BM78 EEPROM Upgrade Protocol

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1 Overview

BM78 firmware behavior is configurable by EEPROM setting, which is stored in configuration memory(EEPROM). The configurable EEPROM setting can be edited with PC UI tool which outputs a structured text file, which in turn can be downloaded into the EEPROM with PC tool. Beside the PC tool, one may download the EEPROM setting from the host MCU. Either with PC tool or with the host MCU, the EEPROM upgrade procedure uses the same protocol described below.

Note that:

- The abbreviation E2PROM and EEPROM are identical and exchangeable.

1.1 E2PROM Programming Mode

To perform any EEPROM programming operation, the user needs to follow the process flow shown in the flowchart Figure 1 with respect to the protocols. The steps are described below:

- **Enter memory programming mode**

  Set the module into the 'Test(Write EEPROM)' mode by setting P2_0/P2_4/EAN to state as the TABLE 2-4 in the BM78 EVB user guide and then issue a hardware reset by controlling RESET pin.

TABLE 2-4: BM78 EVB MODE SWITCH POSITIONS

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

- **Connect to EEPROM**

Send HCI_Reset command to BM78 to activate E2PROM read/write operation. And then send HCI_E2PROM_PAGE_WRITE_NUM to set the E2PROM parameter.

- **EEPROM operations**

Use HCI_E2PROM_WRITE for E2PROM setting update and use HCI_E2PROM_READ to read back the E2PROM setting for verification.

- **Disconnect from EEPROM**

  Host MCU needs set BM78 into 'Application Mode' by setting P2_0/P2_4/EAN to OFF as the TABLE 2-4 in the BM78 EVB user guide and then issue a hardware reset by controlling RESET pin.

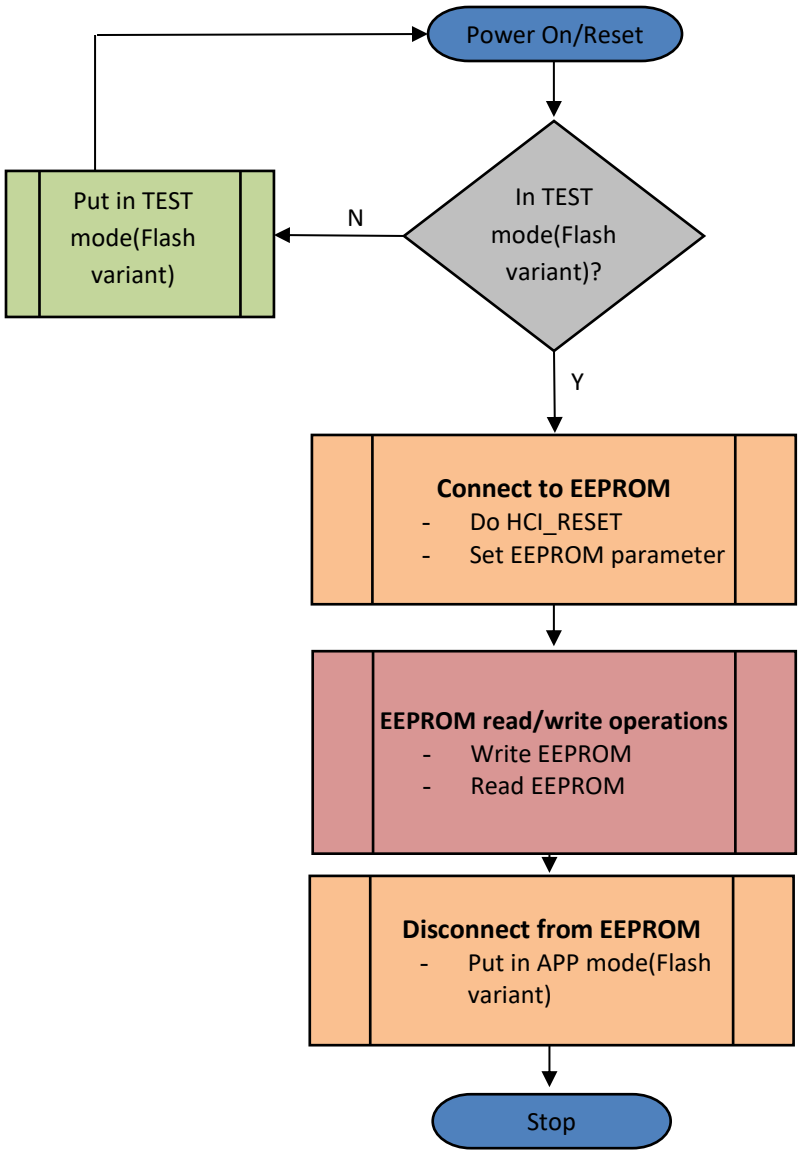


Figure 1. Overview of EEPROM programming process

2 E2PROM Operation Command and Event

The E2PROM operation command and event are packed into HCI command and event packet. Refer to Table 2.1 digested from Bluetooth Core Specification v5.2(Core_v5.2).

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

Table 2.1: HCI packet indicators

The E2PROM command packet always starts with 0x01. The rest part of the HCI command packet is organized as Figure 5.1 from Core_v5.2. The OpCode is in 16bit length. Each OpCode is combined by OCF(OpCode Command Field) in lower 12bit and OGF(OpCode Group Field) in the high 6bit. The OpCode for E2PROM operation is vendor defined.

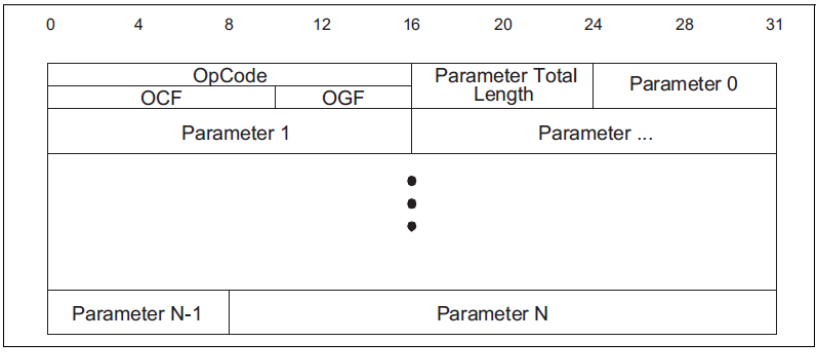


Figure 5.1: HCI Command packet

The E2PROM event packet always starts with 0x04. The rest part of the HCI event packet is organized as Figure 5.4 from Core_v5.2.

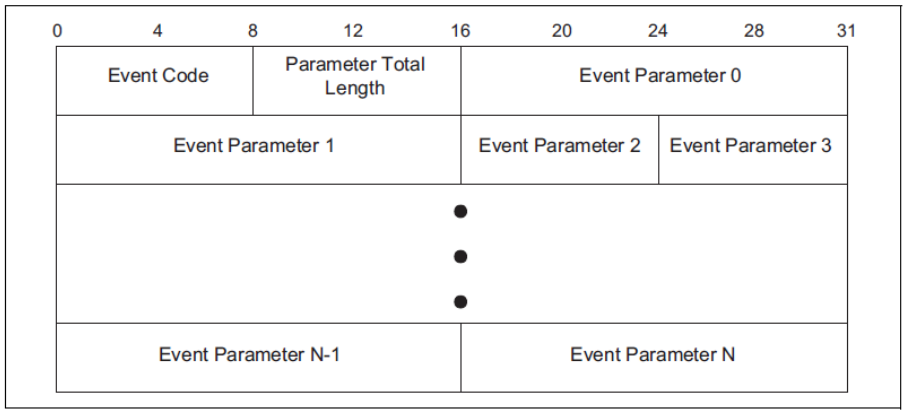


Figure 5.4: HCI Event packet

Especially, the E2PROM event is packed in 'Command Complete Event' with the event code set to 0x0E like the section 7.7.14 digested from Core_v5.2.

7.7.14 Command Complete event

Event	Event Code	Event Parameters
HCI_Command_-Complete	0x0E	Num_HCI_Command_Packets, Command_Opcode, Return_Parameters

2.1 HCI_Reset Command and Event

See section 7.3.2 from Core_v5.2. This is used to enable E2PROM operation. The OGF is 0x03 and the OCF is also 0x03 so the OpCode is 0x0C03.

7.3.2 Reset command

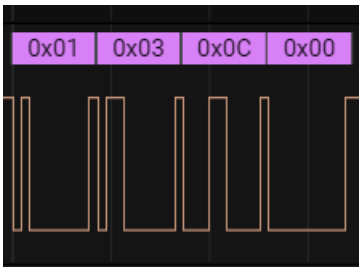
Command	OCF	Command Parameters	Return Parameters
HCI_Reset	0x0003		Status

- Example data: HCI_Reset command

0x01: HCI command packet

0x03 0x0c: OpCode 0x0C03 is sent in little endian as 0x03 0x0C.

0x00: The HCI_Reset packet has no parameter so the length field is set to 0x00.



- Example data: the event to HCI_Reset

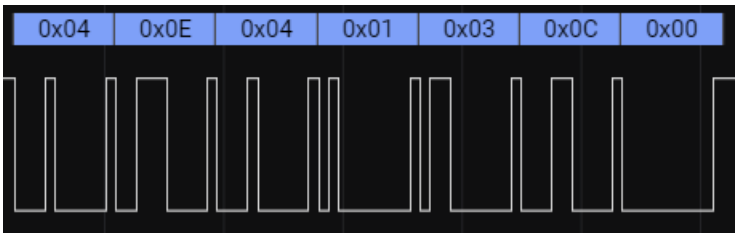
0x04: HCI event packet

0x0E: command complete event of HCI event

0x04: totally 4 bytes of parameter appended

0x01 0x03 0x0C: the processed HCI command

0x00: indicate a success.



2.2 HCI_E2PROM_WRITE_NUMBER Command and Event

This HCI OpCode is 0xFC2D. This is used to specify the size of E2PROM write operation.

- OCF is 0x2D
- size of E2PROM page write operation: For BM78 the parameter is fixed as 0x08; takes up 1 byte

Command	OCF	Command Parameters	Return Parameters
E2PROM_PAGE_WRITE_NUMBER	0x2D	PAGE_WRITE_NUMBER	Status

The E2PROM_PAGE_WRITE_NUMBER command is used to set the number of E2PROM page write.

PAGE_WRITE_NUMBER: *SIZE: 1 BYTES*

Value	Parameter Description
0xXX	The supported number of E2PROM page write. Atmel: 8 bytes. ISSI: 16 byte. A-Plus: 8 bytes.

STATUS: *SIZE: 1 BYTES*

Value	Parameter Description
0x00	E2PROM_PAGE_WRITE_NUMBER command succeeded.
0x01 – 0xFF	E2PROM_PAGE_WRITE_NUMBER command failed.

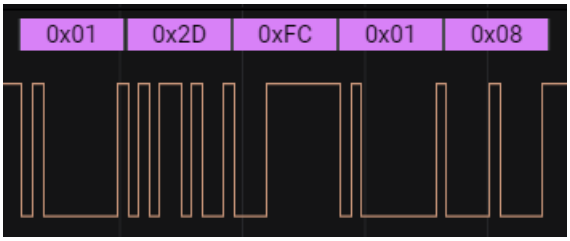
- Example data: the HCI_E2PROM_WRITE_NUMBER command

0x01: HCI command packet

0x2D 0xFC: OpCode 0xFC2D is sent in little endian as 0x2D 0xFC.

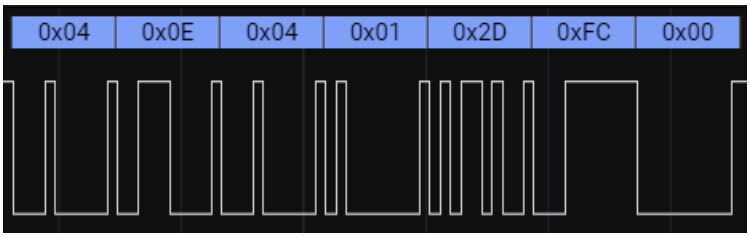
0x01: The parameter length.

0x08: the write number is 0x08 for BM78.



- Example data: event to the HCI_E2PROM_WRITE_NUMBER command

0x04: HCI event packet
0x0E: command complete event of HCI event
0x04: totally 4 bytes of parameter appended
0x01 0x2D 0xFC: the processed HCI command
0x00: indicate a success.



2.3 HCI_E2PROM_WRITE Command and Event

This HCI OpCode is 0xFC27. This command is used to write data to E2PROM location specified by Start_Address.

- OCF is 0x27
- Start_Address: start address of the E2PROM record; takes up 2 bytes
- Length: the length of the E2PROM record to be written; takes up 1 byte; ranges 1~240
- Data: the data of the E2PROM record; takes up 'Length' bytes

Command	OCF	Command Parameters	Return Parameters
E2PROM_Write	0x27	Start_Address, Length, Data	Status

The E2PROM_Write command is used to write data into E2PROM.

START_ADDRESS: *SIZE: 2 BYTES*

Value	Parameter Description
0xXXXX	Start writing address

LENGTH: *SIZE: 1 BYTES*

Value	Parameter Description
N	Length of data desired to be written (in bytes) to E2PROM N range: 1~240

DATA: *SIZE: N BYTES*

Value	Parameter Description
	N bytes of data to be written into E2PROM

STATUS: *SIZE: 1 BYTES*

Value	Parameter Description
0x00	E2PROM_Write command succeeded.
0x01 – 0xFF	E2PROM_Write command failed. See listing of Error Codes.

- Example data: **HCI_E2PROM_WRITE Command**

0x01: HCI command packet

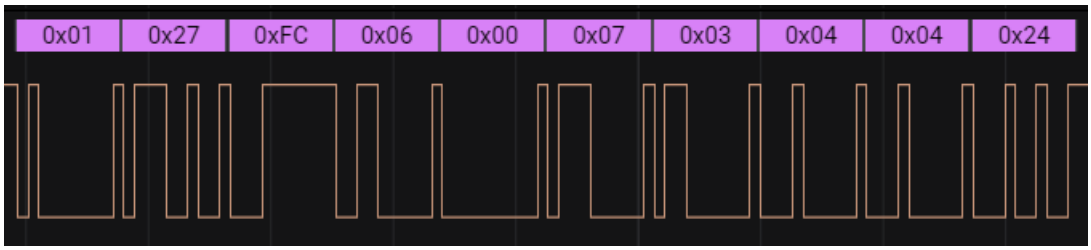
0x27 0xFC: OpCode 0xFC27 is sent in little endian as 0x27 0xFC.

0x06: The parameter length of the HCI command

0x00 0x07: Start_Address of the E2PROM record

0x03: the length of the E2PROM record to be written

0x04 0x04 0x24: the data of the E2PROM record



- Example data: event to **HCI_E2PROM_WRITE Command**

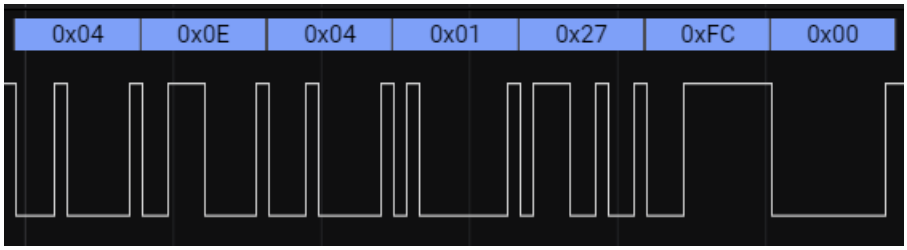
0x04: HCI event packet

0x0E: command complete event of HCI event

0x04: totally 4 bytes of parameter appended

0x01 0x27 0xFC: the processed HCI command

0x00: indicate a success.



2.4 HCI_E2PROM_READ Command and Event

This HCI OpCode is 0xFC29. This command is used to read back data from E2PROM location specified by Start_Address. The command is used to read back the E2PROM record for verification after a write.

- OCF is 0x29
- Start_Address: start address of the E2PROM record; takes up 2 bytes
- Length: the length of the E2PROM record to be written; takes up 1 byte; ranges 1~240

Data is returned in the command complete event:

- Status: operation status; takes up 1byte
- Start_Address: start address of the E2PROM record; takes up 2 bytes
- Length: the length of the E2PROM record to be written; takes up 1 byte; ranges 1~240
- Data: the data of the E2PROM record; takes up 'Length' bytes

Command	OCF	Command Parameters	Return Parameters
E2PROM_Read	0x29	Start_Address, Length	Status, Start_Address, Length, Data

The E2PROM_Read command is used to read data from the E2PROM.

START_ADDRESS: *SIZE: 2 BYTES*

Value	Parameter Description
0xXXXX	Start reading address

LENGTH: *SIZE: 1 BYTES*

Value	Parameter Description
N	Length of data desired to be read (in bytes) from E2PROM N range: 1~240

STATUS: *SIZE: 1 BYTES*

Value	Parameter Description
0x00	E2PROM_Read command succeeded.
0x01 – 0xFF	E2PROM_Read command failed. See listing of Error Codes.

START_ADDRESS: *SIZE: 2 BYTES*

Value	Parameter Description
0xXXXX	Start reading address

LENGTH: *SIZE: 1 BYTES*

Value	Parameter Description
N:0x00-0xFF	Length of data read (in bytes) from E2PROM

DATA: *SIZE: N BYTES*

Value	Parameter Description
	N bytes of data as read from E2PROM

- Example data: **HCI_E2PROM_READ Command**

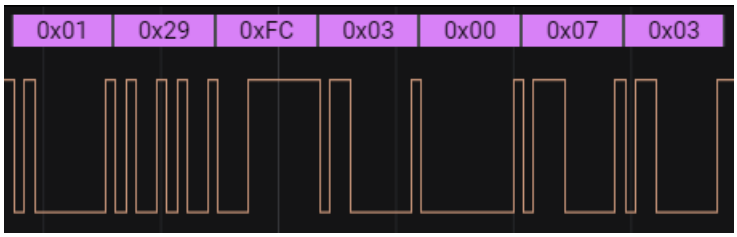
0x01: HCI command packet

0x29 0xFC: OpCode 0xFC29 is sent in little endian as 0x29 0xFC.

0x03: The parameter length of the HCI command

0x00 0x07: Start_Address of the E2PROM record

0x03: the length of the E2PROM record to be read back



- Example data: event to **HCI_E2PROM_ READ Command**

0x04: HCI event packet

0x0E: command complete event of HCI event

0x0A: totally 10 bytes of parameter appended

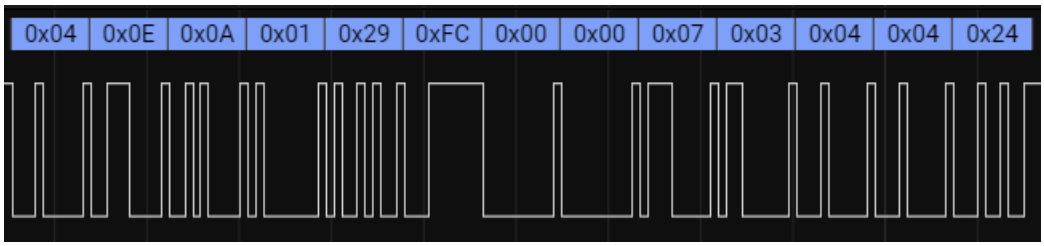
0x01 0x29 0xFC: the processed HCI command

0x00: indicate a success

0x00 0x07: Start_Address of the E2PROM record

0x03: the length of the E2PROM record to be read back

0x04 0x04 0x24: the readback data of the E2PROM record



3 EEPROM UI File Manipulation

The UI File manipulation is not part of this protocol and it is only a reference for host MCU to do EEPROM upgrade. For details, please refer to BM7x Configuration Library for PIC MCUs on page https://www.microchip.com/wwwproducts/en/bm70.