

BM78 EEPROM Upgrade Protocol

Introduction

The BM78 module is a fully certified, embedded 2.4 GHz Bluetooth[®] Low Energy wireless module with Basic Rate (BR) and Enhanced Data Rate (EDR) features. This application note provides the details about the list of procedures and data formats to conduct the EEPROM upgrade.

The BM78 module includes the following components:

- On-board Bluetooth stack
- Power management subsystem
- 2.4 GHz transceiver
- Radio Frequency (RF) power amplifier

The user can use the BM78 module to embed the Bluetooth functionality into any application. The EEPROM settings configure the behavior of the BM78 firmware, and the external host Microcontroller Unit (MCU) upgrades the EEPROM settings.

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1. Quick References

1.1 Reference Documentation

For further details, refer to the following:

• Bluetooth Core Specification v5.2 (Core_v5.2)

1.2 Software Requirements

Note: For the following software tools and firmware files, refer to the www.microchip.com/BM78.

IS1678 UI Tool

1.3 Acronyms and Abbreviations

Table 1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Description
BDR	Basic Data Rate
BLE	Bluetooth Low Energy
BR	Basic Rate
EDR	Enhanced Data Rate
OCF	OpCode Command Field
OGF	OpCode Group Field
RF	Radio Frequency
MCU	Microcontroller Unit
Core_v5.2	Bluetooth Core Specification v5.2

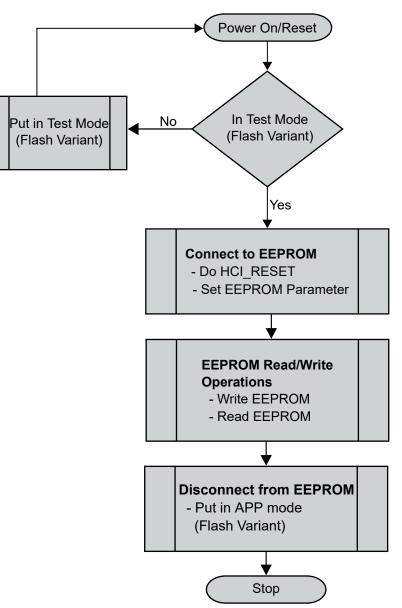
2. BM78 Module Overview

The EEPROM configuration memory stores the EEPROM settings, and the EEPROM settings configure the BM78 module firmware behavior. The IS1678 UI tool allows users to edit the configurable EEPROM setting and generates the output as a structured text file. The IS1678 UI tool also allows users to download the structured text file into the EEPROM memory. In addition to the IS1678 UI tool, the host MCU can also upgrade the EEPROM settings. With either the IS1678 UI tool or with the host MCU, the EEPROM upgrade procedure uses the same protocol as described in the following sections.

2.1 EEPROM Programming Process

The following figure illustrates the steps to follow to perform any EEPROM programming operation with respect to the protocols.

Figure 2-1. Overview of EEPROM Programming Process



The following are the steps in the EEPROM programming process:

- In Test Mode (Flash Variant) Set the BM78 module into the Test (Write EEPROM) mode. Set the pin P2_0 to ON and the pin P2_4/EAN to the OFF state to enter the Memory Programming mode, and, then, initiate a hardware reset using the RESET pin. The following table provides details about the BM78 Evaluation Board (EVB) mode switch positions. For more details, refer to the BM78 Evaluation Board (EVB) User's Guide (DS70005246A).
- Connect to EEPROM Send the HCI_Reset command to the BM78 module to activate the EEPROM read/ write operation, and, then, send the HCI_EEPROM_PAGE_WRITE_NUM command to set the EEPROM parameter.
- EEPROM Read/Write Operations Use the HCI_EEPROM_WRITE command for the EEPROM setting update, and use the HCI_E2PROM_READ to read back the EEPROM setting for verification.
- Disconnect from EEPROM The host MCU sets the BM78 module into the Application mode using the pins P2_0 and P2_4/EAN. Set the pins P2_0 to ON and P2_4/EAN to the OFF state, and, then, initiate a hardware reset using the RESET pin. The following table provides details about the BM78 Evaluation Board (EVB) mode switch positions. For more details, refer to the *BM78 Evaluation Board (EVB) User's Guide* (DS70005246A).

Mode			Pin Definition		
		Positions	1/P2_0	2/P2_4	3/EAN
Flash	Write Flash	ON 1 2 3	ON	ON	ON
ROM	Test (Write EEPROM)	ON 1 2 3	ON	OFF	ON
	Application (default)	ON 1 2 3	OFF	OFF	ON
Flash	Test (Write EEPROM)	O N 1 2 3	ON	OFF	OFF
	Application (default)	ON 1 2 3	OFF	OFF	OFF

Table 2-1. BM78 Evaluation Board (EVB) Mode Switch Positions

3. EEPROM Operation Command and EEPROM Operation Event

The EEPROM operation command is packed into the HCI command packet, and the E2PROM operation event is packed into the HCI event packet. For more details, see the following table from Bluetooth Core Specification v5.2 (Core_v5.2).

Table 3-1. HCI Packet Indicators

HCI Packet Type	HCI Packet Indicator
HCI command packet	0x01
HCI ACL data packet	0x02
HCI synchronous data packet	0x03
HCI event packet	0x04
HCI ISO data packet	0x05

The EEPROM command packet always starts with 0x01. The following figure illustrates the rest of the HCI command from the Core_v5.2. The OpCode has a 16-bit length, where the OpCode Command Field (OCF) combines each OpCode in the lower 10 bits and the OpCode Group Field (OGF) in the upper 6 bits.

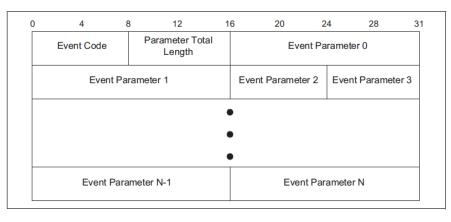
Note: This application note defines the OpCode for the EEPROM operation.

Figure 3-1. HCI Command Packet

(0	4	8	12	16	20	24	28	31		
	OpCode OCF OGF					Parameter Total Length Parameter 0					
	Parameter 1					Р	aramet	ter			
					•						
					•						
	Parameter N-1					Parameter N					

The EEPROM event packet always starts with 0x04. The following figure illustrates the E2PROM event = 0x04, along with the rest of the HCI event packet from the Core_v5.2.

Figure 3-2. HCI Event Packet



The EEPROM event is packed in the HCI_Command_Complete event with the event code set to 0x0E. For more details, refer to Section 7.7.14 from the *Bluetooth Core Specification v5.2*.

Table 3-2. HCI Command Complete Event

Event	Event Code	Event Parameters
HCI_Command_Complete	0x0E	Num_HCI_Command_PacketsCommand_OpcodeReturn_Parameters

3.1 HCI_Reset Command and Event

Use the HCI_Reset command to enable the EEPROM operation. The OGF is 0x03 and the OCF is 0x03, so the HCI OpCode is 0x0C03. For more details, refer to the *Bluetooth Core Specification* v5.2.

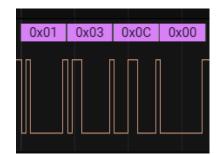
Table 3-3. HCI Reset Command

Command	OCF	Command Parameters	Return Parameters
HCI_Reset	0x0003		Status

• Example data - The HCI_Reset command

- 0x01 HCI command packet
- 0x03 0x0C OpCode 0x0C03 is sent in little endian as 0x03 and 0x0C
- 0x00 The HCI_Reset packet has no parameter, so the length field is set to 0x00

Figure 3-3. Example of HCI_Reset Command



- Example data The event to HCI_Reset
 - 0x04 HCI event packet
 - 0x0E Command complete event of HCI event
 - 0x04 Total 4 bytes of parameter appended
 - 0x01 0x03 0x0C The processed HCI command
 - 0x00 Indicate a success

Figure 3-4. Event to HCI_Reset Command

0x04	0x0E	0x04	0x01	0x03	0x0C	0x00

3.2 HCI_EEPROM_WRITE_NUMBER Command and Event

Use the HCI_EEPROM_WRITE_NUMBER command to specify the size of the EEPROM write operation. The OCF is 0x2D and the HCI OpCode is 0xFC2D.

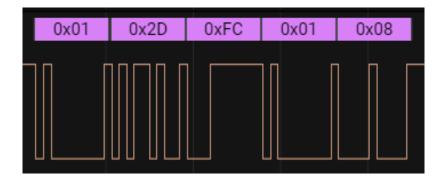
• Page_Write_Number - For the BM78 module, the Page_Write_Number parameter is fixed as 0x08 and takes 1 byte.

Table 3-4. HCI_EEPROM_Page_Write_Number Command

Command	OCF	Command Parameters	Return Parameters		
HCI_EEPROM_Page_Write_Numbe	0x2D	Page_Write_Number	Status		
Use the HCI_EEPROM_Page_Write_	Number	command to set the number of E	EPROM page write.		
Page_Write_Number			Size – 1 byte		
Value	Parameter Description				
0xXX	For the BM78 module, the supported number of EEPROM page write Atmel – 8 bytes ISSI – 16 bytes A-plus – 8 bytes				
Status			Size – 1 byte		
Value	Parame	eter Description			
0x00	HCI_EEPROM_Page_Write_Number command succeeded				
0x01-0xFF	HCI_EE	PROM_Page_Write_Number C	ommand failed		

- Example data The HCI_EEPROM_WRITE_NUMBER command
 - 0x01 HCI command packet
 - 0x2D 0xFC OpCode 0xFC2D is sent in a little endian as 0x2D 0xFC
 - 0x01 The parameter length
 - 0x08 The write number is 0x08 for the BM78 module

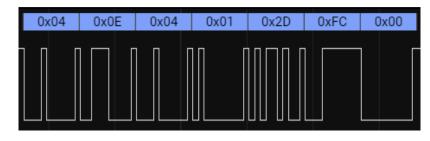
Figure 3-5. Example of Data HCI_EEPROM_WRITE_NUMBER Command



- Example data Event to the HCI_EEPROM_WRITE_NUMBER command
 - 0x04 HCI event packet
 - 0x0E Command complete event of HCI event

- 0x04 Total 4 bytes of parameter appended
- 0x01 0x2D 0xFC The processed HCI command
- 0x00 Indicate a success

Figure 3-6. Event of HCI_EEPROM_WRITE_NUMBER Command



3.3 HCI_EEPROM_WRITE Command and Event

Use the <code>HCI_EEPROM_WRITE</code> command to write data into the EEPROM location specified by the <code>Start_Address</code> parameter. The OCF is 0x27 and the HCI OpCode is 0xFC27.

- Start Address Indicates the start address of the EEPROM record and takes 2 bytes
- Length Indicates the write length of the EEPROM record and takes 1 byte (approximately ranging from 1 to 240)
- Data Indicates the data of the EEPROM record and takes Length bytes

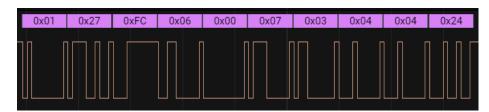
Table 3-5. HCI_EEPROM_Write Command

Command	OCF	Command Parameters	Return Parameters					
HCI_EEPROM_WRITE	0x27	Start_Address, Length and Data	Status					
Use the HCI_EEPROM_Write command to write the data into EEPROM.								
Start_Address	Start_Address Siz							
Value	Parame	ter Description						
0xXXXX	Start wri	ting address						
Length	Length							
Value	Parameter Description							
Ν	Length o							
	N: 1-240							
Data			Size – N byte					
Value	Parame	ter Description						
	-	of the data written to EEPROM						
	N: 1-240							
Status	Size – 1 byte							
Value	Parame	ter Description						
0x00	HCI_EE	PROM_Write command succeeded						

continued							
Command	OCF	Command Parameters	Return Parameters				
0x01-0xFF	HCI_EE	PROM_Write command failed					

- Example data HCI_EEPROM_WRITE command
 - 0x01 HCI command packet
 - 0x27 0xFC OpCode 0xFC27 is sent in a little endian as 0x27 0xFC
 - 0x06 The parameter length of the HCI command
 - 0x00 0x07 Start_Address of the EEPROM record
 - 0x03 Write the length of the EEPROM record
 - 0x04 0x04 0x24 The data of the EEPROM record

Figure 3-7. Example of HCI_EEPROM_WRITE Command



- Example data Event to HCI_EEPROM_WRITE command
 - 0x04 HCI event packet
 - 0x0E Command complete event of HCI event
 - 0x04 Total 4 bytes of parameter appended
 - 0x01 0x27 0xFC The processed HCI command
 - 0x00 Indicate a success

Figure 3-8. Event of HCI_EEPROM_WRITE Command

0x04	0x0E	0x04	0x01	0x27	0xFC	0x00
		ın r	וח ר] [) Г

3.4 HCI_EEPROM_READ Command and Event

Use the HCI_EEPROM_READ command to read back the data from the EEPROM location specified by the Start_Address parameter. The OCF is 0x29 and the HCI OpCode is 0xFC29. To verify, use the HCI EEPROM READ command to read back the EEPROM record after a HCI EEPROM WRITE command.

- Start Address Indicates the start address of the EEPROM record and takes 2 bytes
- Length Indicates the read length of the EEPROM record and takes 1 byte (approximately ranging from 1-240)

Data is returned in the command complete event:

- Status Indicates the operation status and takes 1 byte
- Start_Address Indicates the start address of the EEPROM record and takes 2 bytes
- Length Indicates the length of the EEPROM record and takes 1 byte (approximately ranging from 1-240)
- Data Indicates the data of the EEPROM record and takes Length bytes

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Table 5-0. HCI_EEFKO		Johnnana	
Command	OCF	Command Parameters	Return Parameters
HCI_EEPROM_Read	0x29	Start_Address and Length	Status, Start_Address, Length and Data
Use the HCI_EEPROM_	_Read co	mmand to read the data from EEPRC	9M.
Start_Address			Size – 2 bytes
Value	Parame	ter Description	
0xXXXX	Start rea	ading address	
Length			Size – 1 byte
Value	Parame	ter Description	
Ν	Indicate	s the length of the data to read (in by	es) from EEPROM.
	N: 1-240		
Status			Size – 1 byte
Value	Parame	ter Description	
0x00	HCI_EE	PROM_Read command succeeded	
0x01-0xFF	HCI_EE	PROM_Read command failed. See lis	ting of Error Codes.
Start_Address			Size – 2 bytes
Value	Parame	ter Description	
0xXXXX	Start rea	ading address	
Length			Size – 1 byte
Data			Size – N bytes
Value	Parame	ter Description	
	N bytes	of data read from EEPROM	

Table 3-6. HCI_EEPROM_Read Command

• Example data – HCI_EEPROM_READ Command

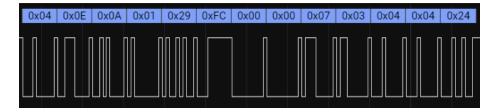
- 0x01 HCI command packet
- 0x29 0xFC OpCode 0xFC29 is sent in a little endian as 0x29 0xFC
- 0x03 The parameter length of the HCI command
- 0x00 0x07 Start_Address of the E2PROM record
- 0x03 Read back the length of the EEPROM record

0x01 0x29 0xFC 0x03 0x00 0x07 0x03

Figure 3-9. Exampe of HCI_EEPROM_READ Command

- Example data Event to HCI_EEPROM_ READ command
 - 0x04 HCI event packet
 - 0x0E Command complete event of the HCI event
 - 0x0A Total 10 bytes of parameter appended
 - 0x01 0x29 0xFC The processed HCI command
 - 0x00 Indicate a success
 - 0x00 0x07 Start_Address of the EEPROM record
 - 0x03 Read back the length of the EEPROM record
 - 0x04 0x04 0x24 Read back data of the EEPROM record

Figure 3-10. Event of HCI_EEPROM_READ Command



4. Document Revision History

Revision	Date	Section	Description
А	11/2021	Document	Initial Revision

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