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H8S Family

Using the HCAN (1): Standard Format, One Byte of Data

Introduction

The Controller Area Network (HCAN) module is used to control the Controller Area Network (CAN), which provides a means for real-time communications in automobiles and industrial equipment systems.

This application note presents an example of communications operation using the H8S/2636's on-chip HCAN module and is offered to users for reference in the software and hardware design processes.

Although the operation of the sample application and programs provided in this application note has been confirmed, please verify operation in your environment before actually using them.

Target Device

H8S/2636

Contents

1. Specifications

Between two H8S/2636 devices, one byte of data is transmitted and received in a standard format message.

(1) Specifications common to the transmitter and receiver

- Channel 0 (HCAN0) is used
- Baud rate: 250 Kbps (in 20-MHz operation)
- Message identifier: H'555

(2) Specifications of the transmitter

- Uses mailbox 1
- Data length is one byte, and data for transmission is H'AA
- Polls the transmission-complete flag during transmission
- After confirming that the transmission-complete flag has been set, clears the flag as the final operation

(3) Specifications of the receiver

- Uses mailbox 0
- Sets the message identifier masks so that messages are only received if the identifier matches the mask setting
- Stores the received data in on-chip RAM and ends

2. Functional Descriptions of the Transmitter and Receiver

Table 1 lists the function assignment of the relevant pins and registers.

Table 1 Function Assignment for the HCAN Module

Pin Usage		Function
Pin	HTxD0	Used for message transmission by the HCAN module (pin 97)
	HRxD0	Used for message reception by the HCAN module (pin 98)

Relevant Registers		Function
Registers common to transmission and reception	MSTPCRC	Module stop control register C Takes HCAN0 out of the module stop mode.
	IRR	Interrupt register Indicates the states of individual interrupt sources.
	BCR	Bit configuration register Configures the baud-rate prescaler for CAN and sets up the bit-timing parameters.
	MBCR	Mailbox configuration register Configures mailboxes for transmission or reception.
	MCR	Master control register Controls the CAN interface.
	GSR	General status register Indicates the CAN bus states.
	MCx[n]	Message control registers (x = mailbox number)
	n = 1	Sets the data length for data frames and remote frames.
	n = 2 to 4	Reserved
	n = 5	Holds standard ID bits (STD_ID2 to STD_ID0), extended ID bits (EXD_ID17 and EXD_ID16), RTR (indicates data frame or remote frame), and IDE (indicates standard format or extended format).
	n = 6	Holds standard ID bits (STD_ID10 to STD_ID3)
	n = 7	Holds extended ID bits (EXD_ID7 to EXD_ID0)
	n = 8	Holds extended ID bits (EXD_ID15 to EXD_ID8)
	MDx[n]	Message data registers (x = mailbox number)
	n = 1 to 8	Hold CAN message data for transmission or received CAN message data.
Transmission-related registers	TXPR	Transmit wait register After a message for transmission has been stored in the mailbox, the corresponding bit in this register is set, indicating a transmission-wait state.
	TXACK	Transmit acknowledge register Each bit in this register indicates whether or not the message in the corresponding mailbox has been transmitted normally.
Reception-related registers	RXPR	Receive complete register Each bit in this register indicates that a message has been received normally in the corresponding mailbox.
	LAFMH, LAFML	Local acceptance filter mask H, L Identifier filter mask settings for the mailboxes configured for reception.

3. Flowchart for the Transmitter

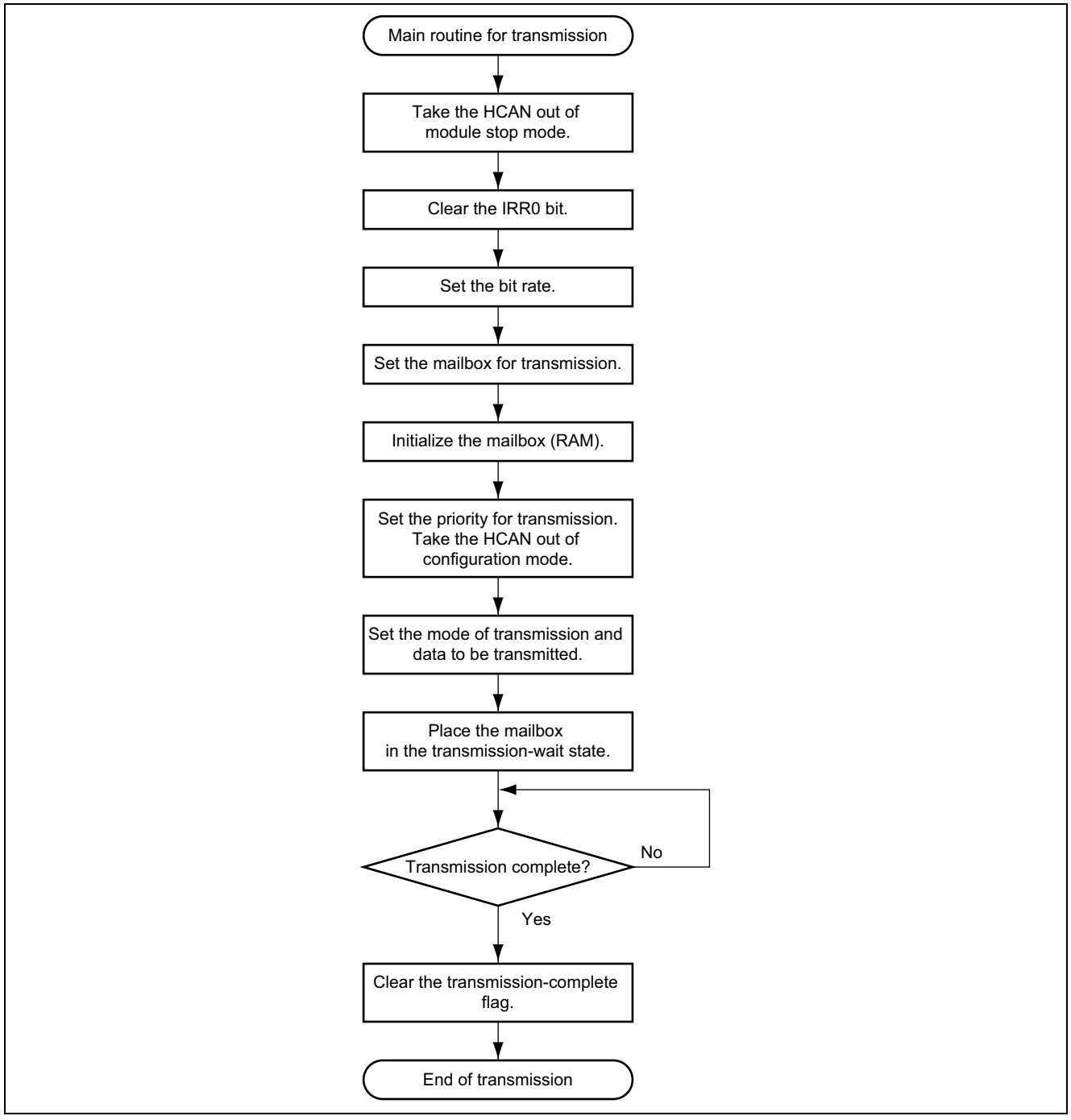

Figure 1 Flowchart for the Transmitter

4. Description of Software (Transmitter)

4.1 Module

Table 2 Description of Module

Module	Label	Function
Main Routine	t_main	Initialize the HCAN and makes settings for transmission.

4.2 Registers

Table 3 Description of Registers*

Register	Function	Setting	Used in
MSTP.CRC.BYTE	Takes HCAN0 out of module stop mode.	H'F7	Main routine
HCAN0.IRR.WORD	The reset interrupt flag in this register is cleared. (Clearing condition: writing a 1 to the bit)	H'0100	
HCAN0.BCR.WORD	Sets the bit rate to 250 Kbps when ϕ = 20 MHz	H'0334	
HCAN0.MBCR.WORD	Sets mailbox 1 for transmission.	H'FDFF	
HCAN0.MCR.BYTE	Selects transmission in mailbox-number order and takes the HCAN module out of configuration mode.	H'04	
HCAN0.GSR.BYTE	Checked to confirm that HCAN0 is out of configuration mode.	—	
HCAN0.MC[1][4]	For mailbox 1, sets the frame type to data frame and the frame format to standard format. Also holds the message identifier bits, STD_ID2 to STD_ID0 (for message ID = H'555).	H'A0	
HCAN0.MC[1][5]	Holds the message identifier bits, STD_ID10 to STD_ID3 (for message ID = H'555).	H'AA	
HCAN0.MC[1][0]	Sets the data length for transmission from mailbox 1 to one byte.	H'01	
HCAN0.MD[1][0]	Holds the 1st byte for transmission from mailbox 1.	H'AA	
HCAN0.TXPR.WORD	Places mailbox 1 in the transmission-wait state.	H'0200	
HCAN0.TXACK.WORD	Checked to see if the transmission-complete flag for mailbox 1 is set; when set, the flag is cleared. (Clearing condition: writing a 1 to the bit)	H'0200	

Note: * The register names shown above are defined in a header file which is available for downloading from the following web page.
http://download.renesas.com/eng/mpumcu/sample_codes/h8sx_h8s_h8_family/io_register/index.html

5. Program Listing (Transmission)

```
/*****************************************************************************************/
/*  HCAN Transmission Program (No.1)                                                     */
/*****************************************************************************************/
#include <stdio.h>                          /* Header file for library functions         */
#include <machine.h>                        /* Header file for library functions         */
#include "2636S.h"                          /* Header file of peripheral register definitions  */

void t_main(void){
    unsigned char i,j;

/* Initialization */
    MSTP.CRC.BYTE = 0xF7;                   /* Cancel module stop mode of HCAN           */
    HCAN0.IRR.WORD = 0x0100;                /* Initialize reset flag for HCAN module     */
    HCAN0.BCR.WORD = 0x0334;                /* Bit rate: 250 kbps                        */
    HCAN0.MBCR.WORD = 0xFDFF;               /* Set mailbox 1 for transmission            */

    for(i=0; i<=15; i++){                   /* Initialize mailboxes (RAM)                */
        for(j=0; j<=7; j++){
            HCAN0.MC[i][j] = 0x00;
        }
    }
    for(i=0; i<=15; i++){                   /* Initialize mailboxes (RAM)                */
        for(j=0; j<=7; j++){
            HCAN0.MD[i][j] = 0x00;
        }
    }

    HCAN0.MCR.BYTE = 0x04;                  /* Transmission in mailbox No. order;        */
                                            /*                              cancel config. mode */
    while(HCAN0.GSR.BYTE & 0x08);           /* Configuration mode cancellation check     */

/* Transmit data setting */
    HCAN0.MC[1][4] = 0xA0;                  /* Standard format, data frame, and          */
                                            /*                               identifier setting */
    HCAN0.MC[1][5] = 0xAA;                  /* Identifier setting                        */
    HCAN0.MC[1][0] = 0x01;                  /* Data length: 1 byte                       */
    HCAN0.MD[1][0] = 0xAA;                  /* Data for transmission: 10101010           */
/* Message transmission */
    HCAN0.TXPR.WORD = 0x0200;               /* Place mailbox 1 in a transmission wait state  */
    while((HCAN0.TXACK.WORD & 0x0200) != 0x0200);
                                            /* Wait until transmission is complete       */
/* Transmission-complete flag clearing */
    HCAN0.TXACK.WORD &= 0x0200;             /* Clear transmission-complete flag          */
    while(1);
}
```

6. Flowchart for the Receiver

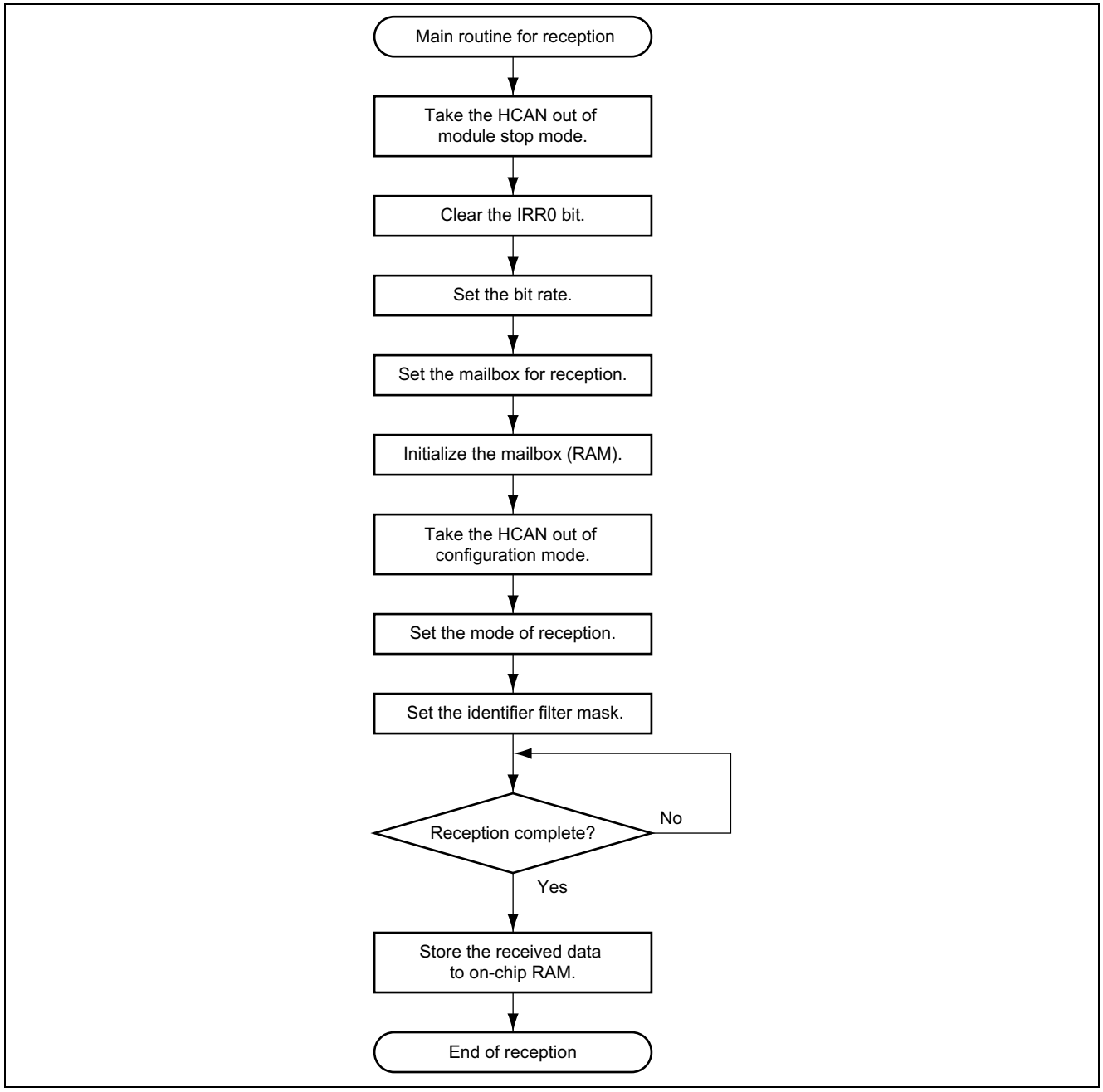

Figure 2 Flowchart for the Receiver

7. Description of Software (Receiver)

7.1 Module

Table 4 Description of Modules

Module	Label	Function
Main Routine	r_main	Initializes the HCAN and makes settings for reception.

7.2 Registers

Table 5 Description of Registers*

Register	Function	Setting	Used in
MAIL_BOX0	Storage for the received data	—	Main routine
MSTP.CRC.BYTE	Takes HCAN0 out of module stop mode.	H'F7	
HCAN0.IRR.WORD	The reset interrupt flag in this register is cleared. (Clearing condition: writing a 1 to the bit)	H'0100	
HCAN0.BCR.WORD	Sets the bit rate to 250 Kbps when ϕ = 20 MHz	H'0334	
HCAN0.MBCR.WORD	Sets mailbox 0 for reception.	H'0100	
HCAN0.MCR.BYTE	Takes HCAN0 out of configuration mode.	H'FE	
HCAN0.GSR.BYTE	Checked to confirm that HCAN0 is out of configuration mode.	—	
HCAN0.MC[0][4]	For mailbox 0, sets the frame type to data frame and the frame format to standard format. Also holds the message identifier bits, STD_ID2 to STD_ID0 (for message ID = H'555).	H'A0	
HCAN0.MC[0][5]	Holds the message identifier bits, STD_ID10 to STD_ID3 (for message ID = H'555).	H'AA	
HCAN0.LAFMH.WORD	Provides the filter mask setting.	H'0000	
HCAN0.MD[0][0]	Reception register for mailbox 0	—	
HCAN0.RXPR.WORD	The reception-complete flag for mailbox 0 in this register is cleared. (Clearing condition: writing a 1 to the bit)	H'0100	

Note: * The register names shown above are defined in a header file which is available for downloading from the following web page.
http://download.renesas.com/eng/mpumcu/sample_codes/h8sx_h8s_h8_family/io_register/index.html

8. Program Listing (Reception)

```
/*****************************************************************************************/
/*  HCAN Reception Program (No.1)                                                        */
/*****************************************************************************************/
#include <stdio.h>                          /* Header file for library functions         */
#include <machine.h>                        /* Header file for library functions         */
#include "2636S.h"                          /* Header file of peripheral register definitions  */
/*****************************************************************************************/
/*  Definitions of Constants                                                             */
/*****************************************************************************************/
#define MAIL_BOX0    (*(unsigned char *) 0xFFE000)
                                            /* Received data storage for mailbox 0       */

void r_main(void){
    unsigned char i,j;
/* Initialization */
    MSTP.CRC.BYTE = 0xF7;                   /* Cancel module stop mode of HCAN           */
    HCAN0.IRR.WORD = 0x0100;                /* Initialize reset flag for HCAN module     */
    HCAN0.BCR.WORD = 0x0334;                /* Bit rate: 250 kbps                        */
    HCAN0.MBCR.WORD = 0x0100;               /* Set mailbox 0 for reception               */
    for(i=0; i<=15; i++){                   /* Initialize mailboxes (RAM)                */
        for(j=0; j<=7; j++){
            HCAN0.MC[i][j] = 0x00;
        }
    }
    for(i=0; i<=15; i++){                   /* Initialize mailboxes (RAM)                */
        for(j=0; j<=7; j++){
            HCAN0.MD[i][j] = 0x00;
        }
    }
    HCAN0.MCR.BYTE &= 0xFE;                 /* Cancel configuration mode                 */
    while(HCAN0.GSR.BYTE & 0x08);           /* Configuration mode cancellation check     */
/* Reception data settings */
    HCAN0.MC[0][4] = 0xA0;                  /* Standard format, data frame, and          */
                                            /*                              identifier setting */
    HCAN0.MC[0][5] = 0xAA;                  /* Identifier setting                        */
    HCAN0.LAFMH.WORD = 0x0000;              /* Set identifier filter mask for mailbox 0  */
    while((HCAN0.RXPR.WORD & 0x0100) != 0x0100);
                                            /* Wait until reception is complete          */
/* Storing received data to on-chip RAM */
    MAIL_BOX0 = HCAN0.MD[0][0];             /* Store received data                       */
    while(1);
}
```

9. Waveforms during Operation (Transmission and Reception)

Figure 3 shows the waveforms seen during the execution of this application.

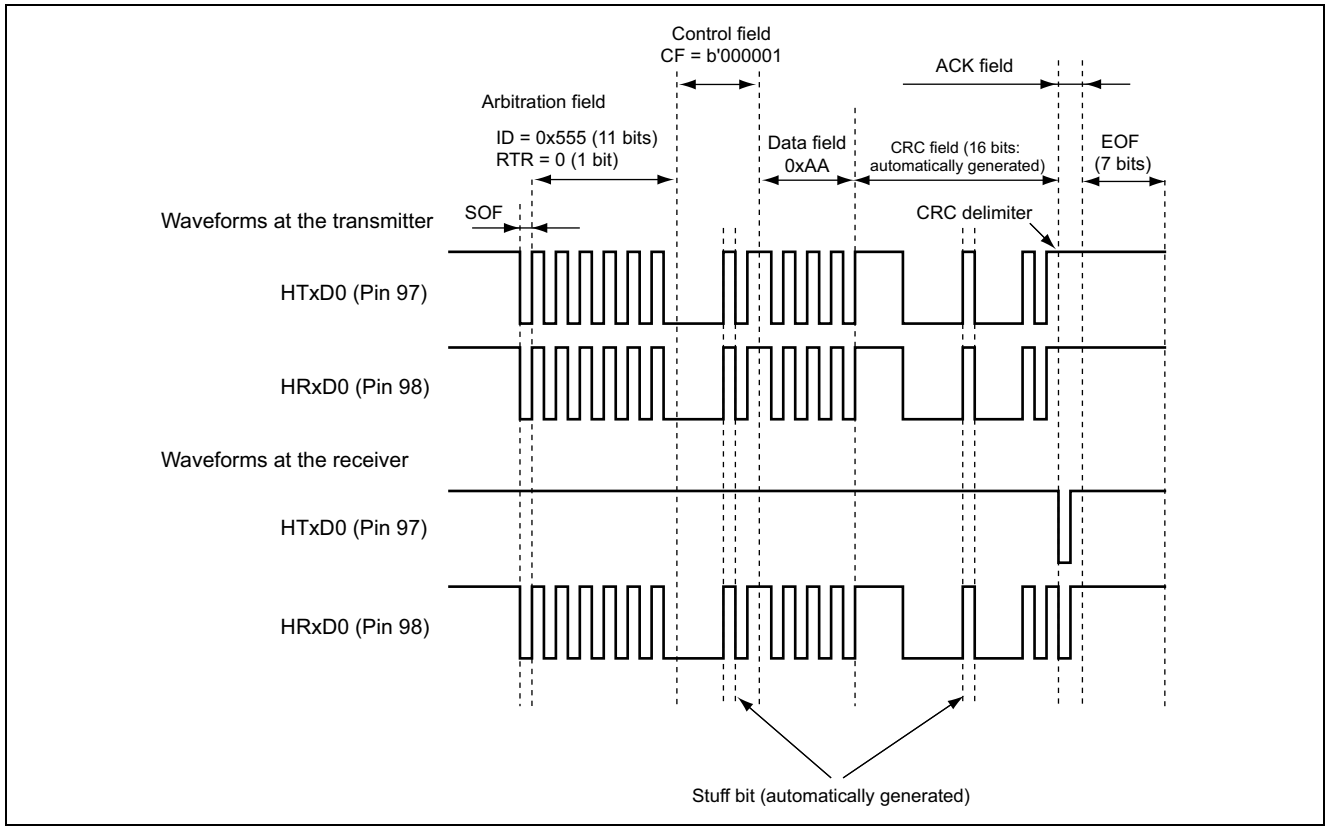

Figure 3 Waveforms during Operation

Revision Record

		Description	
Rev.	Date	Page	Summary
1.00	Jul.22.05	—	First edition issued

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