User's Manual

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RH850/D1x Device Family

Renesas Graphics Library
Video Output Checker A (VOCA) Driver
User's Manual: Software

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Rev. 1.0 April 2020

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(Rev.4.0-1 November 2017)

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding the functions of VOCA dirver. This manual is written for engineers who use VOCA 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 VOCA 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 (This manual)

	Description of DISCOM	Renesas Graphics Library Display Output Comparator (DISCOM) Driver User's Manual: Software	LLWEB-10063802
	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
bpp	bit per pixel
CLUT	Color Look Up table
CPU	Central Processing Unit. The microprocessor core of the LSI.
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.

Table of Contents

1.Overview

1.1 Feature and Scope

The VOCA driver checks whether the display content is correctly output by the Video Output.
The VOCA driver is only available for the RH850/D1Mx RGL package.

1.2 Component Structure

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

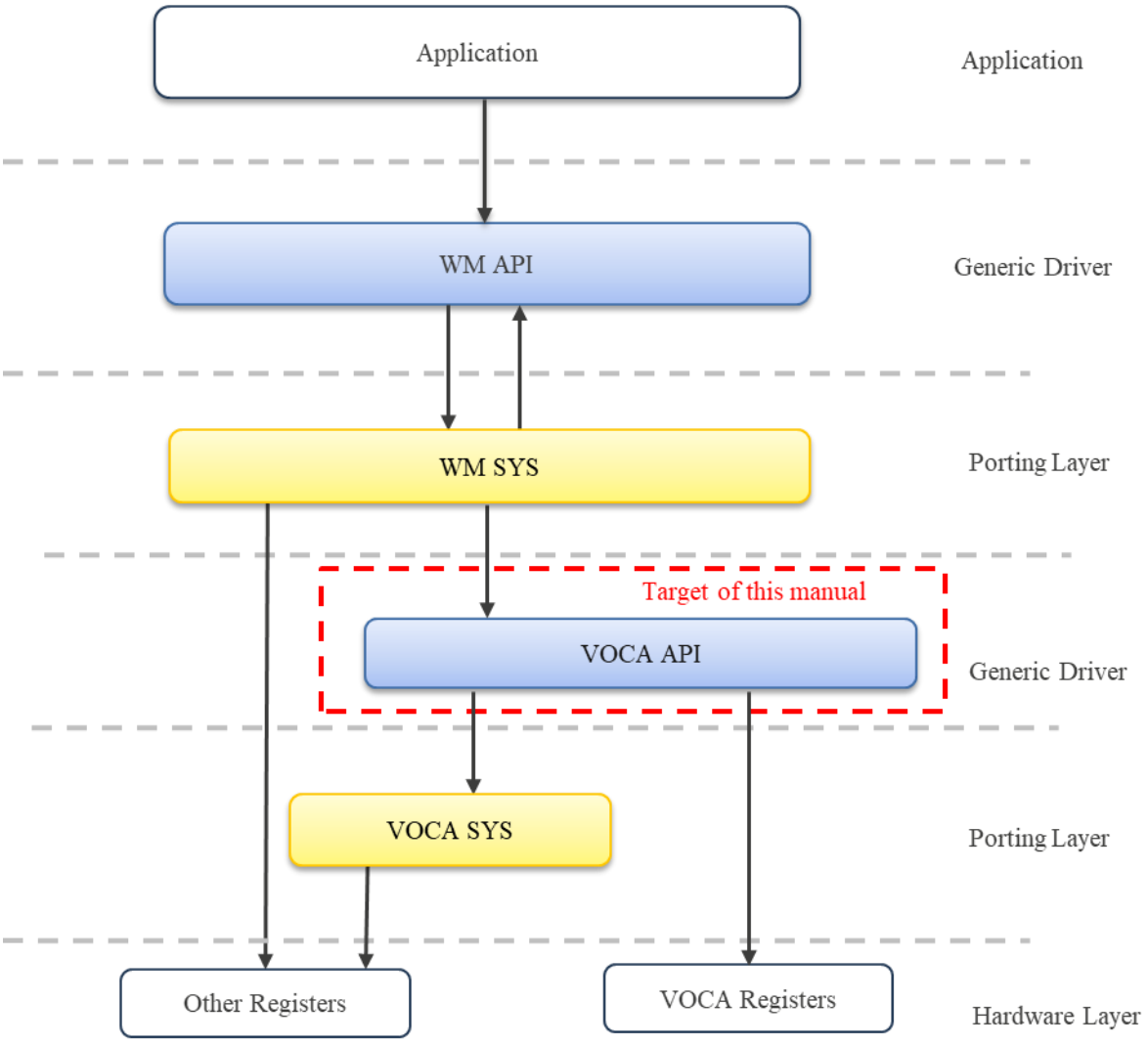


Figure 1-1 Component Structure

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

2.Basic Specification

2.1 Summary Specification

The summary of specification is described in *Table 2-1.*

Table 2-1 Summary Specification

Items	Description
Target LSI	RH850/D1M1(H), RH850/D1M1-V2, RH850/D1M1A, RH850/D1M2(H)
Main Feature	• Total of up to 16 monitored areas • Up to 32,768 pixels in total over all monitored areas • Four programmable reference color ranges for each monitored area • Programmable discriminator threshold for fail/pass decision • Interrupt generation upon – symbol detection mismatch – Activity Monitor • Support both video channels of D1M2(H) and D1M1A devices, that means in particular: – Total of up to 16 monitored areas on both video output screens supported – Different number of monitored areas can be assigned to the video outputs – Activity Monitor supports two separate time windows for the video channels.
Semaphore / Mutex	N/A. This can be implemented with porting layer.
Interrupts	Interrupts can be obtained via ECM. For more details please see *section 2.3*.

2.2 Reserved Word

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

Table 2-2 Prefixes

Prefix	Description
R_VOCA_*	Prefix for VOCA Module
r_voca_*	

2.3 Interrupt Handler List

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

Table 2-3 Interrupt Handler List

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

2.4 Error Handling

2.4.1 Return code

VOCA driver has 4 types of error codes.

2.4.1.1 Parameter level

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

- R_VOCA_ERR_PARAM_INCORRECT
- R_VOCA_ERR_RANGE_UNIT
- R_VOCA_ERR_RANGE_PARAM

2.4.1.2 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_VOCA_ERR_NOT_ACCEPTABLE

2.4.1.3 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_VOCA_ERR_FATAL_OS

2.4.1.4 Hardware level

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

- R_VOCA_ERR_FATAL_HW

2.5 State Transition

Each VOCA unit has following status.

Table 2-4 VOCA unit State Details

No.	State Name	Description
(1)	Uninitialized	Specifies that the VOCA driver is not initialized.
(2)	Initialized	Specifies that the VOCA driver is initialized.
(3)	Idle	Specifies that the configuration for Video Output Monitor area or Activity Monitor has been set.
(4)	Executing	Specifies that Video Output Monitor or Activity Monitor operation is enabled.

The image describes state transition.

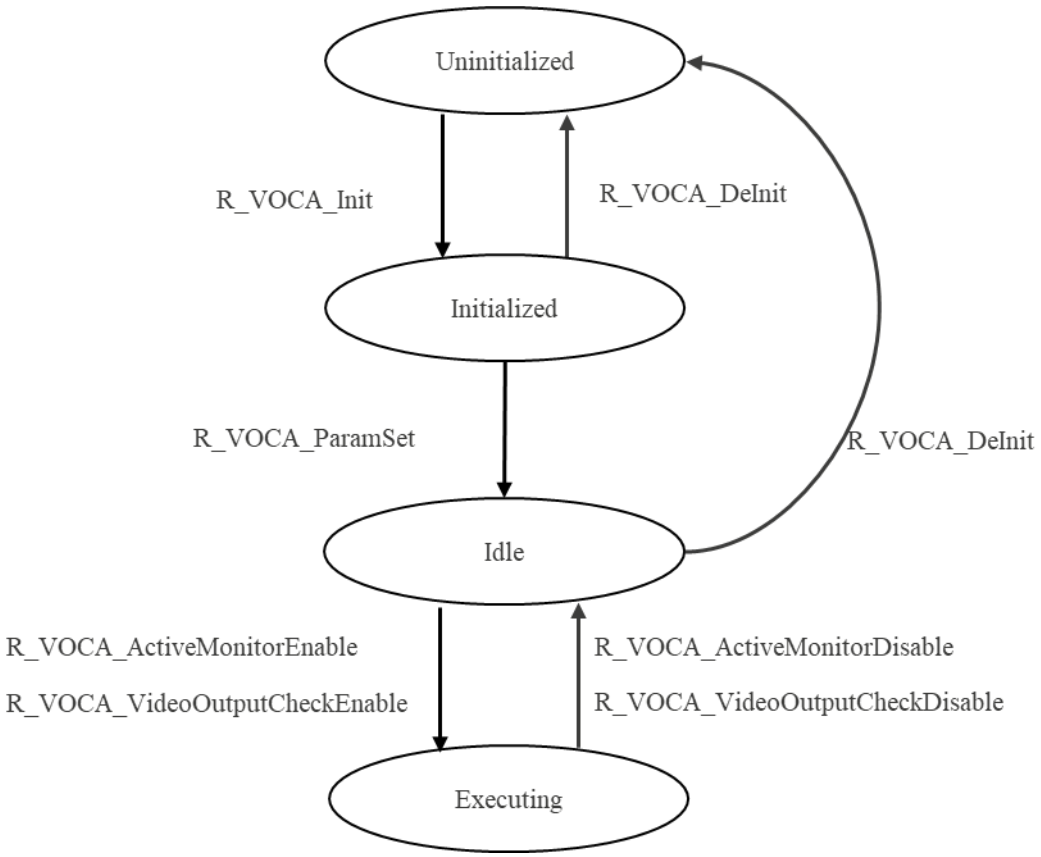


Figure 2-1 State Transition Diagram of VOCA driver

Table 2-5 State Transition Table of VOCA unit

Function Name	State			
	Uninitialized	Initialized	Idle	Executing
R_VOCA_Init	OK	NG	NG	NG
R_VOCA_DeInit	OK	OK	OK	NG
R_VOCA_ErrorCallbackSet	NG	OK	OK	OK
R_VOCA_ParamSet	NG	OK	OK	NG
R_VOCA_ActiveMonitorEnable	NG	NG	OK	OK
R_VOCA_ActiveMonitorDisable	NG	OK	OK	OK
R_VOCA_VideoOutputCheckEnable	NG	NG	OK	OK
R_VOCA_VideoOutputCheckDisable	NG	OK	OK	OK
R_VOCA_StatusGet	NG	OK	OK	OK
R_VOCA_StatusClear	NG	OK	OK	OK
R_VOCA_MonitorAreaSet	NG	OK	OK	OK
R_VOCA_ColorRamSet	NG	OK	OK	OK
R_VOCA_VersionStringGet	OK	OK	OK	OK
R_VOCA_MacroVersionGet	OK	OK	OK	OK
R_VOCA_IntEnable	NG	OK	OK	OK
R_VOCA_IntDisable	NG	OK	OK	OK

3.Function Description

3.1 Fundamental Concepts

3.1.1 VOCA unit

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

Table 3-1 Number of units

Feature	RH850/D1x Device Name	
	D1L2(H)	D1M1(H), D1M1-V2, D1M1A, D1M2(H)
VOCA Units	0	1
Unit indexes	None	VOCA0

Almost VOCA API functions have the argument “Unit”.
User specifies the VOCA H/W unit number to be controlled.

3.1.2 Video channel

RH850/D1x device has the following number of Video channels of the VOCA.
Video channel 0 is VDCE Unit 0 output. Video channel 1 is VDCE Unit 1 output.

Table 3-2 Number of Video channels

Feature	RH850/D1x Device Name	
	D1M1(H), D1M1-V2	D1M1A, D1M2(H)
Video channels	1	2
Video channel indexes	Video channel0	Video channel0, Video channel1

3.1.3 Video Output Monitor

RH850/D1x device has up to 16 monitored area of unit of the VOCA.
In the case of D1M1A and D1M2(H), the Video Output Monitor are up to the total 16 monitored areas on both video output screens.

3.1.4 Video Output Monitoring

VOCA checks the video output image and the reference image for a rectangle area. The check method is discriminator is calculated, which is a measure of the deviation between the output rectangle and its reference. If the discriminator exceeds a certain threshold the video output is judged as incorrect.

The discriminator calculation is calculated as follows.

- The video output is performed on reduced 12-bit RGB444 color format instead of 16-/18-/24-bit color.
- The reference image compares against a reference color range (minimum/maximum reference color component) rather than on a particular 12-bit color reference value.
- The discriminator calculation forms an integral value over all pixels of the entire rectangular area.

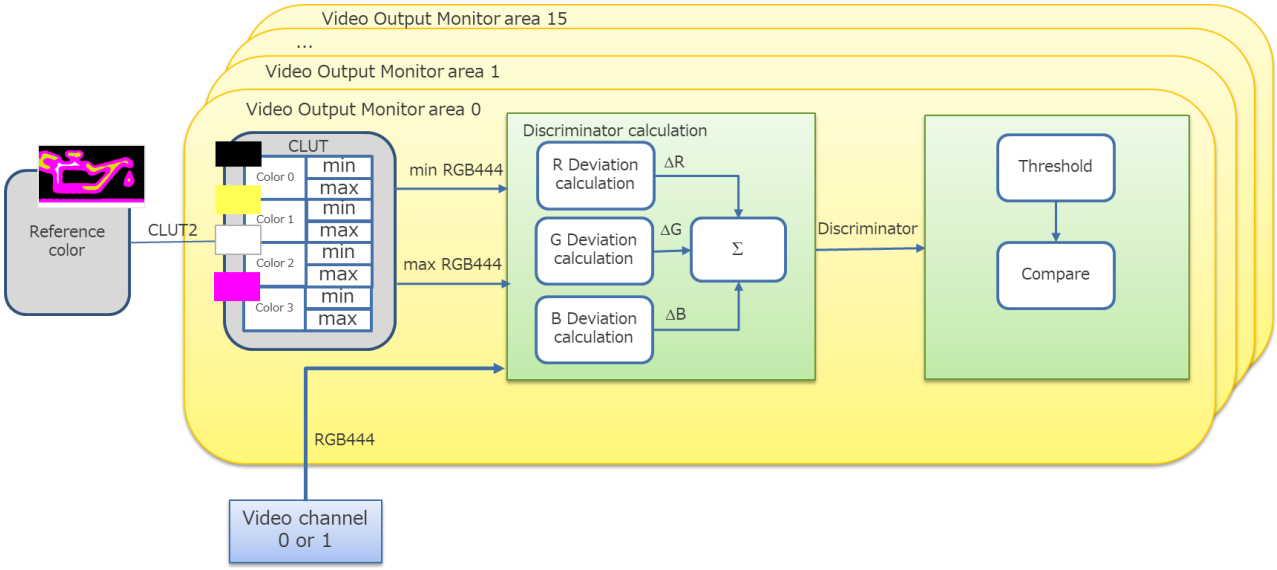


Figure 3-1 Video Output Monitoring

3.1.5 Discriminator calculation

The discriminator value is a sum of deviations ΔR, ΔG, ΔB of the video output pixel color components from the allowed minimum/maximum reference color component range.

Discriminator = Σ (ΔR + ΔG + ΔB)

The following figure shows an example how a discriminator is calculated.

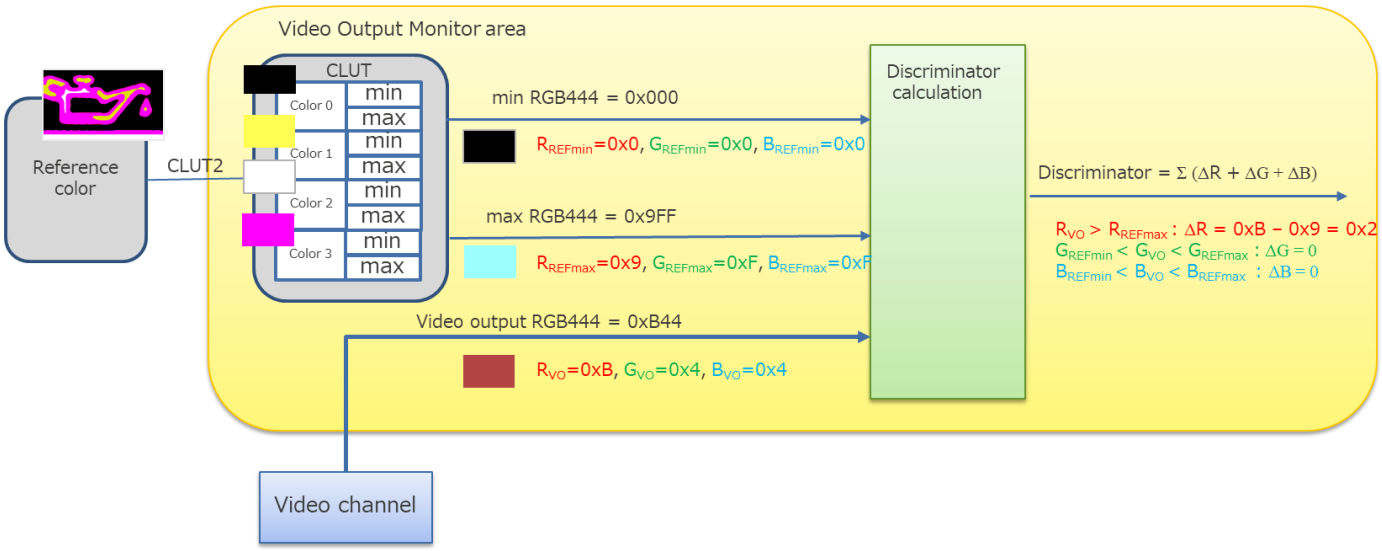


Figure 3-2 Deviation calculation example

3.1.6 Monitoring sequence

VOCA monitors only one Video Output Monitor area for one video output frame. If several Video Output Monitor areas are enabled, the monitoring order follows a fixed priority:

priority Video Output Monitor area = 0 > 1 > ... > 15

The time of a content mismatch detection for Video Output Monitor area depends on the total number of monitored areas. Also during switching between the video channels, the detection time of Video Output Monitor area takes one frame for synchronization.
So, the monitoring of Video Output Monitor area recommends to setting Video Output Monitors related to the same video channel consecutively.
e.g. area = 0 to 7 are assigned to Video channel 0, area = 8 to 15 are assigned to Video channel 1.

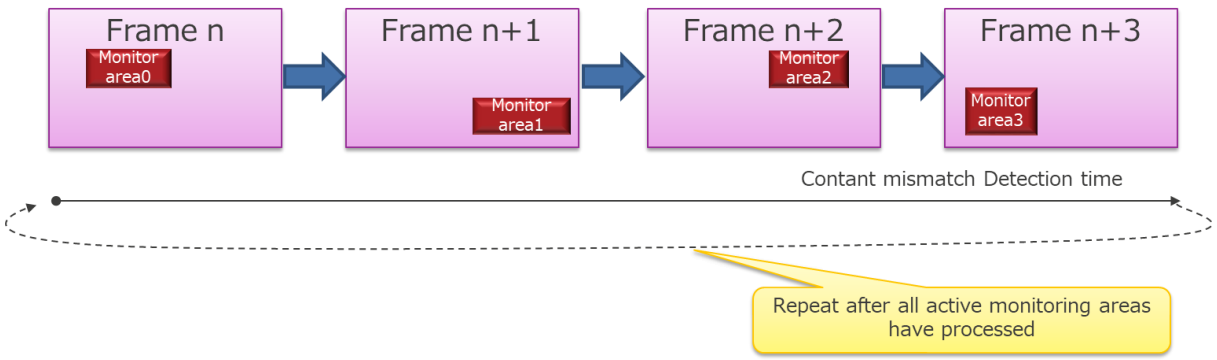


Figure 3-3 Monitor area priority

3.1.7 Activity Monitor

The Activity Monitor checks the following conditions. If any of the conditions is not fulfilled the Activity Monitor notifies an error.

- The Video Output Monitor has completed the check of a monitor area before the next VSYNC signal occurs.
- The next VSYNC signal is asserted within a certain time window.

The Activity Monitor works when at least one Video Output Monitor is enabled for the respective Video channel.

3.2 Using the API

3.2.1 Initialization / De-Initialization

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

3.2.2 Display Area

The R_VOCA_ParamSet sets the timing information of the horizontal / vertical back porch offset and horizontal / vertical size for a Video channel. The horizontal / vertical back porch offset can be calculated from the parameter of 'Timing' for R_VDCE_DisplayTimingSet function. For detail of'Timing' parameter, please refer to the 'RH850/D1x Family Renesas Graphics Library Video Data Controller E (VDCE) Driver' specification.

The horizontal / vertical back porch offset values is depending on the polarity of the Hsync and Vsync signals.

- If Hsync and Vsync signals are active high.

The back porch (HOffset) = H.BlankWidth – H.SyncWidth – H.FrontPorch
The back porch (VOffset) = V.BlankWidth – V.SyncWidth – V.FrontPorch

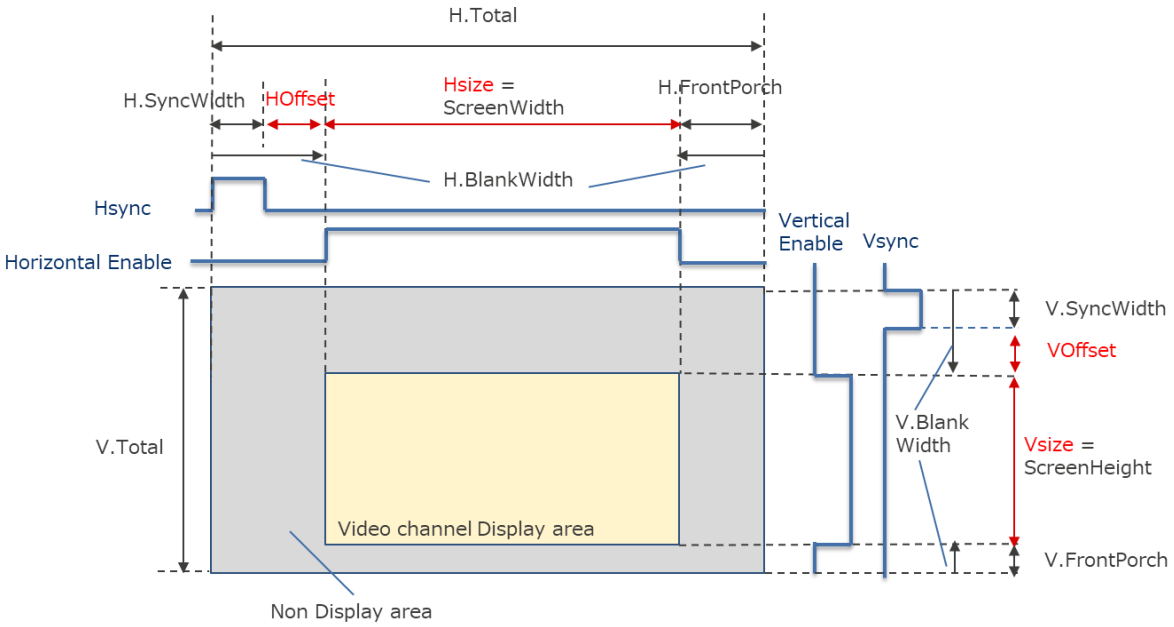


Figure 3-4 horizontal / vertical back porch offset and horizontal / vertical size for Sync is active high

- If Hsync and Vsync signals are active low.

The back porch (HOffset) = H.BlankWidth – H.FrontPorch
The back porch (VOffset) = V.BlankWidth – V.FrontPorch

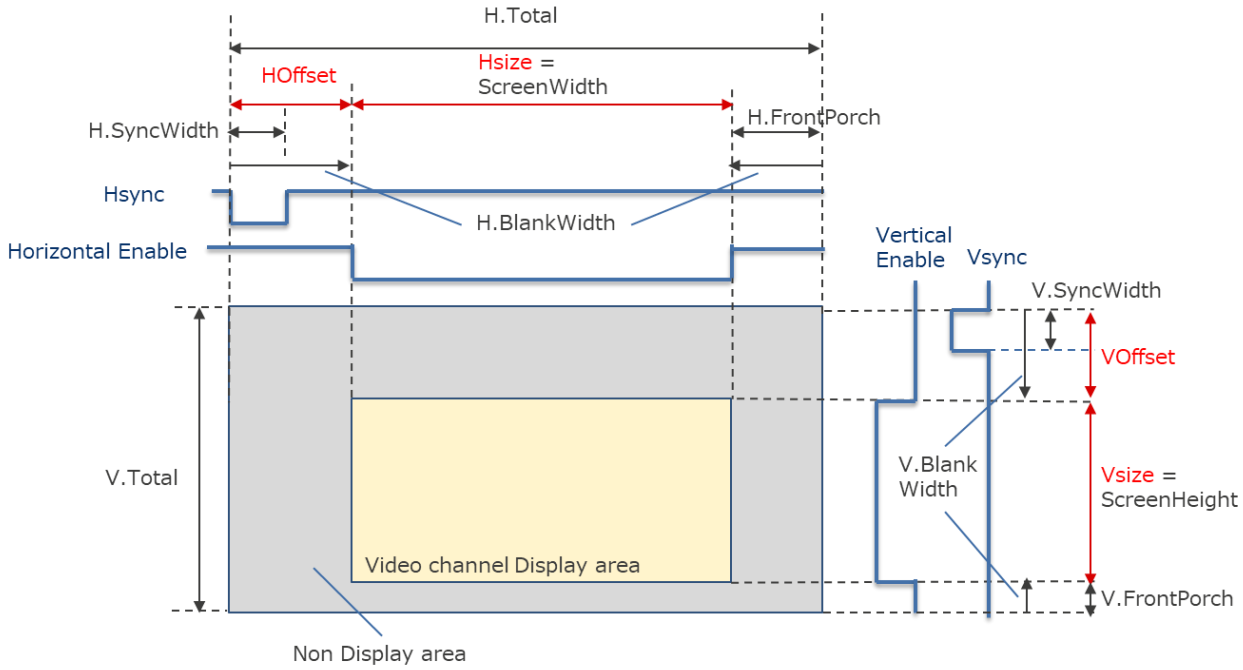


Figure 3-5 horizontal / vertical back porch offset and horizontal / vertical size for Sync is active low

3.2.3 Video Output Monitor area

R_VOCA_MonitorAreaSet sets the information of horizontal / vertical start position, size and reference colors for a Video Output Monitor area.

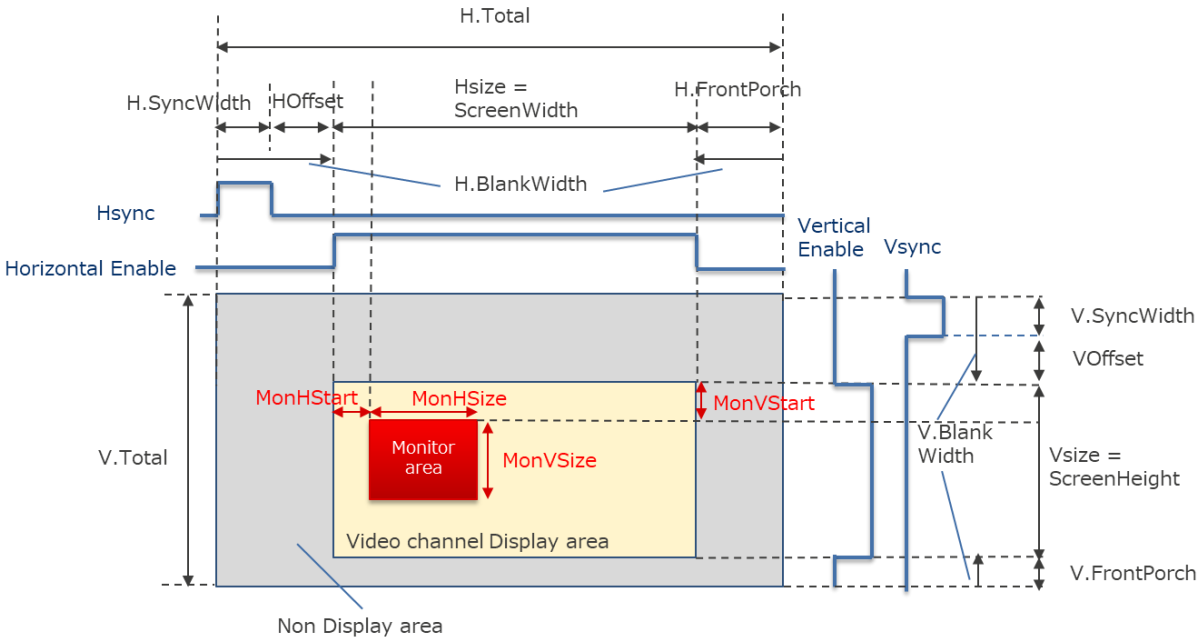


Figure 3-6 Video Output Monitor area

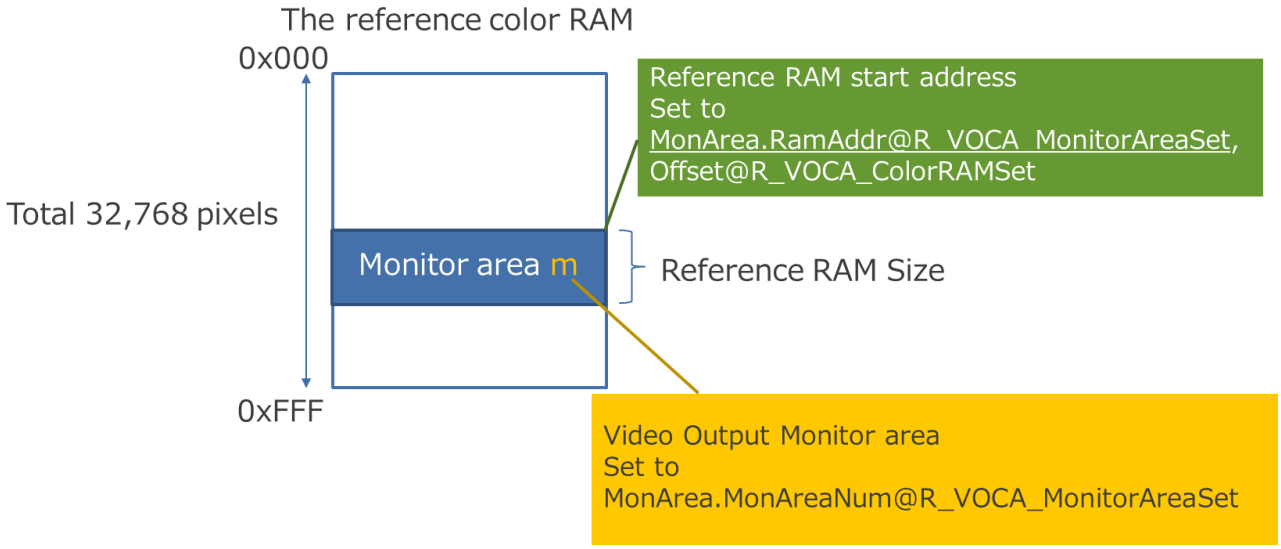
3.2.4 Reference color

The reference colors for the discriminator calculation are stored as 2-bit CLUT2 indices, that select one out of four 12-bpp RGB444 colors from a color look-up table.

R_VOCA_ColorRamSet sets the address, size and the color table of the reference colors RAM for Video Output Monitor areas. The total number of monitored pixel is up to 32,768 pixels.

The reference colors RAM and video output monitor area numbers are associated to as follows.

- The reference RAM address set by R_VOCA_ColorRamSet is set to RamAddr of r_voca_MonArea_t structure using R_VOCA_MonitorAreaSet.
- Video Output Monitor area number is set to MonAreaNum of the r_voca_MonArea_t structure.



The reference colors should be placed sequentially from top-left to bottom-down.

Table 3-3 The reference colors bit position example for R_VOCA_ColorRamSet

Table	bit position							
	15-14	13-12	11-10	9-8	7-6	5-4	3-2	1-0
Table[0x000]	pixel 0	pixel 1	pixel 2	pixel 3	pixel 4	pixel 5	pixel 6	pixel 7
Table[0x001]	pixel 8	pixel 9	pixel 10	pixel 11	pixel 12	pixel 13	pixel 14	pixel 15
:	:	:	:	:	:	:	:	:
Table[0x07F]	pixel 1016	pixel 1017	pixel 1018	pixel 1019	pixel 1020	pixel 1021	pixel 1022	pixel 1023
:	:	:	:	:	:	:	:	:

3.2.5 The Video Output Monitor Check Enable / Disable

R_VOCA_VideoOutputCheckEnable enables the check of the Video Output Monitor specified. The result of the Video Output Monitor area uses R_VOCA_StatusGet. R_VOCA_VideoOutputCheckDisable ends check of the Video Output Monitor specified.

3.2.6 The Activity Monitor Enable / Disable

R_VOCA_ActiveMonitorEnable sets the upper and lower detection time for Activity Monitor for the Video channel specified, and completed the check of the next VSYNC signal occurs, and the next VSYNC signal is asserted within a certain time. The result of the Activity Monitor uses R_VOCA_StatusGet. R_VOCA_ActiveMonitorDisable ends the Activity Monitor.

3.3 Device difference

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

Table 3-4 APIs supported by VOCA driver

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

The following table shows units difference depending on the device.

Table 3-5 Number of Video channels

Feature	RH850/D1x Device Name	
	D1M1(H), D1M1-V2	D1M1A, D1M2(H)
Video channels	1	2
Video channel indexes	Video channel0	Video channel0, Video channel1

3.4 Header File List

Table 3-6 Header File List

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

4.Functions

4.1 Function List

This section describes about the VOCA API functions which are in *Table 4-1* and executable state of each function is described in the specification of each function.

Table 4-1 List of VOCA API Functions

Function Name	Purpose
R_VOCA_Init	This function initializes the driver and the hardware as far as necessary.
R_VOCA_DeInit	This function de initializes the driver and the hardware.
R_VOCA_ErrorCallbackSet	This function registers for retrieving the notification on an event.
R_VOCA_ParamSet	This function sets the information of a Video channel.
R_VOCA_ActiveMonitorEnable	This function enables Activity Monitor.
R_VOCA_ActiveMonitorDisable	This function disables Activity Monitor.
R_VOCA_VideoOutputCheckEnable	This function enables Video Output Monitor check.
R_VOCA_VideoOutputCheckDisable	This function disables Video Output Monitor check.
R_VOCA_StatusGet	This function gets the result of Video Output Monitor area error and Activity Monitor error.
R_VOCA_StatusClear	This function clears the result of Video Output Monitor area error and Activity Monitor error.
R_VOCA_MonitorAreaSet	This function sets the information of Video Output Monitor area.
R_VOCA_ColorRamSet	This function sets the reference colors.
R_VOCA_VersionStringGet	This function returns the version string of this VOCA driver.
R_VOCA_MacroVersionGet	This function returns the major and minor version of the H/W macro.
R_VOCA_IntEnable	This function enables the specified VOCA interrupt.
R_VOCA_IntDisable	This function disables the specified VOCA interrupt.

4.2 VOCA API Functions

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

4.2.1 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.

4.2.1.1 R_VOCA_Init

Function Prototypes

```
r_voca_Error_t R_VOCA_Init(const uint32_t     Unit)
```

Input Parameter

Table 4-2 Input parameter of R_VOCA_Init

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_VOCA_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

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

This function issues a software reset of VOCA unit. So, wait for occurrence of interrupt INTVDCE0S0LOVSYNC for VDCE0 in order to the VOCA software reset has been completed.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.
This function must be called after call to R_VDCE_DisplayEnable for VDCE0 function.

See also

r_voca_Error_t

4.2.1.2 R_VOCA_DeInit

Function Prototypes

```
r_voca_Error_t R_VOCA_DeInit(const uint32_t        Unit)
```

Input Parameter

Table 4-3 Input parameter of R_VOCA_DeInit

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

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

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.3 R_VOCA_ErrorCallbackSet

Function Prototypes

```
r_voca_Error_t R_VOCA_ErrorCallbackSet (const uint32_t Unit,
                                        void(*const ErrorCallback)(const uint32_t       Unit,
                                                                   const r_voca_Error_t Error))
```

Input Parameter

Table 4-4 Input parameter of R_VOCA_ErrorCallbackSet

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

Table 4-5 Output parameter of R_VOCA_ErrorCallbackSet

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

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_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 VOCA units.
The error callback is notified during the VOCA unit is not Uninitialized state.
The installed error callback can be uninstalled by R_NULL setting in this function. And all VOCA units are de-initialized by R_VOCA_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_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.4 R_VOCA_ParamSet

Function Prototypes

```
r_voca_Error_t R_VOCA_ParamSet(const uint32_t               Unit,
                               const r_voca_VoCh_t          VoCh,
                               const r_voca_Param_t  *const Param)
```

Input Parameter

Table 4-6 Input parameter of R_VOCA_ParamSet

Parameter	Description
Unit	Specifies the VOCA unit number.
VoCh	Specifies the Video channel.
Param	Specifies the VOCA configuration parameter information.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_RANGE_PARAM	- A parameter was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function sets the display timing information of horizontal / vertical back porch offset and horizontal / vertical size for a Video channel.
This function returns R_VOCA_ERR_OK if successful.
This setting is valid until R_VOCA_DeInit is executed.

See ***Table 3-2*** about the range for Video channels.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t
r_voca_VoCh_t
r_voca_Param_t

4.2.1.5 R_VOCA_ActiveMonitorEnable

Function Prototypes

```
r_voca_Error_t R_VOCA_ActiveMonitorEnable(const uint32_t        Unit,
                                          const r_voca_VoCh_t   VoCh,
                                          const uint16_t        MaxTime,
                                          const uint16_t        MinTime)
```

Input Parameter

Table 4-7 Input parameter of R_VOCA_ActiveMonitorEnable

Parameter	Description
Unit	Specifies the VOCA unit number.
VoCh	Specifies the Video channel.
MaxTime	Specifies the upper detection time for Activity Monitor in 0.033 ms units 0: 0 ms 1: 0.033 ms 2: 0.067 ms 3: 0.1 ms ... 4094: 136.467 ms
MinTime	Specifies the lower detection time for Activity Monitor in 0.033 ms units 0: 0 ms 1: 0.033 ms 2: 0.067 ms 3: 0.1 ms ... 4094: 136.467 ms 4095: 136.5 ms

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_RANGE_PARAM	- A parameter was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function enables Activity Monitor for the specified Video channel.
MaxTime and MinTime of the parameters set the upper and lower detection time for Activity Monitor for Video channel.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.
VOCA unit status will become Executing state after the execution of this function.
This function works when at least one Video Output Monitor is enabled for the respective Video channel.

See ***Table 3-2*** about the range for Video channels.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t
r_voca_VoCh_t

4.2.1.6 R_VOCA_ActiveMonitorDisable

Function Prototypes

```
r_voca_Error_t R_VOCA_ActiveMonitorDisable(const uint32_t       Unit,
                                           const r_voca_VoCh_t  VoCh)
```

Input Parameter

Table 4-8 Input parameter of R_VOCA_ActiveMonitorDisable

Parameter	Description
Unit	Specifies the VOCA unit number.
VoCh	Specifies the Video channel.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function disables Activity Monitor for the specified Video channel.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.
VOCA unit status will become Idle state if all Video channels has been disabled after the execution of this function.

See ***Table 3-2*** about the range for Video channels.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t
r_voca_VoCh_t

4.2.1.7 R_VOCA_VideoOutputCheckEnable

Function Prototypes

```
r_voca_Error_t R_VOCA_VideoOutputCheckEnable(const uint32_t            Unit,
                                             const uint32_t            MonArea)
```

Input Parameter

Table 4-9 Input parameter of R_VOCA_VideoOutputCheckEnable

Parameter	Description
Unit	Specifies the VOCA unit number.
MonAreaNum	Specifies the Video Output Monitor area number. It can be set multiple flags with OR operation. 0x00000001 : Video Output Monitor area 0 0x00000002 : Video Output Monitor area 1 0x00000004 : Video Output Monitor area 2 0x00000008 : Video Output Monitor area 3 0x00000010 : Video Output Monitor area 4 0x00000020 : Video Output Monitor area 5 0x00000040 : Video Output Monitor area 6 0x00000080 : Video Output Monitor area 7 0x00000100 : Video Output Monitor area 8 0x00000200 : Video Output Monitor area 9 0x00000400 : Video Output Monitor area 10 0x00000800 : Video Output Monitor area 11 0x00001000 : Video Output Monitor area 12 0x00002000 : Video Output Monitor area 13 0x00004000 : Video Output Monitor area 14 0x00008000 : Video Output Monitor area 15

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function enables monitoring for the specified Video Output Monitor area.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.
VOCA 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_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.8 R_VOCA_VideoOutputCheckDisable

Function Prototypes

```
r_voca_Error_t R_VOCA_VideoOutputCheckDisable(const uint32_t            Unit,
                                              const uint32_t            MonArea)
```

Input Parameter

Table 4-10 Input parameter of R_VOCA_VideoOutputCheckDisable

Parameter	Description
Unit	Specifies the VOCA unit number.
MonAreaNum	Specifies the Video Output Monitor area number. It can be set multiple flags with OR operation. 0x00000001 : Video Output Monitor area 0 0x00000002 : Video Output Monitor area 1 0x00000004 : Video Output Monitor area 2 0x00000008 : Video Output Monitor area 3 0x00000010 : Video Output Monitor area 4 0x00000020 : Video Output Monitor area 5 0x00000040 : Video Output Monitor area 6 0x00000080 : Video Output Monitor area 7 0x00000100 : Video Output Monitor area 8 0x00000200 : Video Output Monitor area 9 0x00000400 : Video Output Monitor area 10 0x00000800 : Video Output Monitor area 11 0x00001000 : Video Output Monitor area 12 0x00002000 : Video Output Monitor area 13 0x00004000 : Video Output Monitor area 14 0x00008000 : Video Output Monitor area 15

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function disables monitoring for the specified Video Output Monitor area.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.
VOCA unit status will become Idle state if all Video Output Monitors has been disabled 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_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.9 R_VOCA_StatusGet

Function Prototypes

```
r_voca_Error_t R_VOCA_StatusGet(const uint32_t                    Unit,
                                r_voca_AreaStatus_t   *const State)
```

Input Parameter

Table 4-11 Input parameter of R_VOCA_StatusGet

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

Table 4-12 Output parameter of R_VOCA_StatusGet

Parameter	Description
State	Specified the pointer to the status of Video Output Monitor area error and Activity Monitor error information.

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function gets the result of Video Output Monitor area error and Activity Monitor error.
This function gets the number of the current Video Output Monitor area monitored.

Reentrancy

Reentrant.

Sync/Async

Synchronous

Call from Interrupt

Permitted.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t
r_voca_AreaStatus_t

4.2.1.10 R_VOCA_StatusClear

Function Prototypes

```
r_voca_Error_t R_VOCA_StatusClear(const uint32_t      Unit)
```

Input Parameter

Table 4-13 Input parameter of R_VOCA_StatusClear

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_VOCA_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function clears the result of Video Output Monitor area error and Activity Monitor error.
This function processes the error interrupt factor of VOCA.

Reentrancy

Non-reentrant.
This function doesn't call R_VOCA_Sys_Lock and R_VOCA_Sys_Unlock.
User should control not to re-enter the same VOCA unit. And user should not execute other functions while this function is being executed.

Sync/Async

Synchronous

Call from Interrupt

Permitted.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.11 R_VOCA_MonitorAreaSet

Function Prototypes

```
r_voca_Error_t R_VOCA_MonitorAreaSet(const uint32_t                Unit,
                                     const r_voca_VoCh_t           VoCh,
                                     const r_voca_MonArea_t *const MonArea)
```

Input Parameter

Table 4-14 Input parameter of R_VOCA_MonitorAreaSet

Parameter	Description
Unit	Specifies the VOCA unit number.
VoCh	Specifies the Video channel.
MonArea	Specifies the Video Output Monitor area information.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_RANGE_PARAM	- A parameter was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.
R_VOCA_ERR_FATAL_HW	- Fatal error has occurred at H/W.

Description

This function sets the information of the start position, the size, the reference RAM start address, the reference color upper and lower limit value for Video Output Monitor area.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.

See *Table 3-2* about the range for Video channels.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t
r_voca_VoCh_t
r_voca_MonArea_t

4.2.1.12 R_VOCA_ColorRamSet

Function Prototypes

```
r_voca_Error_t R_VOCA_ColorRamSet(const uint32_t          Unit,
                                  const uint16_t          Offset,
                                  const uint16_t          Size,
                                  const uint16_t   *const Table)
```

Input Parameter

Table 4-15 Input parameter of R_VOCA_ColorRamSet

Parameter	Description
Unit	Specifies the VOCA unit number.
Offset	Specifies the Video Output reference RAM first address. Range is 0 – 4095.
Size	Specifies the Video Output Monitor reference RAM size. Unit is pixel. Range is 1 – 16384.
Table	Specifies the 2-bpp CLUT2 indices of the reference colors. See ***Table 3-3.***

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_RANGE_PARAM	- A parameter was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function sets the reference colors of the 2-bpp CLUT2 indices.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.
The total number of all monitored areas is up to 32,768 pixels.
See ***3.2.4*** for the detail.
Following equations must be satisfied. Otherwise this function will return error.
· (Offset * 8 + Size) <= 32,768 pixels.

This function sets the reference color in units of 8 pixels. If the Size is not in units of 8 pixels, set the last remainder data and set the fraction to 0.

e.g. Offset = 0x010, Size = 1 pixel, Table sets the reference color.

Table	bit position							
	15-14	13-12	11-10	9-8	7-6	5-4	3-2	1-0
Table[0x010]	pixel 0	0	0	0	0	0	0	0

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.1.13 R_VOCA_VersionStringGet

Function Prototypes

```
const uint8_t *R_VOCA_VersionStringGet(void)
```

Input Parameter

None

Input-Output Parameter

None

Output Parameter

None

Return Codes

Version string.

Description

This function returns version string of the VOCA driver.

Reentrancy

Reentrant.

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

None

4.2.1.14 R_VOCA_MacroVersionGet

Function Prototypes

```
r_voca_Error_t R_VOCA_MacroVersionGet(uint32_t *const Major,
                                      uint32_t *const Minor)
```

Input Parameter

None

Input -Output Parameter

None

Output Parameter

Table 4-16 Output parameter of R_VOCA_MacroVersionGet

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

Return Codes

R_VOCA_ERR_OK - No error has occurred.
R_VOCA_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_VOCA_ErrorCallbackSet function, errors is notified to Unit0.

Reentrancy

reentrant**.**

Sync/Async

Synchronous

Call from Interrupt

Prohibited**.**

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.2 Interrupt functions

4.2.2.1 R_VOCA_IntEnable

Function Prototypes

```
r_voca_Error_t R_VOCA_IntEnable(const uint32_t              Unit)
```

Input Parameter

Table 4-17 Input parameter of R_VOCA_IntEnable

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function enables VOCA interrupt.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock.

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

4.2.2.2 R_VOCA_IntDisable

Function Prototypes

```
r_voca_Error_t R_VOCA_IntDisable(const uint32_t              Unit)
```

Input Parameter

Table 4-18 Input parameter of R_VOCA_IntDisable

Parameter	Description
Unit	Specifies the VOCA unit number.

Input-Output Parameter

None

Output Parameter

None

Return Codes

R_VOCA_ERR_OK	- No error occurred.
R_VOCA_ERR_RANGE_UNIT	- The unit-number was outside the range.
R_VOCA_ERR_PARAM_INCORRECT	- Parameter was incorrect.
R_VOCA_ERR_NOT_ACCEPTABLE	- A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	- Fatal error has occurred at OS interface.

Description

This function disables VOCA interrupt.
If the function successfully executes, the return code will be R_VOCA_ERR_OK.

Reentrancy

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

- R_VOCA_Sys_Lock
- R_VOCA_Sys_Unlock.

Sync/Async

Synchronous

Call from Interrupt

Prohibited.

Preconditions

See ***Table 2-5*** about VOCA unit status conditions.

See also

r_voca_Error_t

5.Types

5.1 Basic Types

This section shows the basic types used on this library.

Table 5-1 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

5.2 Definition

This section shows the definitions used in VOCA API.

5.2.1 API Version

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

Table 5-2 Definition of VOCA API Version

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

5.2.2 Reference color entry number

This constant is the value which shows the number of Video Output Monitor area reference color range.

Table 5-3 Definition of Video Output Monitor area reference color range

Name	Description
R_VOCA_REFCOLOR_RANGE_NUM	Number of Video Output Monitor area reference color range.

5.3 Enumerated Type

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

5.3.1 r_voca_Error_t

Description

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

Definition

```
typedef enum
{
    R_VOCA_ERR_OK = 0,
    R_VOCA_ERR_PARAM_INCORRECT,
    R_VOCA_ERR_RANGE_UNIT,
    R_VOCA_ERR_RANGE_PARAM,
    R_VOCA_ERR_NOT_ACCEPTABLE,
    R_VOCA_ERR_FATAL_OS,
    R_VOCA_ERR_FATAL_HW,
    R_VOCA_ERR_LAST
} r_voca_Error_t;
```

Table 5-4 Enumerator of r_voca_Error_t

Name	Description
R_VOCA_ERR_OK	No error occurred.
R_VOCA_ERR_PARAM_INCORRECT	A parameter provided to a function was incorrect.
R_VOCA_ERR_RANGE_UNIT	The unit-number was outside the range.
R_VOCA_ERR_RANGE_PARAM	Parameter is the outside the range.
R_VOCA_ERR_NOT_ACCEPTABLE	A function was called in an incorrect state.
R_VOCA_ERR_FATAL_OS	Fatal error has occurred at OS interface.
R_VOCA_ERR_FATAL_HW	Fatal error has occurred at H/W.

See also

None

5.3.2 r_voca_MonAreaNum_t

Description

Video Output Monitor areas.

Definition

```
typedef enum {
    R_VOCA_MONITOR_AREA_0     = 0,
    R_VOCA_MONITOR_AREA_1,
    R_VOCA_MONITOR_AREA_2,
    R_VOCA_MONITOR_AREA_3,
    R_VOCA_MONITOR_AREA_4,
    R_VOCA_MONITOR_AREA_5,
    R_VOCA_MONITOR_AREA_6,
    R_VOCA_MONITOR_AREA_7,
    R_VOCA_MONITOR_AREA_8,
    R_VOCA_MONITOR_AREA_9,
    R_VOCA_MONITOR_AREA_10,
    R_VOCA_MONITOR_AREA_11,
    R_VOCA_MONITOR_AREA_12,
    R_VOCA_MONITOR_AREA_13,
    R_VOCA_MONITOR_AREA_14,
    R_VOCA_MONITOR_AREA_15,
    R_VOCA_MONITOR_AREA_LAST,
} r_voca_MonAreaNum_t;
```

Table 5-5 Enumerator of r_voca_MonAreaNum_t

Name	Description
R_VOCA_MONITOR_AREA_0	Video Output Monitor 0 is assigned.
R_VOCA_MONITOR_AREA_1	Video Output Monitor 1 is assigned.
R_VOCA_MONITOR_AREA_2	Video Output Monitor 2 is assigned.
R_VOCA_MONITOR_AREA_3	Video Output Monitor 3 is assigned.
R_VOCA_MONITOR_AREA_4	Video Output Monitor 4 is assigned.
R_VOCA_MONITOR_AREA_5	Video Output Monitor 5 is assigned.
R_VOCA_MONITOR_AREA_6	Video Output Monitor 6 is assigned.
R_VOCA_MONITOR_AREA_7	Video Output Monitor 7 is assigned.
R_VOCA_MONITOR_AREA_8	Video Output Monitor 8 is assigned.
R_VOCA_MONITOR_AREA_9	Video Output Monitor 9 is assigned.
R_VOCA_MONITOR_AREA_10	Video Output Monitor 10 is assigned.
R_VOCA_MONITOR_AREA_11	Video Output Monitor 11 is assigned.
R_VOCA_MONITOR_AREA_12	Video Output Monitor 12 is assigned.
R_VOCA_MONITOR_AREA_13	Video Output Monitor 13 is assigned.
R_VOCA_MONITOR_AREA_14	Video Output Monitor 14 is assigned.
R_VOCA_MONITOR_AREA_15	Video Output Monitor 15 is assigned.

See also

None

5.3.3 r_voca_VoCh_t

Description

Video channels. Video channel is different depending on RH850/D1x device. See *Table 3-2*.

Definition

```
typedef enum {
    R_VOCA_VO_0     = 0,
    R_VOCA_VO_1,
    R_VOCA_VO_LAST,
} r_voca_VoCh_t;
```

Table 5-6 Enumerator of r_voca_VoCh_t

Name	Description
R_VOCA_VO_0	Video channel 0
R_VOCA_VO_1	Video channel 1

See also

None

5.4 Structure Type

This section shows the structure used in VOCA API Function.

5.4.1 r_voca_Param_t

Description

The type describes the VOCA configuration parameter information.

Definition

```
typedef struct
{
    uint16_t HOffset;
    uint16_t VOffset;
    uint16_t HSize;
    uint16_t VSize;
} r_voca_Param_t;
```

Table 5-7 Member of r_voca_Param_t

Name	Description
HOffset	Horizontal back porch offset of the Video channel Display area. Range is 1 – 2047.
VOffset	Vertical back porch offset of the Video channel Display area. Range is 1 – 2047.
HSize	Horizontal size of the Video channel Display area. Range is 1 – 1280.
VSize	Vertical size of the Video channel Display area. Range is 1 – 1024.

See also

None

5.4.2 r_voca_MonRefColor_t

Description

The type describes the Video Output Monitor reference color range. Set each component as RGB888 format.

Definition

```
typedef struct
{
    uint8_t RUpper;
    uint8_t GUpper;
    uint8_t BUpper;
    uint8_t RLower;
    uint8_t GLower;
    uint8_t BLower;
} r_voca_MonRefColor_t;
```

Table 5-8 Member of r_voca_MonRefColor_t

Name	Description
RUpper	Video Output Monitor reference color red upper limit. Range is 0 – 255.
GUpper	Video Output Monitor reference color green upper limit. Range is 0 – 255.
BUpper	Video Output Monitor reference color blue upper limit. Range is 0 – 255.
RLower	Video Output Monitor reference color red lower limit. Range is 0 – 255.
GLower	Video Output Monitor reference color green lower limit. Range is 0 – 255.
BLower	Video Output Monitor reference color blue lower limit. Range is 0 – 255.

See also

None

5.4.3 r_voca_MonArea_t

Description

The type describes the Video Output Monitor area information.

Definition

```
typedef struct
{
    uint16_t MonAreaNum;
    uint16_t MonHStart;
    uint16_t MonVStart;
    uint16_t MonHSize;
    uint16_t MonVSize;
    uint16_t RamAddr;
    uint32_t Threshold;
    r_voca_MonRefColor_t RefColor[R_VOCA_REFCOLOR_RANGE_NUM];
} r_voca_MonArea_t
```

Table 5-9 Member of r_voca_MonArea_t

Name	Description
MonAreaNum	Video Output Monitor area number. Range is 0 – 15.
MonHStart	Video Output Monitor area horizontal start position. Range is 0 – 1279. Horizontal start position value is pixel. Horizontal start position value should be smaller than ‘HSize’. ‘HSize’ is the parameter of R_VOCA_ParamSet function.
MonVStart	Video Output Monitor area vertical start position. Range is 0 – 1023. Vertical start position value is pixel. Vertical start position value should be smaller than ‘VSize’. ‘VSize’ is the parameter of R_VOCA_ParamSet function.
MonHSize	Horizontal size of Video Output Monitor area. Range is 1 – 128. Horizontal start position value is pixel. The value should be set as follows: ‘HSize@r_voca_Param_t >= MonHStart+ MonHSize‘.
MonVSize	Vertical size of Video Output Monitor area. Range is 1 – 128. Vertical start position value is pixel. The value should be set as follows: ‘VSize@r_voca_Param_t >= MonVStart + MonVSize‘.
RamAddr	Video Output Monitor reference RAM start address. Range is 0 – 4095.
Threshold	Video Output Monitor m acceptance threshold. Range is 1 – 262143.
RefColor	Video Output Monitor reference color range.

See also

r_voca_MonRefColor_t

5.4.4 r_voca_AreaStatus_t

Description

The type describes the status of Video Output Monitor area and Activity Monitor.

Definition

```
typedef struct {
   uint32_t            MonArea;
   uint32_t            VoCh;
   r_voca_MonAreaNum_t SelMon;
} r_voca_AreaStatus_t;
```

Table 5-10 Member of r_voca_AreaStatus_t

Name	Description
MonArea	Video Output Monitor area error information. 0x00000000 : There is no error in Video Output Monitor area 0x00000001 : Video Output Monitor area 0 0x00000002 : Video Output Monitor area 1 0x00000004 : Video Output Monitor area 2 0x00000008 : Video Output Monitor area 3 0x00000010 : Video Output Monitor area 4 0x00000020 : Video Output Monitor area 5 0x00000040 : Video Output Monitor area 6 0x00000080 : Video Output Monitor area 7 0x00000100 : Video Output Monitor area 8 0x00000200 : Video Output Monitor area 9 0x00000400 : Video Output Monitor area 10 0x00000800 : Video Output Monitor area 11 0x00001000 : Video Output Monitor area 12 0x00002000 : Video Output Monitor area 13 0x00004000 : Video Output Monitor area 14 0x00008000 : Video Output Monitor area 15
VoCh	Video Output Channel error information for Activity Monitor. 0x00000000 : There is no error in Video Output channel 0x00000001 : Video Output channel error 0 0x00000002 : Video Output channel error 1
SelMon	The number of the current Video Output Monitor area monitored.

See also

r_voca_MonAreaNum_t

Revision History	Renesas Graphics Library Video Output Checker A (VOCA) Driver User's Manual: Software

Rev.	Date	Description	
		Page	Summary
0.1	Oct 11, 2019	-	First edition.
0.2	Nov 22, 2019	25, 39	Added the const or the pointer to arguments.
		21, 27, 29, 31, 33, 39,	Added the return code.
		55	Fixed typo.
		56	Fixed the value of r_voca_AreaStatus_t.
0.3	Dec 20, 2019	8	Changed "Executing" State transition for R_VOCA_ParamSet.
		23	Added argument.
		41	Added the description about the setting if the reference colors are 7 pixels or less.
		49	Added R_VOCA_REFCOLOR_RANGE_NUM to Definition.
1.0	April 24, 2020	9-16	Added traceability ID

Renesas Graphics Library
Video Output Checker A (VOCA) 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

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