RL78 Family

DMX512 Receive Module Software Integration System

Introduction

This application note describes the DMX512 Receive module.

Target Device

RL78/G24

Related Documents

- RL78/G24 User's Manual: Hardware (R01UH0961)
- USITT DMX512 / 1990

Contents

1. Overview

1.1 DMX512 Standards Overview

DMX512 is a wired communication protocol for digital data transmission and is widely used in industrial lighting applications such as stage and exhibition lighting (devices equipped with dimmers, scanners, moving lights, strobes, etc.). The system configuration consists of a single transmitter, called a controller or host, and multiple receivers.

Communication data is transmitted at a rate of 250 kbps (each bit: 4 µs) using a physical interface compatible with the RS-485 transmission standard, and data signals are transferred by two differential signal lines and GND (0 V).

1.1.1 Communication Specifications

The data structure of the DMX512 standard is described below.

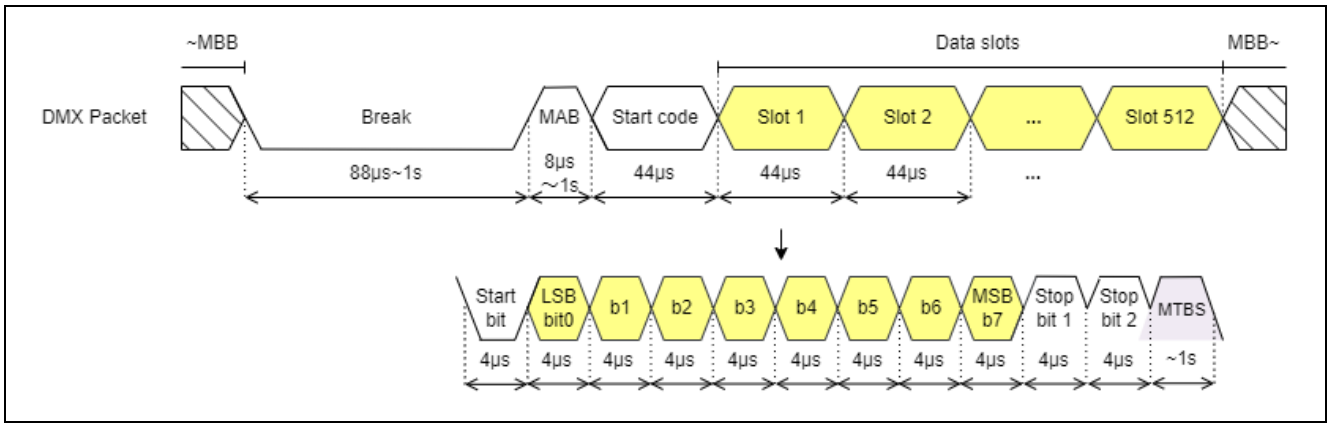

Figure 1-1 data structure diagram

Details of each data:

MBB (Mark Before Break)
Indicates the time from the last Data Slot to the next Break.

MAB (Mark After Break)
Split Break and Start code.

MTBS (Mark Time Between Slots)
Split each Data slots.

Break
Indicates the start of a new packet.

Start code
In the first Slot after MAB, the Data slots indicate what kind of data is stored.
For dimming commands, 0x00 is stored.

Data slots
Each data slot consists of 1 start bit, 8-bit data, and 2 stop bits, with a maximum of 512 bytes
The time between each data slots may vary depending on the MTBS.

1.1.2 Start Address and Channels

If you want to execute multiple devices individually, you need to give a unique starting address to each device.

Also, if the content to be executed differs for each device, the number of Data slots (4CH, 8CH, etc.) must be set according to the purpose. An example assignment is shown below.

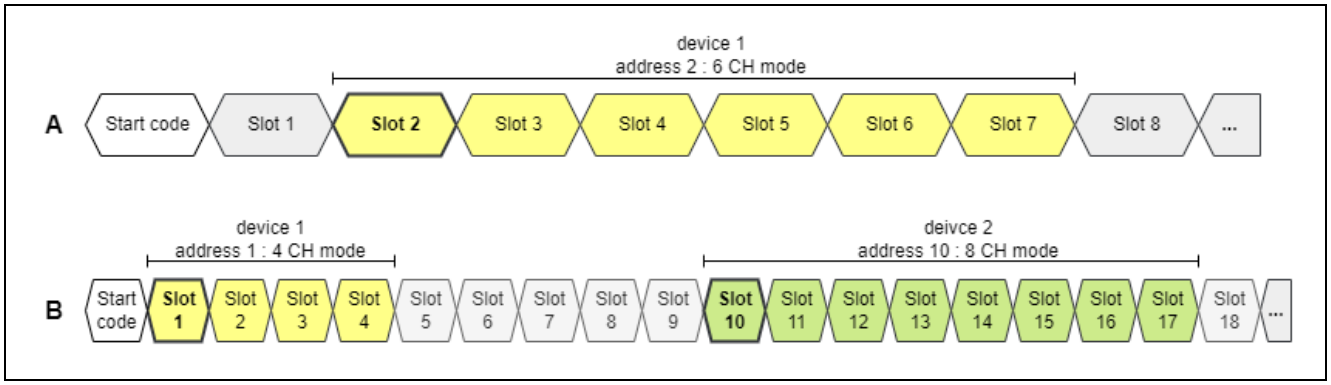

Figure 1-2 Example of Start address and channel settings

Details of example assignments:

A: 1 DMX device.
Assigned Start address in Data slot 2.
Use Data slots 2 ~ 7 as the device operates 6 CHs of information.

B: 2 DMX device.
The Start Address of device 1 is assigned to 1 in the Data slot.
Use Data slots 1 ~ 4 as the device 1 operates with 4 CHs of information.
The Start Address of device 2 is assigned to 10 in the Data slot.
Use Data slots 10 ~ 7 as the device 2 operates with 8 CHs of information.

1.2 DMX512 Receive Driver (DMXRDRV) Features Overview

This module consists of a driver layer (DMX512 Receive Driver) and provides an interface to receive data via DMX512 communication.

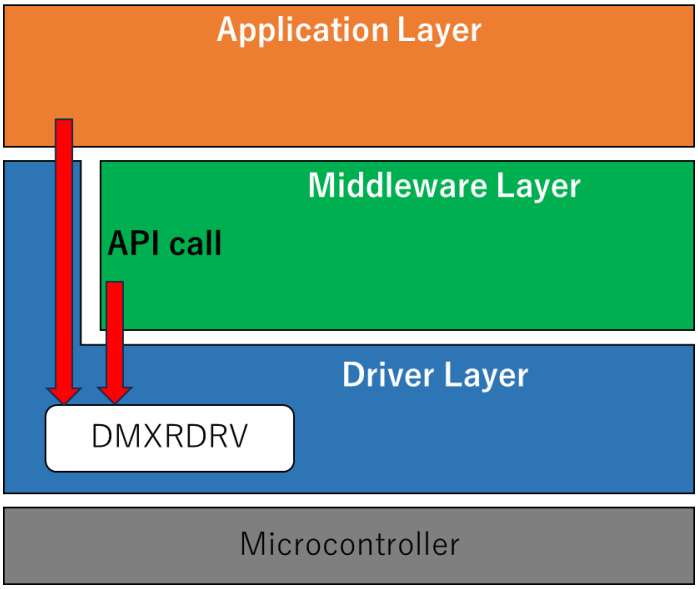

Figure 1-3 Module construction

The DMX512 Receive Driver is intended to be accessed from the middleware layer and application layer.

The DMX512 Receive Driver provides the following features as the driver layer of the DMX512 Receive module.

1.2.1 Serial Communication Features

DMX512 receive operations are performed using the serial array unit SAU.

Operation at signal detection

The timing of DMX512 signal detection is described below.

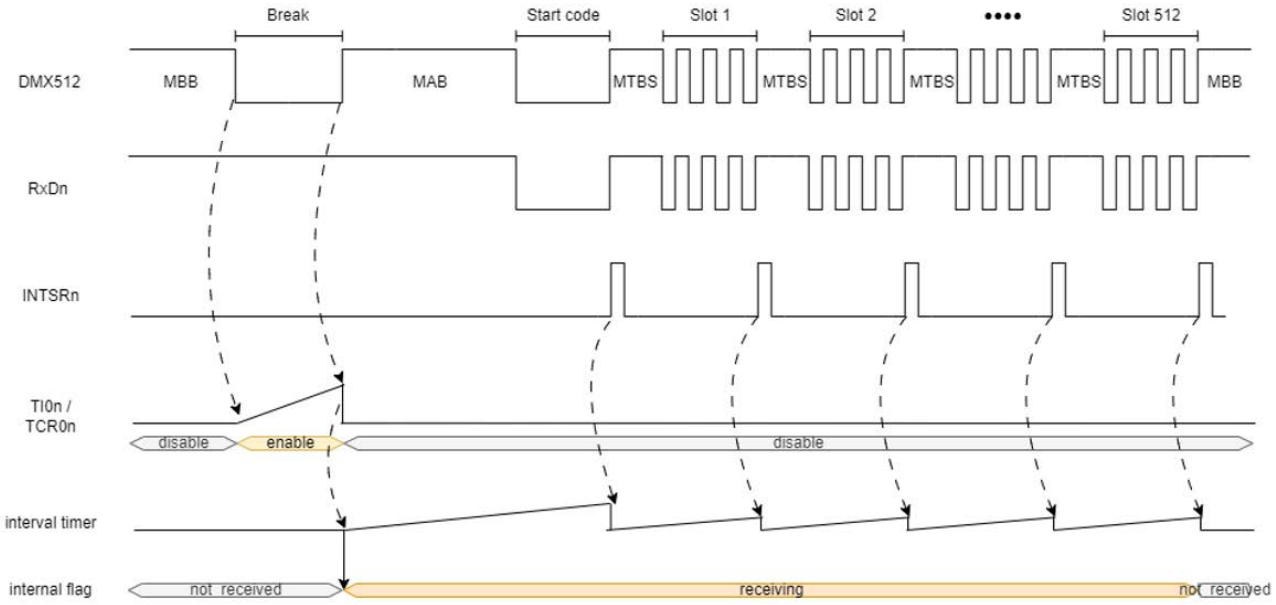

Figure 1-4 Detection timing diagram

When a break signal is detected in the "no received" state, the signal width measurement time will shift to the "receiving" state if the signal width is longer than the specified time. If the break signal is not completed within the specified time, it is assumed to be a communication error and the receiving operation is terminated.

If the "receiving" state can be shifted to the "receiving" state, the received data is stored in the UART interrupt process.

MAB and MTBS in the "receiving" state use an interval timer to determine if the signal has been output for more than the specified time. If the specified time is exceeded, the receiving operation is terminated in the same way as the Break signal.

When the received data has been received up to Slot:512 or when no data has been received for a certain period of time, it enters the "No Reception" state and waits for the next DMX512 communication data to be received.

1.2.2 User Notification of Receive Data

Received data can be specified and retrieved based on information set in the smart configurator.

2. API Information

This section describes the API information for this module.

2.1 Hardware Requirements

Requires an RS-485 compatible transceiver in the hardware environment.

The MCU to be used must support the following pins.

- UART pin: RxDn / TxDn
- Input pin for Timer: TI0n

n is the channel number used by the corresponding resource.

2.2 Software Requirements

This driver depends on the following modules.

- Board Support Package (r_bsp) v1.61 or later

In addition, the following API functions of r_bsp must be enabled, which can be configured from the Software Component Settings screen on the Smart Configurator.

- R_BSP_GetFclkFreqHz

  (BSP_CFG_GET_FREQ_API_FUNCTIONS_DISABLE = 0)

Configurations	
Start up select	Enable (use BSP startup)
Control of illicit memory access detection(IAWEN)	Disable
Protected area in the RAM(GRAM0-1)	Disabled
Protection of the port control registers(GPORT)	Disabled
Protection of the interrupt control registers(GINT)	Disabled
Protection of the clock, voltage detector, and RAM parity error detection control regi	Disabled
Data flash memory area/extra area access control(DFLEN)	Disables
Initialization of peripheral functions by Code Generator/Smart Configurator	Enable
API functions disable(R_BSP_StartClock, R_BSP_StopClock)	Disable
API functions disable(R_BSP_GetFclkFreqHz)	Enable
API functions disable(R_BSP_SetClockSource)	Disable

Figure 2-1 Smart Configurator BSP setting

2.3 Supported Tool Chains

This module has been tested with the following toolchains.

- Renesas CC-RL Toolchain v1.12.01
- IAR Embedded Workbench for Renesas RL78 v5.10.3

2.4 Header files

API calls and I/F definitions used are described in "r_dmxrdrv_api.h".

2.5 Integer Type

This driver uses ANSI C99. These types are defined in "stdint.h".

2.6 Code Size

ROM and RAM sizes increase or decrease depending on the settings on the Smart Configurator and compiler option settings. Here, the sizes are given for reference when the settings on the Smart Configurator are the default settings and the compile options on the CC-RL compiler are set to the default settings.

ROM : 850 [byte]
RAM : 554 [byte]

3. Configuration Specifications

A list of configuration items that can be set in the Smart Configurator is shown below.

Table 3-1 DMX512 Receive Driver setting items list

Item	Possible values	Description
Number of receive device	1~4	Select the number of receiving devices to be controlled.
Start address of receive device 1	1~512	Set the starting address of device 1.
Start address of receive device 2	1~512	Set the starting address of device 2.
Start address of receive device 3	1~512	Set the starting address of device 3.
Start address of receive device 4	1~512	Set the starting address of device 4.
Number of channel used by receive device 1	1~16	Sets the number of channels used by device 1.
Number of channel used by receive device 2	1~16	Sets the number of channels used by device 2.
Number of channel used by receive device 3	1~16	Sets the number of channels used by device 3.
Number of channel used by receive device 4	1~16	Sets the number of channels used by device 4.
UART channel	UART0[Note1] UART1 UART2	Select UART resource for DMX512 communication.
Timer resource for input capture	TAU0_0 TAU0_1 TAU0_2 TAU0_3	Select the Timer Source for measuring Break time.
Timer resource for interval timer	TAU0_0 TAU0_1 TAU0_2 TAU0_3	Selects the Timer Source for measuring Receive Timeout.
Interrupt level for INTSR	Level 0(Highest) Level 1 Level 2 Level 3(Lowest)	Selects the interrupt priority for INTSR0 or INTSR1 or INTSR2.
Interrupt level for INTTM by input capture	Level 0(Highest) Level 1 Level 2 Level 3(Lowest)	Selects the interrupt priority for INTTM00 or INTTM01 or INTTM02 or INTTM03.
Interrupt level for INTTM by interval timer	Level 0(Highest) Level 1 Level 2 Level 3(Lowest)	Selects the interrupt priority for INTTM00 or INTTM01 or INTTM02 or INTTM03.
Pin for setting DMX512 Link common[Note2]	Unused, P00~P147	DMX512 Link Sets the terminal to be connected to the Common.

Note1 In Smart Configurator v1.8.0, when using UART channel 0 pins RxD0:P11/TxD0:P12, no pin setting code generation is performed. Please add the code for the pin settings.

Note2 The pin set in this item is set to Low output. To set the Link Common pin Low in a hardware environment, select Unused.

4. API Specification

4.1 API typedef Definitions

This section describes the Typedef definition provided by this module.

4.1.1 st_dmxrdrv_rdata_t

This Typedef defines a data information structure.

```
typedef struct
{
uint8_t     device;                 /* Device number */
uint8_t     length;                 /* Data length */
uint8_t *   p_data;                 /* Pointer to the received data */
} st_dmxrdrv_rdata_t;
```

Description

Used as the argument and return value of the API function "R_DMXRDRV_GetReceiveData". The received data can be acquired by the contents of the member.

(a) device

Device number to be managed.
It is used as an argument.
Be sure to set the device number when calling the function.

(b) length

Number of CHs used by the device associated with the device number.
Used as the return value.

(c) p_data

Address to store DMX communication data.
Used as return value.

4.2 API Function Specifications

This section describes the API function specifications provided by this module.

4.2.1 R_DMXRDRV_Open

This function initializes the module and starts the DMX512 communication feature.

Format

```
void R_DMXRDRV_Open (void)
```

Parameters

None

Return Values

None

Properties

Prototype declared in r_dmxrdrv_api.h.

Description

Initialize the driver layer and start the DMX512 communication feature.

Example

```
/** Start DMX512 communication */
R_DMXRDRV_Open();
```

4.2.2 R_DMXRDRV_Close

This function performs the module shutdown process and terminates the DMX512 communication feature.

Format

```
void R_DMXRDRV_Close (void)
```

Parameters

None

Return Values

None

Properties

Prototype declared in r_dmxrdrv_api.h.

Description

Stop the driver layer and terminate the DMX512 communication feature.

Example

```
/** Terminate DMX512 communication */
R_DMXRDRV_Close();
```

4.2.3 R_DMXRDRV_GetReceiveData

This function gets the received data from the specified content.

Format

```
void R_DMXRDRV_GetReceiveData (st_dmxrdrv_rdata_t * p_info)
```

Parameters

`p_info->device`
Device number from which to obtain data.

Return Values

`p_info->length`
Number of CHs (Slots) used by the specified device.

`p_info->p_data`
First address of received data.

Properties

Prototype declared in r_dmxrdrv_api.h.

Description

The following information is obtained based on the device information set in the smart configuration.

- Number of CHs used by the device.
- First address of received data.

Example

```
static st_dmxrdrv_rdata_t gs_slot_data;

/* specify channel */
gs_slot_data.device = 1;

/* get receive data */
R_DMXRDRV_GetReceiveData(&gs_slot_data);

len = gs_slot_data.length;
if (gs_slot_data.p_data[len-1] >= 0)
{
  . . .
}
```

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http://www.renesas.com/

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr.19.2024	-	First edition issued

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   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time 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 time 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 time 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 time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
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   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 the 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.
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   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is 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. Additionally, 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.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
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