

RZ/T1 Group

R01AN3635EJ0230

Rev.2.30

Encoder I/F A-format application package

October 1, 2019

Summary

This document explains about RZ/T1 Encoder I/F A-format application package.

To use this application package, please obtain release package of “RZ/T1 Encoder I/F Configuration Library”.

If you require detailed specifications of A-format™ industry standard and Nikon encoder, please contact Nikon corporation to obtain them.

Device that A-format functionality is checked

RZ/T1 CPU Board (RTK7910018C00000BE)

Version History

Ver.	Date	Content	Note
2.30	October 2019	Update the RZ/T1 A-format sample driver code. (1) Fixed bug of disables input of the ELC event triggers processing. (2) Fixed bug initialization of the internal variables.	
2.20	August 2018	Update the RZ/T1 A-format sample driver code. (1) Supported bypass reception for ch1. (2) Fixed bug of bypass reception processing. (3) Changed the operation procedure of DS-5 and e2 studio. (4) Added restriction	
2.10	April 2018	Update the RZ/T1 A-format sample driver code. (1) Added ID macro definition for ch1. (2) Changed register definition for ch1.	
		Update the RZ/T1 Group A-format Interface User's Manual.	
2.00	April 2017	Update the RZ/T1 A-format sample driver code. (1) Supported the Configuration Data Ver.1.8.	
		Updated Configuration Data to Ver.1.8. (1) Added the bypass transmission and reception function using FIFO. (2) Added the received data setting completion Interrupt. (3) Added the ELC Event Input Trigger.	
		Update the RZ/T1 Group A-format Interface User's Manual.	
		Update the RZ/T1 Group A-format Sample Program Application Note.	
1.01	January 2017	Update the RZ/T1 A-format sample driver code. (1) Improved the stability of the module stop release operation.	
1.0	September 2016	Fixed bug of interrupt routine of sample program.	
		Update the RZ/T1 Group A-format Interface User's Manual.	
		Update the RZ/T1 Group A-format Sample Program Application Note.	
0.8	June 2016	Fixed bug of macro value of sample program.	
		Fixed bug of interrupt routine of sample program.	
		Fixed bug of terminal screen display of sample program.	
		Changing the input method of the console commands of the sample program.	
		Update the RZ/T1 Group A-format Interface User's Manual.	
		Update the RZ/T1 Group A-format Sample Program Application Note (Japanese).	
		Added the RZ/T1 Group A-format Sample Program Application Note (English).	
0.7	October 2015	Newly created	

Table of contents

1. Contents of package	4
1.1 Software	4
▪ Source code.....	4
▪ Configuration data	4
1.2 Document.....	4
2. File Structures	5
3. Information about A-format sample program	6
3.1 Software information	6
3.1.1 Independent from Operating System.....	6
3.1.2 Memory footprint	6
3.2 Hardware information	7
3.2.1 Device	7
3.2.2 Target Board	7
3.3 Procedure on Development Environments	8
3.3.1 Preparation before the execution of the sample program	8
3.3.2 EWARM from IAR systems.....	8
3.3.3 DS-5 from ARM.....	10
3.3.4 e2 studio from RENESAS	13
4. Restriction	15
5. Note.....	15
5.1 Processing time.....	15

1. Contents of package

Contents of this package are described in this chapter.

Configuration data and sample programs in this package support only 1 channel of Encoder I/F. In order to use 2 channels of Encoder I/F, obtain the RZ/T1 group Encoder I/F 2ch Tool (R01AN4306) and change the Configuration Data and sample program.

1.1 Software

- Source code

No.	Title	Version
1	A set of RZ/T1 A-format sample driver code	2.5

- Configuration data

No.	Title	Version
1	RZ/T1 Encoder I/F Configuration Data(A-format)	1.8

1.2 Document

No.	Document name	Ver.	File name
1	RZ/T1 Encoder I/F A-format application package release note	2.30	(English) r01an3635ej0230-rzt1.pdf (this document) (Japanese) r01an3635jj0230-rzt1.pdf
2	RZ/T1 Group A-format Interface User's Manual	2.10	(English) r01uh0604ej0210-rzt1-a-format.pdf (Japanese) r01uh0604jj0210-rzt1-a-format.pdf
3	RZ/T1 Group A-format Sample Program Application Note	2.00	(English) r01an2948ej0200_rzt1_a-format.pdf (Japanese) r01an2948jj0200_rzt1_a-format.pdf

2. File Structures

File structures and contents of this package are described below.

```

Top
├──r01an3635ej0230-rzt1.pdf
├──r01an3635jj0230-rzt1.pdf
├──workspace
│   ├──Software
│   │   ├──armcc
│   │   │   └──RZ_T1_a_as.zip : A set of RZ/T1 A-format sample driver code (DS-5)
│   │   ├──iccam
│   │   │   └──RZ_T1_a_as.zip : A set of RZ/T1 A-format sample driver code (IAR)
│   │   └──kpitgcc
│   │       └──RZ_T1_a_as.zip : A set of RZ/T1 A-format sample driver code (e2 studio)
│   └──Documentation
│       ├──r01uh0604ej0210-rzt1-a-format.pdf
│       ├──r01uh0604jj0210-rzt1-a-format.pdf
│       ├──r01an2948ej0200_rzt1_a-format.pdf
│       └──r01an2948jj0200_rzt1_a-format.pdf

```

The file structures of “RZ_T1_a_as.zip” are shown in Figure 2.1 File Structure.

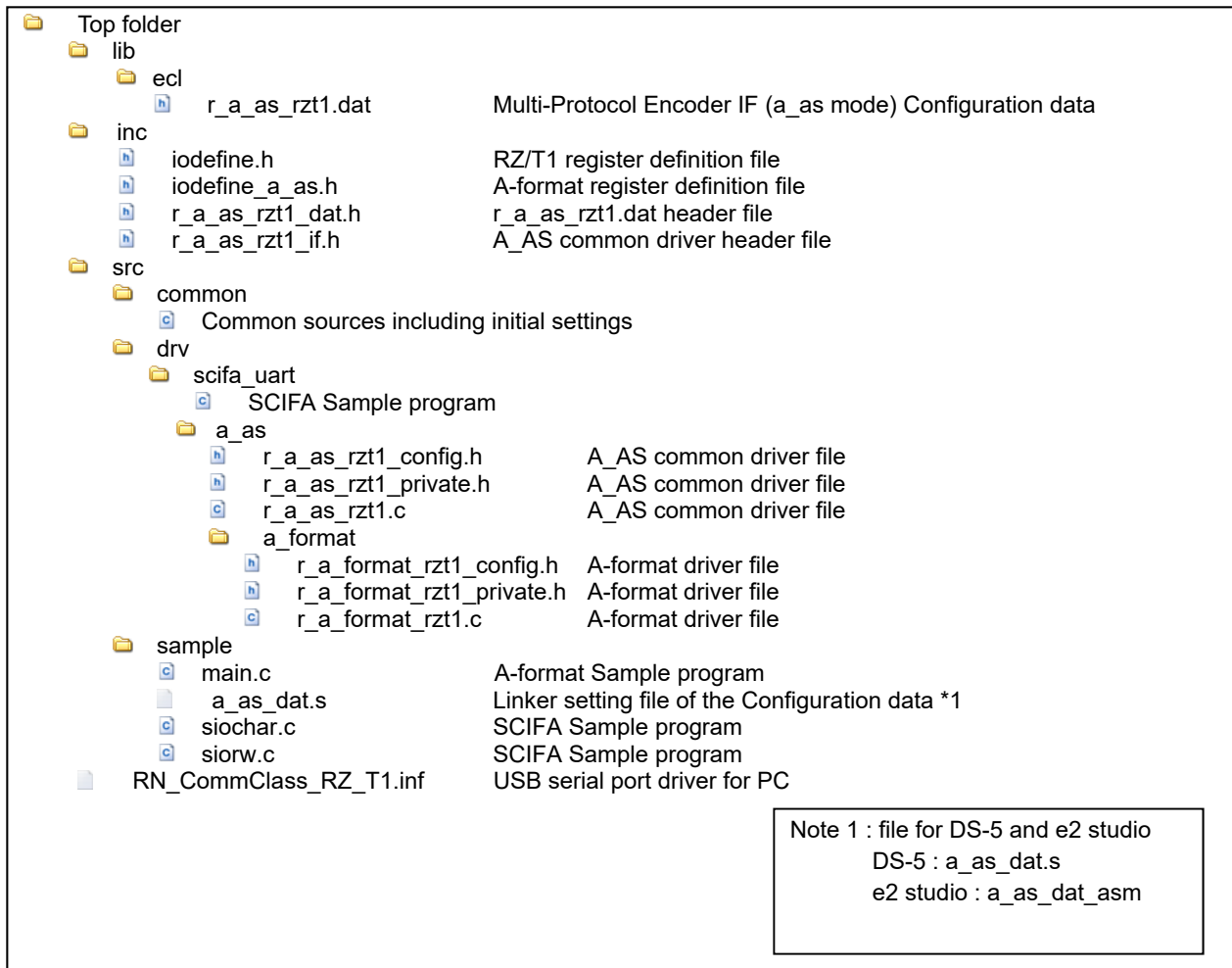


Figure 2.1 File Structure

3. Information about A-format sample program

This chapter describes information to use a set of A-format sample driver code.

3.1 Software information

3.1.1 Independent from Operating System

This software is independent from operating system.

3.1.2 Memory footprint

Section name		Memory Size			
		IAR [bytes]	DS-5 [bytes]	e2 studio [bytes]	
A-format driver	Code	6400	8440	16236	
	Data (with initial value)	16	26	16	
	Data (without initial value)	1160	1152	1164	
	Constant Data	132	132	140	
	Stack size of function	R_A_AS_Open	60	68	144
		R_A_AS_Close	16	28	84
		R_A_AS_Control	64	88	192
		R_A_AS_GetVersion	0	16	72
a_as0_int_isr		168+n *1	116+n *1	156+n *1	
a_as0_fss_isr	160+n *1	100+n *1	132+n *1		
A-format Configuration data	Code	0	0	0	
	Data (with initial value)	0	0	0	
	Data (without initial value)	0	0	0	
	Constant Data	21932	21932	21932	
Sample program	Code	6008	8676	14244	
	Data (with initial value)	136	152	136	
	Data (without initial value)	1829	1816	1836	
	Constant Data	2168	328	2138	

Note 1. “n” is the Maximum stack size of user defined callback functions that are registered to R_A_AS_Control function.

3.2 Hardware information

3.2.1 Device

RZ/T1

3.2.2 Target Board

➤ Board name

RZ/T1 CPU Board (RTK7910018C00000BE)

(2) Settings of CPU Board

SW4-1: ON

SW4-2: ON in case of serial flash memory is used, OFF in case of NOR flash memory is used

SW4-3: ON

SW4-4: ON

SW4-5: ON

SW4-6: OFF

JP2: 2-3 Connect

JP7: 1-2 Connect

3.3 Procedure on Development Environments

3.3.1 Preparation for the execution of the sample program

This sample program communicates with the PC. And for setting the PC, please refer to 6.1.2 Preparations of "RZ/T1 Group FIFO Integrated Serial Communication Interface (SCIFA) Application Note".

3.3.2 EWARM from IAR systems

➤ Build environment

IAR Embedded Workbench for ARM v8.40.1

➤ Execution environment

I-jet

➤ How to build sample program

1. Extract files from RZ_T1_a_as.zip and copy the files to arbitrary holder
2. Copy the following files of "RZ/T1 Encoder I/F Configuration Library" (for IAR EWARM) to each folder
 - lib\ec\l_r_ecl_rzt1.a
 - inc\l_r_ecl_rzt1_if.h
3. Launch EWARM
4. Select [File]menu -> [Open] -> [Workspace]
5. Open RZ_T1_a_as_boot\RZ_T1_a_as_****_boot.eww

NOR version	RZ_T1_a_as_nor_boot.eww
Serial Flash version	RZ_T1_a_as_serial_boot.eww

6. Select [Project]menu -> [Rebuild all]

Following file is generated.

RZ_T1_a_as_boot\Debug\Exe\RZ_T1_a_as_****_boot.out

NOR version	RZ_T1_a_as_nor_boot.out
Serial Flash version	RZ_T1_a_as_serial_boot.out

➤ How to execute sample program

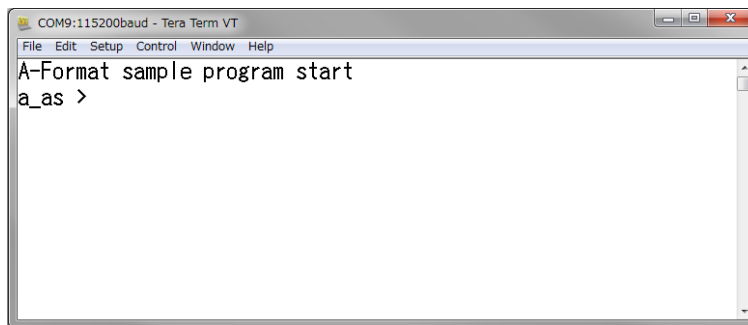
After executing "How to build sample program", connect the target board and the debugger properly, and execute the following operations.

1. Select [Project] menu-> [Download and Debug]
2. Select [Debug] menu-> [Go]

➤ Execution result of sample program

After executing a sample program, input the command to " Terminal I/O" window.

Please refer to RZ/T1 Group A-format Sample Program Application Note about the command.



The screenshot shows a terminal window titled "COM9:115200baud - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal content displays the text "A-Format sample program start" followed by a new line with the command "a_as >" and a cursor.

3.3.3 DS-5 from ARM

➤ Build environment

ARM Development Studio 5 (DS-5) Version 5.29.2

ARM Compiler 5.06 update 6

➤ Execution environment

ULINK2 (v2.01)

➤ How to build sample program

1. Startup the DS-5 environment. Go to [File] > [Import]. On the [Import] window, select [Existing Projects into Workspace] in the [General] folder and click the [Next] button.
2. Select the [Select archive file:] radio button and click on the [Browse...] button. Select the compressed program file “RZ_T1_a_as.zip” on the list in the window and click on the [Finish] button.
3. Copy the following files of “RZ/T1 Encoder I/F Configuration Library” (for ARM DS-5) to each folder imported and expanded.

lib\ecl\r_ecl_rzt1.a

inc\r_ecl_rzt1_if.h

4. Select [Project] menu -> [Build All]

Following file is generated.

Debug\RZ_T_nor_sample.axf

(In case of serial flash, use the “RZ_T_sflash_sample.axf” instead of the “RZ_T_nor_sample.axf”)

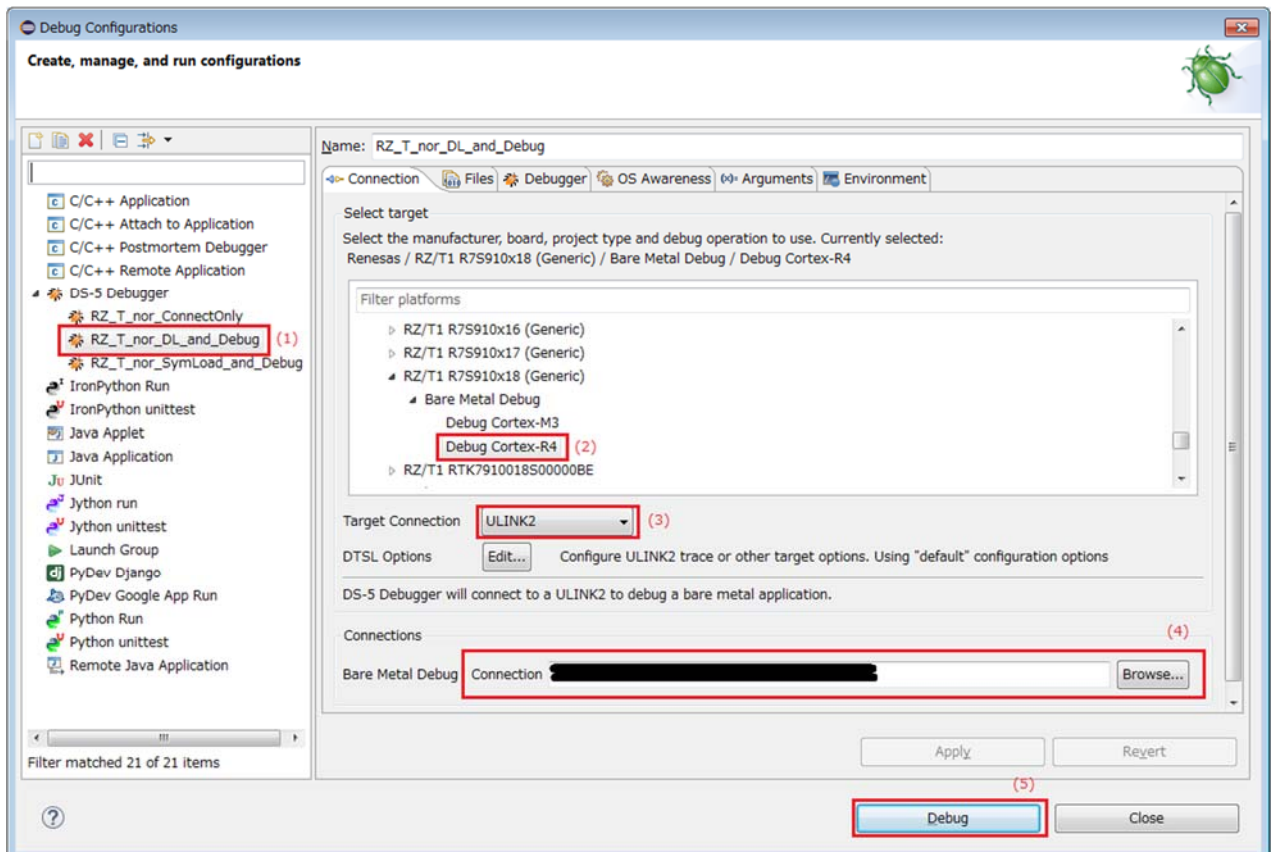
➤ How to execute sample program

After executing “How to build sample program”, connect the target board and the debugger properly, and execute the following operations.

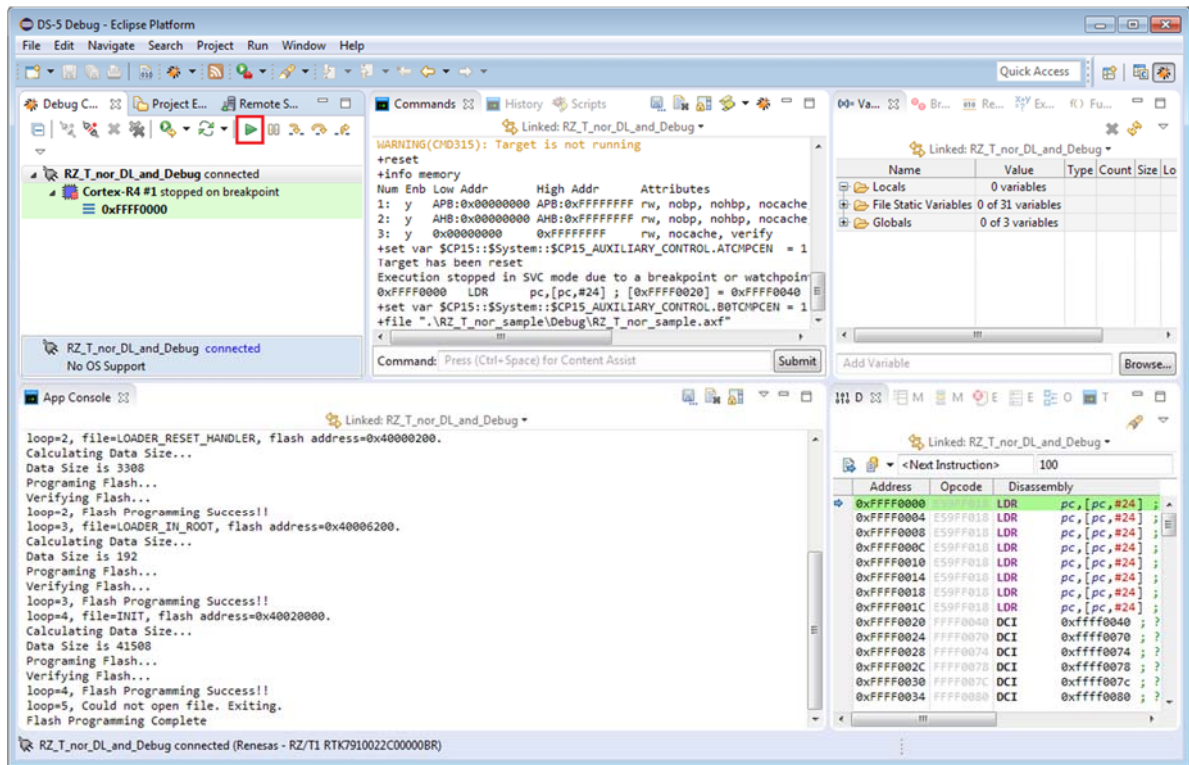
1. Open the debug configuration from the [Run] -> [Debug Configurations...], select the configuration window for “RZ_T_nor_DL_and_Debug”. (In case of serial flash, use the “RZ_T_sflash_DL_and_Debug” instead of the “RZ_T_nor_DL_and_Debug”)

Select “Debug Cortex-R4” of “RZ/T1 R7S910x18 (Generic)” in [Select target].

Select the ULINK2 of [Target Connection] in [Connection] tab, click on [Browse] and select the target connection from the list in the window. Click on [Debug] in the debug configurations window and start debugging.

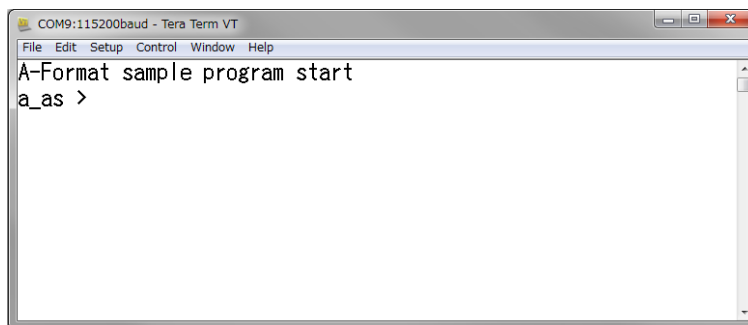


- On completion of writing to the flash memory by the script, the message “Flash Programming Complete” appears in the application console window. Debugging can then start.



➤ Execution result of sample program

After executing a sample program, input the command to "Terminal I/O" window. Please refer to RZ/T1 Group A-format Sample Program Application Note about the command.



3.3.4 e2 studio from RENESAS

➤ Build environment

RENESAS e2 studio 7.5.0

KPIT GNUARM-NONE-EABI Toolchain v16.01

➤ Execution environment

J-Link BASE

➤ How to build sample program

1. Start up the e2 studio environment. In the workspace, go to [File] > [Import]. On the [Import] window, select [Existing Projects into Workspace] in the [General] folder and click the [Next] button.
2. Select the [Select archive file:] radio button and click on the [Browse..] button. Select the compressed program file “RZ_T1_a_as.zip” on the list in the window and click on the [Finish] button.
3. Copy the following files of “RZ/T1 Encoder I/F Configuration Library” (for KPIT GCC) to each folder imported and expanded.

lib\ec\l_r_ecl_rzt1.a

inc\l_r_ecl_rzt1_if.h

4. Select [Project] menu -> [Build All]

Following file is generated.

HardwareDebug\RZ_T_nor_sample.x

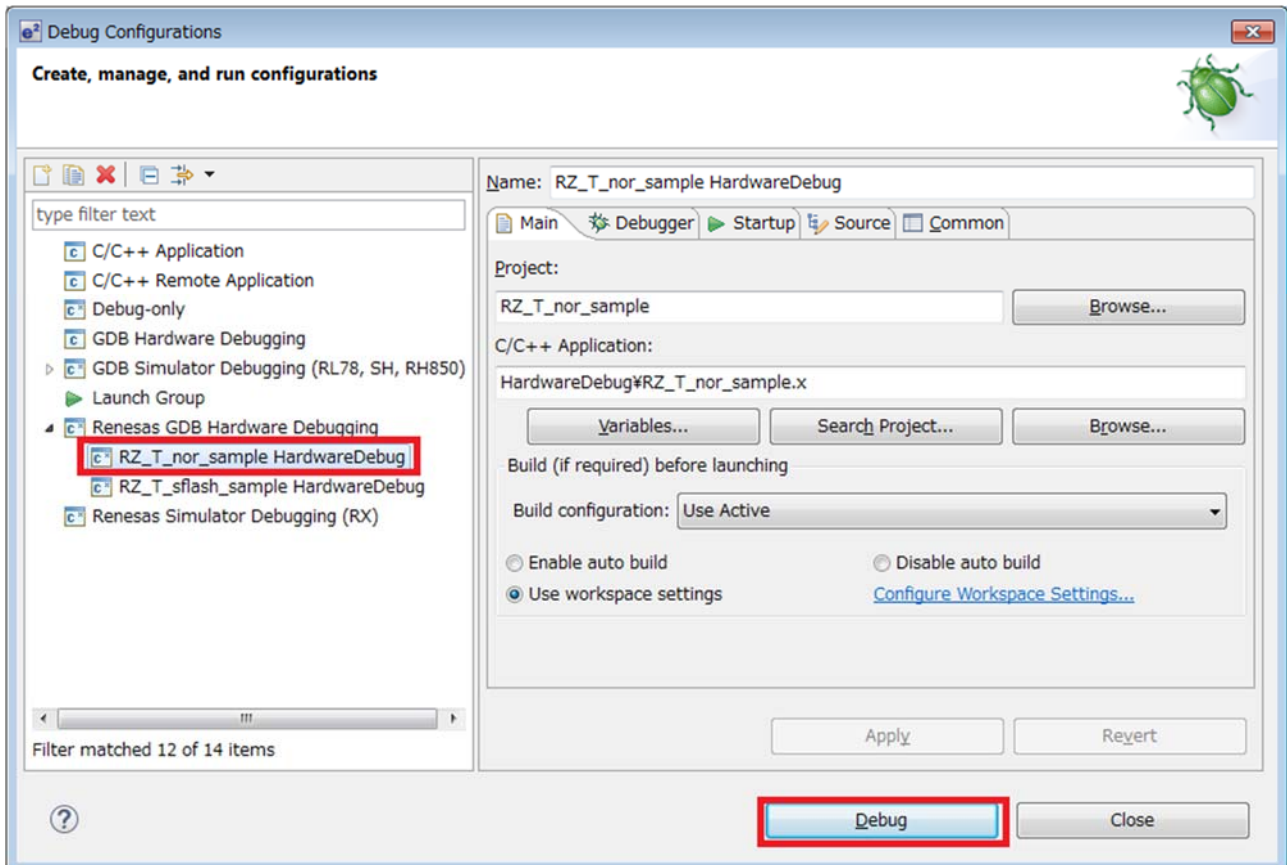
(In case of serial flash, use the “RZ_T_sflash_sample.x” instead of the “RZ_T_nor_sample.x”)

➤ How to execute sample program

After executing “How to build sample program”, connect the target board and the debugger properly, and execute the following operations.

1. Select [Run] from the [Project] menu and then select [Debug Configurations].
2. Select the [RZ_T_nor_sample_HardwareDebug] in the following screen. Click the [Debug] and start the download to flash memory.

(In case of serial flash, use the [RZ_T_sflash_sample_HardwareDebug] instead of the [RZ_T_nor_sample_HardwareDebug])

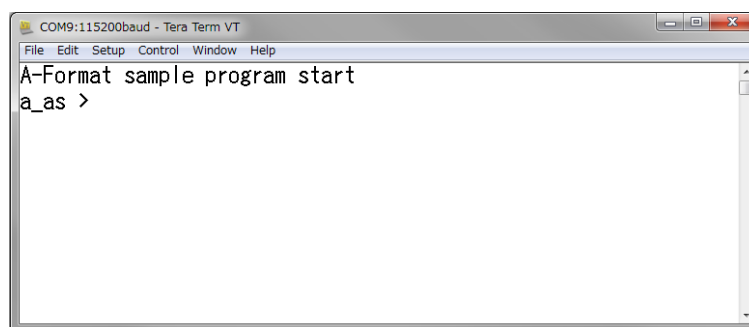


3. Click the [Resume] from the [Run] to start execution of the sample program.

➤ Execution result of sample program

After executing a sample program, input the command to " Terminal I/O" window.

Please refer to RZ/T1 Group A-format Sample Program Application Note about the command.



4. Restriction

4.1 RZ/T1 A-format sample driver

- When bypass reception is enabled, member variable "rxbpnde" of structure "r_a_as_req_t" sets enable or disable of FSS_UPD interrupt request by FSS.RXEND bit = 1. If set to disable, A-format sample driver will not operate properly. Therefore, member variable "rxbpnde" of structure "r_a_as_req_t" must be fixed to "true".

5. Note

5.1 Processing time

Available time for user processing of Encoder I/F A-format sample program in a control loop is as follows.

Please confirm that there are no problems in your environment.

The example of the case that the control cycle is 62.5us and the connection type is one to one is indicated below.

In the case of normal reception, the time used by the sample program is about 9 us (15%) of 62.5us, and available time for user processing is about 53.5 us (85%).

In the case of bypass reception, the time used by the sample program is about 6 us (10%) of 62.5us, and available time for user processing is about 56.5 us (90%).

Processing		Time		Occupancy rate	
A-format sample processing *2	normal reception	Time setting registers for transmission	about 4 us	about 9 us	15%
		Interrupt time	about 5 us		
		Available time for user processing	about 53.5 us *1		
	bypass reception	Time setting registers for transmission	about 4 us	about 6 us	10%
		Interrupt time	about 2 us		
		Available time for user processing	about 56.5 us *1		

Note 1. Communication time with the encoder (when the bitrate is 8Mbps and the command to be sent is CDF0 which is individual transmission command) is 17.75us of available time for user processing. For more information, refer to the "RZ/T1 Group A-format Interface User's Manual".

Note2. Initial setting time is not included.

5.2 About mistake of Application Note

The following mistake is existing in "RZ/T1 Group A-format Sample Program Application Note Rev.2.00".

- Table 5.4 Results of Transmission and Reception Stored in Each Array Element in Bypass Reception Correct:

Array Number	Content
pbp_result[0]	Result of transmission and reception for the encoder section ENC1 when the setting of received data is complete(RXSET).
pbp_result[1]	Result of transmission and reception for the encoder section ENC2 when the setting of received data is complete(RXSET).
pbp_result[2]	Result of transmission and reception for the encoder section ENC3 when the setting of received data is complete(RXSET).
pbp_result[3]	Result of transmission and reception for the encoder section ENC4 when the setting of received data is complete(RXSET).
pbp_result[4]	Result of transmission and reception for the encoder section ENC5 when the setting of received data is complete(RXSET).
pbp_result[5]	Result of transmission and reception for the encoder section ENC6 when the setting of received data is complete(RXSET).
pbp_result[6]	Result of transmission and reception for the encoder section ENC7 when the setting of received data is complete(RXSET).
pbp_result[7]	Result of transmission and reception for the encoder section ENC8 when the setting of received data is complete(RXSET).
pbp_result[8]	Result of transmission and reception when the transmission and reception of data has been completed(RXEND) ^{*1} .

Note1. The result is invalid when the interrupt source RXEND is disabled.

Incorrect:

Array Number	Content
pbp_result[0]	Result of transmission and reception for the encoder section ENC1 when the setting of received data is complete(RXSET).
pbp_result[1]	Result of transmission and reception for the encoder section ENC2 when the setting of received data is complete(RXSET).
pbp_result[2]	Result of transmission and reception for the encoder section ENC3 when the setting of received data is complete(RXSET).
pbp_result[3]	Result of transmission and reception for the encoder section ENC4 when the setting of received data is complete(RXSET).
pbp_result[4]	Result of transmission and reception for the encoder section ENC5 when the setting of received data is complete(RXSET).
pbp_result[5]	Result of transmission and reception for the encoder section ENC6 when the setting of received data is complete(RXSET).
pbp_result[6]	Result of transmission and reception for the encoder section ENC7 when the setting of received data is complete(RXSET).
pbp_result[7]	Result of transmission and reception when the transmission and reception of data has been completed(RXEND) ^{*1} .

Note1. The result is invalid when the interrupt source RXEND is disabled.

- Table 5.20 Static Variables Used in the Sample Program

Correct: a_as_bp_result[A_AS_BP_RESULT_NUM]

Incorrect: a_as_bp_result[A_AS_ENC_NUM]