User's Manual

CONFIDENTIAL

RH850/D1x Device Family

Renesas Graphics Library Display Output Comparator (DISCOM) Driver

User's Manual: Software

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by Renesas Electronics Corp. without notice. Please review the latest information published by Renesas Electronics Corp. through various means, including the Renesas Electronics Corp. website (http://www.renesas.com).

Renesas Electronics
www.renesas.com

Rev. 1.0 April 2020

CONFIDENTIAL

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.
   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.
   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

CONFIDENTIAL

Trademark

- Green Hills, the Green Hills logo, INTEGRITY, MULTI, DoubleCheck, EventAnalyzer, Integrate, SuperTrace, ResourceAnalyzer, CodeFactor, INTEGRITY MULTIvisor, GMART, GSTART, G-Cover, PathAnalyzer, GHNet, TimeMachine, µ-velOSity, Padded Cell, TotalDeveloper, and Optimizing Compiler are trademarks or registered trademarks of Green Hills Software in the US and/or internationally.
- This software contains the technology owned by TES Electronic Solutions GmbH. All rights reserved for TES Electronic Solutions GmbH
- Trademarks and trademark symbols (® or ™) are omitted in the text of this manual.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding the functions of DISCOM driver. This manual is written for engineers who use DISCOM driver.

> Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

> The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

Please refer to documents of drivers and hardware for a target system implementing DISCOM as necessary.

The following documents are related documents. Make sure to refer to the latest versions of these documents.

Document Type	Description	Document Title	Document No.
User's manual for Hardware	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and operation description	RH850/D1L/D1M Group User's Manual: Hardware	R01UH0451EJ0220
User's manual for Software	Description of RGL overview	Renesas Graphics Library User's Manual: Software	R01US0181ED0400
	Description of WM	Renesas Graphics Library Window Manager (WM) Driver User's Manual: Software	LLWEB-10035990
	Description of SPEA	Renesas Graphics Library Sprite Engine A (SPEA) Driver User's Manual: Software	LLWEB-10035991
	Description of VDCE	Renesas Graphics Library Video Data Controller E (VDCE) Driver User's Manual: Software	LLWEB-10035992
	Description of VOWE	Renesas Graphics Library Video Output Warping Engine (VOWE) Driver User's Manual: Software	LLWEB-10035993
	Description of JCUA	Renesas Graphics Library JPEG Codec Unit A (JCUA) Driver User's Manual: Software	LLWEB-10035994
	Description of SFMA	Renesas Graphics Library Serial Flash Memory Interface A (SFMA) Driver User's Manual: Software	LLWEB-10064753
	Description of HYPB	Renesas Graphics Library HyperBus Controller (HYPB) Driver User's Manual: Software	LLWEB-10064754
	Description of OCTA	Renesas Graphics Library OctaBus Controller (OCTA) Driver User's Manual: Software	LLWEB-10064755
	Description of VOCA	Renesas Graphics Library Video Output Checker A (VOCA) Driver User's Manual: Software	LLWEB-10063801

	Description of DISCOM	Renesas Graphics Library Display Output Comparator (DISCOM) Driver User's Manual: Software	LLWEB-10063802 (This manual)
	Description of DRW2D	Renesas Graphics Library 2D Graphics (DRW2D) Driver User's Manual: Software	LLWEB-10059472
Porting Layer Guide	Description of porting layer of RGL	Renesas Graphics Library Porting Layer Guide	LLWEB-10035995

2. Notation of Numbers and Symbols

This manual uses the following notation.

Binary	0bXXXXXXXX	(X=0 or 1)
Decimal	XXX	(X=0-9)
Hex	0xXXXXXXXX	(X=0-9,A-F)

3. List of Abbreviations and Acronyms

Abbreviation	Full Form
API	Application Programming Interface
CRC	Cyclic Redundancy Check.
DISCOM	Display Output Comparator
ECM	Error Control Module
H/W	Hardware
VDCE	Video Data Controller E. This is H/W, which controls video input, image synthesis and video output.
VOCA	Video Output Checker A

All trademarks and registered trademarks are the property of their respective owners.

1.1 Table of Contents

1. Overview 3
1.1 Feature and Scope 3
1.2 Component Structure 3

2. Basic Specification 4
2.1 Summary Specification 4
2.2 Reserved Word 4
2.3 Interrupt Handler List 5
2.4 Error Handling 6
2.4.1 Return code 6
2.4.1.1 Parameter level 6
2.4.1.2 Timing level 6
2.4.1.3 System level 6
2.4.1.4 Hardware level 6
2.5 State Transition 7

3. Function Description 9
3.1 Fundamental Concepts 9
3.1.1 DISCOM unit 9
3.1.2 Target comparison data 9
3.1.3 Pixel Format 10
3.1.4 CRC Calculation method 10
3.2 Using the API 11
3.2.1 Initialization / De-Initialization 11
3.2.2 Rectangular Area 11
3.2.3 Expected CRC code 11
3.2.4 The Display Output Comparison Enable / Disable 11
3.3 Device difference 12
3.4 Header File List 12

4. Functions 13
4.1 Function List 13
4.2 DISCOM API Functions 14
4.2.1 Basic functions 14
4.2.1.1 R_DISCOM_Init 14
4.2.1.2 R_DISCOM_DeInit 16
4.2.1.3 R_DISCOM_ErrorCallbackSet 18
4.2.1.4 R_DISCOM_ParamSet 20
4.2.1.5 R_DISCOM_Enable 22
4.2.1.6 R_DISCOM_Disable 24
4.2.1.7 R_DISCOM_StatusGet 26
4.2.1.8 R_DISCOM_StatusClear 28
4.2.1.9 R_DISCOM_CrcSet 30
4.2.1.10 R_DISCOM_CrcGet 32
4.2.1.11 R_DISCOM_VersionStringGet 34
4.2.1.12 R_DISCOM_MacroVersionGet 35
4.2.2 Interrupt functions 36
4.2.2.1 R_DISCOM_IntEnable 36
4.2.2.2 R_DISCOM_IntDisable 38

5. Types 40
5.1 Basic Types 40
5.2 Definition 40

5.3 Enumerated Type 41
5.3.1 r_discom_Error_t 41
5.3.2 r_discom_Alpha_t 42
5.4 Structure Type 43
5.4.1 r_discom_Param_t 43

2.Overview

2.1 Feature and Scope

The DISCOM driver checks whether the data output from the VDCE agrees with the expected graphics data.
The DISCOM driver is only available for the RH850/D1Mx RGL package.

2.2 Component Structure

The component structure of DISCOM is shown in ***Figure 2-1.***

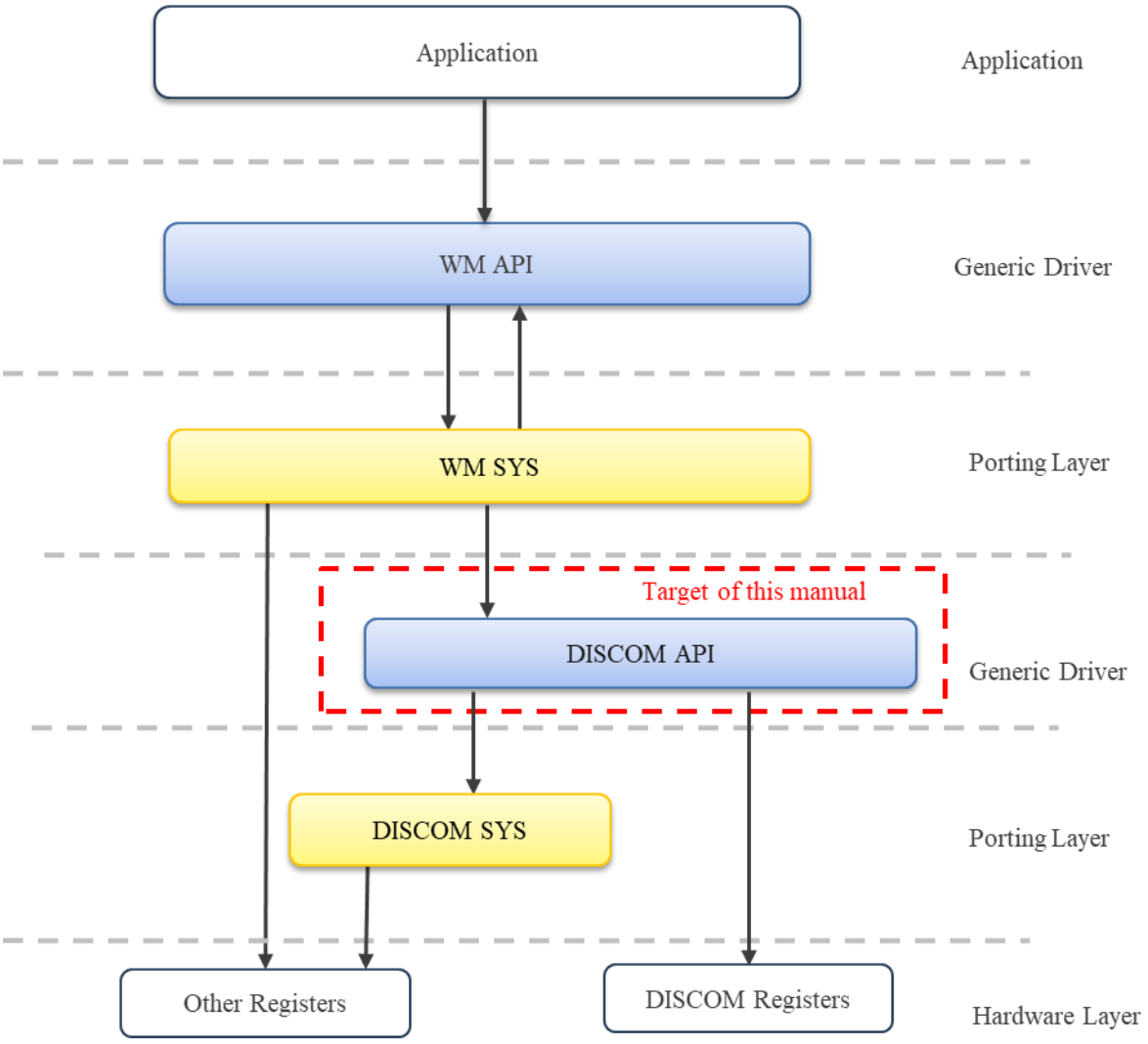

Figure 2-1 Component Structure

For the details of the API, please refer to ***Chapter 4.***

3.Basic Specification

3.1 Summary Specification

The summary of specification is described in *Table 3-1.*

Table 3-1 Summary Specification

Items	Description
Target LSI	RH850/D1M1(H), RH850/D1M1-V2, RH850/D1M1A, RH850/D1M2(H)
Main Feature	• The CRC code of the graphics data obtained after alpha blending in the graphics display module can be compared with the expected CRC code. • The rectangular area can be specified based on the graphics data output from the graphics display module and its CRC code can be compared with the expected CRC code. • Pixel format: 32-bit ARGB888 with fixed A = FF_H • CRC is calculated from most significant byte (MSB) to least significant byte (LSB)
Semaphore / Mutex	N/A. This can be implemented with porting layer.
Interrupts	Interrupts can be obtained via ECM. For more details please see *section 3.3*.

3.2 Reserved Word

DISCOM uses the following prefixes for avoiding confusion from other software. Prefixes of DISCOM is described in *Table 3-2.*

Table 3-2 Prefixes

Prefix	Description
R_DISCOM_*	Prefix for DISCOM Module
r_discom_*	

3.3 Interrupt Handler List

The DISCOM interrupts are notified via the Error Control Module (ECM).
The DISCOM interrupts are logically OR combined with VOCA interrupt outputs and input to INTVOCAERR of the ECM.

Table 3-3 Interrupt Handler List

No.	Interrupt Name	Description
(1)	INTVOCAERR	Logically OR combination of VOCA and DISCOM error signals.

3.4 Error Handling

3.4.1 Return code

DISCOM driver has 4 types of error codes.

3.4.1.1 Parameter level

Following errors occur by a cause such as abnormality of parameter. In this case, please set valid parameter again.

- R_DISCOM_ERR_PARAM_INCORRECT
- R_DISCOM_ERR_RANGE_UNIT
- R_DISCOM_ERR_RANGE_PARAM

3.4.1.2 Timing level

Following errors occur by a cause such as abnormality of execution timing. In this case, please call again after changing to valid state or timing.

- R_DISCOM_ERR_NOT_ACCEPTABLE

3.4.1.3 System level

Following errors occur by a cause such as OS dependent error (e.g. system call error, resource shortage). In this case, please do recovery processing from a system layer, because this status cannot be restored only in this library.

- R_DISCOM_ERR_FATAL_OS

3.4.1.4 Hardware level

Following errors occur when unexpected error occurs internally. In this case, please reset the RH850/D1x device.

- R_DISCOM_ERR_FATAL_HW

3.5 State Transition

Each DISCOM unit has following status.

Table 3-4 DISCOM unit State Details

No.	State Name	Description
(1)	Uninitialized	Specifies that the DISCOM driver is not initialized.
(2)	Initialized	Specifies that the DISCOM driver is initialized.
(3)	Idle	Specifies that the configuration for CRC compare has been set.
(4)	Executing	Specifies that CRC compare operation is enabled.

The image describes state transition.

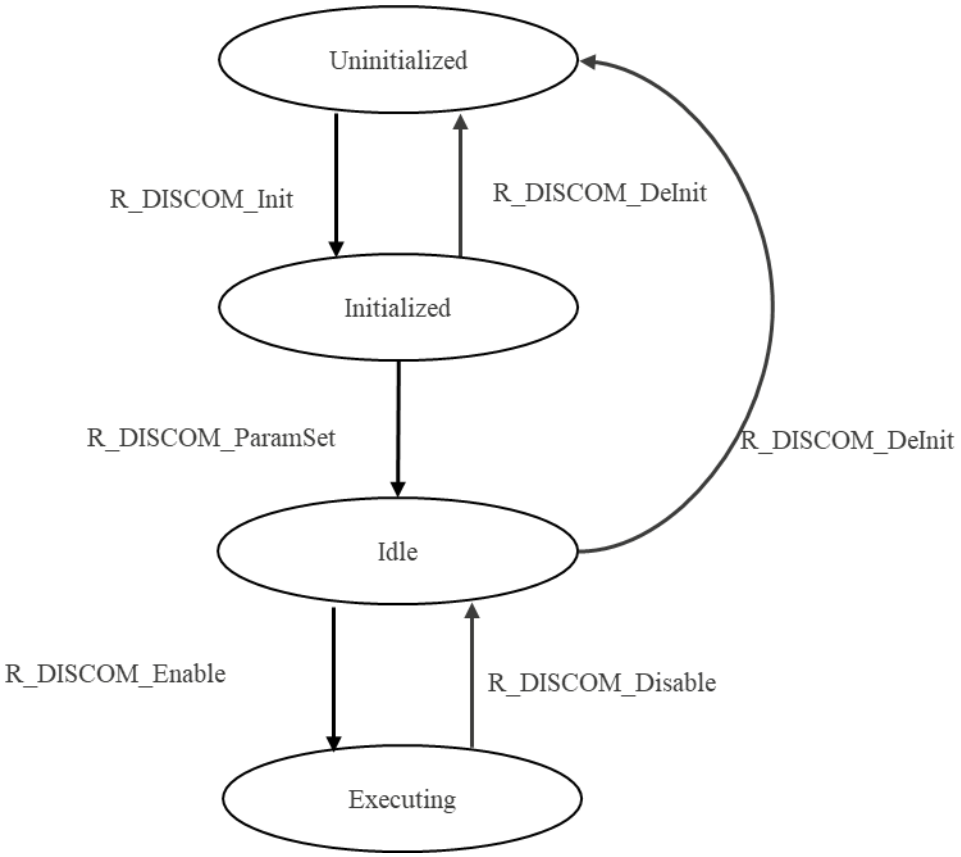

Figure 3-1 State Transition Diagram of DISCOM driver

Table 3-5 State Transition Table of DISCOM unit

Function Name	State			
	Uninitialized	Initialized	Idle	Executing
R_DISCOM_Init	OK	NG	NG	NG
R_DISCOM_DeInit	OK	OK	OK	NG
R_DISCOM_ErrorCallbackSet	NG	OK	OK	OK
R_DISCOM_ParamSet	NG	OK	OK	NG
R_DISCOM_Enable	NG	NG	OK	OK
R_DISCOM_Disable	NG	OK	OK	OK
R_DISCOM_StatusGet	NG	OK	OK	OK
R_DISCOM_StatusClear	NG	OK	OK	OK
R_DISCOM_CrcSet	NG	OK	OK	OK
R_DISCOM_CrcGet	NG	OK	OK	OK
R_DISCOM_VersionStringGet	OK	OK	OK	OK
R_DISCOM_MacroVersionGet	OK	OK	OK	OK
R_DISCOM_IntEnable	NG	OK	OK	OK
R_DISCOM_IntDisable	NG	OK	OK	OK

4.Function Description

4.1 Fundamental Concepts

4.1.1 DISCOM unit

RH850/D1x device has the following number of units of the DISCOM.

Table 4-1 Number of units

Feature	RH850/D1x Device Name		
	D1L2(H)	D1M1(H), D1M1-V2	D1M1A, D1M2(H)
DISCOM Units	0	2	4
Unit indexes	None	DISCOM0 to DISCOM1	DISCOM0 to DISCOM3

Almost DISCOM API functions have the argument “Unit”.
User specifies the DISCOM H/W unit number to be controlled. The range is 0 to 3.

4.1.2 Target comparison data

The DISCOM compares the CRC code of the data output in the arbitrary rectangular area of graphics data and the pre-calculated CRC code of the expected graphics data. The timing of the data to compared can check after alpha blending.

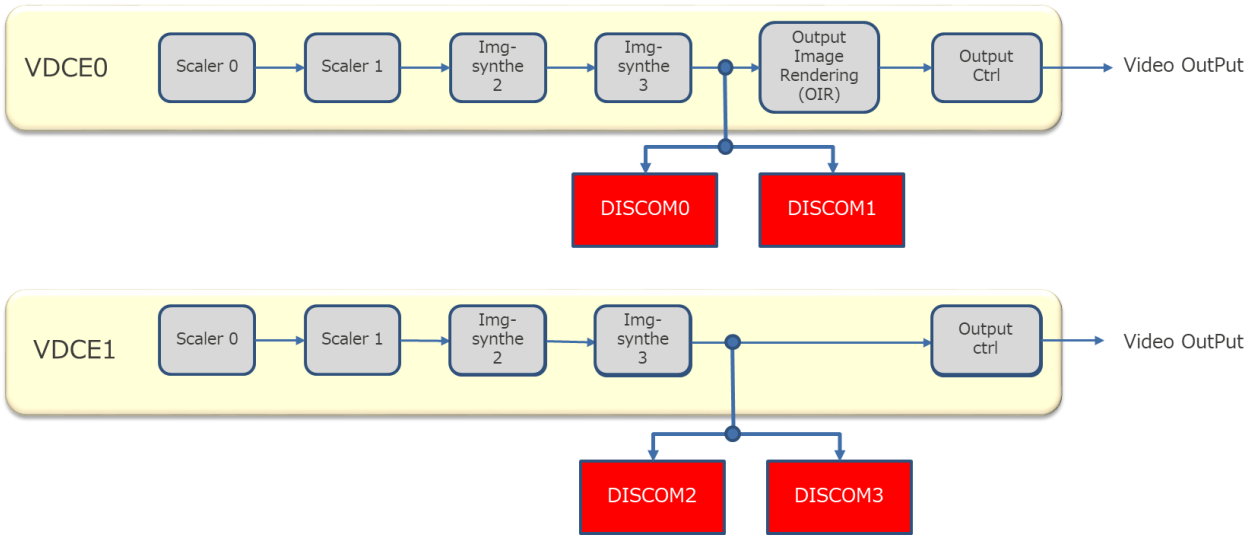

Figure 4-1 Target comparison data

4.1.3 Pixel Format

The pixel format of arbitrary rectangular area of the selected graphics data sets only 32-bit ARGB8888 (A=0xFF fixed).

4.1.4 CRC Calculation method

The DISCOM gets the result of the CRC code. The CRC code is generated a 32-bit CRC code by using the following CRC polynomial (IEEE802.3).

$$x^{32}+ x^{26}+ x^{23}+ x^{22}+ x^{16}+ x^{12}+ x^{11}+ x^{10}+ x^{8}+ x^{7}+ x^{5}+ x^{4}+ x^{2}+ x+1$$

CRC is sequentially calculated beginning with LSB in pixel units.
It is calculated in units of 32 bits.
The initialization value of CRC code is 0xFFFFFFFF.

4.2 Using the API

4.2.1 Initialization / De-Initialization

R_DISCOM_Init initializes the driver and the hardware as far as necessary. The Unit parameter holds a number that specifies the DISCOM unit number being initialized. This function initializes the Error Callback function. R_DISCOM_DeInit function de-initializes the driver and the hardware as far as necessary.

4.2.2 Rectangular Area

The R_DISCOM_ParamSet sets the start position, the size and the alpha value of the rectangular area for which the CRC code is calculated in r_discom_Param_t structure.

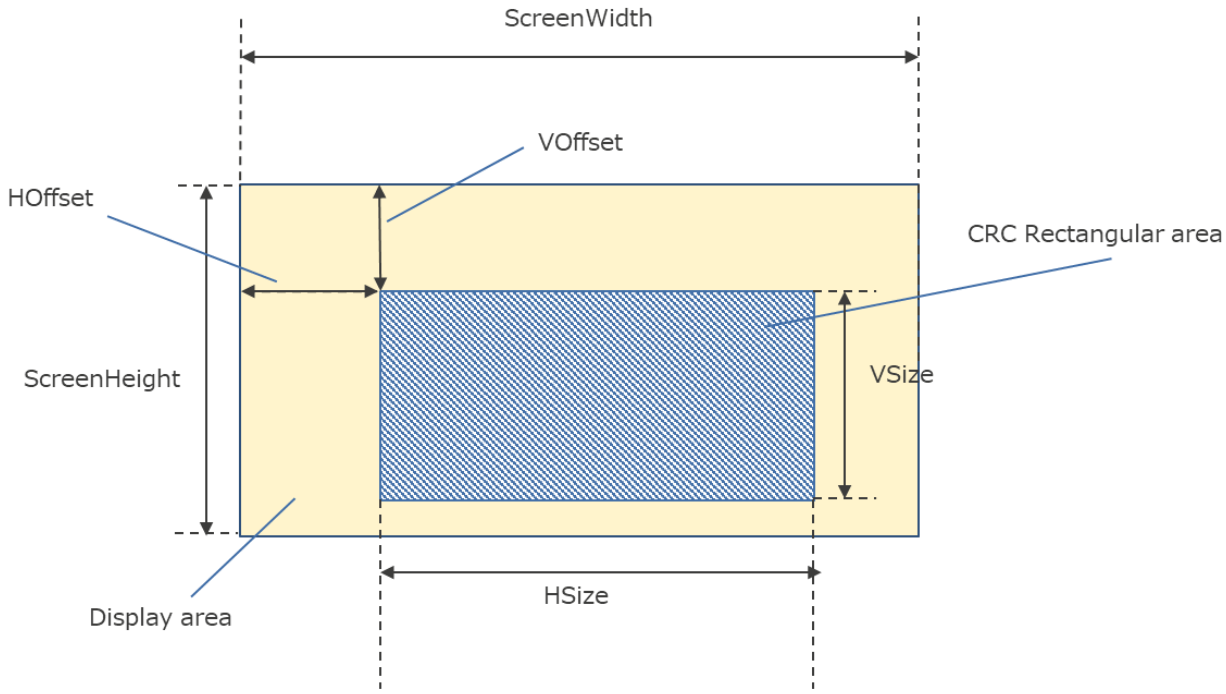

Figure 4-2 Rectangular Area

4.2.3 Expected CRC code

R_DISCOM_CrcSet specifies the pre-calculated expected CRC code value.
See *4.1.4* about CRC Calculation method.

4.2.4 The Display Output Comparison Enable / Disable

R_DISCOM_Enable calculates the CRC code of the arbitrary rectangular area of graphics data and compares with the pre-calculated expected CRC code value.
The result of CRC code comparison can be got by using R_DISCOM_StatusGet.
R_DISCOM_Disable ends the display output calculation and comparison.

4.3 Device difference

The following table shows the function differences depending on the device.

Table 4-2 APIs supported by DISCOM driver

Feature	RH850/D1x Device Name	
	D1L2(H)	D1M1(H), D1M1-V2, D1M1A, D1M2(H)
All API of DISCOM driver	No	Full

The following table shows units difference depending on the device.

Table 4-3 Units

Feature	RH850/D1x Device Name	
	D1M1(H), D1M1-V2	D1M1A, D1M2(H)
DISCOM Units	2	4
Unit indexes	DISCOM0 to DISCOM1	DISCOM0 to DISCOM3

4.4 Header File List

Table 4-4 Header File List

No.	Header File Name	Description
(1)	r_discom_api.h	Header file for DISCOM API.
(2)	r_typedefs.h	Header file for predefined data types.

5.Functions

5.1 Function List

This section describes about the DISCOM API functions which are in *Table 5-1* and executable state of each function is described in the specification of each function.

Table 5-1 List of DISCOM API Functions

Function Name	Purpose
R_DISCOM_Init	This function initializes the driver and the hardware as far as necessary.
R_DISCOM_DeInit	This function de initializes the driver and the hardware.
R_DISCOM_ErrorCallbackSet	This function de initializes the driver and the hardware.
R_DISCOM_ParamSet	This function sets the information of DISCOM configuration parameters.
R_DISCOM_Enable	This function enables the display output comparison start.
R_DISCOM_Disable	This function disables the display output comparison start.
R_DISCOM_StatusGet	This function gets the compare result of the CRC code.
R_DISCOM_StatusClear	This function clears the compare result of the CRC code.
R_DISCOM_CrcSet	This function sets the expectation value of the CRC code.
R_DISCOM_CrcGet	This function gets the current value of the CRC code.
R_DISCOM_VersionStringGet	This function returns the version string of this DISCOM driver.
R_DISCOM_MacroVersionGet	This function returns the major and minor version of the H/W macro.
R_DISCOM_IntEnable	This function enables the specified DISCOM interrupt.
R_DISCOM_IntDisable	This function disables the specified DISCOM interrupt.

5.2 DISCOM API Functions

This chapter describes the application interface functions, which are required for general use of the driver.

5.2.1 Basic functions

The section describes driver functions, which are required for general use of the driver, but which are related to a specific functionality of the macro itself.

5.2.1.1 R_DISCOM_Init

Function Prototypes

```
r_discom_Error_t R_DISCOM_Init(const uint32_t     Unit)
```

Input Parameter

Table 5-2 Input parameter of R_DISCOM_Init

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_DISCOM_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function initializes the driver and the hardware as far as necessary.
DISCOM unit status will become Initialized state after the execution of this function.

Reentrancy

Non-reentrant
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.2 R_DISCOM_DeInit

Function Prototypes

```
r_discom_Error_t R_DISCOM_DeInit(const uint32_t        Unit)
```

Input Parameter

Table 5-3 Input parameter of R_DISCOM_DeInit

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function de-initializes the driver and the hardware.
DISCOM unit status will become Uninitialized state after executing this function.
If DISCOM unit is already de-initialized status, this function does nothing and returns R_DISCOM_ERR_OK

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.3 R_DISCOM_ErrorCallbackSet

Function Prototypes

```
r_discom_Error_t R_DISCOM_ErrorCallbackSet (const uint32_t Unit,
                            void(*const ErrorCallback)(const uint32_t         Unit,
                                                       const r_discom_Error_t Error))
```

Input Parameter

Table 5-4 Input parameter of R_DISCOM_ErrorCallbackSet

Parameter	Description
Unit	Specifies the DISCOM unit number.
ErrorCallback	Specifies a function that is called in case an error occurred. Set R_NULL if callback is uninstalled.

Table 5-5 Output parameter of R_DISCOM_ErrorCallbackSet

Parameter	Description
Unit	DISCOM unit number where the error occurred.
Error	Error type.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK - No error occurred.
R_DISCOM_ERR_NOT_ACCEPTABLE - A function was called in an incorrect state.
R_VDCE_ERR_FATAL_OS - Fatal error has occurred at OS interface.

Description

This function sets a callback function that is called in case of an error.
Error notified in this callback can be checked also by return value of each API function, so use of callback is not mandatory. The error callback is global for all DISCOM units.
The error callback is notified during the DISCOM unit is not Uninitialized state.
The installed error callback can be uninstalled by R_NULL setting in this function. And all DISCOM units are de-initialized by R_DISCOM_DeInit, the callback is also uninstalled.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.4 R_DISCOM_ParamSet

Function Prototypes

```
r_discom_Error_t R_DISCOM_ParamSet(const uint32_t                Unit,
                                   const r_discom_Param_t  *const Param)
```

Input Parameter

Table 5-6 Input parameter of R_DISCOM_ParamSet

Parameter	Description
Unit	Specifies the DISCOM unit number.
Param	Specifies the DISCOM configuration parameter.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_RANGE_PARAM	- A parameter was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_DISCOM_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function sets the information of DISCOM configuration parameters.
This function returns R_DISCOM_ERR_OK if successful.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t
r_discom_Param_t

5.2.1.5 R_DISCOM_Enable

Function Prototypes

```
r_discom_Error_t R_DISCOM_Enable(const uint32_t      Unit)
```

Input Parameter

Table 5-7 Input parameter of R_DISCOM_Enable

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function enables the display output comparison start.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.
DISCOM unit status will become Executing state after the execution of this function.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.6 R_DISCOM_Disable

Function Prototypes

```
r_discom_Error_t R_DISCOM_Disable(const uint32_t      Unit)
```

Input Parameter

Table 5-8 Input parameter of R_DISCOM_Disable

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function disables the display output comparison.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.
DISCOM unit status will become Idle state after the execution of this function.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.7 R_DISCOM_StatusGet

Function Prototypes

```
r_discom_Error_t R_DISCOM_StatusGet(const uint32_t      Unit,
                                    uint32_t     *const State)
```

Input Parameter

Table 5-9 Input parameter of R_DISCOM_StatusGet

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

Table 5-10 Output parameter of R_DISCOM_StatusGet

Parameter	Description
State	Specified the pointer to the compare result of the CRC code. 0 : Compared CRC codes match. 1 : Compared CRC codes do not match

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function gets the compare result of the CRC code.
The compare result of the CRC code can be got after the end of the valid period of Display area.
See RH850/D1L/D1M Group User's Manual: Hardware for the detail about the timing of the compare result of the CRC code.

Reentrancy

Reentrant.

Sync/Async

Synchronous

Call from Interrupt

Permitted.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.8 R_DISCOM_StatusClear

Function Prototypes

```
r_discom_Error_t R_DISCOM_StatusClear(const uint32_t      Unit)
```

Input Parameter

Table 5-11 Input parameter of R_DISCOM_StatusClear

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_DISCOM_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function clears the compare result of the CRC code.
This function processes the error interrupt factor of DISCOM.

Reentrancy

Non-reentrant.
This function doesn't call R_DISCOM_Sys_Lock and R_DISCOM_Sys_Unlock.
User should control not to re-enter the same DISCOM unit.

Sync/Async

Synchronous

Call from Interrupt

Permitted.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.9 R_DISCOM_CrcSet

Function Prototypes

```
r_discom_Error_t R_DISCOM_CrcSet(const uint32_t      Unit,
                                 const uint32_t      Crc,
                                 const uint32_t      Flags)
```

Input Parameter

Table 5-12 Input parameter of R_DISCOM_CrcSet

Parameter	Description
Unit	Specifies the DISCOM unit number.
Crc	Specifies the Expected CRC code value of the selected graphics data of rectangular area.
Flags	It specifies the Display Output comparison period flags. See *Table 6-3.*

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_DISCOM_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function sets the expectation value of the CRC code.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.
See *4.1.4* about CRC Calculation method.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.10 R_DISCOM_CrcGet

Function Prototypes

```
r_discom_Error_t R_DISCOM_CrcGet(const uint32_t      Unit,
                                 uint32_t     *const Crc)
```

Input Parameter

Table 5-13 Input parameter of R_DISCOM_CrcGet

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

Table 5-14 Output parameter of R_DISCOM_CrcGet

Parameter	Description
Crc	Specified the pointer to the current CRC code value of the selected graphics data of rectangular area.

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function gets the current value of the CRC code.
The current value of the CRC code can be got after the end of the valid period of Display area.
See RH850/D1L/D1M Group User's Manual: Hardware for the detail about the timing of CRC calculation.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.

Reentrancy

Reentrant.

Sync/Async

Synchronous

Call from Interrupt

Permitted.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.1.11 R_DISCOM_VersionStringGet

Function Prototypes

```
const uint8_t *R_DISCOM_VersionStringGet(void)
```

Input Parameter

None

Input-Output Parameter

None

Output Parameter

None

Return Codes

Version string.

Description

This function returns version string of the DISCOM driver.

Reentrancy

Reentrant.

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

None

5.2.1.12 R_DISCOM_MacroVersionGet

Function Prototypes

```
r_discom_Error_t R_DISCOM_MacroVersionGet(uint32_t *const Major,
                                          uint32_t *const Minor)
```

Input Parameter

None

Input -Output Parameter

None

Output Parameter

Table 5-15 Output parameter of R_DISCOM_MacroVersionGet

Parameter	Description
Major	The major version.
Minor	The minor version.

Return Codes

R_DISCOM_ERR_OK	- No error has occurred.
R_DISCOM_ERR_PARAM_INCORRECT	- Either parameter Major or parameter Minor was R_NULL

Description

This function returns the major and minor version of the H/W macro.
If a callback function is installed with the R_DISCOM_ErrorCallbackSet function, errors is notified to Unit0.

Reentrancy

Reentrant**.**

Sync/Async

Synchronous

Call from Interrupt

Prohibited**.**

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.2 Interrupt functions

5.2.2.1 R_DISCOM_IntEnable

Function Prototypes

```
r_discom_Error_t R_DISCOM_IntEnable(const uint32_t            Unit)
```

Input Parameter

Table 5-16 Input parameter of R_DISCOM_IntEnable

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function enables DISCOM interrupt.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

5.2.2.2 R_DISCOM_IntDisable

Function Prototypes

```
r_discom_Error_t R_DISCOM_IntDisable(const uint32_t            Unit)
```

Input Parameter

Table 5-17 Input parameter of R_DISCOM_IntDisable

Parameter	Description
Unit	Specifies the DISCOM unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_DISCOM_ERR_OK	- No error occurred.
R_DISCOM_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_DISCOM_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_DISCOM_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function disables DISCOM interrupt.
If the function successfully executes, the return code will be R_DISCOM_ERR_OK.

Reentrancy

Non-reentrant as default.
If user implements following functions to prevent multiple executions, this function will become re-entrant.

- R_DISCOM_Sys_Lock
- R_DISCOM_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 3-5*** about DISCOM unit status conditions.

See also

r_discom_Error_t

6.Types

6.1 Basic Types

This section shows the basic types used on this library.

Table 6-1 Basic type

Types	Definition		Basic types
char_t	typedef char	char_t	signed char
int8_t	typedef signed char	int8_t	signed char
int16_t	typedef signed short	int16_t	signed short
int32_t	typedef signed int	int32_t	signed int
int64_t	typedef signed long long	int64_t	signed long long
uint8_t	typedef unsigned char	uint8_t	unsigned char
uint16_t	typedef unsigned short	uint16_t	unsigned short
uint32_t	typedef unsigned int	uint32_t	unsigned int
uint64_t	typedef unsigned long long	uint64_t	unsigned long long
float32_t	typedef float	float32_t	float
float64_t	typedef double	float64_t	double

6.2 Definition

This section shows the definitions used in DISCOM API.

6.2.1 API Version

This constant is the value which shows the version information of the VOCA driver.

Table 6-2 Definition of DISCOM API

Name	Description
R_DISCOM_VERSION_HI	MSB byte of the version information. It is major version information. This value is changed with release version.
R_DISCOM_VERSION_LO	LSB byte of the version information. It is miner version information. This value is changed with release version.

6.2.2 Comparison period

This constant is the value which shows the Display Output comparison period.

Table 6-3 Definition of Display Output comparison period

Name	Description
R_DISCOM_PERIOD_FRAME	Flame CRC calculation period.
R_DISCOM_PERIOD_VBLANK	Vertical blanking period.

6.3 Enumerated Type

This section shows the enumerated types used in DISCOM API Function.

6.3.1 r_discom_Error_t

Description

DISCOM driver error code.
If an error occurs, these enumerations give information about the reason.

Definition

```
typedef enum
{
    R_DISCOM_ERR_OK = 0,
    R_DISCOM_ERR_PARAM_INCORRECT,
    R_DISCOM_ERR_RANGE_UNIT,
    R_DISCOM_ERR_RANGE_PARAM,
    R_DISCOM_ERR_NOT_ACCEPTABLE,
    R_DISCOM_ERR_FATAL_OS,
    R_DISCOM_ERR_FATAL_HW,
    R_DISMIM_ERR_LAST
} r_discom_Error_t;
```

Table 6-4 Enumerator of r_discom_Error_t

Name	Description
R_DISCOM_ERR_OK	No error occurred.
R_DISCOM_ERR_PARAM_INCORRECT	A parameter provided to a function was incorrect.
R_DISCOM_ERR_RANGE_UNIT	The unit-number was outside the range.
R_DISCOM_ERR_RANGE_PARAM	Parameter is the outside the range.
R_DISCOM_ERR_NOT_ACCEPTABLE	A function was called in an incorrect state.
R_DISCOM_ERR_FATAL_OS	Fatal error has occurred at OS interface.
R_DISCOM_ERR_FATAL_HW	Fatal error has occurred at H/W.

See also

None

6.3.2 r_discom_Alpha_t

Description

The alpha value which is used for CRC code comparison.

Definition

```
typedef enum
{
    R_DISCOM_ALPHA_DEFAULT = 0,
} r_discom_Alpha_t;
```

Table 6-5 Enumerator of r_discom_Alpha_t

Name	Description
R_DISCOM_ALPHA_DEFAULT	Display Out Comparison default alpha value use

See also

None

6.4 Structure Type

This section shows the structure used in DISCOM API Function.

6.4.1 r_discom_Param_t

Description

The type describes the DISCOM configuration parameter information.

Definition

```
typedef struct
{
    uint16_t HOffset;
    uint16_t VOffset;
    uint16_t HSize;
    uint16_t VSize;
    r_discom_Alpha_t AlphaMode;
    uint8_t  Alpha;
} r_discom_Param_t;
```

Table 6-6 Member of r_discom_Param_t

Name	Description
HOffset	Horizontal start position of the rectangular area for which the CRC code is calculated. Range is 0 – 1279. Horizontal start position value should be smaller than 'ScreenWidth'. 'ScreenWidth' is the parameter of R_VDCE_DisplayTimingSet function. See 'RH850/D1x Family Renesas Graphics Library Video Data Controller E (VDCE) Driver' specification.
VOffset	Vertical start position of the rectangular area for which the CRC code is calculated. Range is 0 – 1023. Vertical start position value should be smaller than 'ScreenHeight'. 'ScreenHeight' is the parameter of R_VDCE_DisplayTimingSet function. See 'RH850/D1x Family Renesas Graphics Library Video Data Controller E (VDCE) Driver' specification.
HSize	Horizontal size of the rectangular area for which the CRC code is calculated. Range is 1 – 1280. The value should be set as follows: 'ScreenWidth' >= HOffset+ HSize.
VSize	Vertical size of the rectangular area for which the CRC code is calculated. Range is 1 – 1024. The value should be set as follows: 'ScreenHeight' >= VOffset+ VSize.
AlphaMode	Alpha mode to use.
Alpha	Default alpha value. Specify only '0xFF'.

See also

r_discom_Alpha_t

Revision History	Renesas Graphics Library Display Output Comparator (DISCOM) Driver User's Manual: Software

Rev.	Date	Description	
		Page	Summary
0.1	Oct 11, 2019	-	First edition.
0.2	Nov 22, 2019	16	Added R_DISCOM_ERR_NOT_ACCEPTABLE to Return Codes.
		20	Added the const to arguments.
0.3	Dec 20, 2019	8	Changed "Executing" State transition for R_DISCOM_ParamSet.
		18, 30	Added argument.
		40	Added Definitions for display output comparison timing.
1.0	April 24,2020	9-11	Added traceability ID

Renesas Graphics Library
Display Output Comparator (DISCOM) Driver
User's Manual: Software
Publication Date: Rev.0.1 Oct 11, 2019
Rev.1.0 April 24, 2020

Published by: Renesas Electronics Corporation

SALES OFFICES

Renesas Electronics Corporation

http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics Corporation
TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

Renesas Electronics America Inc. Milpitas Campus
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics America Inc. San Jose Campus
6024 Silver Creek Valley Road, San Jose, CA 95138, USA
Tel: +1-408-284-8200, Fax: +1-408-284-2775

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 101-T01, Floor 1, Building 7, Yard No. 7, 8th Street, Shangdi, Haidian District, Beijing 100085, China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai 200333, China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, #06-02 Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit No 3A-1 Level 3A Tower 8 UOA Business Park, No 1 Jalan Pengaturcara U1/51A, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia
Tel: +60-3-5022-1288, Fax: +60-3-5022-1290

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338

© 2020 Renesas Electronics Corporation. All rights reserved.

Colophon 7.0

ルネサス エレクトロニクス株式会社

■営業お問合せ窓口

http://www.renesas.com

※営業お問合せ窓口の住所は変更になることがあります。最新情報につきましては、弊社ホームページをご覧ください。

ルネサス エレクトロニクス株式会社 〒135-0061 東京都江東区豊洲3-2-24（豊洲フォレシア）

■技術的なお問合せおよび資料のご請求は下記へどうぞ。
総合お問合せ窓口：https://www.renesas.com/contact/

© 2020 Renesas Electronics Corporation. All rights reserved.
Colophon 3.1

Renesas Graphics Library
Display Output Comparator (DISCOM) Driver

Renesas Electronics Corporation