RL78/G10 Group

Programmer Edition

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Introduction

This Application Note describes the information to develop dedicated flash memory programmers for rewriting the internal flash memory of the RL78/G10 group.

Target Device

RL78 Family RL78/G10 group

Contents

1. Flash Memory Programming

To rewrite the contents of the internal flash memory of the RL78/G10, a dedicated flash memory programmer (hereafter referred to as the "programmer") is usually used.

This Application Note explains how to develop a dedicated programmer.

Refer to the chapter "FLASH MEMORY" of "RL78/10 User's Manual: Hardware" (R01UH0384EJ).

1.1 Overview

The RL78/G10 incorporates the dedicated circuit that controls flash memory programming. The programming to the internal flash memory is performed by transmitting/receiving commands between the programmer and the RL78/G10 via serial communication.

1.2 Single-wire UART communication

As serial communications for writing the flash memory, single-wire UART communication can be used.

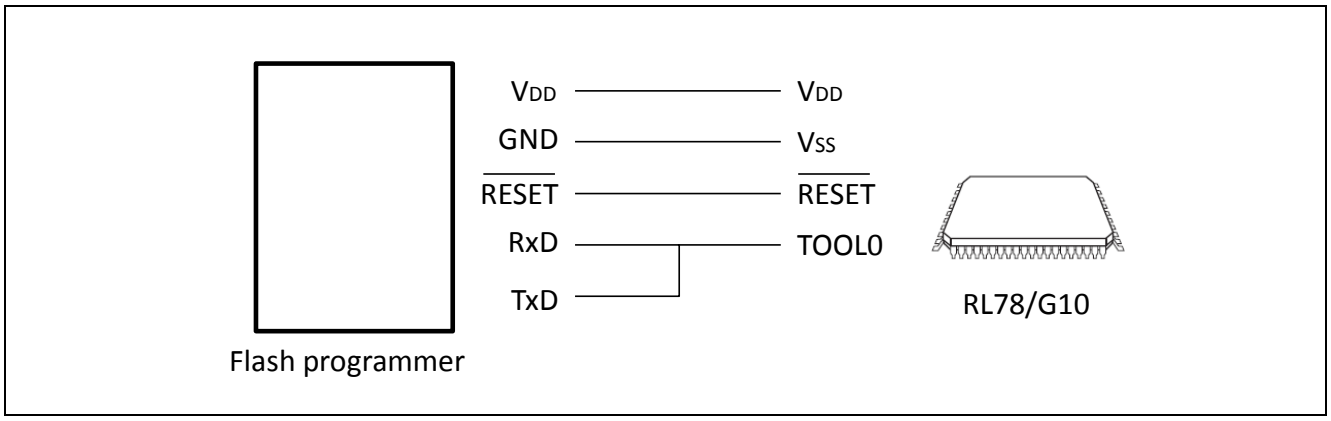


Figure 1 System Outline of Flash Memory Programming in RL78/G10

For the detail of the connection between the programmer and RL78/G10, refer to "Connection of Pins on Board" in the chapter "FLASH MEMORY" of "RL78/10 User's Manual: Hardware".

Table 1 Single-wire UART Communication Conditions

Item	Descriptions
Baud rate	115,200 bps
Parity bit	Odd parity
Data length	8 bits (LSB first)
Start bit	1 bit
Stop bit	2 bits (programmer → RL78) 1 bit (RL78 → programmer)

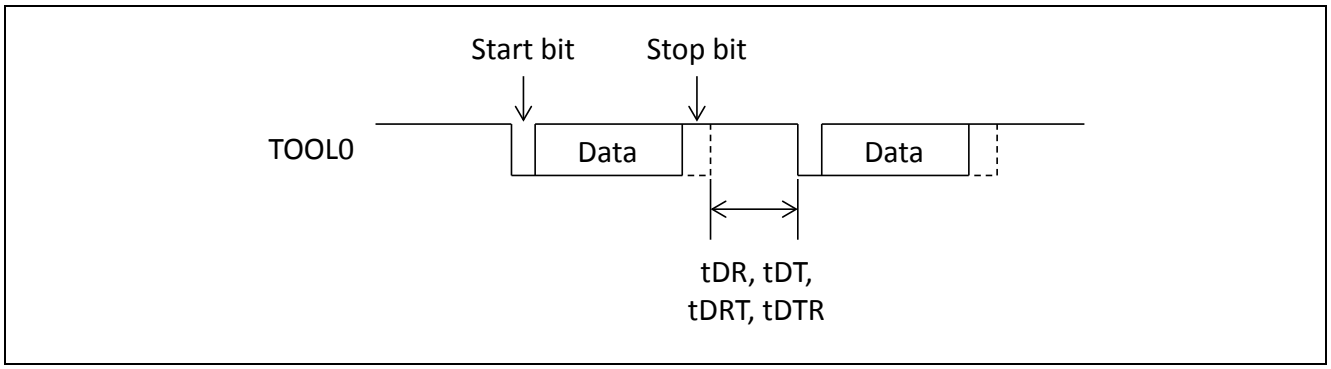


Figure 2 Communication format

Table 2 Communication characteristics

Item	Descriptions	Min	Max
tDR (1)	Data receive interval	104ns (3)	-
tDT (1)	Data transmit interval	104ns	1us (2)
tDRT (1)	Data transmit interval after data received	240ns (3)	1us (2)
tDTR (1)	Data receive interval after data transmitted	104ns (3)	-

Notes: 1. Receive/Transmit operation from the RL78/G10
2. This value does not include the time of Erase, Program, Verify and CRC process.
3. The programmer has to wait this time before transmitting a data.

1.3 Command and Status List

The flash memory incorporated in the RL78/10 can be rewritten by using the commands. The programmer transmits commands to control these functions to the RL78/10, and checks the response status sent from the RL78/G10, to manipulate the flash memory.

1.3.1 Command List

The commands used by the programmer and their functions are listed below.

Table 3 List of Commands Transmitted from Programmer to RL78/G10

Command Number	Command Name	Function
3AH	Mode setting one-byte data	Entries the flash memory programming mode.
53H	CRC Check	Calculates the CRC checksums of the data in the entire flash memory.
60H	Write after erase	Erases the entire flash memory and writes the target data to the flash memory.

1.3.2 Status List

The following table lists the status codes the programmer receives from the RL78/G10.

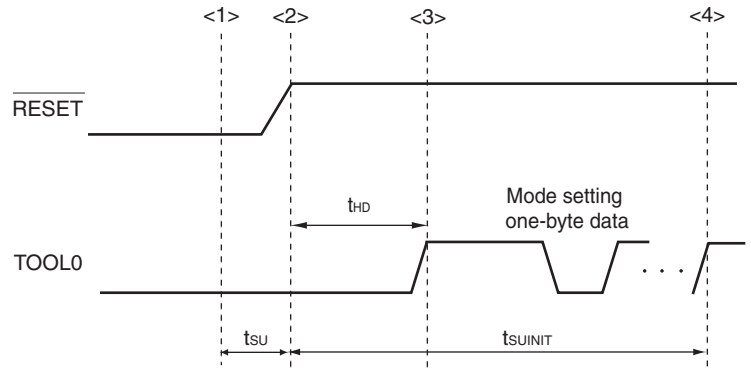
Table 4 Status code List

Status Code	Status	Descriptions
04H	Command number error	An unsupported command was received
06H	Normal acknowledgment (ACK)	On transmission by the microcontroller : Normal reply On transmission by the programmer : Flash processing is enabled.
15H	Negative acknowledgment (NACK)	Negative acknowledgment
1AH	Erase error	Erase error
1BH	Verify error / Blank error	Internal verify error / Blank error
1CH	Write error	Write error

1.4 Power-on Target Power Supply and Setting Flash Memory Programming Mode

To rewrite the contents of the flash memory with the programmer, the RL78/G10 must first be set to the flash memory programming mode (serial programming mode). The command number of “Mode setting one-byte data” is described in Table 3 List of Commands Transmitted from Programmer to RL78/G10”.

For the detail of the Flash Memory Programming mode, refer to “Flash memory programming mode” in the chapter “FLASH MEMORY” of “RL78/10 User’s Manual: Hardware”.



<1> The low level is input to the TOOL0 pin.

<2> The external reset ends (SPOR reset must end before the external reset ends.).

<3> The TOOL0 pin is set to the high level.

<4> Setting of entry to the flash memory programming mode by UART reception.

Figure 3 Setting Flash Memory Programming Mode

1.5 Shutting Down Target Power Supply

After each command execution is completed, shut down the power supply to the target after setting the RESET pin to low level, as shown below.

Set other pins to Hi-Z when shutting down the power supply to the target.

Note: Shutting down the power supply and inputting a reset during command processing are prohibited.

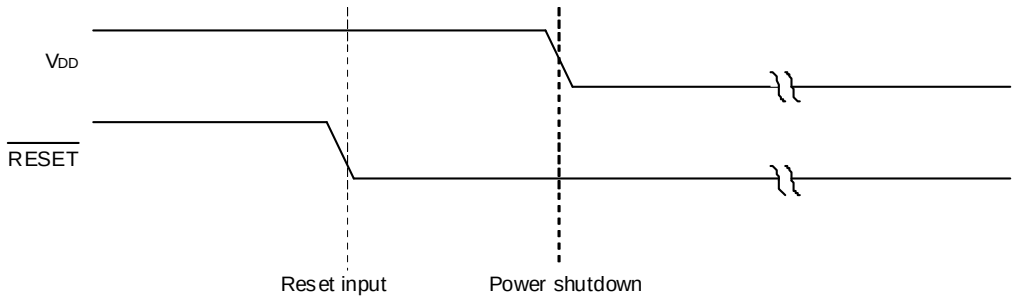


Figure 4 Timing for Terminating Flash Memory Programming Mode

2. Command Execution Flow

2.1 Write after erase command

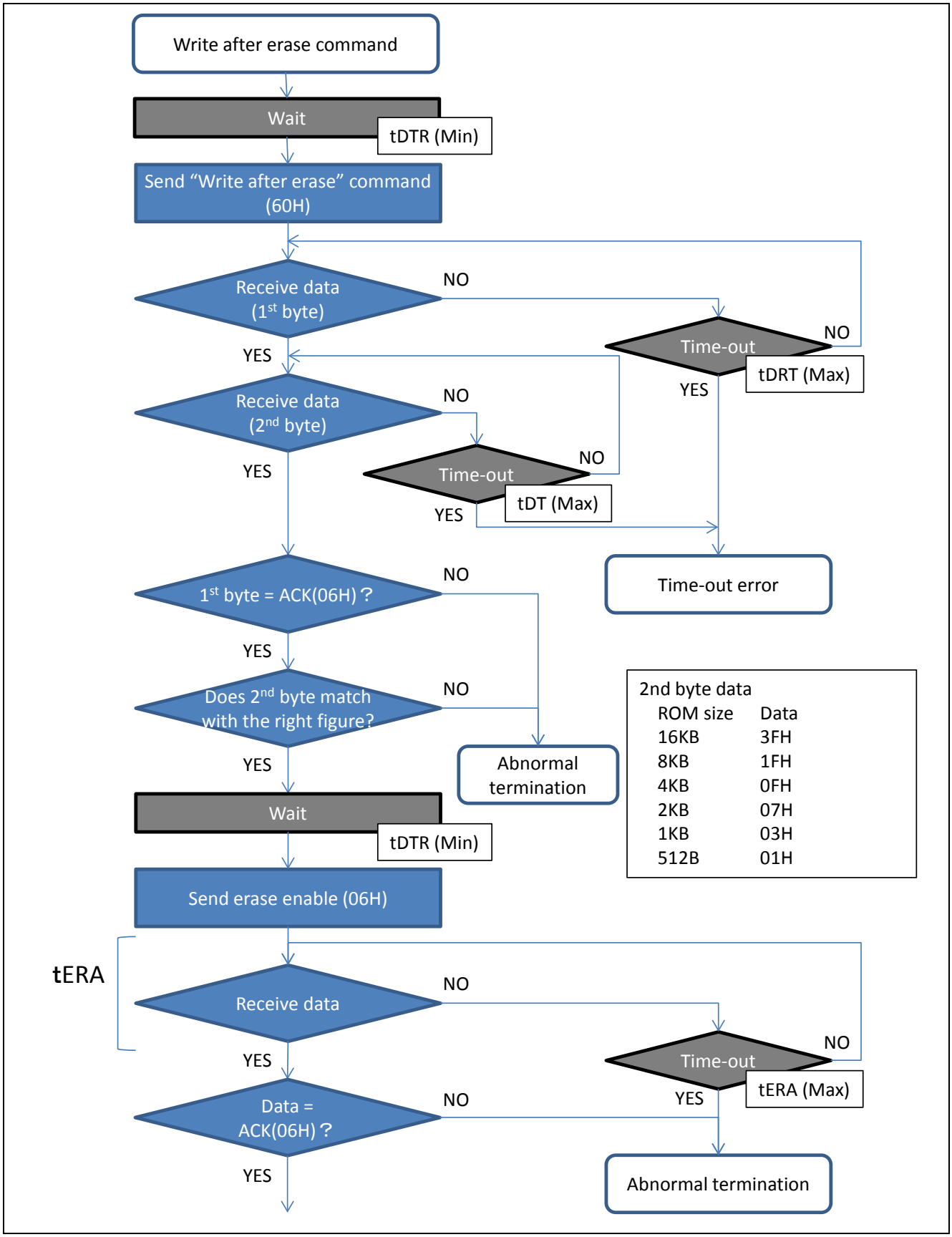


Figure 5 Write after erase command (1 of 2)

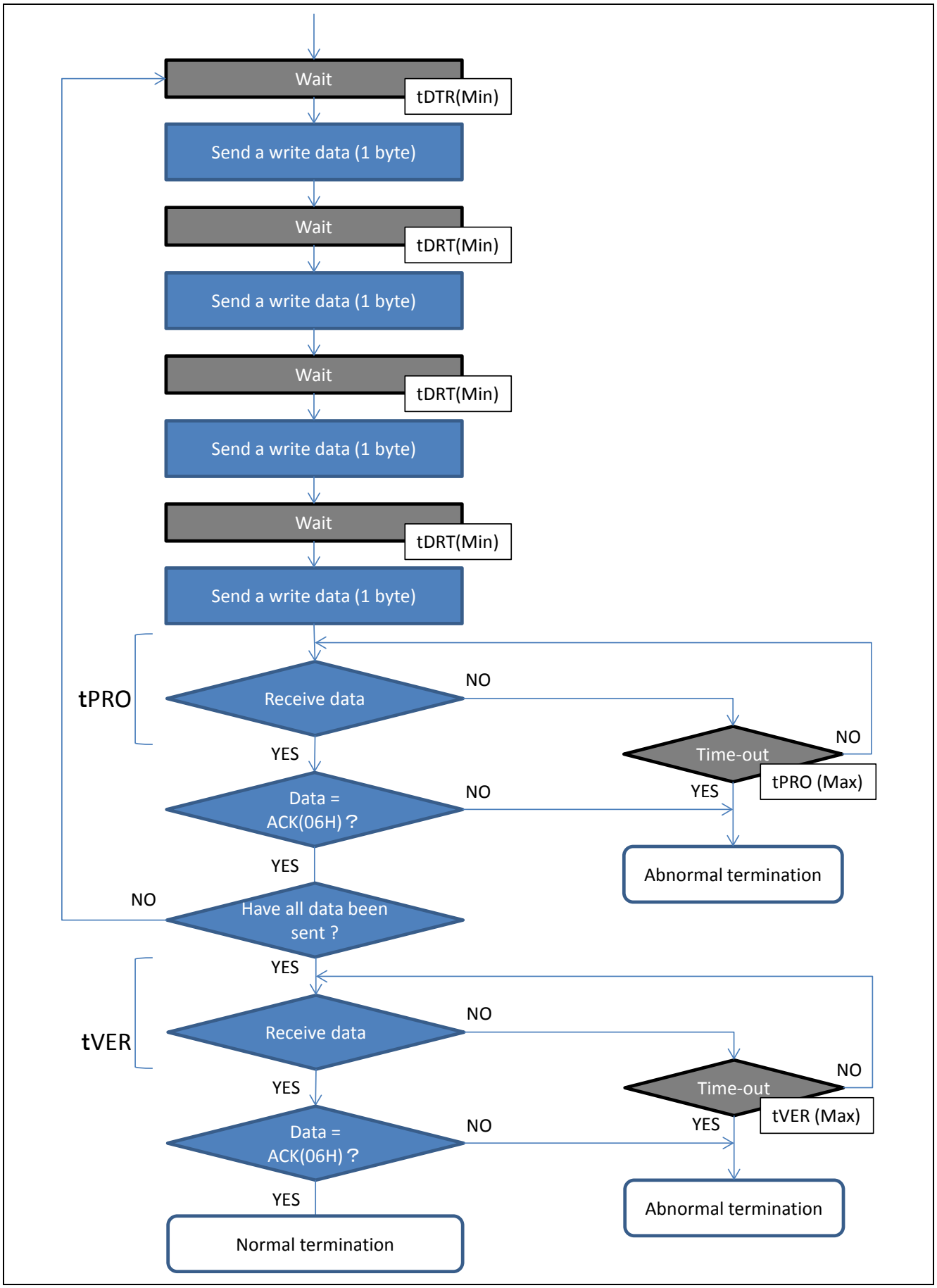


Figure 6 Write after erase command (2 of 2)

2.2 CRC check command

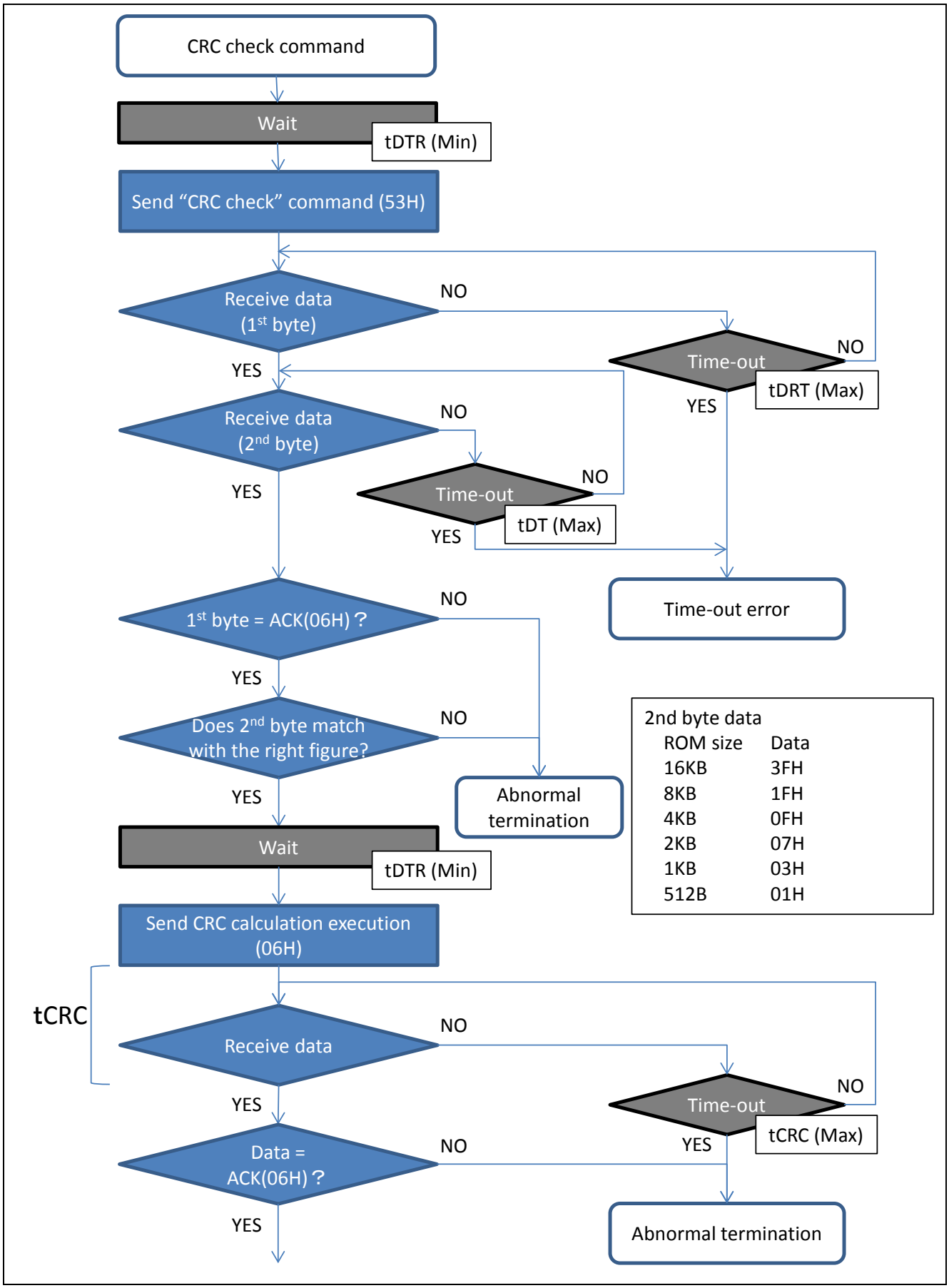


Figure 7 CRC check command (1 of 2)

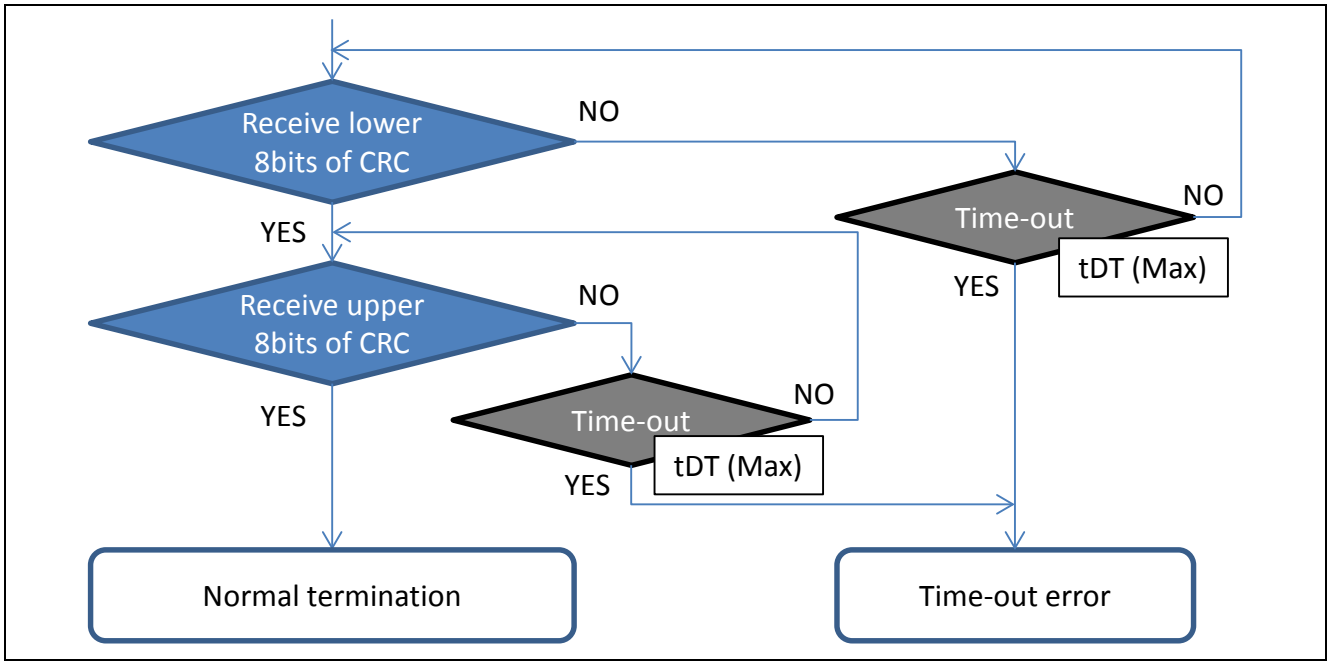


Figure 8 CRC check command (2 of 2)

```
/* The generator polynomial used for this table is: */
/* x^16+x^12+x^5+x^0 according to CCITT-16 standard. */
/* Binary: 0x1021 */
const uint16_t CRC16_Tab [256]= {
      0x0000,0x1021,0x2042,0x3063,0x4084,0x50A5,0x60C6,0x70E7,
      0x8108,0x9129,0xA14A,0xB16B,0xC18C,0xD1AD,0xE1CE,0xF1EF,
      0x1231,0x0210,0x3273,0x2252,0x52B5,0x4294,0x72F7,0x62D6,
      0x9339,0x8318,0xB37B,0xA35A,0xD3BD,0xC39C,0xF3FF,0xE3DE,
      0x2462,0x3443,0x0420,0x1401,0x64E6,0x74C7,0x44A4,0x5485,
      0xA56A,0xB54B,0x8528,0x9509,0xE5EE,0xF5CF,0xC5AC,0xD58D,
      0x3653,0x2672,0x1611,0x0630,0x76D7,0x66F6,0x5695,0x46B4,
      0xB75B,0xA77A,0x9719,0x8738,0xF7DF,0xE7FE,0xD79D,0xC7BC,
      0x48C4,0x58E5,0x6886,0x78A7,0x0840,0x1861,0x2802,0x3823,
      0xC9CC,0xD9ED,0xE98E,0xF9AF,0x8948,0x9969,0xA90A,0xB92B,
      0x5AF5,0x4AD4,0x7AB7,0x6A96,0x1A71,0x0A50,0x3A33,0x2A12,
      0xDBFD,0xCBDC,0xFBBF,0xEB9E,0x9B79,0x8B58,0xBB3B,0xAB1A,
      0x6CA6,0x7C87,0x4CE4,0x5CC5,0x2C22,0x3C03,0x0C60,0x1C41,
      0xEDAE,0xFD8F,0xCDEC,0xDDCD,0xAD2A,0xBD0B,0x8D68,0x9D49,
      0x7E97,0x6EB6,0x5ED5,0x4EF4,0x3E13,0x2E32,0x1E51,0x0E70,
      0xFF9F,0xEFBE,0xDFDD,0xCFFC,0xBF1B,0xAF3A,0x9F59,0x8F78,
      0x9188,0x81A9,0xB1CA,0xA1EB,0xD10C,0xC12D,0xF14E,0xE16F,
      0x1080,0x00A1,0x30C2,0x20E3,0x5004,0x4025,0x7046,0x6067,
      0x83B9,0x9398,0xA3FB,0xB3DA,0xC33D,0xD31C,0xE37F,0xF35E,
      0x02B1,0x1290,0x22F3,0x32D2,0x4235,0x5214,0x6277,0x7256,
      0xB5EA,0xA5CB,0x95A8,0x8589,0xF56E,0xE54F,0xD52C,0xC50D,
      0x34E2,0x24C3,0x14A0,0x0481,0x7466,0x6447,0x5424,0x4405,
      0xA7DB,0xB7FA,0x8799,0x97B8,0xE75F,0xF77E,0xC71D,0xD73C,
      0x26D3,0x36F2,0x0691,0x16B0,0x6657,0x7676,0x4615,0x5634,
      0xD94C,0xC96D,0xF90E,0xE92F,0x99C8,0x89E9,0xB98A,0xA9AB,
      0x5844,0x4865,0x7806,0x6827,0x18C0,0x08E1,0x3882,0x28A3,
      0xCB7D,0xDB5C,0xEB3F,0xFB1E,0x8BF9,0x9BD8,0xABBB,0xBB9A,
      0x4A75,0x5A54,0x6A37,0x7A16,0x0AF1,0x1AD0,0x2AB3,0x3A92,
      0xFD2E,0xED0F,0xDD6C,0xCD4D,0xBDAA,0xAD8B,0x9DE8,0x8DC9,
      0x7C26,0x6C07,0x5C64,0x4C45,0x3CA2,0x2C83,0x1CE0,0x0CC1,
      0xEF1F,0xFF3E,0xCF5D,0xDF7C,0xAF9B,0xBFBA,0x8FD9,0x9FF8,
      0x6E17,0x7E36,0x4E55,0x5E74,0x2E93,0x3EB2,0x0ED1,0x1EF0
};

uint16_t CalcMemoryCRC16 (uint32_t address, uint32_t length)
{
      uint32_t i, rd_ptr;
      uint16_t crc_accum;
      uint8_t byte, data [4];
      crc_accum= 0x0000; /* Init Pattern */
      for (i= 0, rd_ptr= 0; i < length; i++)
      {
            /* Check flash read buffer and fill if needed */
            if (rd_ptr == 0)
            {
                  Memory_Read (address, 4, data);
                  rd_ptr= 4;
                  address+= 4;
            }
            byte= (crc_accum >> 8) ^ data [--rd_ptr];
            crc_accum= (crc_accum << 8) ^ CRC16_Tab [byte];
      }
      return crc_accum;
}
```

Figure 9 16 bits CRC calculation algorithm

2.3 Command characteristics

Table 5 2.3 Command characteristics

Item	Descriptions	Min	Max
tERA	Erase time	-	208 + 6 x N [ms]
tPRO	Programming time	-	1 [ms]
tVER	Verify time	-	1.1 x N [ms]
tCRC	CRC calculation time	-	14 x N [us]

Notes: “N” is memory size [KB].

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Jan. 20, 2016	-	First edition issued

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1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

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