5.4 USART ISP communication protocol

All USART ISP commands should be sent as single ASCII strings. Strings should be terminated with Carriage Return (CR) and/or Line Feed (LF) control characters. Extra <CR> and <LF> characters are ignored. All ISP responses are sent as <CR><LF> terminated ASCII strings. Data is sent and received in plain binary format.

5.4.1 USART ISP initialization

Once the USART ISP mode is entered, the auto-baud routine needs to synchronize with the host via the serial port (USART).

The host should send a '?' (0x3F) as a synchronization character and wait for a response. The host side serial port settings should be 8 data bits, 1 stop bit and no parity. The auto-baud routine measures the bit time of the received synchronization character in terms of its own frequency and programs the baud rate generator of the serial port. It also sends an ASCII string ("Synchronized<CR><LF>") to the host. In response to this, the host should send back the same string ("Synchronized<CR><LF>").

The auto-baud routine looks at the received characters to verify synchronization. If synchronization is verified then "OK<CR><LF>" string is sent to the host. The host should respond by sending the crystal frequency (in kHz) at which the part is running. The response is required for backward compatibility of the boot loader code and is ignored. "OK<CR><LF>" string is sent to the host after receiving the crystal frequency. If synchronization is not verified then the auto-baud routine waits again for a synchronization character. In USART ISP mode, the part is clocked by the FAIM configuration and the crystal frequency is ignored.

Once the crystal frequency is received the part is initialized and the ISP command handler is invoked. For safety reasons an "Unlock" command is required before executing the commands resulting in flash erase/write operations and the "Go" command. The rest of the commands can be executed without the unlock command. The Unlock command is required to be executed once per ISP session. The Unlock command is explained in Section 5.5 "USART ISP commands".

5.4.2 USART ISP command format

"Command Parameter_0 Parameter_1 ... Parameter_n<CR><LF>" "Data" (Data only for Write commands).

5.4.3 USART ISP response format

"Return_Code<CR><LF>Response_0<CR><LF>Response_1<CR><LF> ... Response_n<CR><LF>" "Data" (Data only for Read commands).

5.4.4 USART ISP data format

The data stream is in plain binary format.

5.5 USART ISP commands

The following commands are accepted by the ISP command handler. Detailed status codes are supported for each command. The command handler sends the return code INVALID_COMMAND when an undefined command is received. Commands and return codes are in ASCII format.

CMD_SUCCESS is sent by ISP command handler only when received ISP command has been completely executed and the new ISP command can be given by the host. Exceptions from this rule are "Set Baud Rate", "Write to RAM", "Read Memory", and "Go" commands.

Table 15. USART ISP command summary

ISP Command	Usage	Section
Unlock	U <Unlock Code>	5.5.1
Set Baud Rate	B <Baud Rate> <stop bit>	5.5.2
Echo	A <setting>	5.5.3
Write to RAM	W <start address> <number of bytes>	5.5.4
Read Memory	R <address> <number of bytes>	5.5.5
Prepare sectors for write operation	P <start sector number> <end sector number>	5.5.6
Copy RAM to flash	C <Flash address> <RAM address> <number of bytes>	5.5.7
Go	G <address> <Mode>	5.5.8
Erase sector(s)	E <start sector number> <end sector number>	5.5.9
Erase page(s)	X <start page number> <end page number>	5.5.10
Blank check sector(s)	I <start sector number> <end sector number>	5.5.11
Read Part ID	J	5.5.12
Read Boot code version	K	5.5.13
Compare	M <address1> <address2> <number of bytes>	5.5.14
ReadUID	N	5.5.15
Read CRC checksum	S <address> <number of bytes>	5.5.16
Read flash signature	Z	5.5.17
Read/Write FAIM Page	O	5.5.18

Table 16 lists the supported USART ISP commands for each CRP level.

Table 16. ISP commands allowed for different CRP levels

ISP command	CRP1	CRP2	CRP3 (no entry in ISP mode allowed)
Unlock	yes	yes	n/a
Set Baud Rate	yes	yes	n/a
Echo	yes	yes	n/a
Write to RAM	yes; above 0x1000 0600 only	no	n/a
Read Memory	no	no	n/a
Prepare sectors for write operation	yes	yes	n/a
Copy RAM to flash	yes; not to sector 0	no	n/a
Go	no	no	n/a

Table 16. ISP commands allowed for different CRP levels

ISP command	CRP1	CRP2	CRP3 (no entry in ISP mode allowed)
Erase sector(s)	yes; sector 0 can only be erased when all sectors are erased.	yes; all sectors only	n/a
Erase page(s)	yes; page 0 can only be erased when all pages are erased (not recommended, use Erase Sector).	yes; all pages only	n/a
Blank check sectors	no	no	n/a
Read Part ID	yes	yes	n/a
Read Boot code version	yes	yes	n/a
Compare	no	no	n/a
ReadUID	yes	yes	n/a
Read CRC	no	no	n/a
Read flash signature	yes (full range of the flash only)	no	n/a
Read/Write FAIM page	yes	yes	n/a

5.5.1 Unlock

Table 17. USART ISP Unlock command

Command	U
Input	Unlock code: 23130_{10}
Return Code	CMD_SUCCESS | INVALID_CODE | PARAM_ERROR
Description	This command is used to unlock Flash Write, Erase, and Go commands.
Example	"U 23130<CR><LF>" unlocks the Flash Write/Erase & Go commands.

5.5.2 Set Baud Rate

Table 18. USART ISP Set Baud Rate command

Command	B
Input	Baud Rate, FAIM configuration dependant: 9600 | 19200 | 38400 | 57600 | 115200 | 230400 | 460800 Stop bit: 1 | 2
Return Code	CMD_SUCCESS | INVALID_BAUD_RATE | INVALID_STOP_BIT | PARAM_ERROR
Description	This command is used to change the baud rate. The new baud rate is effective after the command handler sends the CMD_SUCCESS return code.
Example	"B 57600 1<CR><LF>" sets the serial port to baud rate 57600 bps and 1 stop bit.

5.5.3 Echo

Table 19. USART ISP Echo command

Command	A
Input	Setting: ON = 1 | OFF = 0
Return Code	CMD_SUCCESS | PARAM_ERROR
Description	The default setting for echo command is ON. When ON the ISP command handler sends the received serial data back to the host.
Example	"A 0<CR><LF>" turns echo off.

5.5.4 Write to RAM

The host should send the plain binary code after receiving the CMD_SUCCESS return code. This ISP command handler responds with “OK<CR><LF>” when the transfer has finished.

Table 20. USART ISP Write to RAM command

Command	W
Input	**Start Address:** RAM address where data bytes are to be written. This address should be a word boundary. **Number of Bytes:** Number of bytes to be written. Count should be a multiple of 4
Return Code	CMD_SUCCESS | ADDR_ERROR (Address not on word boundary) | ADDR_NOT_MAPPED | COUNT_ERROR (Byte count is not multiple of 4) | PARAM_ERROR | CODE_READ_PROTECTION_ENABLED
Description	This command is used to download data to RAM. This command is blocked when code read protection levels 2 or 3 are enabled. Writing to addresses below 0x1000 0600 is disabled for CRP1.
Example	"W 268437504 4<CR><LF>" writes 4 bytes of data to address 0x1000 0800.

5.5.5 Read Memory

Reads the plain binary code of the data stream, followed by the CMD_SUCCESS return code.

Table 21. USART ISP Read Memory command

Command	R
Input	**Start Address:** Address from where data bytes are to be read. This address should be a word boundary. **Number of Bytes:** Number of bytes to be read. Count should be a multiple of 4.
Return Code	CMD_SUCCESS followed by <actual data (plain binary)> | ADDR_ERROR (Address not on word boundary) | ADDR_NOT_MAPPED | COUNT_ERROR (Byte count is not a multiple of 4) | PARAM_ERROR | CODE_READ_PROTECTION_ENABLED
Description	This command is used to read data from RAM or flash memory. This command is blocked when code read protection is enabled.
Example	"R 268437504 4<CR><LF>" reads 4 bytes of data from address 0x1000 0800.