

Fallguy *ULTRA 2*
UNIVERSAL EMBEDDED MP3 MODULE
WITH SD-CARD SLOT
AND 2 SERIAL HIGH-SPEED-INTERFACES

STANDARD FIRMWARE V2.28 / V1.28

Firmware version 2.28 (Rev.E), 1.28 (Rev.C)
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General

The MP3 files are played from the main directory of the SD card.

The ULTRA 2 module can be controlled by the following interfaces:

- Button inputs BUTTON_1 to BUTTON_8 – Direct connection for up to 8 buttons/relays/sensors
- Digital inputs GPIO_1 to GPIO_8 – 8 digital inputs
- Serial interface UART 1 with 115.200 bps and hardware handshake
- Serial interface UART 2 with 921.600 bps and hardware handshake for LAN (XPORT) or USB connections (FTDI-IC)

These interfaces can be either used separately or combined.

By using an optional configuration file *config.txt* the module could start with specific starting parameters and the different interfaces from above could be set.

Additional digital outputs are prepared to drive a LC-Display, 3 status LEDs, a RTC module (Real Time Clock) and a RF module. The LC-Display shows track information (ID3 tags), file names and status information.

SD card, MP3 files and configuration file

The SD card must be formatted with the file system FAT32.

The MP3 files **must** be within the main directory of the SD card and must **NOT** be named in a defined order.

The ULTRA 2 module reads a maximum of 100 MP3 files into an internal list and sorts them by their first two file name characters in alphanumerical order. The MP3 files can be accessed from this list using the button or digital inputs (00 – 99). The names of these MP3 files can contain additional information, only the first two characters are important, for example:

00ACDC-Thunderstruck.MP3

01Die_Biene_Maja.MP3

02_U2.MP3

...

Using the serial interfaces UART 1 and UART 2 the MP3 files can be accessed through their number of the internal list or their complete file name. File names up to 100 characters are possible.

The MP3 files are copied manually to the SD card **or** using the MP3 upload commands and the serial interfaces.

After start up the ULTRA 2 module loads the configuration parameter from the EEPROM memory. Afterwards the configuration file *config.txt* in the main directory is searched and loaded. The configuration parameter from the EEPROM memory are overwritten. If there are no configuration parameter inside the EEPROM memory and if there is no *config.txt* in the main directory, the following standard values are loaded:

OV!0100	-	The volume level of both channels is set to 0dB
BA!00	-	The bass (100Hz) is set to 0dB
TR!00	-	The treble (3kHz) is set to 0dB
SH!00	-	The shuffle mode is deactivated
BU!01	-	The button inputs BUTTON_4 – BUTTON_8 are in DIRECT mode
RP!00	-	The repeat mode is deactivated
FD!00	-	The fading out of MP3 files is deactivated
IN!00	-	The interrupt function is deactivated
LO!00	-	The front buttons T1, T2, and T3 (BUTTON_1 – BUTTON_3) are activated
LC!0000	-	The LC-Display is deactivated
RS!00	-	The RS232 interface mode is activated
EC!00	-	The first serial interface (UART 1) sends answers (Echoes)
AD!00	-	No serial address is set (UART 1)
LI!00	-	The ID3 tags are not interpreted during playback
AS!00	-	The automatic playback is not activated
NW!00	-	The serial welcome message (UART 1) is activated
NH!00	-	The handshake (RTS/CTS hardware handshake, UART 1) is activated
BR!00	-	The baud rate of the serial interface (UART 1) is set to 115.200 bps
BO!0000	-	The 8 button inputs are configured for normally open buttons
LE!00	-	The external LEDs/Relais are active, if the corresponding MP3 file is being played (00 – 04)
NA!MODULE00	-	The name of the module is MODULE00
LL!01	-	The level of the external LED/Relais outputs is high active
PO!00	-	The pause option of the button inputs BUTTON_1 and BUTTON_4 is activated
GP!00	-	The optional functions of the digital inputs GPIO_1 – GPIO_8 are deactivated
L1!00	-	The blink function of the first LED/Relay output is deactivated
L2!00	-	The blink function of the second LED/Relay output is deactivated
L3!00	-	The blink function of the third LED/Relay output is deactivated
L4!00	-	The blink function of the fourth LED/Relay output is deactivated
L5!00	-	The blink function of the fifth LED/Relay output is deactivated
AM!00	-	The control of an external amplifier is set to Class D
AV!01	-	The automatic saving of the volume into the EEPROM memory is activated
MO!00	-	The motion sensor mode is deactivated
VL!0100	-	The volume level of the left channel is set to 0dB
VR!0100	-	The volume level of the right channel is set to 0dB
SM!00	-	The serial master mode is deactivated
FF!00	-	The recording format is set to MP3
FQ!08	-	The MP3 recording quality is set to 128kbit/s (constant)
FM!00	-	The monitoring while recording is deactivated
FW!00	-	The WAV audio codec is set to IMA ADPCM
FS!03	-	The recording sample rate is set to 44,1kHz
FH!00	-	The channel selection while recording is set to Joint Stereo
FG!00	-	The recording input gain is set to Automatic

All settings in the file *config.txt* relate to the serial commands. Every command must be terminated like the serial commands with a 0Dh (CR character) and additionally with a 0Ah (LF character).

Button inputs

The button inputs BUTTON_1 – BUTTON_3 (Front button T1 / T2 / T3) have the following functions:

- BUTTON_1 – Starts the first MP3 file from the internal list (00 – 99) or pauses (*PO!00*) the playback
- BUTTON_2 – Stops the playback
- BUTTON_3 – Selects the next MP3 file from the internal list (00 – 99) during playback

The playback is started using the button input BUTTON_1. If the shuffle mode is activated (*SH!01*), an endless and random playback is started. If the shuffle mode is deactivated (*SH!00*), the playback is sequential till the last MP3 file from the internal list (*RP!00*), sequential endless (*RP!01*), loops always the first file (*RP!02*) or it ends after the first file (*RP!03*).

Using the button input BUTTON_3 during playback the next MP3 file from the internal list can be started. If the shuffle mode is activated (*SH!01*), a random MP3 file is selected.

The button inputs BUTTON_4 – BUTTON_8 can be configured for two different modes. Per default the DIRECT mode is activated, the STANDARD mode must be activated using the command *BU!00*.

STANDARD mode:

- BUTTON_4 – Starts the first MP3 file from the internal list (00 – 99) or pauses (*PO!00*) the playback
- BUTTON_5 – Stops the playback
- BUTTON_6 – Selects the next MP3 file from the internal list (00 – 99) during playback
- BUTTON_7 – Decrease the volume by 2dB
- BUTTON_8 – Increase the volume by 2dB

The playback is started using the button input BUTTON_4. If the shuffle mode is activated (*SH!01*), an endless and random playback is started. If the shuffle mode is deactivated (*SH!00*), the playback is sequential till the last MP3 file from the internal list (*RP!00*), sequential endless (*RP!01*), loops always the first file (*RP!02*) or it ends after the first file (*RP!03*).

Using the button input BUTTON_6 during playback the next MP3 file from the internal list can be started. If the shuffle mode is activated (*SH!01*), a random MP3 file is selected.

DIRECT mode:

- BUTTON_4 – Starts first MP3 file (00)
- BUTTON_5 – Starts second MP3 file (01)
- BUTTON_6 – Starts third MP3 file (02)
- BUTTON_7 – Starts fourth MP3 file (03)
- BUTTON_8 – Starts fifth MP3 file (04)

In this mode up to 5 MP3 files from the internal list can be started using one button. The shuffle mode has no effect on the DIRECT mode. After playing one MP3 file, the playback stops (*RP!00* or *RP!01*) or the selected MP3 file is played again (*RP!02*). During the playback any other MP3 file can be started by pressing another button. Using the interrupt option (*IN!01*) the same file can also be started again. Using *IN!02* the playback cannot be interrupted by any button. If *IN!03* is set the button must be hold, otherwise the playback is stopped.

More settings (*SH!* / *RP!* / *IN!* *PO!* / *BU!*) are described in the ASCII protocol.

The button inputs must be pressed for at least 50ms to be a valid signal!

The button inputs can be configured for normally open buttons or normally closed buttons. Per default they are configured for normally open buttons (*BO!0000*).

GPIO mode

The digital in- and outputs GPIO_1 – GPIO_8 can also be driven in other GPIO modes. Additional electronics must be provided externally (PullUp/PullDown resistors)! The GPIO modes must be activated using the corresponding command (*GP!01/GP!02/GP!03*).

GPIO mode – Binary (*GP!01*):

- GPIO_6 (MSB) – GPIO_1 (LSB) – (0b00111111 – 0b00000001) – Starts MP3 file 00 – 62

In this mode up to 63 MP3 files from the internal list can be started using the binary selection. After playing one MP3 file, the playback stops (*RP!00* or *RP!01*) or the selected MP3 file is played again (*RP!02*). During the playback any other MP3 file can be started by pressing another button. Using the interrupt option (*IN!01*) the same file can also be started again. Using *IN!02* the playback cannot be interrupted by any other selection.

The binary signal must be valid for at least 50ms!

GPIO mode – Extension of the button inputs (*GP!02*):

- GPIO_1 – Starts MP3 file 05
- GPIO_2 – Starts MP3 file 06
- GPIO_3 – Starts MP3 file 07
- GPIO_4 – LED/Relay output 6
- GPIO_5 – LED/Relay output 7
- GPIO_6 – LED/Relay output 8

GPIO mode – Extension of the button inputs (*GP!04*):

- GPIO_1 – Starts MP3 file 05
- GPIO_2 – Starts MP3 file 06
- GPIO_3 – Starts MP3 file 07
- GPIO_4 – Starts MP3 file 08
- GPIO_5 – Starts MP3 file 09
- GPIO_6 – Starts MP3 file 10
- GPIO_7 – Starts MP3 file 11
- GPIO_8 – Starts MP3 file 12

In this modes up to 8 more MP3 files from the internal list can be started using one button. After playing one MP3 file, the playback stops (*RP!00* or *RP!01*) or the selected MP3 file is played again (*RP!02*). During the playback any other MP3 file can be started by pressing another button. Using the interrupt option (*IN!01*) the same file can also be started again. Using *IN!02* the playback cannot be interrupted by any button. If *IN!03* is set the button must be hold, otherwise the playback is stopped.

GPIO mode – Matrix mode (*GP!03*):

- GPIO_1-GPIO_8 – Starts MP3 file 00 - 15

In this mode 16 MP3 files can be started using a 4x4 matrix wiring off he GPIOs. GPIO_1-4 are inputs and must be connected to a PullUp resistor. GPIO_5-8 are outputs. Bridging GPIO_1 with GPIO_5 starts file 00, bridging GPIO_2 with GPIO_5 starts file 01, etc, bridging GPIO_4 with GPIO_8 starts file 15. After playing one MP3 file, the playback stops (*RP!00* or *RP!01*) or the selected MP3 file is played again (*RP!02*). During the playback any other MP3 file can be started by pressing another button. Using the interrupt option (*IN!01*) the same file can also be started again. Using *IN!02* the playback cannot be interrupted by any button. If *IN!03* is set the button must be hold, otherwise the playback is stopped.

More settings (*SH!* / *RP!* / *IN!* / *GP!*) are described in the ASCII protocol.

The button inputs must be pressed for at least 50ms to be a valid signal!

Serial interfaces UART 1 and UART 2

Via the serial interfaces the ULTRA 2 module can be controlled from an external PC or microcontroller. For this purpose an ASCII based protocol was developed, which is an element of this firmware (see below) and is effective for both serial interfaces. Both interfaces can be used parallel. Answers take place using the interface, which was used lastly. The signal level for both interfaces is 0 – 3,3 Volt. If the Fallguy ULTRA Carrier Board from LOETRONIC ® (Article-No.0201) is used, the first serial interface (UART 1) can be set to RS232 or RS485 functionality. The user has to set one of these modes using jumpers on the Carrier Board and by a configuration parameter (*RS!xx*).

The settings for the first serial interface (UART 1) are (Can changed using *NH!xx* and *BR!xx!*):

115.200 bit/s, 1 start bit / 8 data bits / 1 stop bit / no parity (8N1), RTS/CTS hardware handshake if RS232 or RE/TE control if RS485.

The settings for the second serial interface (UART 2) are:

921.600 bit/s, 1 start bit / 8 data bits / 1 stop bit / no parity (8N1), hardware handshake.

ASCII protocol for serial interfacing

The following protocol rules are effective:

- A command consists of ASCII coded characters.
- All commands are terminated by a 0Dh (CR character).
- A command consists of one identifier, a ,!' and optional data.
- A command identifier consists of two alphabetic characters (a-z or A-Z).
- Optional data consists of additional characters (a-z, A-Z or 0-9).
- The first UART sends always answers (restrictions see below *EC!xx / AD!xx*).
- The second UART sends always answers.
- Every command is answered (restrictions see below UART 1: *EC!xx / AD!xx*).
- The answer consists of one identifier and a ,!'.
- The answer informs, whether the command was executed or an error occurred.
- Some commands are answered additionally by an extended answer.

The ULTRA 2 module sends some welcome messages by the UART 1 (restrictions see below *EC!xx / AD!xx*) after starting, reads an existing configuration file *config.txt* and executes the entries in this file.

Besides the answers on the commands all playback changes are send from the ULTRA 2 module via the serial interface. This affects also the control of the module by the button and digital inputs (restrictions see below *EC!xx / AD!xx*).

List of general answers:

Answer	Description
RD!	The ULTRA 2 module was started and initialized.

Answer	Description
BE : xx	There was an error initializing the module.
xx	01 There is no SD card inserted!
	02 The SD card cannot be initialized!
	03 The SD card is not formatted in FAT32!
	04 The MP3 decoder chip cannot be initialized!

Answer	Description
OK!	The comand was ok.

Answer	Description
NP!	The command cannot be processed.

Answer	Description
CD!	The length of the command is not ok.

Answer	Description
BL!	The command parameters are beyond limits.

Answer	Description
UC!	The command is unknown.

Answer	Description
WF!	The ULTRA 2 module waits for the transfer of a MP3 file or firmware file.

Answer	Description
FC!	The transfer of a MP3 file or firmware file is completed.

List of general answers:

Answer	Description
TE : xxxx	An error occurred through transmission.
xxxx	0002 Framing error
	0004 Noise
	0008 Buffer overrun
	0016 Buffer full

Answer	Description
PL : xyz .mp3 or PL : xx	The playback of a MP3 file was started.
xyz .mp3	The selected MP3 file with file name (max. 100 characters).
xx	The selected MP3 file with number of the internal list (00 – 99).

Answer	Description
ST : xyz .mp3 or ST : xx	The playback of a MP3 file was stopped.
xyz .mp3	The selected MP3 file with file name (max. 100 characters).
xx	The selected MP3 file with number of the internal list (00 – 99).

Answer	Description
PA : xyz .mp3 or PA : xx	The playback of a MP3 file was paused.
xyz .mp3	The selected MP3 file with file name (max. 100 characters).
xx	The selected MP3 file with number of the internal list (00 – 99).

Answer	Description
PS : xyz .mp3 or PS : xx	The playback of a MP3 file was repaused.
xyz .mp3	The selected MP3 file with file name (max. 100 characters).
xx	The selected MP3 file with number of the internal list (00 – 99).

Answer	Description
AR : xyz .mp3	The recording of a MP3 file was started.
xyz .mp3	The selected MP3 file with file name (max. 100 characters).

List of commands – MP3 playback and recording:

Command	Description
PL!xyz.mp3 or PL!xyz hh:mm:ss	Starts the playback of a MP3 file. After ending the MP3 file, the playback stops.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters).
hh:mm:ss	The start time within the MP3 file.

Command	Description
PX!xx or PX!xx hh:mm:ss	Starts the playback of a MP3 file from the internal list. After ending the MP3 file, the playback stops.
	Not possible while playback or recording.
xx	00 – 99 The selected MP3 file from the internal list.
hh:mm:ss	The start time within the MP3 file.

Command	Description
SP!	Starts the playback of the first MP3 file from the internal list. After ending the MP3 file, the module proceeds according the parameter <i>RP!xx</i> and <i>SH!xx</i> .
	Not possible while playback or recording.

Command	Description
SP!xx	Starts the playback of a MP3 file from the internal list. After ending the MP3 file, the module proceeds according the parameter <i>RP!xx</i> and <i>SH!xx</i> .
	Not possible while playback or recording.
xx	00 – 99 The selected MP3 file from the internal list.

Command	Description
NT!	Starts the playback of next MP3 file from the internal list.
	Only possible while playback.

Command	Description
PT!	Starts the playback of previous MP3 file from the internal list.
	Only possible while playback.

Command	Description
ST!	Stops the playback or recording.
	Only possible while playback or recording.

Command	Description
PA!	Pauses or repauses the playback.
	Only possible while playback.

Command	Description
ID!xyz.mp3	Returns the ID3 tag from a MP3 file.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters).
Extended Answer	
IT:xyz	The ID3 title information (max. 64 characters).
IP:xyz	The ID3 performer information (max. 64 characters).
IA:xyz	The ID3 album information (max. 64 characters).
Example	
IT:U 96 IP:Klaus Doldinger IA:Das Boot	

List of commands – MP3 playback and recording:

Command	Description
IX!xx	Returns the ID3 tag from a MP3 file.
	Not possible while playback or recording.
xx	The selected MP3 file with number of the internal list (00 – 99).
Extended Answer	
IT:xyz	The ID3 title information (max. 64 characters).
IP:xyz	The ID3 performer information (max. 64 characters).
IA:xyz	The ID3 album information (max. 64 characters).
Example	
IT:U 96	
IP:Klaus Doldinger	
IA:Das Boot	

Command	Description
SF!	Starts the MP3 upload of a MP3 file without storing it to the SD card.
	Not possible while playback or recording.
	As soon as the ULTRA 2 module sends a <i>WF!</i> back, the transfer of the complete MP3 file can be started. Other commands are not possible at this time. The MP3 file is played back in real time from the ULTRA 2 module (<i>Streaming</i>).
	As soon as the ULTRA 2 module sends a <i>FC!</i> back, the transfer of the MP3 file is completed and the ULTRA 2 module can accept new commands.

Command	Description
AR!xyz.mp3	Starts the recording of a MP3 file.
	Not possible while playback or recording.
xyz.mp3	The file name (max. 100 characters) of the new MP3 file.

Command	Description
AF!xyz.mp3	Starts the recording of an existing MP3 file with replacing it on the SD card.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters).

Command	Description
AX!xx	Starts the recording of an existing MP3 file with replacing it on the SD card.
	Not possible while playback or recording.
xx	00 – 99 The selected MP3 file from the internal list.

List of commands – MP3 upload:

Command	Description
RC!xyz.mp3	Starts the MP3 upload of a new MP3 file with storing it to the SD card.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters). As soon as the ULTRA 2 module sends a <i>WF!</i> back, the transfer of the complete MP3 file can be started. Other commands are not possible at this time. As soon as the ULTRA 2 module sends a <i>FC!</i> back, the transfer of the MP3 file is completed and the ULTRA 2 module can accept new commands.

Command	Description
DL!xyz.mp3	Deletes a MP3 file from the SD card.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters). As soon as the ULTRA 2 module sends a <i>FC!</i> back, the MP3 file is deleted and the ULTRA 2 module can accept new commands.

Command	Description
DX!xx	Deletes a MP3 file from the SD card.
	Not possible while playback or recording.
xx	The selected MP3 file with number of the internal list (00 – 99). As soon as the ULTRA 2 module sends a <i>FC!</i> back, the MP3 file is deleted and the ULTRA 2 module can accept new commands.

Command	Description
RF!xyz.mp3	Starts the MP3 upload of an existing MP3 file with replacing it on the SD card.
	Not possible while playback or recording.
xyz.mp3	The selected MP3 file with file name (max. 100 characters). As soon as the ULTRA 2 module sends a <i>WF!</i> back, the old MP3 file was deleted and the transfer of the complete MP3 file can be started. Other commands are not possible at this time. As soon as the ULTRA 2 module sends a <i>FC!</i> back, the transfer of the MP3 file is completed and the ULTRA 2 module can accept new commands.

Command	Description
RX!xx	Starts the MP3 upload of an existing MP3 file with replacing it on the SD card.
	Not possible while playback or recording.
xx	The selected MP3 file with number of the internal list (00 – 99). As soon as the ULTRA 2 module sends a <i>WF!</i> back, the old MP3 file was deleted and the transfer of the complete MP3 file can be started. Other commands are not possible at this time. As soon as the ULTRA 2 module sends a <i>FC!</i> back, the transfer of the MP3 file is completed and the ULTRA 2 module can accept new commands.

List of commands – Firmware upload:

Command	Description
FI!	Starts the upload and the programming of a new firmware for the ULTRA 2 module.
	Not possible while playback or recording.
	As soon as the ULTRA 2 module sends a <i>WF!</i> back, the transfer of the complete LOE file can be started. Other commands are not possible at this time. As soon as the ULTRA 2 module sends a <i>FC!</i> back, the transfer of the LOE file is completed and the ULTRA 2 module goes into the bootloader to program the new firmware. After successful programming the module starts again with the new firmware. IMPORTANT: The new firmware is stored on the SD card with the name <i>FIRMWARE.LOE</i> and is rewritten the next time, the command <i>FI!</i> is used. Other firmware files should not be stored on the SD card!

List of commands – General:

Command	Description
GN!	Returns the number of MP3 files in the internal list.
	Always possible.
Extended Answer	
GN: xxxx	
xxxx	0000 – 0100 The number of MP3 files in the internal list.
Example	
GN: 0021	

Command	Description
GS!	Returns the playback or recording status.
	Always possible.
Extended Answer	
GS: 0x xyz.mp3 dd.mm.yyyy hh:mm:ss or GS: 0x xx dd.mm.yyyy hh:mm:ss	
0x	01 No playback.
	02 Playback.
	03 Paused playback.
	04 Recording
xyz.mp3	The selected MP3 file with file name (max. 100 characters).
xx	The selected MP3 file with number of the internal list (00 – 99).
dd.mm.yyyy hh:mm:ss	The date and time while playback or recording.
Example	
GS: 02 test.mp3 01.01.2009 12:07:00	

Command	Description
GV!	Returns the version of the firmware.
	Always possible.
Extended Answer	
GV: STANDARD + Vx.xx	
Vx.xx	The version of the firmware.
Example	
GV: STANDARD V1.35	

Command	Description
GH!	Returns the MP3 header information from the MP3 file.
	Only possible while playback.
Extended Answer	
GH: xyz.mp3 TYPE xkHz MODE xkbit/s	
TYPE	MP3 The coding technique.
xkHz	11.03 kHz – 48 kHz
MODE	STEREO, JOINT STEREO, DUAL CHANNEL, MONO
xkbit/s	8 kbit/s – 320 kbit/s
Example	
GH: test.mp3 MP3 44.1kHz 112 kbit/s	

List of commands – General:

Command	Description
GC!	Returns the total capacity and the size of all MP3 files in MByte on the SD card.
	Not possible while playback or recording.
Extended Answer	
GT:xxxxMB yyyyMB FULL	
xxxxMB	The total capacity of the SD card in MByte.
yyyyMB	The size of all MP3 files in MByte on the SD card.
FULL	If the SD card is full.

Command	Description
RM!	Resets the ULTRA 2 module.
	Always possible.

Command	Description
SD!xxxxxxxx	Configures the name of the SD card (volume name).
	Not possible while playback or recording.
xxxxxxxx	The name of the SD card (8 characters).

Command	Description
GB!	Returns the version of the bootloader.
	Always possible.
Extended Answer	
GB:UL2 + Vx.xx	
Vx.xx	The version of the bootloader.
Example	
GB:UL2V1.03	

Command	Description
TS!	Starts the playback of a testsound.
	Not possible while playback or recording.

List of commands – Audio:

Command	Description
OV! 0xxx	Adjusts the volume level of both channels.
	Always possible.
0xxx	0000 – 0100 The volume level from –100 dB to 0 dB in 1 dB steps.

Command	Description
VL! 0xxx	Adjusts the volume level of the left channel.
	Always possible.
0xxx	0000 – 0100 The volume level from –100 dB to 0 dB in 1 dB steps.

Command	Description
VR! 0xxx	Adjusts the volume level of the right channel.
	Always possible.
0xxx	0000 – 0100 The volume level from –100 dB to 0 dB in 1 dB steps.

Command	Description
BA! xx	Adjusts the bass frequencies (100Hz).
	Always possible.
xx	00 – 15 The bass frequencies from 0 dB to +15 dB in 1 dB steps.

Command	Description
TR! xx	Adjusts the treble frequencies (3kHz).
	Always possible.
xx	00 – 07 The treble frequencies from 0 dB to +10.5 dB in 1.5 dB steps. 08 – 15 The treble frequencies from -12 dB to -1.5 dB in 1.5 dB steps.

Command	Description
AM! 0x	Adjusts the control of an external amplifier.
	Not possible while playback or recording.
0x	00 An external class D amplifier is selected.
	01 An external class A/B amplifier is selected.

Command	Description
AV! 0x	Activates/Deactivates the automatic saving of the volume.
	Not possible while playback or recording.
0x	00 The automatic saving of the volume is deactivated.
	01 The automatic saving of the volume is activated, changing the volume through the button or GPIO inputs will result into the automatic saving of it into the EEPROM memory.

List of commands – Configuration - Playback:

Command	Description
SH! 0x	Activates/Deactivates the shuffle playback from the internal list.
	Not possible while playback or recording.
0x	00 The shuffle playback is deactivated.
	01 The shuffle playback is activated.

Command	Description
RP! 0x	Activates/Deactivates the endless playback or repeat option of a MP3 file from the internal list.
	Not possible while playback or recording.
0x	00 After ending a MP3 file the next MP3 file from the internal list will be started. After the last MP3 file from the internal list the playback stops.
	01 After ending a MP3 file the next MP3 file from the internal list will be started. After the last MP3 file from the internal list the playback will be restarted with the first MP3 file.
	02 After ending a MP3 file the same MP3 file will be started.
	03 After ending a MP3 file the playback stops.
	04 After ending a MP3 file the first MP3 file from the internal list will be started.

Command	Description
FD! 0x	Adjusts the fading out of MP3 files.
	Not possible while playback.
0x	00 The automatic fading out of MP3 files is deactivated.
	01 The automatic fading out of MP3 files is activated.

Command	Description
AS! 0x	Adjusts the automatic playback (Begin with the first MP3 file from the internal list) after start up.
	Not possible while playback or recording.
0x	00 The automatic playback is deactivated.
	01 The automatic playback is activated.

List of commands – Configuration - Recording:

Command	Description
FF! 0x	Adjusts the recording format. Not possible while playback or recording.
0x	00 The recording format is MP3.
	01 The recording format is OGG Vorbis.
	02 The recording format is WAV.

Command	Description
FQ! 0x	Adjusts the MP3 recording quality (bitrate). Not possible while playback or recording.
0x	00 – 32 kbit/s (constant)
	01 – 40 kbit/s (constant)
	02 – 48 kbit/s (constant)
	03 – 56 kbit/s (constant)
	04 – 64 kbit/s (constant)
	05 – 80 kbit/s (constant)
	06 – 96 kbit/s (constant)
	07 – 112 kbit/s (constant)
	08 – 128 kbit/s (constant)
	09 – 160 kbit/s (constant)
	10 – 192 kbit/s (constant)
	11 – 224 kbit/s (constant)
	12 – 256 kbit/s (constant)
	13 – 320 kbit/s (constant)
	14 – 56 kbit/s (variable)
	15 – 80 kbit/s (variable)
	16 – 128 kbit/s (variable)
	17 – 192 kbit/s (variable)
	18 – 256 kbit/s (variable)

Command	Description
FM! 0x	Adjusts the monitoring while recording. Not possible while playback or recording.
0x	00 The monitoring while recording is deactivated.
	01 The monitoring while recording is activated.

Command	Description
FW! 0x	Adjusts the recording WAV audio codec. Not possible while playback or recording.
0x	00 – IMA ADPCM
	01 – PCM
	02 – G.711 u-law
	03 – G.711 A-law
	04 – G.722 ADPCM

Command	Description
FS! 0x	Adjusts the recording sample rate. Not possible while playback or recording.
0x	00 – 8000 Hz
	01 – 11025 Hz
	02 – 22050 Hz
	03 – 44100 Hz
	04 – 48000 Hz

List of commands – Configuration - Recording:

Command	Description
FH! 0x	Adjusts the recording channel selection.
	Not possible while playback or recording.
0x	00 – Joint Stereo (common AGC)
	01 – Dual channel (separate AGC)
	02 – Left channel
	03 – Right channel
	04 – Mono downmix

Command	Description
FG! 0x	Adjusts the recording input gain.
	Not possible while playback or recording.
0x	00 – Automatic
	01 – 39: -19 dB bis +19 dB.

List of commands – Configuration – Button and GPIO inputs:

Command	Description
BU! 0x	Adjusts the button mode (BUTTON_4 – BUTTON_8).
	Not possible while playback or recording.
0x	00 The button mode is in STANDARD mode.
	01 The button mode is in DIRECT mode.

Command	Description
BO! 0xxx	Configures the button inputs (BUTTON_5 – BUTTON_8, GPIO_1 – 3) for normally open or normally closed buttons.
	Not possible while playback or recording.
0xxxx	0000 / 0b00000000 (Binary) All button inputs are configured for normally open buttons.
	0001 / 0b00000001 (Binary) Button input 1 is configured for normally closed button.
	0002 / 0b00000010 (Binary) Button input 2 is configured for normally closed button.
	0004 / 0b00000100 (Binary) Button input 3 is configured for normally closed button.
	...
	0255 / 0b11111111 (Binary) All button inputs are configured for normally closed buttons.

Command	Description
IN! 0x	Adjusts the interrupt option of the button and GPIO inputs.
	Not possible while playback or recording.
0x	00 A MP3 file being played can be interrupted by starting another MP3 file, but not by starting the same MP3 file.
	01 A MP3 file being played can be interrupted by any MP3 file.
	02 A MP3 file being played cannot be interrupted.
	03 The playback of a MP3 file is stopped, if the button or GPIO input is not being hold.
	04 Special mode.
	05 A MP3 file being played can be stopped after pressing the same button or GPIO input.

Command	Description
LO! 0x	Locks the front buttons T1, T2, T3 (BUTTON_1 – BUTTON_3).
	Not possible while playback or recording.
0x	00 The front buttons T1, T2, and T3 (BUTTON_1 – BUTTON_3) are activated.
	01 The front buttons T1, T2, and T3 (BUTTON_1 – BUTTON_3) are locked and deactivated.

List of commands – Configuration – Button and GPIO inputs:

Command	Description
PO! 0x	Activates/Deactivates the pause option of the button inputs BUTTON_1 und BUTTON_4.
	Not possible while playback or recording.
0x	00 The pause option of the button inputs BUTTON_1 and BUTTON_4 is activated.
	01 The pause option of the button inputs BUTTON_1 and BUTTON_4 is deactivated.
	02 The button inputs BUTTON_1 and BUTTON_4 start the next MP3 files while playback.
	03 The button inputs BUTTON_1 and BUTTON_4 start the next MP3 files while not playback and have no function while playback.
	04 The button inputs BUTTON_1 and BUTTON_4 start the next MP3 files while playback and not playback.
	05 The pause option of the button inputs BUTTON_1 and BUTTON_4 is deactivated. BUTTON_3 and BUTTON_6 select also while not playback the next file. This is printed on the LC-Display.

Command	Description
GP! 0x	Adjusts the GPIO modes.
	Not possible while playback or recording.
0x	00 The optional functions of the digital inputs GPIO_1 – GPIO_8 are deactivated.
	01 The binary GPIO mode for the inputs GPIO_1 – GPIO_6 is activated.
	02 The inputs GPIO_1 – GPIO_3 are three more button inputs. The inputs GPIO_4 – GPIO_6 are three more LED outputs.
	03 The inputs GPIO_1 – GPIO_8 are in matrix mode.
	04 The inputs GPIO_1 – GPIO_8 are eight more button inputs.

Command	Description
MO! xx	Adjusts the motion sensor mode.
	Not possible while playback.
xx	00 The motion sensor mode is deactivated.
	01-99 The motion sensor mode is activated. By starting a MP3 file with connected motion sensor to BUTTON_4 a timer in the area of 01-99s is started. After reaching 0 and no sensor activity the playback is stopped. The normal pause function on BUTTON_4 is deactivated while playback.

List of commands – Configuration – External LEDs/Relais:

Command	Description
LE!0x	Configures the external LEDs/Relais.
	Not possible while playback.
0x	00 The external LEDs/Relais are active, if the corresponding MP3 file is being played (00 – 04)
	01 All external LEDs/Relais are active while any file is being played.

Command	Description
LE!0x	Configures the level of the external LEDs/Relais.
	Not possible while playback.
0x	00 The level of the external LED/Relais outputs is low active.
	01 The level of the external LED/Relais outputs is high active.

Command	Description
L1!xx	Configures the flash function of the first LED/Relay output LED_EXT1.
	Not possible while playback.
xx	00 The flash function of the first LED/Relay output is deactivated.
	01-10 The first LED/Relay output flashes between 200ms – 2s.
	11 The first LED/Relay output is totally turned off.

Command	Description
L2!xx	Configures the flash function of the second LED/Relay output LED_EXT2.
	Not possible while playback.
xx	00 The flash function of the second LED/Relay output is deactivated.
	01-10 The second LED/Relay output flashes between 200ms – 2s.
	11 The second LED/Relay output is totally turned off.

Command	Description
L3!xx	Configures the flash function of the third LED/Relay output LED_EXT3.
	Not possible while playback.
xx	00 The flash function of the third LED/Relay output is deactivated.
	01-10 The third LED/Relay output flashes between 200ms – 2s.
	11 The third LED/Relay output is totally turned off.

Command	Description
L4!xx	Configures the flash function of the fourth LED/Relay output LED_EXT4.
	Not possible while playback.
xx	00 The flash function of the fourth LED/Relay output is deactivated.
	01-10 The fourth LED/Relay output flashes between 200ms – 2s.
	11 The fourth LED/Relay output is totally turned off.

List of commands – Configuration – External LEDs/Relais:

Command	Description
L5 ! xx	Configures the flash function of the fifth LED/Relay output LED_EXT5.
	Not possible while playback.
xx	00 The flash function of the fifth LED/Relay output is deactivated.
	01-10 The fifth LED/Relay output flashes between 200ms – 2s.
	11 The fifth LED/Relay output is totally turned off.

Command	Description
L6 ! xx	Configures the flash function of the sixth LED/Relay output GPIO_4.
	Not possible while playback.
xx	00 The flash function of the sixth LED/Relay output is deactivated.
	01-10 The sixth LED/Relay output flashes between 200ms – 2s.
	11 The sixth LED/Relay output is totally turned off.

Command	Description
L7 ! xx	Configures the flash function of the seventh LED/Relay output GPIO_5.
	Not possible while playback.
xx	00 The flash function of the seventh LED/Relay output is deactivated.
	01-10 The seventh LED/Relay output flashes between 200ms – 2s.
	11 The seventh LED/Relay output is totally turned off.

Command	Description
L8 ! xx	Configures the flash function of the eighth LED/Relay output GPIO_6.
	Not possible while playback.
xx	00 The flash function of the eighth LED/Relay output is deactivated.
	01-10 The eighth LED/Relay output flashes between 200ms – 2s.
	11 The eighth LED/Relay output is totally turned off.

List of commands – Configuration – Serial interfaces UART 1 / UART 2:

Command	Description
RS! 0x	Configures the first UART (UART 1) for RS232 or RS485 mode.
	Not possible while playback or recording.
0x	00 The RS232 interface is activated.
	01 The RS485 interface is activated.

Command	Description
EC! 0x	Adjusts the answer setting of the first serial interface (UART 1).
	Not possible while playback or recording.
0x	00 The first serial interface (UART 1) sends answers (echoes).
	01 The first serial interface (UART 1) sends no answers (echoes).

Command	Description
AD! xx	Configures an optional serial address for the first serial interface (UART 1).
	Not possible while playback or recording.
xx	00 The ULTRA 2 MP3 module has no serial address (UART 1).
	01-99 The ULTRA 2 MP3 module has a serial address (UART 1). - Serial commands are only processed, if there is a xx: before the serial command! - Only the module addressed answers via the serial interface (UART 1)! Example: 01:GS!

Command	Description
NW! xx	Activates the serial welcome message via the first serial interface (UART 1).
	Always possible.
xx	00 The serial welcome message (UART 1) is activated.
	01 The serial welcome message (UART 1) is deactivated.

Command	Description
NH! xx	Configures the hardware handshake RTS/CTS for the first serial interface (UART 1).
	Always possible.
xx	00 The handshake (RTS/CTS hardware handshake, UART 1) is activated.
	01 The handshake (RTS/CTS hardware handshake, UART 1) is deactivated. IMPORTANT: The handshake is important for the MP3 upload, the MP3 streaming and the firmware upload via the first serial interface! For these functions, the hardware handshake should not be turned off!

Command	Description
BR! xx	Configures the baudrate of the first serial interface (UART 1).
	Always possible.
xx	00 The baud rate of the serial interface (UART 1) is set to 115.200 bps.
	01 The baud rate of the serial interface (UART 1) is set to 38.400 bps.
	02 The baud rate of the serial interface (UART 1) is set to 19.200 bps.
	03 The baud rate of the serial interface (UART 1) is set to 9.600 bps.
	IMPORTANT: A higher baud rate is important for a good transfer speed of MP3 or firmware data!

List of commands – Configuration – Serial interfaces UART 1 / UART 2:

Command	Description
SM! 0x	Activates/Deactivates the serial master mode of the first serial interface (UART 1).
	Always possible.
0x	00 The master mode is deactivated.
	01 The master mode is activated, when starting a MP3 file a start command is send via the UART 1 to other modules. No other answers or commands are send via the UART 1!

List of commands – Configuration – LC-Display:

Command	Description
LC! xxyy	Configures the number of lines and character per lines of the LC-Display.
	Not possible while playback or recording.
xx	Number of character per lines.
yy	Number of lines.

Command	Description
LI! 0x	Configures the interpretation of ID3 tags from a MP3 file.
	Not possible while playback or recording.
0x	00 The ID3 tags are not interpreted during playback.
	01 The ID3 tags from a MP3 file are being interpreted and displayed on the LC-Display. The ID3 title is displayed on the second line of the LC-Display. The ID3 album is displayed on the third line of the LC-Display. The ID3 performer is displayed on the fourth line of the LC-Display.

List of commands – Configuration – EEPROM:

Command	Description
SV!	Stores the configuration parameter inside the EEPROM memory.
	Not possible while playback or recording.

Command	Description
LD!	Loads the configuration parameter from the EEPROM memory.
	Not possible while playback or recording.

Command	Description
DF!	Loads the default configuration parameter.
	Not possible while playback or recording.

Command	Description
SC!	Returns the actual configuration parameter.
	Always possible.
Extended Answer	
OV: 0xxx	
BA: xx	
TR: xx	
SH: 0x	
BU: 0x	
RP: 0x	
IN: 0x	
FD: 0x	
LO: 0x	
LC: xxxxx	
RS: 0x	
EC: 0x	
AD: xx	
LI: 0x	
AS: 0x	
NW: 0x	
NH: 0x	
BR: 0x	
BO: 0xxx	
LE: 0x	
NA: xxxxxxxx	
LL: 0x	
PO: 0x	
GP: 0x	
L1: xx	
L2: xx	
L3: xx	
L4: xx	
L5: xx	
AM: 0x	
SD: xxxxxxxx	
AV: 0x	
VL: 0xxx	
VR: 0xxx	
SM: 0x	
FF: 0x	
FQ: 0x	
FM: 0x	
FW: 0x	
FS: 0x	
FH: 0x	
FG: 0x	