
0x24	Set check MPT Data CRC (on/off)			•
....	RFU			
0x30	Start Inventory (1-slot)			
0x31	Start Inventory ISO11785 (1-slot)			
....	RFU			
0x40	Set serial port communication speed (baud rate)	•	•	•
0x41	Get low bit frequency of last uplink			
0x42	Receiver power (on/off)			
0x43	Execute C - trimming			
0x44	Carrier (on / off)			
0x45	RFU			
0x46	STAT pin mode	•	•	•
0x47	Get status of SIG_IN_0			
0x48	Get status of SIG_IN_1			
0x49	Set output SIG_OUT_0			
0x4A	Set output SIG_OUT_1			
0x4B	RFU			
0x4C	Set demodulation threshold mode	•	•	•
0x4D	Power Reader (RFM) connected (on/off)	•	•	•
0x50	Save settings to flash			
0x51	Restore settings to defaults (needs additional keyword)			
0x52	Firmware Update			
0xF0	Get firmware build data & time			

Figure 14: Setup Mode Command Byte 2

(**LMP** = Legacy Microreader Protocol; **BSP** = Bit Sequence Protocol; **ECM** = Easy Code Mode)

1) If Power Burst in Protocol defined as "0"

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4.3.1 Setup Command Format

Command

Start Byte	Length	CMD1	CMD2	Data (optional)	BCC
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4...n	Byte 4 or Byte n + 1
0x01	0xXX	0x83	0xXX	0xXX.....	calculated

- The **Start Byte** has a fix value of **0x01** and marks the beginning of the command.
- The **Length** byte indicates the length in bytes of the following command and data fields.
- **CMD1** has a fix value of **0x83** for setup mode commands.
- **CMD2** represents the command.
- The presence of the Data Field is optional and depends, as well as the number of data bytes, on the command specified as **CMD2**.
- The **BCC** Field is a one byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole command excluding the **Start Byte**.
- An unknown Setup Command should return 0x01 0x00 0x00

4.3.2 Setup Command Response Format

Response

Start Byte	Length	Data	BCC
Byte 0	Byte 1	Byte 2...n	Byte n + 1
0x01	0xXX	0xXX.....	calculated

- The **Start Byte** has a fix value of **0x01** and marks the beginning of the response.
- The **Length** byte indicates the length in bytes of the following data fields.
- The length of the **Data Field** depends on the command that was send.
- The **BCC** Field is a one byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole response excluding the **Start Byte**.

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4.3.3 Setup Commands

The following section is a detailed description of all available setup mode commands.

4.3.3.1 Get Firmware Version (CMD 0x00)

Response is the version of the firmware in a two byte format. Both bytes can range from 0 to 99 (decimal).

The minor version byte will be interpreted always as two digits.

Example:

Major byte = 0x01; Minor Byte = 0x02 will be version 1.02

Major byte = 0x01; Minor Byte = 0x14 will be version 1.20

Get Firmware Version (0x00)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	00 hex
BCC	1	4	81 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Firmware Version Major	1	2	xx hex
Firmware Version Minor	1	3	xx hex
BCC	1	4	calculated

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4.3.3.2 Get Protocol Version (CMD 0x01)

This version will be incremented if protocol relevant changes in the firmware are made, for instance if a new device is implemented.

Response is the version of the protocol in a two byte format. Both bytes can range from 0 to 99 (decimal).

The minor version byte will be interpreted always as two digits.

Example:

Major byte = 0x01; Minor Byte = 0x02 will be version 1.02

Major byte = 0x01; Minor Byte = 0x14 will be version 1.20

Get Protocol Version (0x01)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	01 hex
BCC	1	4	80 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Protocol Version Major	1	2	xx hex
Protocol Version Minor	1	3	xx hex
BCC	1	4	calculated

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4.3.3.3 Get Hardware Type (CMD 0x02)

If hardware changes made that are relevant for the user, for instance added new features, the hardware type information will be changed.

Response is the hardware type of the reader in a two byte format. Both bytes can range from 0 to 99 (decimal).

The minor hardware type byte will be interpreted always as two numbers.

Example:

Major byte = 0x01; Minor Byte = 0x02 will be type 1.02

Major byte = 0x01; Minor Byte = 0x14 will be type 1.20

Get Hardware Type (0x02)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	02 hex
BCC	1	4	83 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Hardware Type Major	1	2	xx hex
Hardware Type Minor	1	3	xx hex
BCC	1	4	calculated

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4.3.3.4 Get Serial Number (CMD 0x03)

The serial number reported with this command is the MSP430 wafer-lot and wafer-position information.

This data is 8 bytes long and can be found in the MSP430 memory beginning at address 0x1A0A.

It can be used for a unique identification of a reader module.

Get Serial Number (0x03)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	03 hex
BCC	1	4	82 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
MSP430 Wafer Lot and Position	8	2..9	xxxxxxxxxxxxxxxx hex
BCC	1	10	calculated

4.3.3.5 Get PWM Timing (CMD 0x04)

The currently active parameters for the PWM downlink timing are reported with this command.

Each of the 4 timing parameters is reported as 2 bytes which represents the timing in microseconds.

Get PWM Timing (0x04)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	04 hex
BCC	1	4	85 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
toffLow [µs]	2	2,3	xxxx hex
tonLow [µs]	2	4,5	xxxx hex
toffHigh [µs]	2	6,7	xxxx hex
tonHigh [µs]	2	8,9	xxxx hex
BCC	1	10	calculated

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4.3.3.6 Set PWM Timing (CMD 0x05)

This command can be used to change the PWM downlink timing parameters. Each of the 4 timing values has to be specified as 2 bytes and represents the timing in microseconds.

If any timing value is set to zero, the complete PWM timing will be set to factory default values.

Set PWM Timing (0x05)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	0A hex
CMD 1		1	2	83 hex
CMD 2		1	3	05 hex
toffLow [μ s]	170 μ s	2	4,5	xxxx hex
tonLow [μ s]	330 μ s	2	6,7	xxxx hex
toffHigh [μ s]	480 μ s	2	8,9	xxxx hex
tonHigh [μ s]	520 μ s	2	10,11	xxxx hex
BCC		1	12	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	08 hex
toffLow [μ s]		2	2,3	xxxx hex
tonLow [μ s]		2	4,5	xxxx hex
toffHigh [μ s]		2	6,7	xxxx hex
tonHigh [μ s]		2	8,9	xxxx hex
BCC		1	10	calculated

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4.3.3.7 Get PWM (R/W & MPT) Timing (CMD 0x06)

The currently active parameters for the PWM downlink timing, which is used for R/W and MPT transponders, are reported with this command.

Each of the 4 timing parameters is reported as 2 bytes which represents the timing in microseconds.

Get PWM (R/W & MPT) Timing (0x06)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	06 hex
BCC	1	4	87 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
toffLow [μ s]	2	2,3	xxxx hex
tonLow [μ s]	2	4,5	xxxx hex
toffHigh [μ s]	2	6,7	xxxx hex
tonHigh [μ s]	2	8,9	xxxx hex
BCC	1	10	calculated

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4.3.3.8 Set PWM (R/W & MPT) Timing (CMD 0x07)

This command can be used to change the PWM downlink timing parameters, which are used for R/W and MPT transponders.

Each of the 4 timing values has to be specified as 2 bytes and represents the timing in microseconds.

If any timing value is set to zero the complete PWM (R/W & MPT) timing will be set to factory default values.

Set PWM (R/W & MPT) Timing (0x07)

Command				
Parameter	Factory Defaults	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	0A hex
CMD 1		1	2	83 hex
CMD 2		1	3	07 hex
toffLow [μs]	300μs	2	4,5	xxxx hex
tonLow [μs]	1700μs	2	6,7	xxxx hex
toffHigh [μs]	1000μs	2	8,9	xxxx hex
tonHigh [μs]	1000μs	2	10,11	xxxx hex
BCC		1	12	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	08 hex
toffLow [μs]		2	2,3	xxxx hex
tonLow [μs]		2	4,5	xxxx hex
toffHigh [μs]		2	6,7	xxxx hex
tonHigh [μs]		2	8,9	xxxx hex
BCC		1	10	calculated

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4.3.3.9 Get PPM Timing (CMD 0x08)

The currently active parameters for the PPM downlink timing are reported with this command.

Each of the 4 timing parameters is reported as 2 bytes which represents the timing in microseconds.

Get PPM Timing (0x08)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	08 hex
BCC	1	4	89 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	08 hex
toffLow [μ s]	2	2,3	xxxx hex
tonLow [μ s]	2	4,5	xxxx hex
toffHigh [μ s]	2	6,7	xxxx hex
tonHigh [μ s]	2	8,9	xxxx hex
BCC	1	10	calculated

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4.3.3.10 Set PPM Timing (CMD 0x09)

This command can be used to change the PPM downlink timing parameters. Each of the 4 timing values has to be specified as 2 bytes and represents the timing in microseconds.

If any timing value is set to zero the complete PPM timing will be set to factory default values.

Set PPM Timing (0x09)

Command				
Parameter	Factory Defaults	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	0A hex
CMD 1		1	2	83 hex
CMD 2		1	3	09 hex
toffLow [μ s]	170 μ s	2	4,5	xxxx hex
tonLow [μ s]	230 μ s	2	6,7	xxxx hex
toffHigh [μ s]	170 μ s	2	8,9	xxxx hex
tonHigh [μ s]	350 μ s	2	10,11	xxxx hex
BCC		1	12	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	08 hex
toffLow [μ s]		2	2,3	xxxx hex
tonLow [μ s]		2	4,5	xxxx hex
toffHigh [μ s]		2	6,7	xxxx hex
tonHigh [μ s]		2	8,9	xxxx hex
BCC		1	10	calculated

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4.3.3.11 Get BLC (HDX+) Timing (CMD 0x0A)

The currently active parameters for the BLC downlink timing are reported with this command.

Each of the 8 timing parameters is reported as 2 bytes which represents the timing in microseconds.

Set BLC (HDX+) Timing (0x0A)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	0A hex
BCC	1	4	8B hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	10 hex
SOFOff [μ s]	2	2,3	xxxx hex
SOFOH [μ s]	2	4,5	xxxx hex
toffLow [μ s]	2	6,7	xxxx hex
tonLow [μ s]	2	8,9	xxxx hex
toffHigh [μ s]	2	10,11	xxxx hex
tonHigh [μ s]	2	12,13	xxxx hex
EOFOff [μ s]	2	14,15	xxxx hex
EOFOH [μ s]	2	16,17	xxxx hex
BCC	1	18	calculated

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4.3.3.12 Set BLC (HDX+) Timing (CMD 0x0B)

This command can be used to change the BLC (HDX+) downlink timing parameters. Each of the 8 timing values has to be specified as 2 bytes and represents the timing in microseconds.

If any timing value is set to zero the complete BLC (HDX+) timing will be set to factory default values.

Set BLC (HDX+) Timing (0x0B)

Command				
Parameter	Factory Defaults	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	12 hex
CMD 1		1	2	83 hex
CMD 2		1	3	0B hex
SOFoff [μ s]	298 μ s	2	4,5	xxxx hex
SOFon [μ s]	499 μ s	2	6,7	xxxx hex
toffLow [μ s]	149 μ s	2	8,9	xxxx hex
tonLow [μ s]	171 μ s	2	10,11	xxxx hex
toffHigh [μ s]	149 μ s	2	12,13	xxxx hex
tonHigh [μ s]	238 μ s	2	14,15	xxxx hex
EOFFoff [μ s]	149 μ s	2	16,17	xxxx hex
EOFFon [μ s]	373 μ s	2	18,19	xxxx hex
BCC		1	20	calculated

Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	10 hex
SOFoff [μ s]	2	2,3	xxxx hex
SOFon [μ s]	2	4,5	xxxx hex
toffLow [μ s]	2	6,7	xxxx hex
tonLow [μ s]	2	8,9	xxxx hex
toffHigh [μ s]	2	10,11	xxxx hex
tonHigh [μ s]	2	12,13	xxxx hex
EOFFoff [μ s]	2	14,15	xxxx hex
EOFFon [μ s]	2	16,17	xxxx hex
BCC	1	18	calculated

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4.3.3.13 Get BLC (Automotive) Timing (CMD 0x0C)

The currently active parameters for the BLC (Automotive) downlink timing are reported with this command.

Each of the 8 timing parameters is reported as 2 bytes which represents the timing in microseconds.

Get BLC (Automotive) Timing (0x0C)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	0C hex
BCC	1	4	8D hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	10 hex
SOFOff [μ s]	2	2,3	xxxx hex
SOFOH [μ s]	2	4,5	xxxx hex
toffLow [μ s]	2	6,7	xxxx hex
tonLow [μ s]	2	8,9	xxxx hex
toffHigh [μ s]	2	10,11	xxxx hex
tonHigh [μ s]	2	12,13	xxxx hex
EOFOff [μ s]	2	14,15	xxxx hex
EOFOH [μ s]	2	16,17	xxxx hex
BCC	1	18	calculated

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4.3.3.14 Set BLC (Automotive) Timing (CMD 0x0D)

This command can be used to change the BLC (Automotive) downlink timing parameters.

Each of the 8 timing values has to be specified as 2 bytes and represents the timing in microseconds.

If any timing value is set to zero the complete BLC (Automotive) timing will be set to factory default values.

Set BLC (Auto) Timing (0x0D)

Command				
Parameter	Factory Defaults	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	12 hex
CMD 1		1	2	83 hex
CMD 2		1	3	0D hex
SOFOff [μ s]	170 μ s	2	4,5	xxxx hex
SOFOF [μ s]	460 μ s	2	6,7	xxxx hex
toffLow [μ s]	170 μ s	2	8,9	xxxx hex
tonLow [μ s]	230 μ s	2	10,11	xxxx hex
toffHigh [μ s]	170 μ s	2	12,13	xxxx hex
tonHigh [μ s]	350 μ s	2	14,15	xxxx hex
EOFOff [μ s]	170 μ s	2	16,17	xxxx hex
EOFOF [μ s]	580 μ s	2	18,19	xxxx hex
BCC		1	20	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	10 hex
SOFOff [μ s]		2	2,3	xxxx hex
SOFOF [μ s]		2	4,5	xxxx hex
toffLow [μ s]		2	6,7	xxxx hex
tonLow [μ s]		2	8,9	xxxx hex
toffHigh [μ s]		2	10,11	xxxx hex
tonHigh [μ s]		2	12,13	xxxx hex
EOFOff [μ s]		2	14,15	xxxx hex
EOFOF [μ s]		2	16,17	xxxx hex
BCC		1	18	calculated

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4.3.3.15 Set Duration of Power Burst 1 (CMD 0x10)

This command can be used to change the duration of the Power Burst 1.
If the duration is set to zero, the duration will be set to the factory default value.

Set Duration Power Burst 1 (0x10)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	04 hex
CMD 1		1	2	83 hex
CMD 2		1	3	10 hex
Duration [ms]	50ms	2	4,5	xxxx hex
BCC		1	6	calculated
Response (n+1 times)				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	02 hex
Duration		2	2,3	xxxx hex
BCC		1	4	calculated

4.3.3.16 Get Duration of Power Burst 1 (CMD 0x11)

The currently active parameter for the Power Burst 1 duration is reported with this command.

Get Duration Power Burst 1 (0x11)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	11 hex
BCC	1	4	90 hex
Response (n+1 times)			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Duration	2	2,3	xxxx hex
BCC	1	4	calculated

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4.3.3.17 Set Duration of Power Burst 2 (CMD 0x12)

This command can be used to change the duration of the Power Burst 2.
If the duration is set to zero, the duration will be set to the factory default value.

Set Duration Power Burst 2 (0x12)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	04 hex
CMD 1		1	2	83 hex
CMD 2		1	3	12 hex
Duration [ms]	17ms	2	4,5	xxxx hex
BCC		1	6	calculated
Response (n+1 times)				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	02 hex
Duration		2	2,3	xxxx hex
BCC		1	4	calculated

4.3.3.18 Get Duration of Power Burst 2 (CMD 0x13)

The currently active parameter for the Power Burst 2 duration is reported with this command.

Get Duration Power Burst 2 (0x13)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	13 hex
BCC	1	4	93 hex
Response (n+1 times)			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
Duration	2	2,3	xxxx hex
BCC	1	4	calculated

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4.3.3.19 Set - Downlink CRC in HDX+ Protocol (CMD 0x20)

HDX+ transponders can use a CRC in the downlink protocol. This command can be used to switch this function on or off.

Set the parameter to “0x00” to switch this function off or set to “0x01” to switch it on. Any other value will not change the setting but returns the current setting in the response.

Set - Downlink CRC in HDX+ protocol on/off (0x20)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	20 hex
Data	on	1	4	0 = off / 1 = on hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (returns current setting)		1	2	xx hex
BCC		1	3	calculated

4.3.3.20 Set - Uplink CRC in HDX+ Protocol (CMD 0x21)

HDX+ transponders can use a CRC in the uplink protocol. This command can be used to switch this function on or off.

Set the parameter to “0x00” to switch this function off or set to “0x01” to switch it on. Any other value will not change the setting but returns the current setting in the response.

Uplink CRC in HDX+ protocol on/off (0x21)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	21 hex
Data	off	1	4	0 = off / 1 = on hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (returns current setting)		1	2	xx hex
BCC		1	3	calculated

4.3.3.21 Set – Check R/W Data CRC (CMD 0x23)

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R/W transponders provide 80bit of data. This data can be handled as 80bit data or as 64bit data and 16bit CRC. When using the ECM protocol this CRC will be checked and the result is reported in the status byte. This check can be turned on or off with this command.

Set the parameter to “0x00” to switch this function off or set to “0x01” to switch it on. Any other value will not change the setting but returns the current setting in the response.

Check R/W Data CRC on/off (0x23)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	23 hex
Data	on	1	4	0 = off / 1 = on hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (returns current setting)		1	2	xx hex
BCC		1	3	calculated

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4.3.3.22 Set – Check MPT Data CRC (CMD 0x24)

MPT transponders have 80bit data in each memory page. This data can be handled as 80bit data or as 64bit data and 16bit CRC. When using the ECM protocol this CRC will be checked and the result is reported in the status byte. This check can be turned on or off with this command.

Set the parameter to “0x00” to switch this function off or set to “0x01” to switch it on. Any other value will not change the setting but returns the current setting in the response.

Check MPT Data CRC on/off (0x24)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	24 hex
Data	off	1	4	0 = off / 1 = on hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (returns current setting)		1	2	xx hex
BCC		1	3	calculated

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4.3.3.23 Start 1-Slot Inventory Process (CMD 0x30)

Execution of this command start the 1-slot inventory process for HDX+ advanced transponders.

Reader responds with every found UID. A timeout in seconds must be specified for this process.

Status Byte is “01” for the first valid UID that is responded and will be incremented for each new responded UID.

Status Byte is “00” if inventory has finished. (UID in response is invalid)

Status Byte is “FF” if timeout has occurred. (UID in response is invalid)

Start 1-Slot Inventory Process (0x30)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 Hex
Length	1	1	03 Hex
CMD 1	1	2	83 Hex
CMD 2	1	3	30 Hex
Timeout [s]	1	4	xx Hex
BCC	1	5	calculated
Response (n+1 times)			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 Hex
Length	1	1	07 Hex
Status Byte	1	2	xx Hex
UID	6	3..8	xxxxxxxxxxx Hex
BCC	1	9	calculated

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4.3.3.24 Start 1-Slot ISO 11785 Inventory Process (CMD 0x31)

Execution of this command start the 1-slot inventory process for HDX+ advanced transponders.

Reader responds with every found UID and AID. A timeout in seconds must be specified for this process.

Status Byte is “01” for the first valid UID that is responded and will be incremented for each new responded UID.

Status Byte is “00” if inventory has finished. (UID and AID data is invalid)

Status Byte is “FF” if timeout has occurred. (UID and AID data is invalid)

Start 1-Slot ISO11785 Inventory Process (0x31)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	31 hex
Timeout [s]	1	4	xx hex
BCC	1	5	calculated
Response (n+1 times)			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	0F hex
Status Byte	1	2	xx hex
UID	6	3..8	xxxxxxxxxxxx hex
AID	8	9..16	xxxxxxxxxxxx hex
BCC	1	17	calculated

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4.3.3.25 Set Serial Port Communication Speed (CMD 0x40)

The communication speed of the serial port can be set with this command.
All other communication parameters are set fix to 1 stop bit, 8 data bits, no parity and no handshake.

(XON, XOFF software handshake is used with a Microreader specific functionality)

Response to command is done with the same baud rate as the command was send.

Valid values range from 1 to 6. Any other value will set the baud rate to 9600 baud.

A value of 0xFF will not change the setting but returns the current setting.

Set Serial Port Communication Speed (0x40)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	40 hex
Baud Rate Setup Value (see Table)	1	4	xx hex
BCC	1	5	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Baud Rate Setup Value (see Table)	1	2	xx hex
BCC	1	3	calculated

Setup Value	Baud Rate	Remark
0,1	9600	Factory default
2	14400	
3	19200	
4	38400	
5	57600	
6	115200	
> 6 to 0xFE	9600	Factory default
0xFF	keeps current setting	Returns current setting

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4.3.3.26 Get last measured Low Bit Frequency (CMD 0x41)

Returns the Low Bit Frequency of the last transponder response in [Hz]

Example:

Return value 01 03 **02 0C 38** xx equals to 134.2kHz.

Read last measured Low Bit Frequency (0x41)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	41 hex
BCC	1	4	C0 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
Low Bit Frequency [Hz]	3	2..4	xxxxxx hex
BCC	1	5	calculated

4.3.3.27 Receiver Power (on/off) (CMD 0x42)

To activate the LF_RX signal for test purposes this command is used to switch the power of the LF receiver.

Receiver Power (on/off) (0x42)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	42 hex
Data	1	4	0 = off / ≠ 0 = on hex
BCC	1	5	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (repeat value from command)	1	2	xx hex
BCC	1	3	calculated

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4.3.3.28 Execute C-Trimming (CMD 0x43)

This command starts a C-trimming sequence to adjust the transponders resonance frequency to a given target frequency.

Because this procedure is device depended the additional specification of the used device is necessary.

The target frequency has to be specified in [Hz].

Example:

Target frequency **02 0C 38** equals to 134.2kHz.

Execute C-Trimming (0x43)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	06 hex
CMD 1	1	2	83 hex
CMD 2	1	3	43 hex
Device Code	1	4	xx hex
Target Frequency	3	5..7	xxxxxxx hex
BCC	1	8	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	05 hex
Status Byte	1	2	xx hex
Programmed C-Trim Value	1	3	xx hex
Measured Lowbit Frequency	3	4..6	xxxxxx hex
BCC	1	7	calculated

Device	Device Code	Remark
TMS37190 (HDX+)	0x03	

The following table shows the description of the status byte.

A successful trimming procedure returns a status byte value of 0x00.

	Bit	Description
Common	0	Unknown device code
	1	Target frequency out of range
	2	No or wrong transponder
	3	Trim value reached limit
Device Specific	Device 0x03 (HDX+)	
	4	Wrong transponder life cycle
	5	No or wrong response to c-trim command
	6	
	7	
	Device 0xxx (RFU)	

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4.3.3.29 Carrier On/Off (CMD 0x44)

For field strength measurements this command can be used to switch on the 134.2kHz carrier signal on. A data value of zero will switch the carrier off; any other value will switch the carrier on. After a timeout of 65 seconds the carrier will be switched off. Following commands, that generate a transponder downlink, will switch the carrier off.

Carrier on / off (0x44)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	44 hex
Data	1	4	0 = off / ≠ 0 = on hex
BCC	1	5	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (repeat value from command)	1	2	xx hex
BCC	1	3	calculated

4.3.3.30 STAT Signal Mode (CMD 0x46)

Two different behaviours of the STAT signal pin are selectable.

If data is set to 0 the STAT signal will toggle at every change of the carrier signal and represents the downlink data (TXCT signal).

If data is set to “0x01” the STAT signal will only toggle at the end of the downlink and can be used for synchronisation purposes.

If data is set to 0x02 the STAT signal represents the demodulated uplink data. In this mode the STAT signal is set to “1” after all uplink data is received or receiving is timed out.

Data set to 0xFF will not change the setting but returns the current setting.

STAT Signal Mode (0x46)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	46 hex
Data	0x00	1	4	xx hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (repeated from Command)		1	2	xx hex
BCC		1	3	calculated

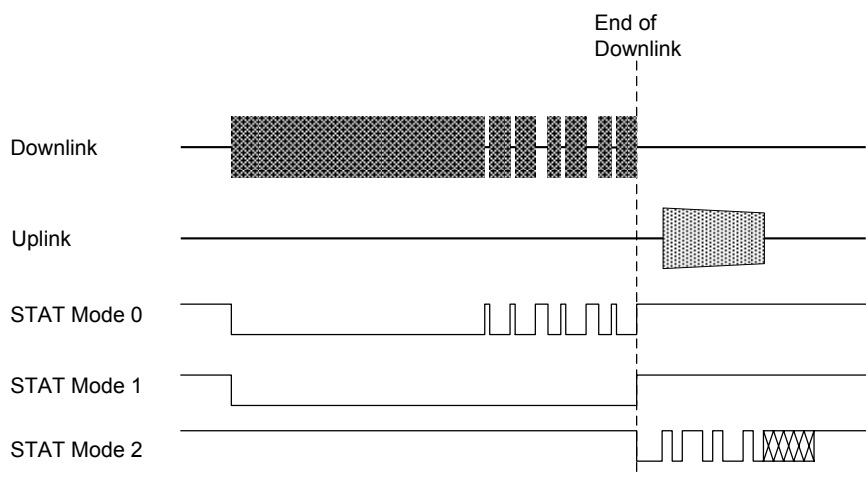


Figure 15: STAT Signal Mode

4.3.3.31 Get Status of SIG_IN_0 (CMD 0x47)

Get the status of the general purpose input signal SIG_IN_0.

Get Status of SIG_IN_0 (0x47)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	47 hex
BCC	1	4	C6 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (0 or 1)	1	2	xx hex
BCC	1	3	calculated

4.3.3.32 Get Status of SIG_IN_1 (CMD 0x48)

Get the status of the general purpose input signal SIG_IN_1.

Get Status of SIG_IN_1 (0x48)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	48 hex
BCC	1	4	C9 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (0 or 1)	1	2	xx hex
BCC	1	3	calculated

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4.3.3.33 Set Signal SIG_OUT_0 (CMD 0x49)

Set the level of the general purpose output signal SIG_OUT_0.

A data of “0” set the pin to low, a value of “1” sets the pins to high. Any other value will not change the pin state but returns the current state.

Set Signal SIG_OUT_0 (0x49)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	49 hex
Data	1	4	0 or 1 hex
BCC	1	5	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (repeated from Command)	1	2	xx hex
BCC	1	3	calculated

4.3.3.34 Set Signal SIG_OUT_1 (CMD 0x4A)

Set the level of the general purpose output signal SIG_OUT_1.

A data of “0” set the pin to low, a value of “1” sets the pins to high. Any other value will not change the pin state but returns the current state.

Set Status of SIG_OUT_1 (0x4A)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	03 hex
CMD 1	1	2	83 hex
CMD 2	1	3	4A hex
Data	1	4	0 or 1 hex
BCC	1	5	calculated
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Data (repeated from Command)	1	2	xx hex
BCC	1	3	calculated

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4.3.3.35 Set Demodulation Threshold Mode (CMD 0x4C)

Set the mode for the demodulation of the uplink.

If data set to 0x00 the mode is automatic, which means that the low-bit frequency is measured and the threshold is set in dependence of the measured frequency.

If data is set to 0x01 the threshold is set fix to 130.2kHz.

A data value of 0xFF will not change the setting but will return the current setting.

This setting is without effect when using an external RFM module (power reader).

Set Demodulation Threshold Mode (0x4C)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	4C hex
Data	auto	1	4	0 = auto / 1 = fix hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (repeated from Command)		1	2	xx hex
BCC		1	3	calculated

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4.3.3.36 Set External Power Reader (RFM) on/off (CMD 0x4D)

Instead of using the readers internal transmit and receive stage it is possible to use a so called RFM module to extend the readers operating distance. The RFM module uses 3 control signals, one for transmit (TXTCT-) and two for receive (RXCK, RXDT). When the RFM mode is enable the reader module signal SIG_IN_1 is used as RXCK, SIG_IN_0 as RXDT and SIG_OUT_1 as TXCT-.

Transmit and receive stage of the disabled in this case.

The measurement of the low-bit frequency is not possible when the RFM is used.

Set External Power Reader (RFM) (0x4D)

Command				
Parameter	Factory Default	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	03 hex
CMD 1		1	2	83 hex
CMD 2		1	3	4D hex
Data	off	1	4	0 = off / 1 = on hex
BCC		1	5	calculated
Response				
Parameter		Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte		1	0	01 hex
Length		1	1	01 hex
Data (repeated from Command)		1	2	xx hex
BCC		1	3	calculated

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4.3.3.37 Save Settings to Flash (CMD 0x50)

Save temporary settings to the flash memory. After a reset or a power up, the saved settings will be used.

Save Settings to Flash (0x50)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	02 hex
CMD 1	1	2	83 hex
CMD 2	1	3	50 hex
BCC	1	4	D1 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Status (see table below)	1	2	xx hex
BCC	1	3	calculated

Status	Description
0	ok
1	Save not ok

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4.3.3.38 Restore Settings to Factory Defaults (CMD 0x51)

This command sets back all parameters to factory defaults. To prevent accidentally restore of the settings to factory defaults an additional 2 bytes “keyword” of 0x55AA is added to the command.

Restore Settings to Factory Defaults (0x51)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	83 hex
CMD 2	1	3	51 hex
Keyword	2	4,5	55AA hex
BCC	1	6	29 hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Status (see table below)	1	2	xx hex
BCC	1	3	calculated

Status	Description
0	ok
1	Restore not ok

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4.3.3.39 Firmware Flashing (CMD 0x52)

This command is used to write a new firmware to the flash memory. To prevent accidentally flashing of the memory an additional 2 bytes “keyword” of 0x5528 is added to the command.

Firmware Flashing (0x52)

Command			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	04 hex
CMD 1	1	2	83 hex
CMD 2	1	3	52 hex
Keyword	2	4,5	5528 hex
BCC	1	6	Xx hex
Response			
Parameter	Length [Bytes]	Byte Number	Data (MSB ...LSB)
Start-Byte	1	0	01 hex
Length	1	1	01 hex
Status (see table below)	1	2	xx hex
BCC	1	3	calculated

Status	Description
0	ok
1	Not ok

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5. Operating Conditions

Operating free-air temperature range	T_oper	-40 to +85°C
Storage temperature range	T_store	-40 to +85°C

Symbol	Parameter	Min	Typ.	Max.	Unit
V_VSP	Supply voltage for power stage	2.7	-	5.5	V
V_VSL	Supply voltage for logic	2.7	-	5.5	V
I_VSP	Supply current for power stage @ 5V	-	100	-	mA
I_VSL	Supply current for logic @ 5V	-	30	-	mA
I_su	Output current sunk an output pin	-	-	15	mA
I_so	Output current sourced by an output pin	-	-	15	mA
I_sutot	Output current sunk by all output pins	-	-	60	mA
I_sotot	Output current sourced by all output pins	-	-	60	mA
V_ret	VSP start voltage to guarantee power on reset	-	-	GND	-
Vrise_ret	VSP rise rate to guarantee power on reset	0.1	-	-	V/ms
I_idle	Supply current when reader is idel	-	-	1	mA
I_act	Supply current when reader is active @ 5V	-	100	-	mA
ViH	Input high voltage	0.8 VSL	-	5.5	V
ViL	Input low voltage	GND	-	0.2 VSL	V
VoH	Output high voltage	VSL – 0.7	-	VSL	V
VoL	Output low voltage	GND	-	0.6	V
Q_Ant	Antenna Quality factor	10	15	20	-
L_Ant	Antenna inductance value	46.1	47	47.9	μH
f_carrier	Carrier frequency	134.1	134.2	134.3	kHz

Table 13: Operating Conditions

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6. Transponder Downlink Timings

The following table shows the default values for the different transponder downlink modulation types. All values can be modified by Setup Mode commands.

Modulation	Bit H		Bit L		SOF		EOF	
	toffH [μs]	tonH [μs]	toffL [μs]	tonL [μs]	toffSOF [μs]	tonSOF [μs]	toffEOF [μs]	tonEOF [μs]
PWM (R/W & MPT)	1000	1000	300	1700	-	-	-	-
PWM (Auto)	480	520	170	330	-	-	-	-
PPM	170	350	170	230	-	-	-	-
BLC (HDX+)	149	238	149	171	298	499	149	373
BLC (Auto)	170	350	170	230	170	460	170	580

Table 14: Transponder Downlink Timings

Default values for the **Power Burst 1** and **Power Burst 2** are:

Power Burst 1 (Charge)	50 ms
Power Burst 2 (Program)	17 ms

Table 15: Default Power Burst Values

7. External Power Reader Module (RFM)

To extend the readers operating distance an external power reader module (RFM) can be connected to the Microreader II.

The following signals should be connected with RFM module:

Microreader II	DIL Pin	SMD Pin	RFM	Description
GND	15	13	GND	Ground
SIG_OUT_1	12	12	TXCT-	Transmit Control (low active)
SIG_IN_0	13	14	RXDT	Receive Data
SIG_IN_1	14	15	RXCK	Receive Clock

Table 16: Microreader RFM Connection

Use the Setup Mode function 0x4D to enable the RFM module.

The measurement of the low-bit frequency is not possible in this mode. This means that automatic C-Trimming (Setup Mode 0x43) and the automatic detection of the demodulation threshold will not work in combination with the RFM module.

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8. Revision History

Rev.	Version	Description of Change	Date submitted	By
0	0.1	Initial Version	31. October 2011	H. Vollbrecht