Application Note

<u>UART_TRANS</u> (UART-C)

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1. Preface

This application note describes the sample software of UART_TRANS using Universal Asynchronous Receiver Transmitter (UART).

This document helps the user check operation of a product under development and develop its program.

2. Technical Term

Term/Abbreviation	Definition
BSP	Board Support Package
CG	Clock Control and Operation Mode
DMA	Direct Memory Access
Timer	T32A:32-bit Timer Event Counter
UART	Universal Asynchronous Receiver Transmitter

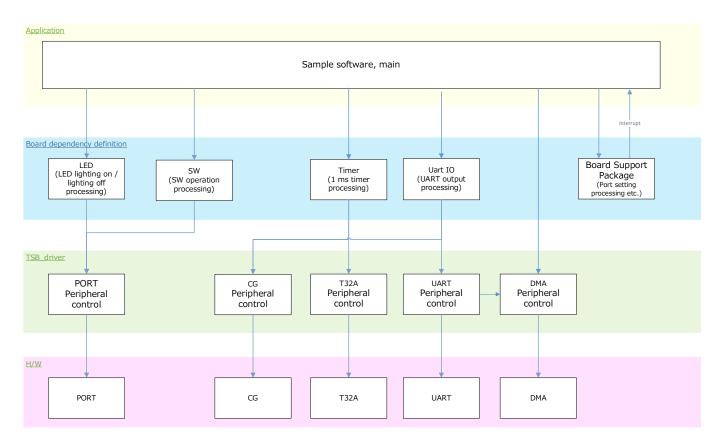
3. Reference Document

Document	Notes
Data sheet	Refer to the data sheet of MCU to be used.
Reference manual	Refer to the reference manual of each IP to be used.
Application note MCU User Guide	Refer to the MCU user guide to be used.

4. Target Sample Program

Sample Program	Outline
UART_TRANS	Sample program of UART function (UART Trans)

5. Configuration Diagram



6. Sample Program:UART_TRANS

This sample software that uses the transmission function of the UART communication function to send logs to the terminal emulator triggered by pressing a switch, and switches the LED turn on / turn off for each UART transmission.

6.1. Outlines of Operation

Wait for BSP_PSW_1 to be pressed.

When BSP_PSW_1 is pressed, the log is transmitted by UART, BSP_LED_2 is turned on / off, and BSP_LED_3 is turned off.

When an error occurs, BSP_LED_3 is turn on.

6.2. Function to Use

The functions to use are as follows:

For the Port assignment of each BSP channel, refer to the MCU user guide.

IP	Channel	Objective
UART	BSP_UART_1	For terminal emulator communication
T32A	BSP_T32A_TIMER_1	Interval timer
PORT(Push-Switch)	BSP_PSW_1	Event Trigger
	BSP_LED_2	For operation check
PORT(LED)	BSP_LED_3	For operation check

6.3. Interrupt to Use

Interrupt	Outlines
	T32A Timer A
INTT32A00A	Timer counter increment every 1ms for switch processing
*1	UART transmit interrupt
*2	UART error interrupt

*1 For SBK-M4KN/SBK-M4KN10, "INTSC0TX", for AdBun-M3HQF10/AdBun-M3HQA, "INTUART0TX"

*2 For SBK-M4KN/SBK-M4KN10, "INTSC0ERR", for AdBun-M3HQF10/AdBun-M3HQA, "INTUART0ERR"

6.4. Configuration

"main.c" configuration setting.

Configuration	Current Value	Description
Character string 1	*1	Character string to send
Communication control selection	*2 NODMAC	Switchable between NODMAC (does not use DMAC) and DMA (uses DMAC)

*1 For SBK-M4KN/SBK-M4KN10, "TMPM4KNFYA¥n" For AdBun-M3HQF10, "TMPM3HQF10" For AdBun-M3HQA, "TMPM3HQFDA"

*2 For details on how to switch when using DMAC, see Chapter 6.6.

6.5. Example of Terminal Emulator Output

Outputs the sent character string

TMPM4KNFYA TMPM4KNFYA

6.6. How to switch DMAC function

Follow the steps below to enable/disable the DMAC function.

6.6.1. IAR Embedded Workbench

Category:					Factory Setting
General Options	📔 🗌 Multi-file Co	mpilation			
Static Analysis	Discard	Unused Publics			
Runtime Checking					
C/C++ Compiler	Language			Optimization	
Assembler	List	Preprocessor	Diagnostics	Encodings	Extra Options
Dutput Converter					
Custom Build	Ignore s	tandard include di	rectories		
Build Actions	Additional	include directories	(one per line)	
Linker	\$PROJ DI				
Debugger		R\$¥¥¥¥¥Utility	finc		
Simulator		R\$¥¥¥¥¥BSP¥S		:	1
CADI	_	R\$¥¥¥¥¥MCU¥			
CMSIS DAP	\$PROJ_DI	R\$¥¥¥¥¥MCU¥	CMSIS¥startup	p¥iar	
GDB Server	Preinclude	file:			
I-jet					
J-Link/J-Trace					
TI Stellaris	Defined syr	mbols: (one per line	:)		
Nu-Link	NODMAC			Preprocessor outp	ut to file
PE micro	UART_DMA	_TRANSFER_USE		Preserve comm	nents
ST-LINK				🔽 Generate #line	directives
Third-Party Driver			*		
TI MCD FFT					

Open "Project" \rightarrow "Options" \rightarrow "C/C++ Compiler" \rightarrow "Preprocessor". Change "Defined symbol" as follows: • If you do not use DMAC: "NODMAC"

- When using DMAC: "DMA" and "UART_DMA_TRANSFER_USE"



Workspace	→ ‡ X	
Sample_FYAx	~	
Files ■ UART_RECEIN - ■ ■ APP - = ■ BSP - = ■ BSP - = ■ BSP.c - = ■ © bsp.config - = ■ © bsp_config	_sbk	
Bsp_c Bstartup Bill Startup Bill TSB_drive Bill Utility	Options Make Compile Rebuild All Clean	
	C-STAT Static Analysis Stop Build	>
	Add	>
UART_RECEIVE	Remove	- 1

egory: atic Analysis	Override inherited settings			Factory Setting
ntime Checking /C++ Compiler ustom Build	List Preprocessor D	Diagnostics	Encodings	Extra Options
astorn solid	Language 1 Language 2	Code	Optimizatio	ns Output
	Language C C++ Auto (extension-based)	O Sta	age conformanc andard with IAR andard rict	
	C dialect C C89 Standard C Allow VLA C++ inline semantics Require prototypes	En	ptions able exceptions able RTTI estroy static obje	cts

Right-click the file you want to configure, open options, and change "Exclude from build". If you want to use the file, uncheck "Exclude from build", otherwise uncheck "Exclude from build".

DMAC disabled:

	bsp_config_sbk_m4xn_uart_io.c bsp_config_sbk_m4xn_uart_io_dma.c	Use files Don't use files
DMAC ena	abled: bsp_config_sbk_m4xn_uart_io.c bsp_config_sbk_m4xn_uart_io_dma.c	Don't use files Use files

Please build after changing the settings.

6.6.2. Keil µVision

🕅 Options for Target 'Sample_FYAx'		×	
Device Target Output Listing User	C/C++ Asm Linker Debug Utilities		
Preprocessor Symbols			
Define: NODMAC,UART_DMA_TRA	NSFER_USE		
Undefine:			
Language / Code Generation			
Execute-only Code	🗆 Strict ANSI C Warnings: All Warnings 💌		
Optimization: Level 1 (-01) 💌	Enum Container always int		
Optimize for Time	Plain Char is Signed		
Split Load and Store Multiple	☐ Read-Only Position Independent		
One ELF Section per Function	☐ Read-Write Position Independent ☐ GNU extensions		
Paths Misc	ART¥UART_RECEIVE;¥¥¥¥¥Utility¥inc;¥¥¥¥¥MCU¥Driver		
Compiler control string			
ОК	Cancel Defaults Help		

Open "Project" \rightarrow "Options for Target 'Sample'" \rightarrow "C/C++". Change "Define:" of "Preprocessor Symbols" as shown below.

- · If you do not use DMAC, select "NODMAC"
- "DMA" and "UART_DMA_TRANSFER_USE" when using DMAC



Project	· I
Project: UART_RECEIVE	
🖨 🞥 Sample_FYAx	
BSP	
bsp.c	
bsp_config_sbk_m4kn_led.c	
bsp_config_sbk_m4kn_uart_io_c	ns for File 'bsp_config_sbk_m4kn_uart_io.c' Alt++7
and papeoning_box_initia_date	re File 'bsp_config_sbk_m4kn_uart_io.c'
TSB driver	
I Utility	ge Project Items
CMSIS	bsp_config_sbk_m4kn_uart_io.c d all target files
Build T	-
Transla	ate bsp_config_sbk_m4kn_uart_io.c
Show	Include File Dependencies
Options for File 'bsp_config_sbk_m4kn_uart_io.c'	×
Properties C/C++	
Fropercies [C/C++]	1
Path:¥¥¥¥BSP¥SBK_M4KN¥src¥b	osp_config_sbk_m4kn_uart_io_c
File Type: C Source file	Include in Target Build
Size: 19873 Bytes	Nways Build
last change: Thu Mar 7 15:40:42 2024	Generate Assembler SRC File
	Assemble SRC File
Stop on Exit Code: Not specified	🗾 🔽 Image File Compression
Custom Arguments:	
Memory Assignment:	
Code / Const; <a>	_
Zero Initialized Data: <a>	
Other Data: <a> </td <td></td>	
Layer: <pre><not assigned=""></not></pre>	V
	Carpool Defaulto Hale
OK	Cancel Defaults Help

Right-click the file you want to configure, open Options for File 'xxxx.c' and change "Include in Target Build". If you want to use the file, check "Include in Target Build", otherwise uncheck "Include in Target Build".

Use files

Don't use files

DMAC disabled:

bsp_config_sbk_m4xn_uart_io.c bsp_config_sbk_m4xn_uart_io_dma.c

DMAC enabled:

bsp_config_sbk_m4xn_uart_io.c bsp_config_sbk_m4xn_uart_io_dma.c

Don't use files a.c Use files

Please build after changing the settings.

6.6.3. SEGGER Embedded Studio

🔪 🧅 Sample_FYAx 🔹	Search Options	Show Modified	Options Onl
Code Assembler	Option	Value	
Build	A Preprocessor		
Code Analyzer	Add Property Group Options	Yes	•
Code Generation	Ignore Includes	No	
Compiler	Include Files		
Compiler Warning	Include Files Assembler Only		
External Build	 Include Files C Compiler Only 		
File	 Include Files C++ Compiler Only 		
Libraries	Macro Files		
Library	Macro Files Assembler Only		
Linker	Macro Files C Compiler Only		
	Macro Files C++ Compiler Only		
Preprocessor	Preprocessor Definitions	NODMAC;UART_DMA_TRA	NSFER_USE
Printf/Scanf	Preprocessor Definitions Assembler Only		-
Runtime Memory Area	Preprocessor Definitions C Compiler Only		
Section	Preprocessor Definitions C++ Compiler Only Preprocessor Undefinitions		
Source Code	Preprocessor Undefinitions		
User Build Step	Add Property Group Options		
Debug	Add Property Group Options		
Debugger	Supply the defines and includes that are selected by the property group.		
GDB Server			
J-Link			
Loader			
Loader			

 $\label{eq:open_project} \mbox{Open "Project"} \ \rightarrow \ \mbox{"Options"} \ \rightarrow \ \mbox{"Preprocessor"}.$

Change "Preprocessor Definitions" as shown below.

- · If you do not use DMAC, select "NODMAC"
- "DMA" and "UART_DMA_TRANSFER_USE" when using DMAC

*Change "Common" as well as "Sample_xxx".

oject 'UART_RECEIV	E' Options	
•	ch Options	Show Modified Options
Bui Public Configurations	option	Value
Co Co Sample_F10Ax	Macro Files Assembler Only	
Co Sample_FYAx	Macro Files C Compiler Only	
Co Private Configurations	Macro Files C++ Compiler Only	
Common	Preprocessor Definitions	DMA;UART DMA TRANSFER USE modified;inherits
External Build	Preprocessor Definitions Assembler Only	
File	Preprocessor Definitions C Compiler Only	
Libraries	 Preprocessor Definitions C++ Compiler On 	
Library	Preprocessor Undefinitions	
Linker	Preprocessor Undefinitions Assembler Only	
Preprocessor	 Preprocessor Undefinitions C Compiler On 	
Printf/Scanf	Preprocessor Undefinitions C++ Compiler	nly
Runtime Memory Area	 System Include Directories 	
Section	Preprocessor Definitions	
Source Code		
User Build Step	Specifies one or more preprocessor definitions.	'his property will have macro expansion applied to it.
ebug	Inherits	
eoug	INCOMACUART DAVA TRANSFER USER (

Project Explorer				
🕄 Sample_F10Ax 🔹 🔄 😭 🖸	• :</td <td>></td> <td>*</td> <td>7 0</td>	>	*	7 0
Project Items			Code	Data+RC
 Solution 'UART_RECEIVE' Project 'UART_RECEIVE' Setup 1 file Sourse Files 15 files APP 1 file BSP 4 files bsp.c bsp_config_sbk_m4kn_led.c bsp_config_sbk_m4kn_uart_io.c bsp_config_sbk_m4kn_uart_io.dm 	1000	Options	Alt+Return	
 TSB_driver 9 files Utility 1 file System 4 files 	°я С С	Compile Export Build Analyze Open Binary Editor Show Preprocessor Output Show Preprocessor Defines Format Code	Ctrl+F7	
		Exclude From Build Import Copy Full Path Select in File Explorer Flag	> ,	
	× 1	Cut Copy Remove	Ctrl+X Ctrl+C	

Right-click the file you want to configure and change "Exclude From Build". If you want to use a file, uncheck "Exclude From Build", otherwise check "Exclude From Build".

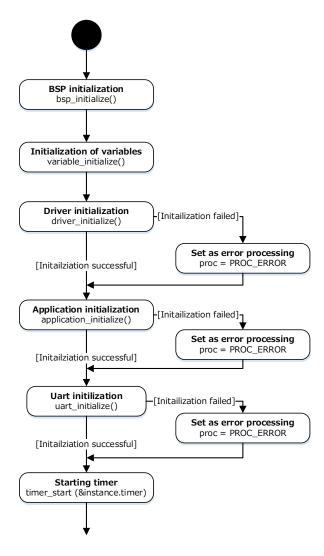
DMAC disabled:

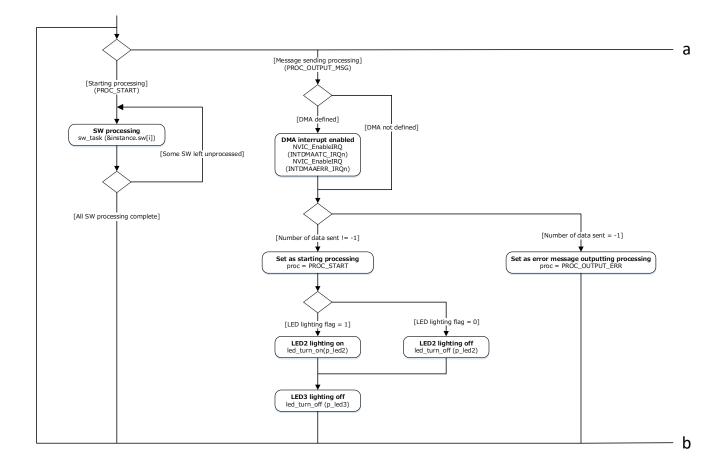
bsp_config_sbk_m4xn_ua bsp_config_sbk_m4xn_ua	Use files Don't use files
DMAC enabled: bsp_config_sbk_m4xn_ua bsp_config_sbk_m4xn_ua	Don't use files Use files

Please build after changing the settings.

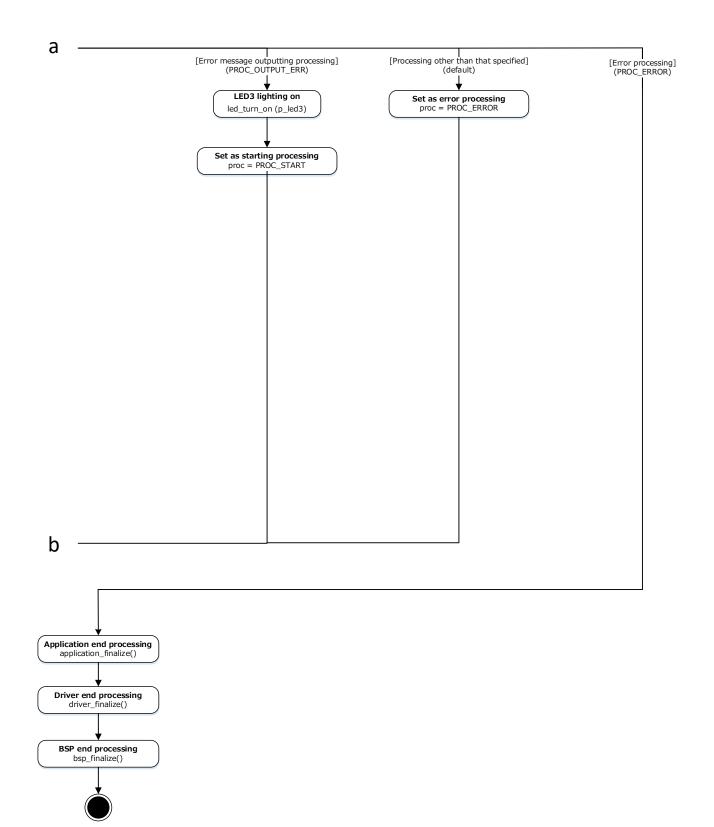
7. Activity diagram

7.1. main

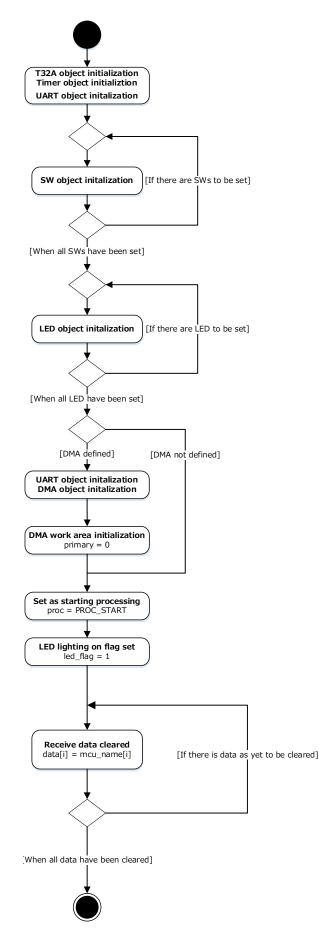




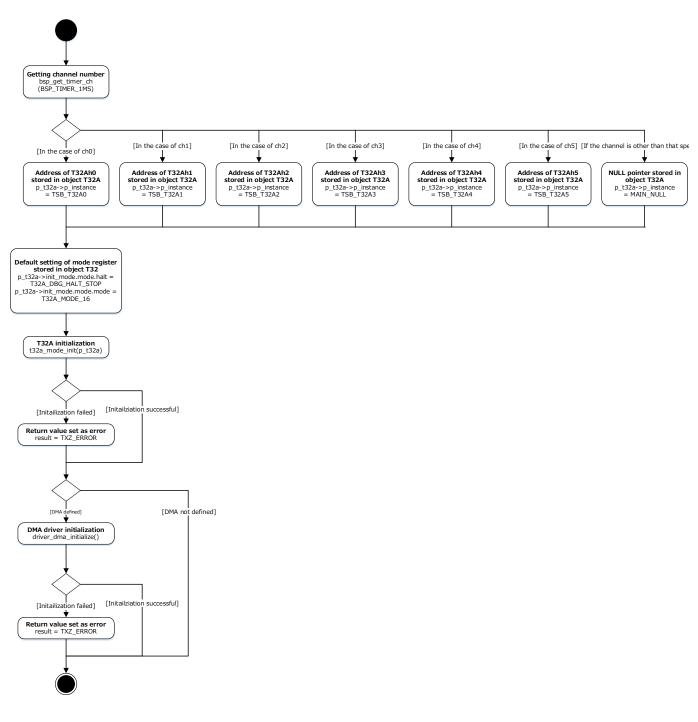




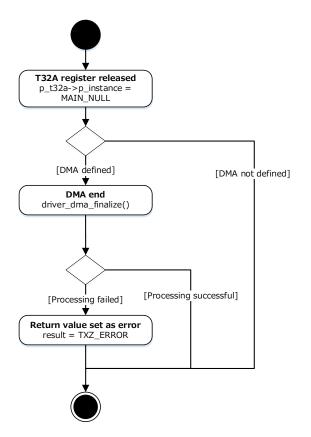
7.2. variable_initalize



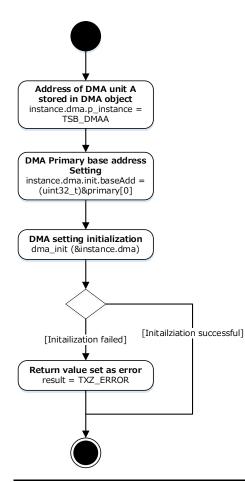
7.3. driver_initialize



7.4. driver_finalize

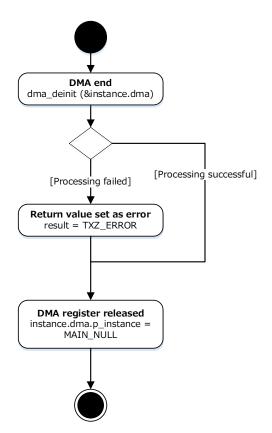


7.5. driver_dma_initialize

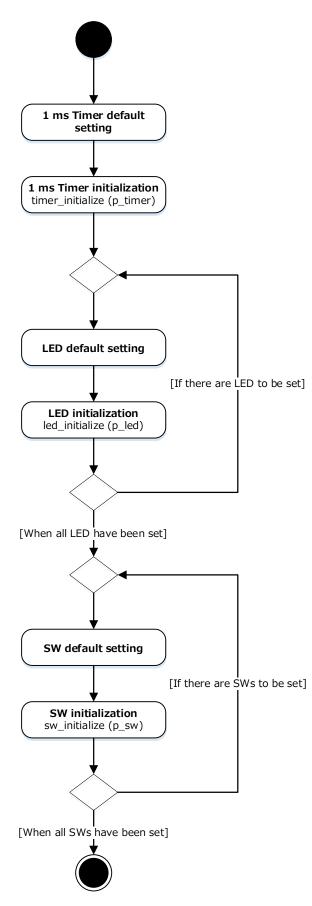




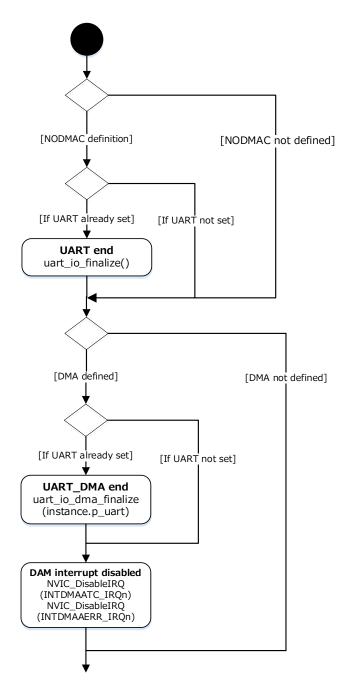
7.6. driver_dma_finalize

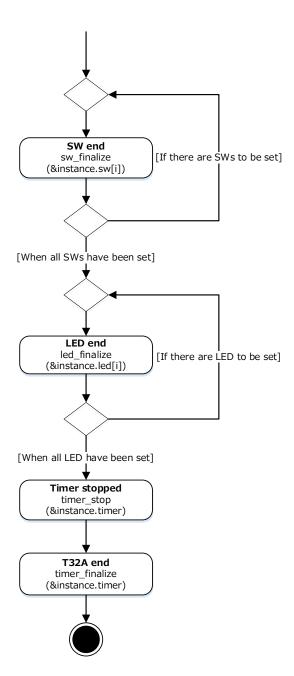


7.7. application_initialize

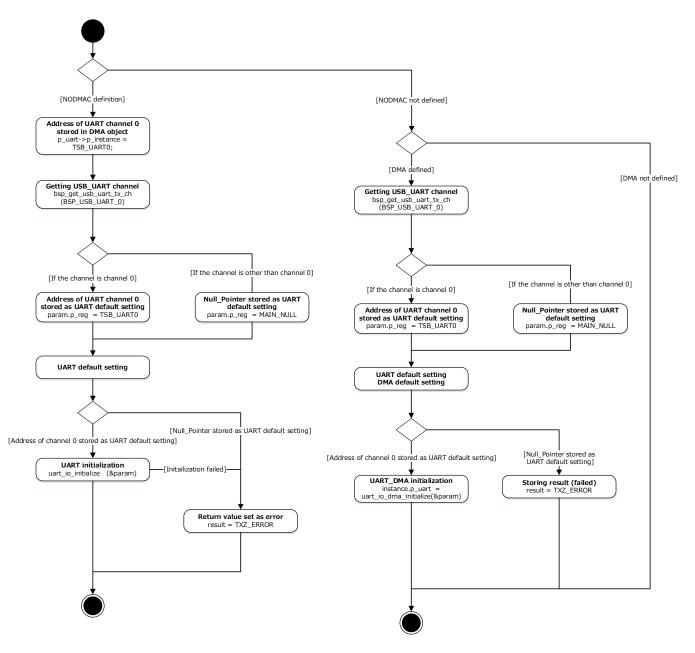


7.8. application_finalize

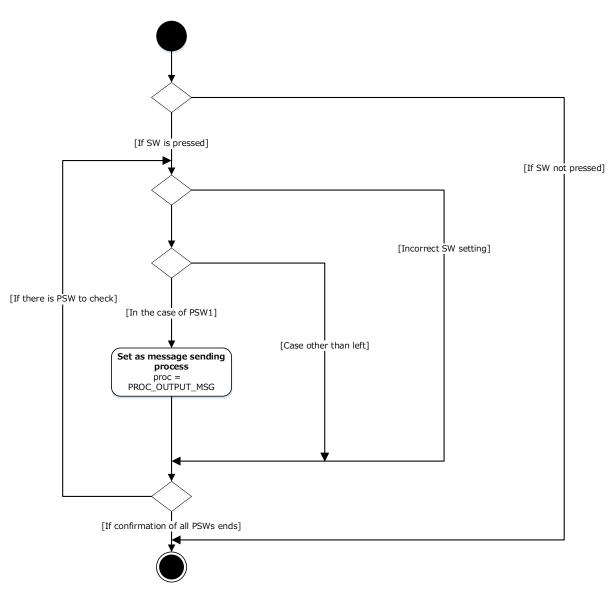




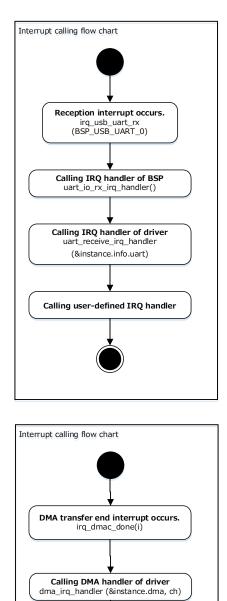
7.9. uart_initialize



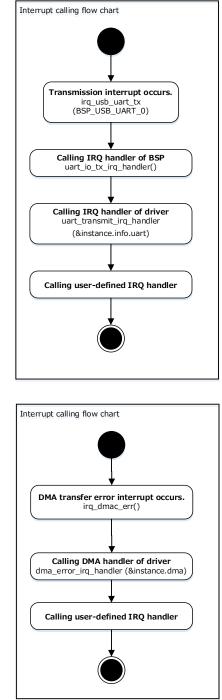
7.10. sw_state_change_handler

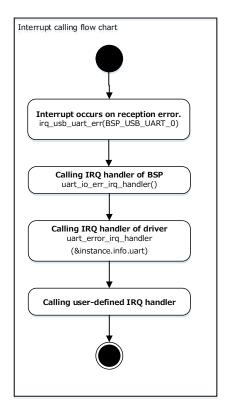


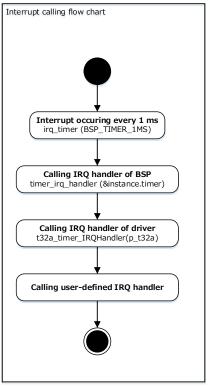
7.11. Interrupt

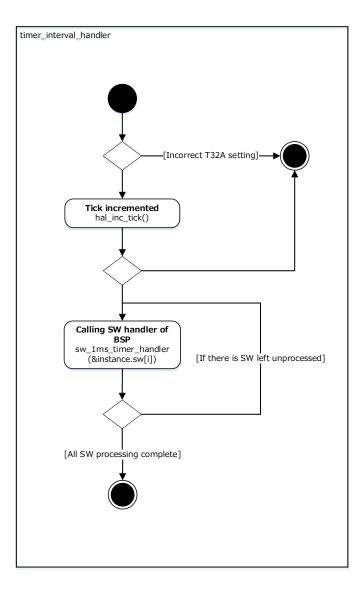


Calling user-defined IRQ handler









8. Revision History

Revision	Date	Description
1.0	2023-10-16	First release
1.1	2024-03-25	Added method to switch DMAC function
1.2	2024-07-16	Added detailed description of DMAC function switching

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