APPLIED WIRELESS ID

MPR Serial Communication Protocol III - 041458

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REVISION HISTORY

Version No.	Date	Sections Affected	Remarks
1.0	8/2011	-	Initial version
1.1	11/2011	5.6	Temperature monitor status messages added
2.0	1/2012	5.2	Conversion formula updated for handling negative values – Temperature command (0x01)
2.1	4/2012	5.2	Editorial update to Regional Frequency Band for Reader Status command; FW: US0-V2.01-25.50.L6
3.0	5/2012	5.2, 5.6	System command (0x43) added for enabling/disabling reporting temperature status, FW 21.03.S1.T
3.1	6/2012	5.2	System command (0x4A) added for extended EPC support, FW 21.03.S3.T
3.2	8/2012	5.2	Changes to antenna commands 0x0D, 0x0E (removed), 0x0F and 0x1D; 0x88 added for 4-port 19xx module support.
4.0	9/2012	5.4	Obsolete EAS commands removed.
4.1	9/2012	5.2	Antenna commands 0x0E, 0x62 added.
4.2	9/2012	5.3, 5.4, 6.4	Appendix section added describing actual indexing assignment for Sensitivity Level Control command (0x07). FW 25.51.S8, 29.51.S8.
4.3	10/2012	-	FW 25.51.L8
5.0	1/2013	5.2	Corrections to 0x0F, 0x88 replies
5.1	3/2013	-	Obsolete multi-protocol commands (0x14) removed. FW 25.52.S1/29.52.S1
6.0	9/2013	5.3	ISO commands updated per FW support
6.1	9/2013	5.2, 5.4	Obsolete system command 0x08 removed; EPC C1G2 commands 0x6D, 0x6F added

1 Purpose and Scope

This document describes the serial (RS232) communication protocol for communications among and between AWID's Multi Protocol RFID (MPR) reading devices and other HOST systems and equipment. Applicable devices are the latest[1] MPR-19xx module and complete reader[2] embedding the module with antenna in same housing and connector for optional external antenna.

A HOST system for purposes of this specification could be a personal computer, a POS system or a data collector.

AWID MPR device reads tags of protocols/types[3] listed below. Commands for each of these protocols are further described in later sections.

- ISO-18000-6 Type B (U-Code, HSL)
- ISO-18000-6 Type C
- EPC Class 1 Gen 2

The device handles one command a time, applications can be developed to issue a sequence of commands of different categories (system, tag read/write, etc.) with each command following receipt of response from the previous command. See 6.3 for a simple scenario.

1.1 Definitions and Acronyms

Terms Used	Description of Terms
RFID	Radio Frequency IDentification
MPR	Multi Protocol RFID
RCSP	AWID's RFID Common Serial Protocol
POS	Point Of Sale

[1] HW version: 2.01 as of initial draft of this document.
[2] MPR-2010BR, MPR-2080BU, etc.
[3] For protocols used in testing for FCC certification, refer to Installation & Operation Manual for each of the readers (modules).

2 References

Document Title	Document#
MPR Serial Communication Manual	041388
MPR Serial Communication Manual II	041377

3 Physical Layer

The device will be connected to the host via RS-232. It will be a three-wire connection (TX, RX and GD) with 9600, 8, N, 1 as the default setting.

- Baud Rate: 9600
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

4 Data Link Layer

This section describes the data link layer of the protocol. In particular it provides sufficient information to describe how devices should implement the data transmission mechanism in order to provide reliable communications of data.

4.1 RCSP Packet Structure

The packet structure is shown below:

LEN (1)	TYPE (1)	CMD (1)	DATA (<50)	CHECKSUM (2)

Where

- LEN – Total number of bytes in packet
- TYPE – Command type: commands are categorized into system (0x00), tag type specific (0x11, 0x15 or 0x20) and multi-protocol (0x14).
- CMD – Command code, i.e., command ID within the command category.
- DATA – Data of 5~50 bytes long depending on the CMD.
- CHECKSUM – CRC-16.

For example, the "RF Power ON" system command should be issued as "05 00 05 xx xx" where "05" in the 1st byte denotes the total bytes in packet, "00" in the 2nd byte the command's type: system, "05" in the 3rd byte the command id. The final 2 bytes are placeholders for CRC. See section 5.1 for command details.

4.2 Checksum Algorithm

The checksum is calculated as follows:

Transmit Link:

CRC Definition:

CRC Type	**Length**	**Polynomial**	**Preset**	**Residue**
CCITT 16	16 bits = 2 bytes	0x1021	0xFFFF	0

Receive Link:

CRC Definition:

CRC Type	**Length**	**Polynomial**	**Preset**	**Residue**
CCITT 16	16 bits = 2 bytes	0x1021	0xFFFF	0xFFFF

The user can use the same routine to do the CRC generate and check. The result for received packet check should be 0xFFFF when input the whole received packet.

Example C program (for transmit):

```
//*****************************************************************************************
unsigned int CRC_Check(unsigned char *ary,unsigned char len)
{
  unsigned int crc;
  unsigned char i,j;

  crc = 0xFFFF;

  for(i=0;i<len;i++,ary++)
          {
          crc = ((unsigned int)*ary << 8) ^ crc;
          for(j=0;j<8;j++)
                  {
                  if(crc & 0x8000)
                          crc = (crc << 1) ^ 0x1021;
                  else
                          crc <<= 1;
                  }
          }

  return (crc ^ 0xFFFF);

}
//*****************************************************************************************
```

Example:
Forward packet:
IN: 0x05, 0x00, 0x00
Out: 0xD8, 0x93

Received packet:
IN:
Out:

4.3 Poll Response

The protocol is poll-response only and therefore half-duplex. The MPR device will respond with 0x00 or 0xFF after it receives the complete command packet. The maximum delay the host has to wait for the response is about 100 ms.

5 Message Layer

This section describes all the commands that can be issued via RCSP packets. They are categorized (or typed) into System, tag type (protocol) specific and multi-protocol. Examples are shown in hexadecimal and include an xx in the placeholder CRC bytes.

If data in a response message are for multiple tags, 1 tag's worth of data per packet are returned. Data exceeding the length of the packet are truncated.

All commands should expect an acknowledgement from the MPR device, some should also expect (a) subsequent response(s). These are noted in the description for each of the commands in sub-sections that follow.

The *Stop* command is applicable to those commands that repeatedly execute and/or generate multiple, continuous responses (see Appendix in section 6.1). *IDs, Portal IDs, Single Tag Meter, Read Single Tag ID, Write ID, Read Single Block Data, Read N Blocks Data* and *Read Single Tag ID with Time-Out* (with a zero value specified for the *TryTimes* parameter for the last three) fall into this sub-category and should be handled accordingly.

A response packet follows the same structure definition as illustrated in section 4.1 for a request command: 1st byte the number of bytes in response, 2nd byte the command type (system or protocol/tag type, e.g., 0x11 for ISO-B), 3rd byte the command id (e.g., 0x0E for ISO-B's *IDs* command), 4th through 3rd –from-last the tag ID/data. For responses that do not contain tag ID data, the 2nd byte is 0xFF indicating that this is (just) a *message* (i.e., no *data*), e.g., "06 FF 03 00 xx xx" for the "Write Success" result of the ePC C1 *Write ID* command.

5.1 Stop Command

Before listing commands of System and tag type specific categories, the *Stop* command is described due to the fact that it does not exactly fall into either category. It should be noted that Stop is the only command the MPR reader accepts any time (even multiple times) during operation with or without another command in execution. It therefore serves as a simple way to verify the basic well being of communication with an MPR device.

Issuing the *Stop* command is a required step to terminate those commands that repeatedly execute and/or generate multiple, continuous responses (see Appendix in section 6.1 *Data Flow*). *IDs, Portal IDs, Single Tag Meter, Read Single Tag ID, Write ID, Read Single Block Data, Read N Blocks Data* and *Read Single Tag ID with Time-Out* (with a zero value specified for the *TryTimes* parameter for the last three) fall into this sub-category and should be handled accordingly. For these commands[4], until a Stop is issued and responded to, their execution is not terminated and another command (system or tag type specific) should ***not*** be issued as it most likely would produce undesirable outcome due to data flow disruptions.

It is recommended that applications on exiting always check if there's any ongoing continuous tag reading activity and issue the essential Stop command if so before the actual exit.

Stop (0x00)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	00	00

This one-byte (0x00) command is issued to stop the reader from executing and sending any more data generated by the previously issued command.

Example:
Command: 00

ACK: 00

Response: None

[4] Also, a second Stop is advisable in these circumstances where the 1st Stop functions as described above and the 2nd Stop ensures RF power's being turned off. By the same token, a good practice is to issue a Stop command after every command execution especially before a subsequent tag read/write command as it basically achieves the tag re-set effect.

5.2 System Command (0x00)

Firmware Version (0x00)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 00 xx xx	00 or FF 17 00 00 55 53 30 2D 76 32 2E 30 31 2D 32 35 2A 35 30 2A 4C 31 xx xx

Example:
Command: 05 00 00 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 17 00 00 55 53 30 2D 76 32 2E 30 31 2D 32 35 2A 35 30 2A 4C 31 xx xx
Where:
55 53 30 2D 76 32 2E 30 31 2D 32 35 2A 35 30 2A 4C 31
– Version Identification

In this example the result is “US0-v2.01-25*50*L1”

Temperature (0x01)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 01 xx xx	00 or FF 07 00 01 01 1D xx xx

This is the command to get the temperature[5] reading of the MPR device in centigrade.

Example:
Command: 05 00 01 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 07 00 01 01 1D xx xx where the 4th byte is Temp1 and 5th byte Temp2 and the temperature reading should be calculated as follows:

When Temp1 is less than 255 (0xFF) the resulting reader temperature should be (Temp1*256 + Temp2)/10 (yields to 28 degrees Celsius from this response)

If Temp1 is a negative value the resulting reader temperature should be –((256 – Temp2) / 10)

[5] This refers to temperature of the embedded module and is ok to be higher (e.g., by 20°C) than what's documented in reader's installation/user manual (sec 2) for (the upper limit of) the operating (ambient) temperature.

RF Power ON (0x05)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 05 xx xx	00 or FF

This is the command to turn on[6] the RF Power of the MPR device.

Example:
Command: 05 00 05 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: No

[6] There is no need to explicitly turn on the RF power before issuing a Read or Write command which automatically turns on the RF power. This command is only useful in generating CW.

RF Power OFF (0x06)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 06 xx xx	00 or FF

Example:
Command: 05 00 06 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: No

Reader Status (0x0B)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 0B xx xx	00 or FF 19 00 0B 00 24 00 09 01 FF FF FF FF FF FF FF FF FF FF 04 04 FF FF 00 xx xx

This is the command to retrieve current system settings for the reader. All except for protocol data rate and frequency related fields are user settable.

Example:
Command: 05 00 0B XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 19 00 0B 00 24 00 09 01 FF FF FF FF FF FF FF FF FF FF 04 04 FF FF 00 xx xx
Where:
00 24 00 09 01 FF FF FF FF FF FF FF FF FF FF 04 04 FF FF 00 - Status

Byte 1: RF Power On/Off
0x00 – Off
0x01 – On

Byte 2: Protocol Data Rate
Bit 0 – N/A
Bit 1 – ISO 18000 – 6 Type B
0: 40k
1: 160k
Bit 2 – N/A
Bit 3 – N/A
Bit 4 – N/A
Bit 5 – ePC C1 Gen 2
0: 40k
1: 20k
Bit 6 – N/A
Bit 7 – N/A

Byte 3: Region Code for Operation Frequency Band[7]
0x00 - 902~928 America[8]
0x01 - 902~928 US 2
0x02 - 922~928 Taiwan
0x03 - 920~925 Singapore, Thailand, Hong Kong

[7] See http://www.gs1.org/docs/epcglobal/UHF_Regulations.pdf for up-to-date definitions.
[8] Argentina, Canada, Chile, Costa Rica, Dominican Republic, Mexico, Peru, Puerto Rico, United States, Uruguay.

0x04 - 910~914 Korea
0x05 – 920~925 China
0x06 – 919~923 Malaysia
0x07 – Reserved
0x08 - 920~926 Australia
0x09 – 915.4~919 South Africa
0x0A – 902~907.5 Brazil 1
0x0B – Reserved
0x0C – Reserved
0x0D – 915~928 Brazil 2
0x0E – N/A
0x0F – N/A
0x10 – 952~954 Japan (High)
0x11 – 952~955 Japan (Low)
0x12 – 922~926 Taiwan 3

Byte 4: Frequency Index Number – frequency table index currently hopped to/at
0x00 ~ 0x32

Byte 5: Frequency Hopping Status – whether frequency hopping is on
0x00 – Fixed
0x01 – Hopping

Byte 6: ISO 18000 – 6 Type B Channel I sensitivity setting
0x00 ~ 0xFF

Byte 7: ISO 18000 – 6 Type B Channel Q sensitivity setting
0x00 ~ 0xFF

Byte 8: N/A

Byte 9: N/A

Byte 10: N/A

Byte 11: N/A

Byte 12: N/A

Byte 13: N/A

Byte 14: N/A

Byte 15: N/A

Byte 16: RF Power level setting
0x00 ~ 0xFF

Byte 17: Write RF Power level setting
0x00 ~ 0xFF

Byte 18: ePC C1 Gen 2 Channel I sensitivity setting
0x00 ~ 0xFF

Byte 19: ePC C1 Gen 2 Channel Q sensitivity setting
0x00 ~ 0xFF

Byte 20: System Flag
Bit 0: N/A
Bit 1 – N/A
Bit 2 – Antenna Switch
0 – Disabled
1 – Enabled
Bit 3 –Antenna Source
0 – Disabled
1 – Enabled
Bit 4 – N/A
Bit 5 – N/A
Bit 6 – N/A
Bit 7 – N/A

Antenna Select (0x0D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 0D Number xx xx	00 or FF 06 FF 0D 00 xx xx or 06 FF 0D 10 xx xx

This command can be issued to a MPR-19xx based reader/module to select the specified antenna (by *Number)* during operation when the Antenna Switch (toggle) capability is disabled[9]. A 6-byte status message is responded by reader upon executing this command, see example below.

Number: 1 or 2 for MPR-20x0BR or MPR-19x0
1 ~ 4 for MPR-1914

Example:
Command: 06 00 0D 02 xx xx - to select Antenna 2

ACK: 00 – Command accepted for execution
FF – Command received in error

Response: 06 FF 0D 00 xx xx – selection made successfully
06 FF 0D 10 xx xx – selection failed (e.g., antenna not configured)

[9] By default the reader has Antenna Switch disabled and Antenna 1 selected.

Antenna Status (0x0E)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 0E xx xx	00 or FF 11 00 0E 01 05 01 02 02 02 02 10 C8 DC C8 DC xx xx

This command is issued to retrieve the Status of Antennas of an MPR-19x4 based unit. See below for definition of status data[10].

Example:
Command: 05 00 0E xx xx

Response: 11 00 0E 01 05 01 02 02 02 02 10 C8 DC C8 DC xx xx
Where:
01 05 01 02 02 02 02 05 05 05 05 10 C8 DC C8 DC FF FF FF FF – status

Byte 1: Switching On/Off
0x00 – Off
0x01 – On

Byte 2: Current Antenna
0x01~0x04 – ID of current Antenna

Byte 3: Number of enabled Antennas
0x00~0x04

Byte 4~7: Switching Rate for each of the 4 Antennas

Byte 8: Bit Status Value for each of the 4 Antennas
Bit 0~7 –Status of Antenna 1~4
0: Disabled (not connected)
1: Enabled

Byte 9~12: antenna RF Power Level settings

[10] Note that information on enabled/disabled antennas may not be correct until the Antenna Configure command is executed.

Antenna Switch (0x0F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 0F Setting xx xx	00 or FF 07 00 0F 03 00 xx xx or, 07 00 0F 00 FF xx xx

This command is issued to enable or disable the Antenna Switch functionality for reader/module. *Setting* is 00 for *Disable* and 01 for *Enable*. When enabled, reader will use antenna by toggling between the two for 2-port reader/module or among up to four for MPR-1914 (based on *switching rates* set for antennas). By default, the switch is off and antenna 1 is selected. Upon executing this command (to enable switching), reader responds with status information (3rd and 4th bytes) as shown in example below.

Example:
Command: 06 00 0F 00 xx xx - disable Antenna Switch
06 00 0F 01 xx xx - enable Antenna Switch

ACK: 00 – Command accepted for execution
FF – Command received in error

Response: 07 00 0F 03 00 xx xx where
3rd byte (0F) denotes command code
4th byte (03) denotes status of *detected antennas*[11] and 5th byte (00) *setting status* (or, result of command execution):

	Length	Type	Command	Ant Detect	Message	CRC-16
# of bytes	1	1	1	1	1	2
Description	0x07	0x00	0x0F	bit 0: ANT1 bit 1: ANT2 bit 2: ANT3 bit 3: ANT4 1:Good[12] 0:No Good	0x00: Success 0xFF: Fail	

[11] ANT3, ANT4 (bits 2, 3) applicable only to MPR-1914; example here shows 1st and 2nd antennas being "*Good*".
[12] Typically "*Good*" for when the numbered antenna is properly connected; "*No Good*" otherwise.

RF Power Level Control (0x12)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 12 Index xx xx	00 or FF

This is the command to control reader's RF Power Level. The reader has an adjustable Output Power range of 20 dB. The *Index* (for *Output Attenuation*[13]) in this command is a one-byte value ranging from 0x00 to 0xFF that can be specified for the adjustment/control. The Output Power decreases when the Index value increases. All subsequent tag Read/Write[14] operations will use this setting until re-set

Example:
Command: 06 00 12 00 xx xx – Maximum Output Power
06 00 12 FF xx xx – Minimum Output Power

ACK: 00 – Command received correct
FF – Command received error

Response: No

[13] Thus a value of zero (0) means no attenuation yielding maximum output power and 255 is maximum attenuation for minimum output power.
[14] If a Write RF Power Level has never been set.

Portal IDs Filter (0x13)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 13 Filter xx xx	00 or FF

This command can be issued to turn on or off the filtering for the Portal IDs command. The MPR device is defaulted to have filtering enabled. When filtering is in effect, a non-zero value for the *Repeat* parameter to the Portal IDs command will result in a set of unique tag IDs being returned every *Repeat**100 ms.

Example:
Command: 06 00 13 00 xx xx – Filtering Off
06 00 13 01 xx xx – Filtering On

ACK: 00 – Command received correct
FF – Command received error

Response: None

Change Baud Rate (0x18)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 18 BaudrateIndex xx xx	00 or FF

This is the command to set[15] the baud rate for the MPR device. Mapping between value for *BaudrateIndex* and the actual baud rate is as follows:

0x00 – 9600
0x01 - 19200
0x02 - 38400
0x03 – 57600
0x04 - 115200

Example:
Command: 06 00 18 02 XX XX to set the baud rate to 38400

ACK: 00 – Command received correct
FF – Command received error

Response: None

[15] The change will be reset back to 9600 after a power or soft reset.

Antenna Switch Rate (0x1D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	09 00 1D Ant1 Ant2 Ant3 Ant4 xx xx	00 or FF

When Antenna Switch (0x0F) is enabled, the reader will operate switching from one enabled antenna to the next based on the switching rate set for each. This command is issued to set the switching rate for all the antennas for an MPR-19xx based unit. *Ant1 ~ Ant4* each takes value in 01~FF denoting Ant1*100 MS ~ Ant4*100 MS. All default to 5 for 500 MS.

Example:
Command: 09 00 1D 05 03 05 03 xx xx
- Antenna Switch Rate is 500 MS for odd-numbered antennas and 300 MS for even-numbered antennas.

Write RF Power Level Control (0x32)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 32 Index xx xx	00 or FF

RF Power Level set through command 0x12 applies to both Read and Write operations, this command can be issued to control RF Power Level specifically for Write operations. If neither 0x12 nor this command has ever been issued the Write operation will use the system default of the maximum RF Power Level.

Example:
Command: 06 00 32 00 xx xx – Maximum Output Power
06 00 32 FF xx xx – Minimum Output Power

ACK: 00 – Command received correct
FF – Command received error

Response: None

Report Temperature Warning (0x43)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	07 00 43 On/Off Threshold xx xx	00 or FF

This command is issued to enable/disable reporting of temperature statuses (see 5.6 for applicable messages). On enabling, the reporting temperature threshold should also be specified with a value in 40~90° Celcius. By default, reporting is disabled in the system though steps are always taken to constantly monitor the temperature and perform necessary actions in safeguarding the system.

Example:
Command: 07 00 43 00 00 xx xx - disable reporting
07 00 43 01 32 xx xx - enable reporting at 50° Celcius

ACK: 00 – Command received correct
FF – Command received error

Response: None

Extended EPC Support (0x4A)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 4A Setting xx xx	00 or FF

By default, reader reports EPC Class 1 Gen 2 tags with EPC numbers of lengths in at most 128 bits. This command can be issued to override such default for reader to include tags with EPC numbers in extended lengths of up to 240 bits.

Example:

Command:	06 00 4A 00 xx xx	- disable extended length, report only tags with EPC numbers of up to 128 bits
	06 00 4A 01 xx xx	- enable extended length of 240 bits

Response: None

Antenna Source (0x53)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 53 Setting xx xx	00 or FF

This command is issued to identify the antenna in use for a particular Read of the tag. When enabled, the antenna number will be returned in responses to a tag reading command taking up an additional byte. For example, if enabled, the response for an ePC C1 Gen 2 Portal IDs command is like “16 20 1E 30 00 11 22 33 44 55 66 77 88 99 AA BB CC yy yy 01 xx xx” where “11 22 33 44 55 66 77 88 99 AA BB CC” is the tag ID and “01” preceding the CRC bytes is the antenna number. Applicable tag reading commands include IDs, Portal IDs, Read Single Tag ID, Read Single Tag ID with Time Out. By default, this capability is disabled in the system.

Example:

Command: 06 00 53 00 xx xx - disable Identifying Antenna Source
06 00 53 01 xx xx - enable Identifying Antenna Source

Response: None

Antenna Power Level Control (0x62)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	09 00 62 Ant1 Ant2 Ant3 Ant4 xx xx	00 or FF

This command is issued to set the Antenna Power Level for an MPR-19x4 based unit[16]. Settings are specified in terms of Output Attenuation Index as in RF Power Level Control (0x12). *Ant1 ~ Ant4* each takes value in 00~FF. All default to 0. When system wide RF Power Level Control is set, all antennas will have the same setting as the system wide RF Power Level until this command is issued.

Example:
Command: 09 00 62 C8 DC C8 DC xx xx
- Power Level is set to C8 (200) for Antenna 1 and 3 and DC (220) for Antenna 2 and 4.

[16] Execution of this command requires longer time for setting up the RF power for each antenna so some delay (e.g., 100ms) is recommended before sending the next command to reader.

Soft Reset (0x80)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 00 80 xx xx	00 or FF 69 69 41 57 49 44 20 4D 50 52 2D 31 39 31 30 20 56 32 2E 30 41 20 55 48 46 20 4D 4F XX XX

Upon receiving this command, in one second the MPR will reset itself by clearing all buffers and start from the beginning.

Example:
Command: 05 00 80 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 69 69 41 57 49 44 20 4D 50 52 2D 31 39 31 30 20 56 32 2E 30 41 20 55 48 46 20 4D 4F XX XX

The greetings message in form of “iiAWID MPR 1910 V2.0A UHF MODULE” (30-32 bytes) is sent back by the reader. Note that it is not exactly a *response* to this particular command as for all other commands, the 1st byte should not be interpreted as the total length of the packet and the whole packet should just be converted through ASCII encoding.

Antenna Configure (0x88)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 00 88 AntennaTotal xx xx	00 or FF 07 00 88 0F 00 xx xx or, 07 00 88 00 FF xx xx

This command can be issued (to MPR-1914) to specify which antennas are enabled/connected. The response packet contains two status info bytes as illustrated below.

AntennaTotal: 01~04 – all (contiguous) antennas up to this one are enabled

Example:

Command: 06 00 88 03 XX XX

ACK: 00 – Command accepted for execution
FF – Command received in error

Response: 07 00 88 07 00 xx xx
3rd byte (88) denotes command code
4th byte (07) denotes status of *detected antennas* (3) and 5th byte (00) *setting status* (or, result of command execution):

	Length	Type	Command	Ant Detect	Message	CRC-16
# of bytes	1	1	1	1	1	2
Description	0x07	0x00	0x88	bit 0: ANT1 bit 1: ANT2 bit 2: ANT3 bit 3: ANT4 1:Good[17] 0:No Good	0x00: Success 0xFF: Fail	

[17] Typically "*Good*" for when the numbered antenna is properly connected; "*No Good*" otherwise.

5.3 ISO-18000-6 Type B (U-Code, HSL) Command (0x11)

This family of tags includes tags from Intermec's Intellitag family, Philips HSL and any future suppliers of ISO-18000-6 Type B family. Dash six (-6) is for UHF, and Type B is the family distinct from those of Type A. Traditionally, Type B is called binary tree splitting and Type A is called Aloha anti-collision. Philips U-Code is similar to the Intellitag family, but with 2K-bits memory.

Read Single Tag ID (0x00)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 11 00 xx xx	00 or FF 0D 11 00 01 A8 E5 8F 80 D8 40 09 xx xx

This command enables reading of a single ISO-18000-6 Type B tag in reading field.

Example –

Command: 05 11 00 xx xx

Ack: 00 – command accepted
FF – command received in error

Response: 0D 11 00 01 A8 E5 8F 80 D8 40 09 xx xx
Where
01 A8 E5 8F 80 D8 40 09 – tag ID

Read Single Block Data (0x0D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	11 11 0D 0C ID StartAddress DataCRC xx xx	00 or FF 0F 11 0D 01 02 03 04 05 06 07 08 yy yy xx xx

This command provides the ability to read single memory block which is total 8 bytes starting from *StartAddress* of the selected ISO-18000-6 Type B Tag ID in the reading field. The command continuously executes until a block of data is located (and responded with) or a Stop command is received.

Example:

Command: 11 11 0D 0C 01 A8 E5 8F 80 B8 40 09 12 39 4B XX XX

Where:

01 A8 E5 8F 80 B8 40 09 – Tag ID

12 – Start Address

39 4B – Data CRC[18]

ACK: 00 – Command received correct

FF – Command received error

Response: 0F 11 0D 01 02 03 04 05 06 07 08 yy yy xx xx

Where:

01 02 03 04 05 06 07 08 – Block Data

yy yy – internal CRC (2 bytes)

[18] The Data CRC is calculated with 10 bytes of data: 0C (4th in command preceding the 8-byte Tag ID), Tag ID (5th-12th) and the Start Address byte (13th) and will be placed in the 14th and 15th bytes of the command.

Write Byte Data (0x0F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	12 11 0F 0D TagID WriteAddress WriteData DataCRC xx xx	00 or FF 06 FF 0F Status xx xx

This command provides the ability to write single byte data to the Write Address of the selected Tag ID in the writing field.

TagID: 8-byte TagID

WriteAddress: 0x08~0xFF - 1-byte address[19] to write at

WriteData: 1-byte data to write with

DataCRC: 2-byte CRC's calculated with 11 bytes of data: 0D (4th in the command preceding the 8-byte Tag ID), Tag ID (5th-12th), the Write Address byte (13th) and the Write Data byte (14th) and will be placed in the15th and 16th bytes of the command.

Example:
Command: 12 11 0F 0D 01 A8 E5 8F 80 B8 40 09 12 31 0C 4E XX XX
Where:
01 A8 E5 8F 80 B8 40 09 – Tag ID
12 – WriteAddress
31 – WriteData
0C 4E – DataCRC

ACK: 00 – Command received correct
FF – Command received error

Response: 06 FF 0F Status xx xx
Where:
Status: 00 – Write Success
10 or FF – Write Fail
80 – No response from Tag

[19] Actual write-able area starts at 0x08 past Tag ID bytes that're read only.

Single Tag Meter (0x11)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	12 11 11 00 00 00 00 00 00 00 00 00 00 00 2B F0 xx xx	00 or FF 0E 11 11 01 A8 E5 8F 80 B8 40 09 20 xx xx

This command provides the ability to read and count the number of times which single ISO-18000-6 Type B tag has been read in 300ms duration in the reading field.

Example:
Command: 12 11 11 00 00 00 00 00 00 00 00 00 00 2B F0 xx xx

ACK: 00 – Command received correct
FF – Command received error

Response: 0E 11 11 01 A8 E5 8F 80 B8 40 09 20 xx xx
Where:
01 A8 E5 8F 80 B8 40 09 – Tag ID
20 – Number of Reads in 300ms period of the same tag reading until other tags detected before 300ms period ends

This command will repeat until user sends a STOP command (0x00).

Portal IDs (0x1E)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	07 11 1E TimeOut Repeat xx xx	00 or FF 0D 11 1E 01 A8 E5 8F 80 B8 40 09 xx xx or 06 FF 1E 80 xx xx

This command provides the ability to read multiple ISO-18000-6 Type B tags present in the reading field. It provides the automatic RF Power Off function thereby optimizes performance in a multi-reader environment.

TimeOut: 0x00 – continuously execute command until user sends STOP command (0x00)

0x01~0xFF – execute command until 100ms multiplied by this value expires

Repeat: 0x00 – continuous returning of tag ID data

0x01~0xFE – returning of unique tag ID data will be repeated every interval of 100 ms multiplied by this value, meaningful only if *filtering* is in effect

Example:
Command: a) 07 11 1E 00 00 XX XX
b) 07 11 1E 04 03 XX XX
Where:
04 – command should stop after 4*100 ms
03 – unique tag ID data will be returned every 3*100 ms if filtering is in effect

ACK: 00 – Command received correct
FF – Command received error

Response:
a) TimeOut is 0x00

0D 11 1E 01 A8 E5 8F 80 B8 40 09 xx xx (repeated every 300 ms)

Where:
01 A8 E5 8F 80 B8 40 09 – Tag ID

This command will repeat until user sends a STOP command (0x00).

b) TimeOut is 0x01~0xFF

b.1)

0D 11 1E 01 A8 E5 8F 80 B8 40 09 xx xx (repeated every 300 ms)

Where:

01 A8 E5 8F 80 B8 40 09 – Tag ID

and

06 FF 1E 80 xx xx – execution stops when 400 ms is up

or

b.2)

06 FF 1E 80 xx xx – “Timed Out” when there is no good data obtained upon expiration of 400 ms

Write Block (0x1F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0F 11 1F 8ByteData StartAddress TryTimes xx xx	00 or FF 06 FF 1F 00 xx xx 06 FF 1F 10 xx xx 06 FF 1F 80 xx xx 06 FF 1F FF xx xx

This command provides the ability to write eight (8) bytes of data to an ISO-18000-6 Type B Tag starting at the specified address.

8ByteData: 8-byte data to write

StartAddress: 0x08~0xFF - 1 byte Hex data for starting address to write at

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the number of tries

Example:
Command: 0F 11 1F 01 02 03 04 05 06 07 08 12 0A xx xx

Where:
01 02 03 04 05 06 07 08 – data to write
12 – StartAddress
0A – number of tries

ACK: 00 – Command received correct
FF – Command received error

Response:
06 FF 1F 00 xx xx – Write Success
06 FF 1F 80 xx xx – Write Time-Out
06 FF 1F 10 xx xx or 06 FF 1F FF xx xx – Write Fail

Read N Blocks Data (0x2D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	08 11 2D StartAddress TotalBlocks TryTimes xx xx	00 or FF 15 11 2D 01 A8 E5 8F 80 B8 40 09 01 02 03 04 05 06 07 08 xx xx 06 FF 2D 80 xx xx

This command provides the ability to read ISO-18000-6 Type B Tag ID plus up to specified total number of (8-byte) memory blocks starting from *StartAddress* of the Tag in the reading field.

StartAddress:	0x00 ~ 0xFF – 1-byte starting address to read from
Total Blocks:	1 ~ 1C[20] – 1-byte value for total number of blocks of data to read
TryTimes:	0x00 – Repeating until good data obtained or user sends a STOP command (0x00) 0x01~0xFF – Repeating until get good data or counter reaches the TryTimes.

Example:
Command: 08 11 2D 12 01 10 XX XX
Where:
12 – Start Address
01 – Total Number of Blocks
10 – Value for TryTimes (number of tries)

ACK: 00 – Command received correct
FF – Command received error

Response:

a) Number of Tries is 0x00
15 11 2D 01 A8 E5 8F 80 B8 40 09 01 02 03 04 05 06 07 08 xx xx
Where:
01 A8 E5 8F 80 B8 40 09 – Tag ID
01 02 03 04 05 06 07 08 – Block Data

b) Number of Tries is 0x01~0xFF

[20] The maximum value 0x1C (28) is based on reading at address 0 and up to 216 bytes of data could have been written (command 0x5F) starting at address 0x08.

15 11 2D 01 A8 E5 8F 80 B8 40 09 01 02 03 04 05 06 07 08 xx xx
Where:

01 A8 E5 8F 80 B8 40 09 – Tag ID
01 02 03 04 05 06 07 08 – Block Data

Or

06 FF 2D 80 xx xx
represents a “time-out when counter reaches value of TryTimes and no good data obtained.

Write Bulk Data (0x5F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 11 5F TagID StartAddress BulkData TryTimes xx xx	00 or FF 06 FF 5F 00 xx xx 06 FF 5F 10 xx xx 06 FF 5F 80 xx xx 06 FF 5F FF xx xx

This command provides the ability to write large amount of data of variable length (up to 216 bytes) to an ISO-18000-6 Type B Tag starting at the specified address.

NN: 1-byte packet length, value depending on much 'BulkData' is to be written, i.e., 15 + length (#bytes) of 'BulkData'

TagID: 8-byte ID of the ISO-18000-6B tag

StartAddress: 0x08~0xFF - 1 byte Hex data of starting address at which data are to be written

BulkData: the bulk of data bytes to write

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the number of tries

Example: to write 168 bytes of data
Command: B7 11 5F E0 04 DB 2F C9 00 00 00 08 <bulk data> 00 xx xx

Where:
B7 – 183 = 15 + length of <bulk data>: 168
E0 04 DB 2F C9 00 00 00 – tag ID
08 – StartAddress
<bulk data> - 168 bytes of data to be written
00 – number of tries

ACK: 00 – Command accepted for execution
FF – Command received in error

Response:
06 FF 5F 00 xx xx – Write Succes
06 FF 5F 80 xx xx – Write Time-Out
5.306 FF 5F 10 xx xx or 06 FF 5F FF xx xx – Write Fail

5.4 EPC Class 1 Generation 2 Command (0x20)

This section and next list commands supported for the EPC Class 1 Generation 2 protocol. For those *Tag ID specific* commands (0x00, 0x10, 0x11, 0x1E, 0x5E, etc.) that result in Tag ID(s), i.e., EPC Number(s) reported back in response(s), the 2-byte Protocol Code (PC) is always preceding the Tag ID (EPC Number) bytes and the actual length (in number of words) of Tag ID/EPC Number can be obtained by extracting the number constituted by the first 5 bits of the first PC byte. In examples below, PC code with value 0x30 in first byte yields 6 words (i.e., 12 bytes or 96 bits) as EPC Number's length.

Read Single Tag ID (0x00)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 20 00 xx xx	00 or FF 15 20 00 30 00 30 00 21 41 60 C0 04 00 10 00 01 15 yy yy xx xx or, 11 20 00 20 00 30 00 21 41 60 C0 04 00 yy yy xx xx

This command provides the ability to read single ePC Class 1 Gen 2 tag ID in the reading field.

Example:
Command: 05 20 00 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 15 20 00 30 00 30 00 21 41 60 C0 04 00 10 00 01 15 yy yy xx xx
Where:
30 00 21 41 60 C0 04 00 10 00 01 15 – ePC Number
30 00 (preceding ePC number) – Protocol Code (PC)
yy yy – tag CRC bytes
or,

11 20 00 20 00 30 00 21 41 60 C0 04 00 yy yy xx xx
Where:
30 00 21 41 60 C0 04 00 – ePC Number
20 00 (preceding ePC number) – Protocol Code (PC)
yy yy – tag CRC bytes

This command will repeat until user sends a STOP command (0x00)

Write ID (0x03)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0E 20 03 ePCNumber TryTimes xx xx or, 12 20 03 ePCNumber TryTimes xx xx	00 or FF 06 FF 03 00 xx xx 06 FF 03 10 xx xx 06 FF 03 80 xx xx 06 FF 03 FF xx xx

This command provides the ability to program the ePC number[21] (as tag's ID) into ePC Class 1 Gen 2 tag's memory. It does a *Read* after *Write* to verify the status.

ePC Number: 8 or 12 bytes Hex data

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example:
Command: 0E 20 03 01 02 03 04 05 06 07 08 03 xx xx
Where:
01 02 03 04 05 06 07 08 – ePC number
03 – Number of Trying Time

or

12 20 03 30 00 21 41 60 C0 04 00 10 00 01 16 00 xx xx
Where:
30 00 21 41 60 C0 04 00 10 00 01 16 – ePC number
00 - TryTimes

ACK: 00 – Command received correct
FF – Command received error

Response:
a) Number of Tries is 0x00

06 FF 03 00 XX XX – Write Success
06 FF 03 FF XX XX – Write Fail

[21] It should be noted that though writing ePC Number of longer than 96 bits is supported through use of Write Memory commands (0x5F, 0x8F) *tag ID* specific commands such as Write ID (0x03), Lock ID (0x05), etc. only allows either 64-bit or 96-bit ePC Numbers to be specified. The latter is also true for performance sensitive tag read commands such as Portal IDs, Read Single Tag ID (with TimeOut), Single Tag Meter, etc.

b) Number of Tries is 0x01~0xFF
06 FF 03 00 XX XX – Write Success
06 FF 03 10 XX XX – Write Fail

Or

06 FF 03 80 XX XX – Counter reaches value of TryTimes

Lock ID (0x05)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 05 AccessCode TryTimes xx xx	00 or FF 06 FF 05 00 xx xx 06 FF 05 10 xx xx 06 FF 05 80 xx xx 06 FF 05 FF xx xx

This command provides the ability to Lock ID of an ePC Class 1 Gen 2 tag in the reading field with an Access Code defined through a previous Write Access Code command (2F).

AccessCode: 4 bytes Hex data
TryTimes: 0x00 – Repeat until lock completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until lock completes or counter reaches the specified number of tries

Example:
Command: 0A 20 05 11 22 33 44 14 XX XX
Where:
11 22 33 44 – access code
14 - tries

ACK: 00 – Command received correct
FF – Command received error

Response[22]:
06 FF 05 00 XX XX – Complete
06 FF 05 10 XX XX or 06 FF 05 FF XX XX – Lock Fail
06 FF 05 80 XX XX
– Lock Time-Out when TryTimes is 0x01~0xFF

[22] Status value of 0 indicates completion of execution of the lock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully locked. Any of the other status values was mostly caused by a failed communication with the tag.

Kill Tag (0x06)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 06 KillCode TryTimes xx xx	00 or FF 06 FF 06 00 xx xx 06 FF 06 10 xx xx 06 FF 06 FF xx xx 06 FF 06 80 xx xx

This command provides the ability to Kill[23] the ePC C1 Gen 2 tag in reading field with a 4-byte Kill Code defined through a previous Write Kill Code command (1F).

KillCode: 4-byte hex data
TryTimes: 0x00 – Repeat until kill success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until kill success or counter reaches the specified number of tries

Example:
Command: 0A 20 06 01 02 03 04 00 xx xx
Where:
01 02 03 04 – Kill Code
00 - TryTimes

ACK: 00 – Command received correct
FF – Command received error

Response:
06 FF 06 00 XX XX – Kill Success
06 FF 06 10 XX XX or 06 FF 06 FF XX XX – Kill Fail
06 FF 06 80 XX XX
– Kill Time-Out when TryTimes is 0x01~0xFF

[23] The tag becomes unusable afterwards.

Sensitivity Control (0x07)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	07 20 07 00 SensitivityLevel xx xx	00 or FF

This is the command used to set Sensitivity Level (see 6.4 for more information) for the selected protocol (ePC Class1 Gen 2. This sensitivity control allows for increasing or decreasing the Receiver[24] detection threshold, to enhance sensitivity (more susceptible to ambient noise) or to decrease sensitivity with improved noise immunity.

Example:
Command: 07 20 07 00 FF xx xx – maximum sensitivity

07 20 07 00 00 xx xx – minimum sensitivity

ACK: 00 – Command received correct
FF – Command received error

Response: No

[24] This receiver uses quadrature I/Q channels. I/Q sensitivity is the detection threshold for each. Once issued, the command causes sensitivity levels for both channels to be set. It should be noted that changing to other value from system default for this setting is *unnecessary* for tag reading operations though sometimes useful in a printer application.

Read Block Data (0x0D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 20 0D MemoryBankID xx xx	00 or FF 12 20 0D 00 00 00 00 00 00 00 00 0E A9 99 0A 80 xx xx

This command provides the ability to read the block of data from the specified memory bank of an ePC Class 1 Gen 2 tag in reading field. The command continuously executes until a block of data is located (and responded with) or a Stop command is received.

MemoryBankID: 1-byte number 0x00 ~ 0x03 for identifying memory bank to retrieve data[25] from.
- 0x00: to retrieve the 8-byte data consisting of 4-byte-kill-code and 4-byte-access-code
- 0x01: EPC data
- 0x02: TID
- 0x03: data[26] from user memory bank

Example:

Command: 06 20 0D 00 XX XX
Where:
00 – to retrieve 4-byte-kill-code and 4-byte-access-code

ACK: 00 – Command received correct
FF – Command received error

Response[27]: 12 20 0D 00 00 00 00 00 00 00 00 0E A9 99 0A 80 xx xx
Where neither access code nor kill code was previously written

Command: 06 20 0D 01 XX XX
Where:
01 – to retrieve EPC data

ACK: 00 – Command received correct
FF – Command received error

Response: 1A 20 0D 13 34 18 00 00 08 91 19 A2 2A B3 3B C4 4C D5 5D ED 89 47 E0 80 xx xx

[25] Data need to be shifted to left by 1 bit.
[26] This command was meant to retrieve data of the whole *block* of a manufacturer defined size, early tags by Philips allowed for up to 14 words (28 byte) of user data be stored however, MPR Readers would reject any command packet of over 30 bytes and at most 11 words of user data were supported. Many newer tags do not support this functionality (i.e., no response) since a more flexible way to retrieve user data (could be of very large size) has been made available by the Read Memory (0x1D) command.
[27] If 1st byte of response contains a value other than the expected (e.g., 0x12) then it implies the memory bank was locked and no meaningful (access+kill code) data retrieved.

Where tag ID 00 11 22 33 44 55 66 77 88 99 AA BB was previously written[28]

Command: 06 20 0D 02 XX XX
Where:
02 – to retrieve TID

ACK: 00 – Command received correct
FF – Command received error

Response[29]: 12 20 0D 71 00 20 00 80 0F 5A 60 BB 73 66 5B 00 xx xx
or
0E 20 0D 71 00 08 20 05 DE A7 90 80 xx xx

Command: 06 20 0D 03 xx xx
Where:
03 – to retrieve user data

ACK: 00 – Command received correct
FF – Command received error

Response: 26 20 0D 00 08 88 88 88 88 88 88 88 99 38 57 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 31 67 1B 78 80 xx xx
Where 8-byte user data of all 1's were previously written at word 0

[28] Therefore after shifting data should be 26 68 30 00 00 11 22 33 44 55 66 77 88 99 AA BB DB 12 8F C1 where 30 00 are the PC number, DB 12 are the 2-byte handle (a random value), etc. for details refer to ePC C1 Gen 2 protocol definition.

[29] Length of response packet in this case is manufacturer dependent, first example response is from a Philip's tag and after shifting, data should be E2 00 40 01 00 1E B4 C1 75 E6 CC B6 where 73 66 (unshifted) would be the 2-byte handle (random value), 5B 00 tag CRC's. Second example response is from a TI tag and data after shifting are E2 00 10 40 0B BD 4F 21 where DE A7 are the handle bytes. For others refer to ePC C1 Gen 2 protocol definition for details.

Write User Data (0x0F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 0F WordID DataWords TryTimes xx xx	00 or FF 06 FF 0F 00 xx xx 06 FF 0F 10 xx xx 06 FF 0F 80 xx xx 06 FF 0F FF xx xx

This command provides the ability to write data starting at the specified word position within the user memory bank of an ePC Class 1 Gen 2 tag. The command is issued to write at least one or more (2-byte) word(s). Packet length is therefore dependent on how many words are to be written.

NN: 1-byte packet length, value depending on how many data words are to be written

WordID: 1-byte word number identifying position within user memory bank to start writing at, 0 denotes 1st word

DataWords: Word data[30] in 2-byte pairs to write

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example:
Command: 0F 20 0F 02 11 22 33 44 55 66 77 88 00 XX XX
Where:
02 – to write starting at the 3rd word
11 22 33 44 55 66 77 88 – 4-word data to write
00 – try times

ACK: 00 – Command received correct
FF – Command received error

Response:
06 FF 0F 00 XX XX – Write Success
06 FF 0F 10 XX XX or
06 FF 0F FF XX XX – Write Fail
06 FF 0F 80 XX XX –

[30] A manufacturer dependent upper limit applies, up to 20 words are supported per one command execution.

WriteTime-Out when TryTimes is 0x01~0xFF

Read Single Tag ID with Time-Out (0x10)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	06 20 10 TryTimes xx xx	00 or FF 15 20 10 30 00 30 00 21 41 60 C0 04 00 10 00 0115 yy yy xx xx, 11 20 10 20 00 30 00 21 41 60 C0 04 00 yy yy xx xx or 06 FF 10 80 xx xx

This command provides the ability to read the first ePC C1 Gen 2 tag in the reading field with a specified number of tries.

TryTimes: 0x00 – Repeat until read success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until read success or counter reaches the number of tries

Example:
Command: 06 20 10 03 xx xx
Where:
03 – TryTimes

ACK: 00 – Command received correct
FF – Command received error

Response:

a) TryTimes is 0x00

15 20 10 30 00 30 00 21 41 60 C0 04 00 10 00 01 15 yy yy xx xx – Read Success w/ tag ID of 30 00 30 00 21 41 60 C0 04 00 10 00

b) TryTimes is 0x01~0xFF

11 20 10 20 00 30 00 21 41 60 C0 04 00 yy yy xx xx – Read Success w/ tag ID of 30 00 21 41 60 C0 04 00

Or

06 FF 10 80 XX XX – "Times Out" when there is no good data obtained and counter reaches value of TryTimes

Single Tag Meter (0x11)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	05 20 11 xx xx	00 or FF 16 20 11 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy 3F xx xx

This command provides the ability to read and count the number of times which single ePC Class 1 Gen 2 tag has been read in 300ms duration in reading field.

Example:
Command: 05 20 11 XX XX

ACK: 00 – Command received correct
FF – Command received error

Response: 16 20 11 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy 3F xx xx
Where:
00 01 08 15 80 00 80 04 28 19 53 88 – ePC number
30 00 (preceding ePC number) – PC
yy yy – tag CRC bytes
3F – Number of Reads in 300ms period or the same tag reading until other tags detected before 300ms period ends

Unlock ID (0x15)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 15 AccessCode TryTimes xx xx	00 or FF 06 FF 15 00 xx xx 06 FF 15 10 xx xx 06 FF 15 80 xx xx 06 FF 15 FF xx xx

This command provides the ability to Unlock the ID of a locked ePC Class 1 Gen 2 tag in reading field with an Access Code defined through a previous Write Access Code command (2F).

AccessCode: 4-byte hex data

TryTimes: 0x00 – Repeat until unlock completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until unlock completes or counter reaches the specified number of tries

Example:
Command: 0A 20 15 11 22 33 44 14 XX XX
Where:
11 22 33 44 – access code
14 - tries

ACK: 00 – Command received correct
FF – Command received error

Response[31]:
06 FF 15 00 XX XX – Complete
06 FF 15 10 XX XX or 06 FF 15 FF XX XX – Unlock Fail
06 FF 15 80 XX XX
– Unlock Time-Out when TryTimes is 0x01~0xFF

[31] Status value of 0 indicates completion of execution of the unlock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully unlocked. Any of the other status values was mostly caused by a failed communication with the tag.

Read Memory (0x1D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	08 20 1D MemoryBank WordAddress WordCount xx xx	00 or FF 1A 20 1D 11 11 11 11 11 11 11 11 11 11 22 22 22 22 00 00 52 16 D3 A1 00 xx xx

This command provides the ability to read data of specified word length from the specified location in the specified memory bank of an ePC Class 1 Gen 2 tag in reading field. The command continuously executes until data is located (and responded with) or a Stop command is received.

MemoryBank: 1-byte specification of memory bank from which data will be retrieved. 0x00 for Reserved, 0x01 EPC, 0x02 TID or 0x03 for User Data.

WordAddress: 1-byte number 0x00 ~ manufacturer's limit for identifying user memory location to retrieve data[32] from.

WordCount: 1-byte number 0x01 ~ manufacturere's limit[33] for specifying length (in no. of *word*s) of data to read

Example:
Command: 08 20 1D 01 02 0F XX XX
Where:
01 – memory bank 1 for ePC Number
02 – starting word address
15 – 15 words (30 bytes) of data to be retrieved

ACK: 00 – Command accepted
FF – Command received in error

Response:
28201D089119A22AB33BC44C80089119A22AB33BC44C80089119A22AB33BC44C802F12A80500XXXX
where starting at the 4th byte is a 240-bit (i.e., 30 bytes or 15 words) ePC Number previously written[34]

Command: 08 20 1D 03 00 08 XX XX
Where:

[32] Data need to be shifted to left by 1 bit.
[33] A reasonable value has to be specified to ensure of retrieval. e.g., if WordCount is > 6 and ReadMemBank is 1 then the reader will simply time out. For User data (ReadMemBank=3) up to 25 words can be retrieved in one command execution.
[34] After shifting: 1122334455667788990011223344556677889900112233445566778899005E25500A01

03 – memory bank 3 for user data
00 – starting word address, 1st word
08 – 8 words (16 bytes) of data to be retrieved

ACK: 00 – Command accepted
FF – Command received error

Response: 1A 20 1D 11 11 11 11 11 11 11 11 11 22 22 22 22 00 00 52 16 D3 A1 00 xx xx
Where user data of 10 bytes (5 words) of 22's and 4 bytes (2 words) of 44's were previously written[35].

[35] After shifting data should be 22 22 22 22 22 22 22 22 22 22 44 44 44 44 00 00 A4 2D A7 42; in response before shifting, 16 D3 were the "handle" bytes, A1 00 tag CRC's and byte preceding handle (w/ value 52) was used up by shifting.

Portal IDs (0x1E)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	07 20 1E TimeOut Repeat xx xx	00 or FF 15 20 1E 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy xx xx or 06 FF 1E 80 xx xx

This command provides the ability to read multiple ePC Class 1 Gen 2 tags present in the reading field. It provides the automatic RF Power Off function thereby optimizes performance in a multi-reader environment.

TimeOut: 0x00 – continuously execute command until user sends STOP command (0x00)

0x01~0xFF – execute command until this value times 100ms expires

Repeat: 0x00 – continuous returning of tag ID data

0x01~0xFE – returning of unique tag ID data will be repeated every interval of 100 ms multiplied by this value, meaningful only if *filtering* is in effect

Example:

Command: a) 07 20 1E 00 00 XX XX
b) 07 20 1E 04 03 XX XX
Where:
04 – command should stop after 4*100 ms
03 – unique tag ID data will be returned every 3*100 ms if filtering is in effect

ACK: 00 – Command received correct
FF – Command received error

Response:

a) TimeOut is 00

15 20 1E 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy xx xx (repeated every 300 ms)

Where:
00 01 08 15 80 00 80 04 28 19 53 88 – ePC number
30 00 (preceding ePC number) – protocol code
yy yy – tag CRC bytes

This command will repeat until user sends a STOP command (0x00).

b) TimeOut is 0x01~0xFF

b.1)

15 20 1E 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy xx xx (repeated every 300 ms)

Where:

00 01 08 15 80 00 80 04 28 19 53 88 – ePC number
30 00 (preceding ePC number) – protocol code
yy yy – tag CRC bytes

and

06 FF 1E 80 xx xx – execution stops when 400 ms is up

or

b.2)

06 FF 1E 80 xx xx – “Timed Out” when there is no good data obtained upon expiration of 400 ms

Write Kill Code (0x1F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 1F KillCode TryTimes xx xx	00 or FF 06 FF 1F 00 xx xx 06 FF 1F 10 xx xx 06 FF 1F FF xx xx 06 FF 1F 80 xx xx

This command provides the ability to define[36] a Kill Code for subsequent executions of the Kill Tag command (06) for ePC C1 Gen 2 tags.

KillCode: 4-byte hex data

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example:

Command: 0A 20 1F 01 02 03 04 00 xx xx

Where:

01 02 03 04 – Kill Code

00 - TryTimes

ACK: 00 – Command received correct

FF – Command received error

Response:

06 FF 1F 00 XX XX – Write Success

06 FF 1F 10 XX XX or 06 FF 1F FF XX XX – Write Fail

06 FF 1F 80 XX XX

– Write Time-Out when TryTimes is 0x01~0xFF

[36] An initial Kill Code of all zero's on a tag cannot effectively kill a tag.

Lock Memory (0x25)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0B 20 25 AccessCode MemoryLocation TryTimes xx xx	00 or FF 06 FF 25 00 xx xx 06 FF 25 10 xx xx 06 FF 25 80 xx xx 06 FF 25 FF xx xx

This command provides the ability to Lock Memory of an ePC Class 1 Gen 2 tag in the reading field at memory location as specified. Access Code is one defined through a previous Write Access Code command (2F).

AccessCode: 4 bytes Hex data

MemoryLocation: 1-byte number 0x00 ~ 0x04 for identifying memory bank/data to lock at.

- 0x00: Kill Code (bank 0)
- 0x01: Access Code (bank 0)[37]
- 0x02: EPC Data (bank 1)
- 0x03: TID (bank 2)
- 0x04: User Data (bank 3)

TryTimes: 0x00 – Repeat until lock completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until lock completes or counter reaches the specified number of tries

Example:

Command: 0B 20 25 11 22 33 44 03 14 XX XX

Where:

11 22 33 44 – access code

03 – memory bank

14 - tries

ACK: 00 – Command accepted for execution

FF – Command received error

Response[38]:

06 FF 25 00 XX XX – Complete

[37] Once data area where Kill Code or Access Code reside is locked, data in bank 0 cannot be read until both get unlocked.

[38] Status value of 0 indicates completion of execution of the lock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully locked. Any of the other status values was mostly caused by a failed communication with the tag.

06 FF 25 10 XX XX or 06 FF 25 FF XX XX – Lock Fail
06 FF 25 80 XX XX
– Lock Time-Out when TryTimes is 0x01~0xFF

Write Access Code (0x2F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 2F AccessCode TryTimes xx xx	00 or FF 06 FF 2F 00 xx xx 06 FF 2F 10 xx xx 06 FF 2F FF xx xx 06 FF 2F 80 xx xx

This command provides the ability to define[39] an Access Code for subsequent executions of Lock and Unlock commands for ePC C1 Gen 2 tags.

AccessCode: 4-byte hex data
TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example:
Command: 0A 20 2F 01 02 03 04 00 xx xx
Where:
01 02 03 04 – Access Code
00 - TryTimes

ACK: 00 – Command received correct
FF – Command received error

Response:
06 FF 2F 00 XX XX – Write Success
06 FF 2F 10 XX XX or 06 FF 2F FF XX XX – Write Fail
06 FF 2F 80 XX XX
– Write Time-Out when TryTimes is 0x01~0xFF

[39] An initial Access Code of all zero's cannot effectively Lock or Unlock a tag.

Unlock Memory (0x35)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0B 20 35 AccessCode MemoryLocation TryTimes xx xx	00 or FF 06 FF 35 00 xx xx 06 FF 35 10 xx xx 06 FF 35 80 xx xx 06 FF 35 FF xx xx

This command provides the ability to Unlock Memory of an ePC Class 1 Gen 2 tag in the reading field at memory location as specified. Access Code is one defined through a previous Write Access Code command (2F).

AccessCode:	4 bytes Hex data
MemoryLocation:	1-byte number 0x00 ~ 0x04 for identifying memory bank/data to be unlocked
0x00:	Kill Code (bank 0)
0x01:	Access Code (bank 0)
0x02:	EPC Data (bank 1)
0x03:	TID (bank 2)
0x04:	User Data (bank 3)
TryTimes:	0x00 – Repeat until unlock completes or user sends a STOP command (0x00)
	0x01~0xFF – Repeat until unlock completes or counter reaches the specified number of tries

Example:
Command: 0B 20 35 11 22 33 44 03 14 XX XX
Where:
11 22 33 44 – access code
03 – memory bank
14 - tries

ACK: 00 – Command accepted for execution
FF – Command received error

Response[40]:
06 FF 35 00 XX XX – Complete
06 FF 35 10 XX XX or 06 FF 35 FF XX XX – Unlockl Fail
06 FF 35 80 XX XX
– Unlock Time-Out when TryTimes is 0x01~0xFF

[40] Status value of 0 indicates completion of execution of the unlock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully unlocked. Any of the other status values was mostly caused by a failed communication with the tag.

Permanent Lock Memory (0x55)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0B 20 55 AccessCode MemoryLocation TryTimes xx xx	00 or FF 06 FF 55 00 xx xx 06 FF 55 10 xx xx 06 FF 55 80 xx xx 06 FF 55 FF xx xx

This command provides the ability to Permanently Lock Memory of an ePC Class 1 Gen 2 tag in reading field at memory location as specified. Access Code is one defined through a previous Write Access Code command (2F).

AccessCode: 4 bytes Hex data

MemoryLocation: 1-byte number 0x00 ~ 0x04 for identifying memory bank/data to lock at.

- 0x00: Kill Code (bank 0)
- 0x01: Access Code (bank 0)[41]
- 0x02: EPC Data (bank 1)
- 0x03: TID (bank 2)
- 0x04: User Data (bank 3)

TryTimes: 0x00 – Repeat until lock completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until lock completes or counter reaches the specified number of tries

Example:

Command: 0B 20 55 11 22 33 44 03 14 XX XX

Where:

11 22 33 44 – access code
03 – memory bank
14 - tries

ACK: 00 – Command accepted for execution
FF – Command received error

Response[42]:

06 FF 55 00 XX XX – Complete

[41] Once data area where Kill Code or Access Code reside is locked, data in bank 0 cannot be read until both get unlocked.

[42] Status value of 0 indicates completion of execution of the lock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully locked. Any of the other status values was mostly caused by a failed communication with the tag.

06 FF 55 10 XX XX or 06 FF 55 FF XX XX – Lock Fail
06 FF 55 80 XX XX
– Lock Time-Out when TryTimes is 0x01~0xFF

Write Memory (0x5F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 5F MemoryBank WordID WordCount DataWords TryTimes xx xx	00 or FF 06 FF 5F 00 xx xx 06 FF 5F 10 xx xx 06 FF 5F 80 xx xx 06 FF 5F FF xx xx

This command provides the ability to write data starting at the specified word position within the specified memory bank of an ePC Class 1 Gen 2 tag. The command is issued to write at least one or more (16-bit) word(s). Packet length is therefore dependent on how many words are to be written.

NN: 1-byte packet length, value depending on how many data words are to be written, i.e., NN = 9 + 2*WordCount

MemoryBank: 1-byte specification of whether the Write occurs in Reserved (0x00), EPC (0x01), TID[43] (0x02) or User Memory (0x03)

WordID: 1-byte word number identifying position (or address) within memory bank to start writing at, 0[44] denotes 1st word

WordCount: 1-byte specification of the number of 16-bit words[45] to be written. If WordCount=0x01, the tag shall write a single data word.

DataWords: the 16-bit words to be written and shall be 16xWordCount bits in length.

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example:
Command: 0F 20 5F 01 02 03 11 22 33 44 55 66 00 XX XX
Where:

[43] Depending on tag manufacturer's policy, this area may be locked and not writable.
[44] It should be noted that when writing in MemoryBank 01 (EPC), one should start writing at WordID=02 since 00 and 01 are used by (tag) CRC and PC and had better not be overwritten.
[45] Up to 20 words (e.g., User data) are supported.

01 – to write in EPC area
02 – to write starting at the 3rd word
03 – to write 3 words
11 22 33 44 55 66 – 3-word (48-bit) data to write
00 – try times

ACK: 00 – Command received correct
FF – Command received error

Response:

06 FF 5F 00 XX XX – Write Success
06 FF 5F 10 XX XX or 06 FF 5F FF XX XX – Write Fail
06 FF 5F 80 XX XX
– WriteTime-Out when TryTimes is 0x01~0xFF

Lock Memory with Action (0x65)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0C 20 65 AccessCode MemoryLocation ActionCode TryTimes xx xx	00 or FF 06 FF 65 00 xx xx 06 FF 65 10 xx xx 06 FF 65 80 xx xx 06 FF 65 FF xx xx

This command allows specification of the exact action to *permanently* (*or not*) *lock* or *unlock* an ePC Class 1 Gen 2 tag in reading field at memory location as specified. Access Code is one defined through a previous Write Access Code command (2F).

AccessCode: 4 bytes Hex data

MemoryLocation: 1-byte number 0x00 ~ 0x04 for identifying memory bank/data to lock at.

- 0x00: Kill Code (bank 0)
- 0x01: Access Code (bank 0)[46]
- 0x02: EPC Data (bank 1)
- 0x03: TID (bank 2)
- 0x04: User Data (bank 3)

ActionCode: 1-byte number 0x00~0x03 denoting the actual lock/unlock action

- 0x00: UnLock
- 0x01: Permanent Unlock
- 0x02: Lock
- 0x03: Permanent Lock

TryTimes: 0x00 – Repeat until lock completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until lock completes or counter reaches the specified number of tries

Example:
Command: 0C 20 65 11 22 33 44 03 02 14 XX XX
Where:
11 22 33 44 – access code
03 – memory bank
02 - lock
14 - tries

[46] Once data area where Kill Code or Access Code reside is locked, data in bank 0 cannot be read until both get unlocked.

ACK: 00 – Command accepted for execution
FF – Command received error

Response[47]:
06 FF 65 00 XX XX – Complete
06 FF 65 10 XX XX or 06 FF 65 FF XX XX – Lock Fail
06 FF 65 80 XX XX
– Lock Time-Out when TryTimes is 0x01~0xFF

[47] Status value of 0 indicates completion of execution of the lock command and not necessarily the actual resulting status of the tag; i.e., tag may or may not be successfully locked. Any of the other status values was mostly caused by a failed communication with the tag.

Read High Capacity Memory (0x6D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	0A 20 6D MemoryBank WordAddress1 WordAddress2 WordCount TryTimes xx xx	00 or FF 3A 20 6D 00 00 08 91 19 A2 2A B3 3B C4 4C 88 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0C 6F 57 4A 40 xx xx

This command provides the ability to read high capacity data[48] of specified word length from the specified location in the specified memory bank of an ePC Class 1 Gen 2 tag in reading field. The command continuously executes until data is located (and responded with), specified try attempts reached or a Stop command is received.

MemoryBank: 1-byte specification of memory bank from which data will be retrieved. 0x00 for Reserved, 0x01 EPC, 0x02 TID or 0x03 for User Data.

WordAddress1: Higher order byte for the integer valued word address value 0x00~0xFF. 0x00 if the integer value does not exceed 255.

WordAddress2: Lower order byte for the integer valued word address value 0x00~0xFF

WordCount: 1-byte number 0x01 ~ manufacturere's limit[49] for specifying length (in no. of *word*s) of data to read

TryTimes: 0x00 – Repeat until data retrieved or user sends a STOP command (0x00)

0x01~0xFF – Repeat until data retrieved or counter reaches the specified number of tries

Example:
Command: 0A 20 6D 01 02 04 18 00 XX XX
Where:
03 – memory bank 3 for user data
02 – higher order byte value for integer word address 516
04 – lower order byte value for integer word address 516

[48] Data need to be shifted to left by 1 bit.
[49] Up to 27 words are supported per one Read Memory command execution.

18 – 24 words (48 bytes) of data to be retrieved
00 – value for try attempts, to try indefinitely until Stop is received

ACK: 00 – Command accepted
FF – Command received in error

Response:

3A206D0000089119A22AB33BC44C888000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000C6F574A40XXXX

where starting at the 4th byte is the 24 word data previously written[50]

[50] After shifting:
1122334455667788991100000000000000000000000000000000000000000000000000000000000000000000000000000018DEAE9480

Write High Capacity Memory (0x6F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 6F MemoryBank WordAddress1 WordAddress2 WordCount DataWords TryTimes xx xx	00 or FF 06 FF 6F 00 xx xx 06 FF 6F 10 xx xx 06 FF 6F 80 xx xx 06 FF 6F FF xx xx

This command provides the ability to write data starting at the specified word position within the specified memory bank of an ePC Class 1 Gen 2 tag. Every write should be at least one or more (16-bit) word(s). Packet length is therefore dependent on how many words are to be written.

NN: 1-byte packet length, value depending on how many data words are to be written, i.e., NN = 10 + 2*WordCount

MemoryBank: 1-byte specification of whether the Write occurs in Reserved (0x00), EPC (0x01), TID[51] (0x02) or User Memory (0x03)

WordAddress1: Higher order byte for the integer valued word address value 0x00~0xFF. 0x00 if the integer value does not exceed 255.

WordAddress2: Lower order byte for the integer valued word address value 0x00~0xFF

WordCount: 1-byte specification of the number of 16-bit words to be written. If WordCount=0x01, the tag shall write a single data word.

DataWords: the 16-bit words to be written and shall be 16xWordCount bits in length.

TryTimes: 0x00 – Repeat until write success or user sends a STOP command (0x00)

0x01~0xFF – Repeat until write success or counter reaches the specified number of tries

Example -

Command: 3A 20 6F 03 00 00 18 11 22 33 44 55 66 77 88 11 22 33 44 55 66 77 88 11 22 33 44 55 66 77 88 11 22 33 44 55 66 77 88 11 22 33 44 55 66 77 88 64 XX XX

[51] Depending on tag manufacturer's policy, this area may be locked and not writable.

Where:

03 – to write in user data area
00, 00 – to write starting at the 1st word
18 – to write 24 words
00 11 22 33 44 55 66 77 88 … 11 22 33 44 55 66 77 88 – 24-word (48-byte) data to write
64 – try times

ACK: 00 – Command accepted
FF – Command received in error

Response:

06 FF 6F 00 XX XX – Write Success
06 FF 6F 10 XX XX or
06 FF 6F FF XX XX – Write Fail
06 FF 6F 80 XX XX – WriteTime-Out

PermaLock User Data (0x9D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 9D AccessCode 01 BlockPtr BlockRange LockMask TryTimes xx xx or, 0D 20 9D AccessCode 00 BlockPtr BlockRange TryTimes xx xx	00 or FF 06 FF 9D 00 xx xx 06 FF 9D 10 xx xx 06 FF 9D 80 xx xx 06 FF 9D FF xx xx 07 20 9D 00 01 xx xx

This command provides the ability to either Read the *PermaLock* status of or *PermaLock* (Permanently Lock) an ePC Class 1 Gen 2 tag for the *block(*s) in User Data memory bank as specified (via BlockPtr and BlockRange). For *PermaLock*, LockMask contains desired per-block *permalock* action for the specified blocks. Access Code is one defined through a previous Write Access Code command (2F).

NN: For PermaLock, the variable1-byte packet length, value depending on how long LockMask is or simply the number of LockMask bytes plus thirteen (13)

AccessCode: 4 bytes Hex data

Read/Lock: 1-byte value to specify either the PermaLock or Read operation to be applied, 0x00 for Read, 0x01 for PermaLock

BlockPtr: Specifies starting address of block(s) for LockMask, in units of 16 blocks; e.g., a value of 0 for block 0 (blocks 0~15), 1 for block 16 (blocks 16~31) and 2 for block 32 (blocks 32~47), etc.

BlockRange: Specifies the range of LockMask, starting at BlockPtr and ending at 16*BlockRange – 1 blocks from BlockPtr.

LockMask: For *PermaLock* operation, this parameter (2 or more bytes) is to specify the bit pattern (1 bit per block) for the actual permalock action to apply to the range of blocks given above. It takes up at least 2 bytes for a minimum of 1 block. The bits must be ordered from low to high, i.e., if BloPtr = 0, then 1st bit in LockMask

refers to block 0. Each bit will be interpreted as follows:

0: no change in current permalock setting for corresponding block
1: apply permalock, if already permalocked, no change

Do not specify this parameter for Read.

TryTimes: 0x00 – Repeat until operation completes or user sends a STOP command (0x00)

0x01~0xFF – Repeat until operation completes or counter reaches the specified number of tries

Example –

Command: 0D 20 9D 11 22 33 44 01 00 01 20 XX XX
Where:
11 22 33 44 – access code
01 – to apply Read operation
00 – to begin at block 0
01 – to end at block 15
20 – tries

ACK: 00 – Command accepted for execution
FF – Command received in error

Response: 07 20 9D YY YY xx xx
Where YY YY contains the *permalock* values for the blocks in request

Or

06 FF 9D 80 XX XX – Operation Time-Out

Command: 0F 20 9D 11 22 33 44 01 00 01 60 00 50 XX XX
Where:
11 22 33 44 – access code
01 – to apply *PermaLock* operation
00 – to begin at block 0
01 – to end at block 15
60 00 – LockMask for bit pattern as follows:

Bit 1 = 0 => Block 0 no change

Bit 2 = 1 => Block 1 PermaLocked
Bit 3 = 1 => Block 2 PermaLocked
Bit 4 = 0 => Block 3 no change
Bit 5 = 0 => Block 4 no change
Bit 6 = 0 => Block 5 no change
Bit 7 = 0 => Block 6 no change
Bit 8 = 0 => Block 7 no change
Bit 9 = 0 => Block 8 no change
Bit 10 = 0 => Block 9 no change
Bit 11 = 0 => Block 10 no change
Bit 12 = 0 => Block 11 no change
Bit 13 = 0 => Block 12 no change
Bit 14 = 0 => Block 13 no change
Bit 15 = 0 => Block 14 no change
Bit 16 = 0 => Block 15 no change

50 - tries

ACK: 00 – Command accepted for execution
FF – Command received in error

Response:

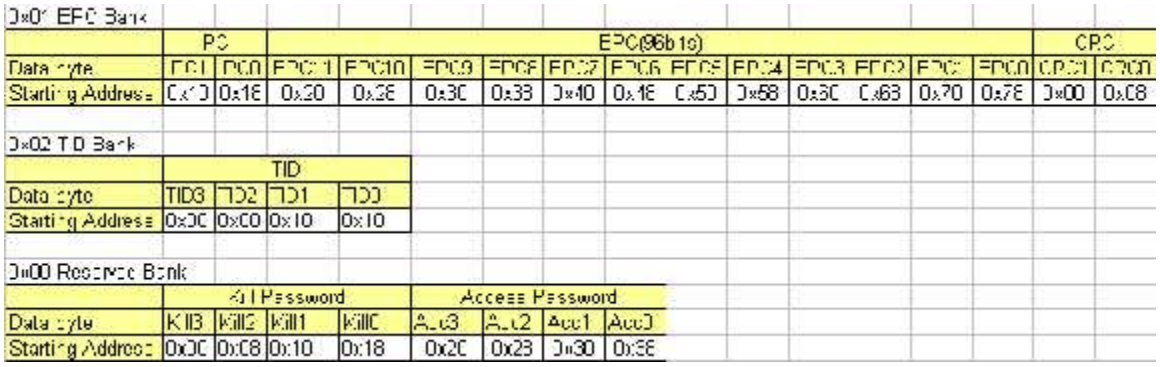
06 FF 9D 00 XX XX – Complete
06 FF 9D 10 XX XX or 06 FF 9D FF XX XX – Operation Fail
06 FF 9D 80 XX XX – Operation Time-Out

5.5 EPC Class 1 Gen 2 Commands with Pre-Selection

This section describes ePC Class 1 Gen 2 commands with the Pre-Selection capability. Selection criteria may be specified in tag's memory as illustrated in diagrams below. EPC Class1 Gen2 tags have 4 memory banks - "Reserved" at Bank 00, "EPC" at Bank 01, "TID" at Bank 10, and "USER" at Bank 11.

The offset is used as a pointer into these various memory blocks to locate the desired information. An offset of 0x20 into memory Bank 01 points to the beginning of the EPC code. There are 16 bytes reserved for EPC.

Selection					
Target	Action	MemBank	Pointer	MaskLength	Mask
1	1	1	1	1	Variable
0x02	0x04	0x00:RFU 0x01:EPC 0x02:TID 0x03:User	Starting Mask Address(bits) see below table	Mask Length (bits)	Mask value



The *Selection Criteria* or briefly, the *Selection* or, the *Mask* is specified in the same way for all these pre-selection capable commands and the corresponding byte sequence is described before the commands are introduced.

02	– fixed value
04	- fixed value
MemBank	- Memory Bank identifier, 01~03 to which Mask applies. 00 is Reserved for Future Use (RFU) and will be ignored if specified.
Pointer	- Address or starting point within the memory bank in ***bit*** position for the Mask. E.g., if MemBank = 01, then a Pointer value of 0x20 means the selection/mask shall start at the 1st bit in byte EPC11. Value range: 0~255.

MaskLength - One-byte specification for length of selection/mask in number of ***bit***s.

Mask - The actual bit Mask in byte(s) for non-zero MaskLength. If MaskLength is not a multiple of 8, the mask should be right filled with 0's to end on the byte boundary. E.g., if MaskLength = 06 and the actual mask data are 111111 for the 6 bits then Mask should be specified as a byte of value FC in hex for bit mask 11111100. No need to specify if MaskLength is zero.

Lock Memory with Mask (0x75)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 75 Mask 01 AccessCode MemoryPosition LockAction TryTime xx xx or, 11 20 75 Mask 01 AccessCode MemoryPosition LockAction TryTime xx xx	00 or FF 15 20 5E 30 00 00 01 08 15 80 00 80 04 28 19 53 88 yy yy xx xx or 06 FF 5E 80 xx xx

This variant of ePC Class 1 Gen 2 Lock Memory allows a user-specified Selection Criteria for command execution.

NN	1-byte packet length, 0D when MaskLength is zero or a value depending on how long the mask is or simply MaskLength plus seventeen
Mask	See beginning of section, length is (5 + length of actual mask data) bytes
01	fixed
AccessCode	4 bytes Hex data
MemoryLocation	1-byte value 0x00 ~ 0x04 for identifying memory bank/data to lock at. 0x00: Kill Code (bank 0) 0x01: Access Code (bank 0)[52] 0x02: EPC Data (bank 1) 0x03: TID (bank 2)

[52] Once data area where Kill Code or Access Code reside is locked, data in bank 0 cannot be read until both get unlocked.

0x04: User Data (bank 3)

LockAction 1-byte value 0x00~0x03 for one of the actions below
0x00: UnLock
0x01: Permanent Unlock
0x02: Lock
0x03: Permanent Lock

TryTime 0 - Cotinuously execute command until user sends STOP command (0x00)

0x01~0xFF – execute command until this value times 100ms expires

Example:
Command: 12 20 75 02 04 01 20 06 FC 01 08 08 08 08 02 04 XX XX

Where:
12 – packet length
20 – protocol
75 – command
02 ~ 04 – fixed value
01 – MemoryBank for EPC
20 – Starting bit position in EPC bank
06 – Mask length of 6 bits
FC – Mask value for bit mask of “111111”
01 – fixed value
08 08 08 08 – Access Code
02 – Lock action
04 – TimeOut

Or,
11 20 75 02 04 01 20 00 01 08 08 08 08 02 04 XX XX
Where:
11 – packet length
20 – protocol
75 – command
02 ~ 04 – fixed value
01 – MemoryBank for EPC
20 – Starting bit position in EPC bank
00 – Mask length of zero
01 – fixed value
08 08 08 08 – Access Code
02 – Lock action
04 – TimeOut

ACK: 00 – Command received correct
FF – Command received error

Response:
06 FF 75 00 XX XX – Complete
06 FF 75 10 XX XX or 06 FF 75 FF XX XX – Action Fail
06 FF 75 80 XX XX – Action Time-Out

PermaLock User Data with Mask (0x76)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	N1 20 76 Mask 01 AccessCode 01 BlockPtr BlockRange LockMask TryTimes xx xx or, N2 20 76 Mask 01 AccessCode 00 BlockPtr BlockRange TryTimes xx xx	00 or FF 06 FF 76 00 xx xx 06 FF 76 10 xx xx 06 FF 76 80 xx xx 06 FF 76 FF xx xx

This command provides the ability to specify a selection criteria and either Read the *PermaLock* status of or *PermaLock* (Permanently Lock) an ePC Class 1 Gen 2 tag for the *block(*s) in User Data memory bank as specified (via BlockPtr and BlockRange). For *PermaLock*, LockMask contains desired per-block *permalock* action for the specified blocks. Access Code is one defined through a previous Write Access Code command (2F).

N1:	Variable1-byte packet length, value depending on how long Mask and LockMask are or simply the number of Mask bytes and LockMask bytes plus fourteen (14)
N2:	Variable1-byte packet length, 19 when MaskLength is zero or a value depending on how long Mask is or simply the number of Mask bytes plus fourteen (14)
Mask	See beginning of section, length is (5 + length of actual mask data) bytes
01	fixed
AccessCode:	4 bytes Hex data

Read/Lock:	1-byte value to specify either the PermaLock or Read operation to be applied, 0x00 for Read, 0x01 for PermaLock
BlockPtr:	Specifies starting address of block(s) for LockMask, in units of 16 blocks; e.g., a value of 0 for block 0 (blocks 0~15), 1 for block 16 (blocks 16~31) and 2 for block 32 (blocks 32~47), etc.
BlockRange:	Specifies the range of LockMask, starting at BlockPtr and ending at 16*BlockRange – 1 blocks from BlockPtr.
LockMask:	For *PermaLock* operation, this parameter (2 or more bytes) is to specify the bit pattern (1 bit per block) for the actual permalock action to apply to the range of blocks given above. It takes up at least 2 bytes for a minimum of 1 block. The bits must be ordered from low to high, i.e., if BloPtr = 0, then 1st bit in LockMask refers to block 0. Each bit will be interpreted as follows: 0: no change in current permalock setting for corresponding block 1: apply permalock, if already permalocked, no change Do not specify this parameter for Read.
TryTimes:	0x00 – Repeat until operation completes or user sends a STOP command (0x00) 0x01~0xFF – Repeat until operation completes or counter reaches the specified number of tries

Example –

Command: 15 20 76 02 04 01 20 10 00 10 01 11 22 33 44 01 00 06 20 XX XX

Where:

15 – packet length
20 – protocol
76 – command
02 ~ 04 – fixed value
01 – MemoryBank for EPC

20 – Starting bit position in EPC bank
10 – Mask Length of 16 bits
00~10 – Mask value for bit mask "0000000000010000"
01 – fixed value
11 22 33 44 – access code
01 – to apply Read operation
00 – to begin at block 0
06 – to end at block 95
20 – tries

Or,

13 20 76 02 04 01 20 00 01 11 22 33 44 01 00 06 20 XX XX
Where:
13 – packet length
20 – protocol
76 - command
02 ~ 04 – fixed value
01 – MemoryBank for EPC
20 – Starting bit position in EPC bank
00 – Mask Length of zero
01 – fixed value
11 22 33 44 – access code
01 – to apply Read operation
00 – to begin at block 0
06 – to end at block 95
20 – tries

ACK: 00 – Command accepted for execution
FF – Command received in error

Response: 10 20 76 YY YY YY YY YY YY YY YY YY YY YY YY XX XX
Where YY YY YY YY YY YY YY YY YY YY YY YY contains the *permalock* values for the blocks in request

Or

06 FF 76 80 XX XX – Operation Time-Out

Command: 17 20 76 02 04 01 20 10 00 10 01 11 22 33 44 01 00 01 60 00 50 XX XX
Where:
17 – packet length
20 – protocol
76 - command
02 ~ 04 – fixed value
01 – MemoryBank for EPC

20 – Starting bit position in EPC bank
10 – Mask Length of 16 bits
00~10 – Mask value for bit mask "0000000000010000"
01 – fixed value
11 22 33 44 – access code
01 – to apply *PermaLock* operation
00 – to begin at block 0
01 – to end at block 15
60 00 – LockMask for bit pattern as follows:

Bit 1 = 0 => Block 0 no change
Bit 2 = 1 => Block 1 PermaLocked
Bit 3 = 1 => Block 2 PermaLocked
Bit 4 = 0 => Block 3 no change
Bit 5 = 0 => Block 4 no change
Bit 6 = 0 => Block 5 no change
Bit 7 = 0 => Block 6 no change
Bit 8 = 0 => Block 7 no change
Bit 9 = 0 => Block 8 no change
Bit 10 = 0 => Block 9 no change
Bit 11 = 0 => Block 10 no change
Bit 12 = 0 => Block 11 no change
Bit 13 = 0 => Block 12 no change
Bit 14 = 0 => Block 13 no change
Bit 15 = 0 => Block 14 no change
Bit 16 = 0 => Block 15 no change

50 - tries

ACK: 00 – Command accepted for execution
FF – Command received in error

Response:
06 FF 76 00 XX XX – Complete
06 FF 76 10 XX XX or 06 FF 76 FF XX XX – Operation Fail
06 FF 76 80 XX XX – Operation Time-Out

Read Memory with Mask (0x7D)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 7D Mask 01 ReadMemBank WordPtr WordCount TryTimes xx xx or, 0F 20 7D Mask 01 ReadMemBank WordPtr WordCount TryTimes xx xx	00 or FF 12 20 7D 00 00 00 00 00 00 00 00 0E A9 99 0A 80 xx xx 06 FF 7D 80 xx xx

This command provides the ability to read data from the specified memory bank of an ePC Class 1 Gen 2 tag in reading field that meets the selection criteria specified in Mask.

NN	1-byte packet length, 0F when MaskLength is zero or a value depending on how long the mask is or simply MaskLength plus fifteen
Mask	See beginning of section, length is (5 + length of actual mask data) bytes
01	fixed
ReadMemBank	1-byte number 0x00~0x03 for identifying memory bank to retrieve data[53] from.
0x00:	to retrieve from the 8-byte data consisting of 4-byte-kill-code and 4-byte-access-code
0x01:	EPC data
0x02:	TID
0x03:	data from user memory bank
WordPtr	1-byte word number identifying position within memory bank to start reading from, 0 denotes 1st word
WordCount	Number of words[54] to read
TryTimes:	0x00 – Repeat until read success or user sends a STOP command (0x00)

[53] Data need to be shifted to left by 1 bit.
[54] A reasonable value has to be specified to ensure of retrieval. E.g., if WordCount is > 6 and ReadMemBank is 1 then the reader will simply time out if TimeOut > 0 or return nothing if TimeOut = 0. For User data (ReadMemBank=3) up to 25 words can be retrieved in one command execution.

0x01~0xFF – Repeat until read success or counter reaches the number of tries

Example:

Command: 11 20 7D 02 04 01 20 10 00 10 01 03 00 08 32 xx xx

Where:

- 11 – packet length
- 20 – protocol
- 7D - command
- 02 ~ 04 – fixed value
- 01 – MemoryBank for EPC
- 20 – Starting bit position in EPC bank
- 10 – Mask Length of 16 bits
- 00~10 – Mask value for bit mask "0000000000010000"
- 01 – fixed value
- 03 – MemoryBank for user data
- 00 – WordPtr: start reading at 1st word
- 08 – WordCount: to read 8 words worth of data
- 32 – TryTimes

Or,

0F 20 7D 02 04 01 20 00 01 03 00 08 32 xx xx

- 0F – packet length
- 20 – protocol
- 7D - command
- 02 ~ 04 – fixed value
- 01 – MemoryBank for EPC
- 20 – Starting bit position in EPC bank
- 10 – Mask Length of zero
- 01 – fixed value
- 03 – MemoryBank for user data
- 00 – WordPtr: start reading at 1st word
- 08 – WordCount: to read 8 words worth of data
- 32 – TryTimes

ACK: 00 – Command received correct
FF – Command received error

Response: 1A 20 7D 4C CC CC CC CC CC CC CC 8C 00 00 00 00 00 00 00 51 54 4C 1D 80 xx xx
for actual data of "99 99 99 99 99 99 99 99 00 00 00 00 00 00 00 00"

Write Memory with Mask (0x8F)

FROM	TO	MSG Example	ACK/RESPONSE Example
Host	Reader	NN 20 8F Mask 01 WriteMemBank WordPtr WordCount DataWords TryTimes xx xx	00 or FF 06 FF 8F 80 xx xx 06 FF 8F F7 xx xx

This command provides the ability to write data starting at the specified word position within the specified memory bank of an ePC Class 1 Gen 2 tag in reading field that meets the selection criteria specified in Mask.

NN	1-byte packet length, value depending on how long the mask is or simply MaskLength plus WordCount*2 plus fifteen
Mask	See beginning of section, length is (5 + length of actual mask data) bytes
01	fixed
WriteMemBank	1-byte number 0x00~0x03 for identifying memory bank to write data to.
0x00:	8-byte data area consisting of 4-byte-kill-code and 4-byte-access-code
0x01:	EPC data
0x02:	TID
0x03:	User Data
WordPtr	1-byte word number identifying position within memory bank to start writing at, 0 denotes 1st word
WordCount	Number of words[55] to write
DataWords:	Word data in 2-byte pairs to write
TryTimes:	0x00 – Repeat until write success or user sends a STOP command (0x00)
	0x01~0xFF – Repeat until write success or counter reaches the number of tries

Example:

Command: 1C 20 8F 02 04 01 20 06 FC 01 01 02 06 0A 0B 0C 0D 0E 0F AA BB CC DD EE FF 03 xx xx

Where:

[55] Up to 20 words of data can be written in one command execution.

1C – packet length
20 – protocol
8F – command
02~04 – fixed value
01 – MemoryBank for EPC
20 – Starting bit position in EPC bank
06 – Mask Length of 6 bits
FC – Mask value for bit mask of "111111"
01 – fixed value
01 – MemoryBank for EPC data
02 – WordPtr: start writing at 3rd[56] word
06 – WordCount: to write 6 words worth of data
0A~FF – the 12-byte EPC number
03 - TryTimes

Or,

1B 20 8F 02 04 01 20 00 01 01 02 06 0A 0B 0C 0D 0E 0F AA BB CC DD EE FF 03 xx xx

Where:

1B – packet length
20 – protocol
8F – command
02~04 – fixed value
01 – MemoryBank for EPC
20 – Starting bit position in EPC bank
00 – Make Length of zero
01 – fixed value
01 – MemoryBank for EPC data
02 – WordPtr: start writing at 3rd word
06 – WordCount: to write 6 words worth of data
0A~FF – the 12-byte EPC number
03 - TryTimes

Response:

06 FF 8F 00 XX XX – Write Success
06 FF 8F 10 XX XX or 06 FF 8F FF XX XX – Write Fail
06 FF 8F 80 XX XX
– WriteTime-Out when TryTimes is 0x01~0xFF or on User Stop when TryTimes is 0x00
06 FF 8F F7 xx xx
– Inconsistent DataWords, i.e., length not matching WordCount

[56] It should be noted that when writing in MemoryBank 01 (EPC), start writing at WordID=02 since 00 and 01 are used by (tag) CRC and PC and had better not be overwritten.

5.6 Temperature Monitor Status Messages

This section describes those temperature related statuses that are reported by reader (after user enables reporting via system command 0x43) for controlling applications to take proper actions.

Warning Notification (0x70)

FROM	TO	MSG Example
Reader	Host	06 FF 00 70 xx xx

This warning notification is sent by the reader when system temperature reaches or exceeds a threshold value, a system default or previously specified by user (via 0x43). The notification is sent approximately every minute when the temperature reaches reporting threshold. The host should then take steps (e.g., issue the Stop command) to prevent the module from being damaged due to high heat.

System Halt Notification (0x7F)

FROM	TO	MSG Example
Reader	Host	06 FF 00 7F xx xx

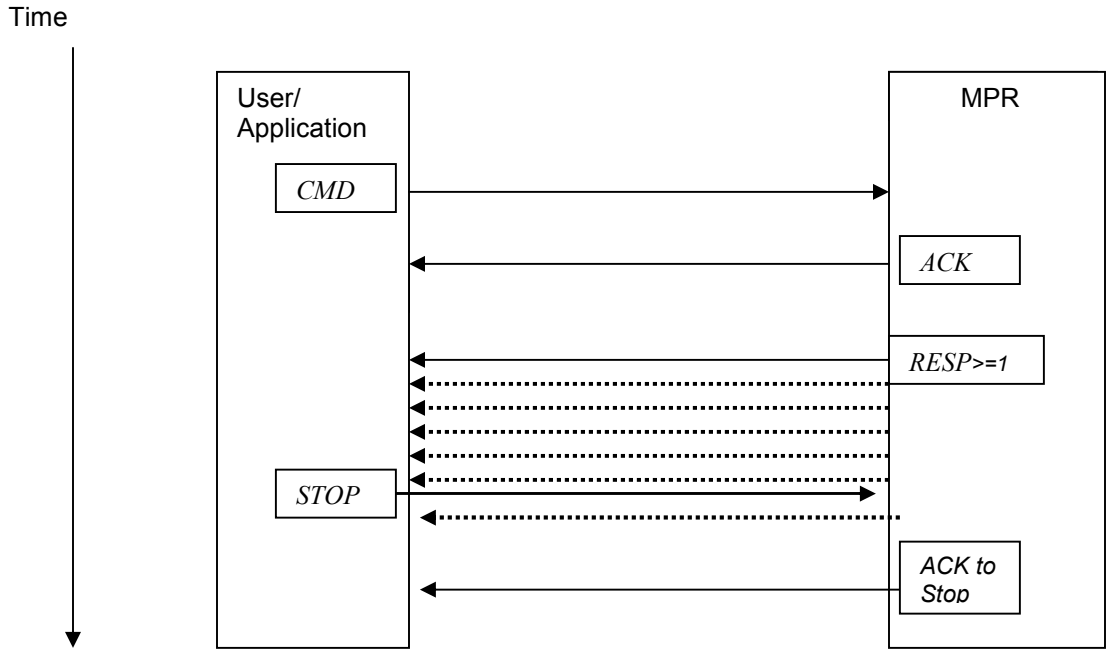
This system halt notification is sent by the reader when system temperature exceeds 90 degrees Celcius. The system will automatically turn off the RF session and go into the IDLE state.

6 Appendix

6.1 Data Flow

Included in this section are diagrams illustrating possible exchanges between an application and the MPR device.

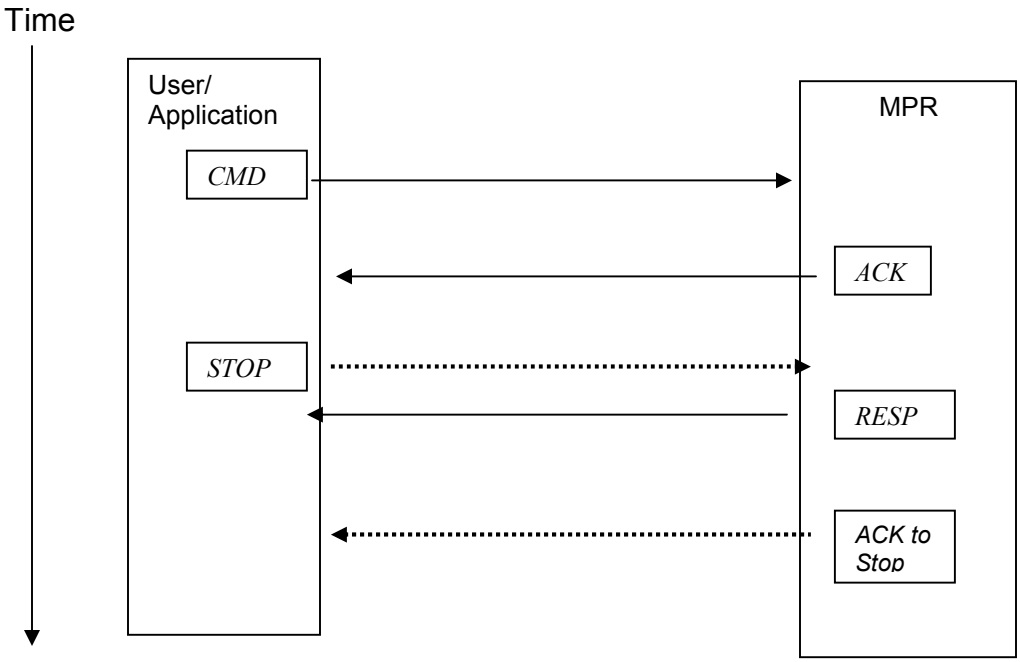
(1) Commands that repeatedly execute and generate continuous, multiple responses until STOP is received. (*IDs, Portal IDs, Single Tag Meter, Read Single Tag ID*)



It should be noted that after an extensive, long period of execution of such a command, response data may sometimes get out-of-sync[57]. So some re-synchronization and recovery of data may be necessary for some applications. . In addition to check for valid response packet length (1st byte) and calculate the Receive Link CRC's (sec. 4.2), command code (e.g., 0x1E for Portal IDs) that's supposed to be the 3rd byte in packet and/or protocol code (2nd byte in packet) if applicable.

[57] This is more likely in TCP/IP networks.

(2) Commands that repeatedly execute (and generate 1 response of either tag ID data or execution result message) until STOP is received or timed out (*Write ID, Read N Blocks Data, Read Single Tag ID with Time-Out*)



6.2 Messages Responses

For those responses that do not contain tag data (i.e., tag ID or user data), they are categorized as (the non-data) *Messages* that provide the status/result of a command execution. For such a *Message* response, the 2nd byte in the packet is always FF, the 3rd byte is as usual the command id, starting at the 4th byte, there can be one or more of the status byte. The table below summarizes these.

Status Byte Value	*Definition*	*Command Example*
00	Success	
10	Fail	Write ID
80	Time-Out or User Stop	(commands w/ "tryTimes") Write Byte Data
FF	Fail	Write Byte Data, Lock ID, Erase ID

6.3 Simple Multi-Protocol RFID Application Scenario

As the acronym "*MPR"* stands for, an MPR device handles read/write of tags of *multiple protocol*s while commands (system, tag protocol) are handled one at a time. In other words, commands of different categories (system, ISO-18000-6B and EPC C1 Gen 2 as supported) can be interspersed in the sequence of operations a SW application is set out to execute.

For example, after connection[58] is established with the device, an application may first issue the *Reader Status* command (05 00 0B xx xx) for examining system settings (obtained in response packet(s) following *Ack*), send an *RF Power Level* setting command (06 00 12 index xx xx), following the confirmation *Ack*, issue the *ISO-18000-6 B Portal IDs* command (07 11 1E 00 00 xx xx), following Ack/Response(s), issue a (or two) *Stop* (00) informing reader to stop reporting tag reads, send another *RF Power Level* setting command for a different value if deemed necessary and then issue an *EPC C1 Gen 2 Single Tag Meter* command (05 20 11 xx xx), *Stop*, *Write ISO-18000-6B Block Data*, …, etc. Basically, one is able to program the following for while connected to an MPR device:

```
…..
begin loop
        ISO-B multitagID() // 07 11 1E 00 00 xx xx)
        wait 500ms // handling ISO-B tag read response(s)
        STOP // 00
        ISO-C multitagID() // 07 20 1E 00 00 xx xx)
        wait 500ms // handling ISO-C tag read response(s)
        STOP // 00
end loop
…..
```

[58] can be verified for its healthy state by issuing a *Stop*

6.4 Note on Sensitivity Level Control Command (0x07)

The *SensitivityLevel* parameter in this command refers to an indexing (range) value. Internally the reader uses 8 indices (3, 6, 9, 12, 15, 18, 21 and 24) and value specified for *SensitivityLevel* in issuing the command results in its actual setting assigned by reader as shown below.

User Setting (x)	Actual Setting
x < 3	3
3 <= x < 6	3
6 <= x < 9	6
9 <= x < 12	9
12 <= x < 15	12
15 <= x < 18	15
18 <= x < 21	18
21 <= x < 24	21
x >= 24	24