easyDSP help

Table of Contents

1. easyDSP ?

Welcome to easyDSP for real-time MCU debugging

'easyDSP' is a powerful graphical user interface (GUI) for the maintaining, configuring and trouble-shooting of embedded software with strict real-time requirements. The tool automatically extracts the symbol information from the files generated by the cross-compiler and presents the user with windows for the viewing, editing, logging and graphing of those symbols, in real-time, while the target software is executing. easyDSP communicates with the target MCU over a serial communication link, typically SCI (or USART). On the target, only a small "remote agent" needs to be called periodically in the background task. Since the remote agent runs on spare processor cycles, it does not interfere with the interrupt driven part of the software. This makes the tool ideal for interfacing with power electronics control software, where the control tasks need to be executed uninterruptedly and with minimal latency. The fact that easyDSP does not depend on JTAG/SWD for communicating with the target makes the tool operate reliably in environments with strong EMI and/or high-voltage isolation requirements. easyDSP can supports multiple operation so that you can control several MCU boards by using several easyDSPs in single PC.

easyDSP is designed for the real-time communication between MCU and an IBM PC or compatible running 64bits Windows .
Supporting MCU :

- TI : C28x, TM4C, MSPM0 and AM263x series
- ST : STM32 series
- Infineon : PSoC4, XCM1 and XMC4 seriels
- Renesas : RA, RX series
- Toshiba : TX and TXZ3 series
- NXP : LPC1x00, S32K, S32M series

The detailed information is available here . For the support of other MCU, please contact easydsp@gmail.com.

Customers are
universities in Korea (Seoul National, HanYang, SungKyunKwan, Kangwon, Busan, KAIST, …),
companies in Korea (Samsung, LG, Hyundai, LS, Onsemi, Infineon, …),
company outside Korea (Yaskawa, Raytheon Technologies, Collins Aerospace, Carrier, General Motors , Delphi, Grid-bridge, R&D Dynamics, ADI American Distributors Ltd ...)
university outside Korea (FEEC@ECE, Virginia Tech)

For more information, visit www.easydsp.com or
mail to easydsp@gmail.com for program bug, improvement idea, and other technical inquiry,
hr.oh@egreenpower.com for purchsing, AS, easyDSP Pod hardware inquiry.

Thank you.

Acknowledgment :
This software is based in part on the work of the Independent JPEG Group.
This software is based in part on the work of the FreeType Team.
This software is based on pugixml library (http://pugixml.org). pugixml is Copyright (C) 2006-2018 Arseny Kapoulkine.

2. Products type

		
type 1	type 2	type 3

In below, you need to purchase easyDSP type by type.

Type	Supporting MCU	MCU Communication Channel	Comments
type 1	TI C28x	SCI	Standard isolation type. Digital isolator is used inside easyDSP pod for isolation purpose.
type 2	TI C28x	SCI	Optic cable isolation type. Stable long-distance communication with optic cable (HFBF1414Z/HFBF2412Z). Cable distance : variable(upto 200m) upon request.
type 3	ST STM32 TI AM263x TI TM4C TI MSPM0 Infineon PSoC4 Infienon XMC1 Infineon XMC4	USART or UART or SCI	Standard isolation type. Digital isolator is used inside easyDSP pod for isolation purpose.

	Renesas RA Renesas RX Toshiba TX Toshiba TXZ3 NXP LPC1x00 NXP S32		

Please check the part number of MCU below.
notation : [a,b] = a or b, x = any

MCU	part number
TI C28x	TMS320F280[1,2,6,8,9], TMS320F2801[5,6], TMS320F28044, TMS320F281[0,1,2], TMS320F2802[20,30,60,70], TMS320F2802[0,1,2,3,6,7,00], TMS320F2803[0,1,2,3,4,5],TMS320F2805[0,1,2,3,4,5],TMS320F2806[2,3,4,5,6,7,8,9],TMS320F2807[4,5,6], TMS320F28001[32,33,35,37], TMS320F28001[52,53,54,55,56,57], TMS320F28002[1,2,3,4,5],TMS320F28003[3,4,6,7,8,9],TMS320F28004[0,1,5,8,9],TMS320F2823[2,4,5],TMS320F2833[2,3,4,5],TMS320C2834[1,2,3,4,5,6],TMS320F2837[4,5,6,7,8,9]S,TMS320F2837[4,5,6,7,8,9]D,TMS320F2838[4,6,8]S, TMS320F2838[4,6,8]D, TMS320F28P55xS[D,G,J], TMS320F28P65x[S,D][H,K]
TI AM263x	AM263[1,2,4]
TI TM4C	TM4C123[0,1,2,3][C3,D5,E6,H6], TM4C123[6,7][D5,E6,H6], TM4C123[A,B,F,G][E6,H6], TM4C129[0,2]NC, TM4C1294[K,N]C, TM4C1297NC, TM4C1299[K,N]C, TM4C129[C,D]NC, TM4C129E[K,N]C, TM4C129LNC, TM4C129X[K,N]C
TI MSPM0	MSPM0Lxxx[3,4,5,6,7], MSPM0Gxxx[5,6,7]
ST STM32	STM32C011x[4,6], STM32C031x[4,6], STM32C051x[6,8] NEW , STM32C071x[8,B], STM32C091x[B,C] NEW , STM32C092x[B,C] NEW , STM32F030x[4,6,8,C], STM32F031x[4,6], STM32F031x6, STM32F038x6, STM32F042x[4,6], STM32F048x6, STM32F051x[4,6,8], STM32F058x8, STM32F070x[6,B], STM32F071x[8,B], STM32F072x[8,B], STM32F078xB, STM32F091x[B,C], STM32F098xC, STM32F100x[4,6,8,B,C,D,E], STM32F101x[4,6,8,B,C,D,E,F,G], STM32F102x[4,6,8,B], STM32F103x[4,6,8,B,C,D,E,F,G], STM32F105x[8,B,C], STM32F107x[B,C], STM32F205x[B,C,E,F,G], STM32F207x[C,E,F,G], STM32F215x[E,G], STM32F217x[E,G], STM32F301x[6,8], STM32F302x[6,8,B,C,D,E], STM32F303x[6,8,B,C,D,E], STM32F318x8, STM32F328x8, STM32F334x[4,6,8], STM32F358xC, STM32F373x[8,B,C], STM32F378xC, STM32F398xE, STM32F401x[B,C,D,E], STM32F405x[E,G], STM32F407x[E,G], STM32F410x[8,B], STM32F411x[C,E], STM32F412x[E,G], STM32F413x[G,H], STM32F415xG, STM32F417x[E,G], STM32F423xH, STM32F427x[G,I], STM32F429x[E,G,I], STM32F437x[G,I], STM32F439x[G,I], STM32F446x[C,E], STM32F469x[E,G,I], STM32F479x[G,I], STM32F722x[C,E], STM32F723x[C,E], STM32F730x8, STM32F732xE, STM32F733xE, STM32F745x[E,G], STM32F746x[E,G], STM32F750x8, STM32F756xG, STM32F765x[G,I], STM32F767x[G,I], STM32F769x[G,I], STM32F77[7,8,9]xI, STM32G030x[6,8], STM32G031x[4,6,8], STM32G041x[6,8], STM32G050x[6,8], STM32G051x[6,8], STM32G061x[6,8], STM32G070xB, STM32G071x[8,B], STM32G081xB, STM32G0B0xE, STM32G0B1x[B,C,E], STM32G0C1x[C,E], STM32G431x[6,8,B], STM32G441xB, STM32G473x[B,C,E], STM32G474x[B,C,E], STM32G483xE, STM32G484xE, STM32G491x[C,E], STM32G4A1xE, STM32H503xB, STM32H523x[C,E], STM32H533xE, STM32H562xG, STM32H562xI, STM32H563xG, STM32H563xI, STM32H573xI,

	STM32H723x[E,G], STM32H725x[E,G], STM32H730xB, STM32H733xG, STM32H735xG, STM32H742x[G,I], STM32H743x[G,I], STM32H745x[G,I], STM32H747x[G,I], STM32H750xB, STM32H753xI, STM32H755xI, STM32H757xI, STM32H7A3x[G,I], STM32H7B0xB, STM32H7B3xI, STM32L010x[4,6,8,B], STM32L011x[3,4], STM32L021x4, STM32L031x[4,6], STM32L041x6, STM32L051x[6,8], STM32L052x[6,8], STM32L053x[6,8], STM32L06[2,3]x8, STM32L07[1,2,3]x[8,B,Z], STM32L08[1,2]x[B,Z], STM32L083x[8,B,Z], STM32L100x[6,8,B,C], STM32L151x[6,8,B,C,E], STM32L152x[6,8,B,C,D,E], STM32L162x[C,D,E], STM32L100x[8,B]-A, STM32L151x[6,8,B,C]-A, STM32L152x[6,8,B,C]-A, STM32L162xC-A, STM32L15[1,2]xD-X, STM32L162xD-X, STM32L412x[8,B], STM32L422xB, STM32L431x[B,C], STM32L432x[B,C], STM32L433x[B,C], STM32L442xC, STM32L443xC, STM32L451x[C,E], STM32L452x[C,E], STM32L462xE, STM32L471x[E,G], STM32L475x[C,E,G], STM32L476x[C,E,G], STM32L486xG, STM32L496AE, STM32L496x[E,G], STM32L4A6xG, STM32L4P5x[E,G], STM32L4Q5xG, STM32L4R5x[G,I], STM32L4R7xI, STM32L4R9x[G,I], STM32L4S[5,7,9]xI, STM32L552x[C,E], STM32L562xE, STM32U031x[4,6,8], STM32U073x[8,C], STM32U083xC, STM32U375x[E,G] NEW, STM32U385xG NEW , STM32U535x[B,C,E], STM32U545xE, STM32U575x[G,I], STM32U585xI, STM32U575x[G,I], STM32U585xI, STM32U595x[I,J], STM32U599x[I,J], STM32U5A5x[I,J], STM32U5A9xJ, STM32U5F[7,9]xJ, STM32U5G[7,9]xJ, STM32WB[10,15]xC, STM32WB30xE, STM32WB35x[C,E], STM32WB50xG, STM32WB55x[C,E,G,Y], STM32WB05xZ, STM32WB06xC, STM32WB07xC, STM32WB09xE, STM32WBA50xG NEW , STM32WBA52x[E,G], STM32WBA5[4,5]x[E,G] , STM32WL33x[8,B,C], STM32WL5[4,5]xC, STM32WLE[4,5]x[8,B,C]
Infineon PSoC4	CY8C402[4,5], CY8C404[5,6], CY8C412[4,5],CY8C4126xxx-S42x, CY8C4126xxx-S43x, CY8C4126xxx-S44x, CY8C4126xxx-S45x, CY8C4126xxx-Mxxx, CY8C4127xxx-Sxxx, CY8C4127xxx-Mxxx, CY8C4127xxx-BLxxx, CY8C4128xxx-Sxxx, CY8C4128xxx-BLxxx, CY8C414[5,6,7,8], CY8C424[4,5], CY8C4246xxx-DSxxx, CY8C4246xxx-Mxxx, CY8C4246xxx-Lxxx, CY8C4247xxx-Mxxx, CY8C4247xxx-Lxxx, CY8C4247xxx-BLxxx, CY8C4248xxx-Lxxx, CY8C4248xxx-BLxxx, CY8C454[6,7,8], CY8C472[4,5], CY8C474[4,5]
Infienon XMC1	XMC1100-xxxxx0[008,016,032,064], XMC120x-xxxxx0[016,032,064,128,200], XMC130x-xxxxx0[016,032,064,128,200], XMC140x-xxxxx0[032,064,128,200],
Infineon XMC4	XMC410x-xxxx[64,128], XMC4200-xxxx256, XMC4300-xxxxx256, XMC440x-xxxxx[256,512], XMC450x-xxxxx[512,768,1024], XMC4700-xxxxx[1536,2048], XMC4800-xxxxx[1024,1536,2048]
Renesas RX	R5F5110[1,3,4,5,H,J], R5F5111[1,3,4,5,6,7,8,J], R5F5113[5,6,7,8], R5F5130[3,5,6,7,8], R5F513T[3,5], R5F5140[3,5,6], R5F5230[5,6], R5F5231[5,6,7,8], R5F523E[5,6], R5F523T[3,5], R5F523W[7,8], R5F524T[8,A,B,C,E], R5F524U[B,C,E], R5F526T[8,9,A,B,F], R5F5651[4,7,9,C,E], R5F565N[4,7,9,C,E,D,N], R5F5660[4,9], R5F566N[D,N], R5F566T[A,E,F,K], R5F5671[9,C,E], R5F571M[F,G,J,L], R5F572M[D,N], R5F572N[D,N], R5F572T[F,K]
Renesas RA	R7FA0E1x[5,7] NEW, R7FA2A1xB, R7FA2A2xD, R7FA2E1x[5,7,9], R7FA2E2x[3,5,7], R7FA2E3x[5,7], R7FA2L1x[9,B], R7FA4E1x[B,D], R7FA4E2x9, R7FA4L1x[B,D] NEW , R7FA4M1AB, R7FA4M2x[B,C,D], R7FA4M3x[D,E,F], R7FA4T1x[9,B], R7FA4W1xD, R7FA6E1x[D,F], R7FA6E2x[9,B],R7FA6M1xD, R7FA6M2x[D,F], R7FA6M3x[F,H], R7FA6M4x[D,E,F], R7FA6M5x[F,G,H], R7FA6T1x[B,D], R7FA6T2x[B,D], R7FA6T3xB, R7FA8D1x[F,H], R7FA8M1x[F,H], R7FA8T1x[F,H], R7FA8E1xF,

	R7FA8E2xF
Toshiba TX and TXZ3	TMPM03[6,7]FW, TMPM06[1,6,7,8]FW, TMPM330F[D,W,Y], TMPM332FW, TMPM333F[D,W,Y], TMPM341F[D,Y], TMPM365FY, TMPM366FD, TMPM367FD, TMPM368FD, TMPM369FD, TMPM370FY, TMPM372FW, TMPM373FW, TMPM374FW, TMPM375FS, TMPM376FD, TMPM37AFS,TMPM380F[W,Y], TMPM381FW, TMPM383F[S,W], TMPM384FD,TMPM3U0FS, TMPM3U6F[W,Y], TMPM3V4F[S,W], TMPM3V6FW, TMPM440F[10,E], TMPM461F[10,15], TMPM462F[10,15], TMPM46BF10, TMPM3H0F[M,S], TMPM3H1F[P,S,W,U], TMPM3H2F[S,U,W], TMPM3H3F[S,U,W], TMPM3H4F[S,U,W], TMPM3H5F[S,U,W], TMPM3H6F[S,U,W], TMPM3HLF[D,Y,Z], TMPM3HMF[D,Y,Z], TMPM3HNF[D,Y,Z], TMPM3HPF[D,Y,Z], TMPM3HQF[D,Y,Z]
NXP S32 NEW	S32K11[6,8], S32K14[2,4,6,8], S32K31[0,1,2,4], S32K34[1,2,4,8], S32M24[1,2,3,4], S32M27[4,6]
NXP LPC1xxx	LPC13x[1,2,3], LPC131[5,6,7], LPC134[5,6,7], LPC15x[7,8,9], LPC175[1,2,4,6,8,9], LPC176[3,4,5,6,7,8,9], LPC177[3,4,6,7,8], LPC178[5,6,7,8], LPC181[2,3,5,7], LPC182[2,3,5,7], LPC183[3,7], LPC185[3,7], LPC18S[3,5]7

Please contact easyDSP@gmail.com for new MCU support.

3. starting easyDSP

For those who use easyDSP first time, please refer to below steps.
The details could be different by target MCU.

Step	Process	Remark
1	hardware connection between easyDSP and MCU	Hardware connection between MCU and easyDSP. Please refer the help file 'How to user MCU'.
2	correction of user program	First, inlude the source file and header file for easyDSP communication into your project. You can find these files in the 'source' folder in the folder easyDSP is installed. Second, modify the #define variable in the header file according to your system. For some MCU, you don't need this process. Third, include this header file in the main.c and call the function for easyDSP communication. Please refer to the help file 'How to user MCU'.
3	creation of easyDSP project	Creates easyDSP project. Refer to the help file 'Menus>Project'.
4	MCU booting	Booting of MCU via either 'RAM booting' or 'Flash ROM' menus. Refer to the help file 'Menus>MCU'.
5	easyDSP monitoring	Monitoring of variables of MCU program by using versatile easyDSP windows.

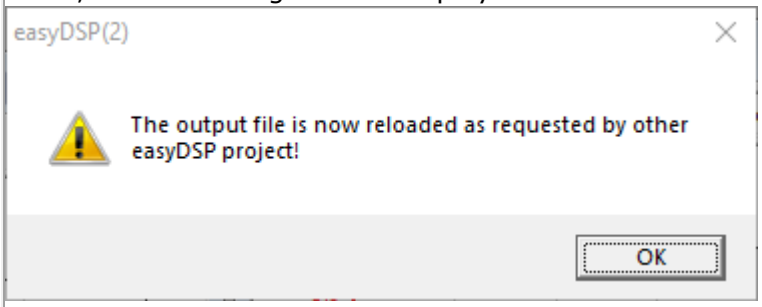
6	modification of user program	For debugging of your program, change your program under IDE environment.
7	MCU booting	Like step 4, boot MCU with new user program.
8	easyDSP monitoring	Like step 5.

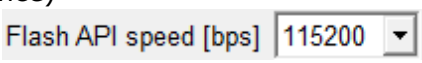
4. Revision History

Version	MCU	Revision items
ver 11.4 Apr/2025	Common	- Sector selection in the flash programming dialog can be blocked by 'Freeze' check box for some MCU series **Bug Fix :** when using auto scale in Y-axis of plot window, same Y-axis range is applied to all plot windows
	TI C28x	- for Gen3 MCU, flash programming is supported even when the address alignment of its section is wrong - new style of flash dialog box for F2837xS, F2807x, F28002x, F28003xand F28004x **Bug Fix :** - for Gen3 MCU, flash programming could fail if the section size exceeds 0xFFFF - wrong identification of used sector in flash dialog of F28Px and F28001x
	ST STM32	- new function to erase all the flash (Erase chip button in the flash dialog) - new support for STM32U375x[E,G] and STM32U385xG (source file easyStm32LL_v11.4.c is required) - new support for STM32WBA50xG, STM32C051x[6,8], STM32C091x[B,C] and STM32C092x[B,C] - The error that periodic writing 32 bytes 0xFF data to flash for the specific bootloader version of STM32H72x and STM32H73x is corrected - support for both single and dual bank for STM32L471xE, STM32L475x[C,E], STM32L476x[C,E] and STM32L496xE **Bug Fix :** - flash programming error for swapped dual bank of STM32U5, STM32L5, STM32H7 and STM32G0 - compile error in the file "easyStm32LL v11.3.c" when using STM32H7 dual core and STM32WL3x - incorrect page address ofdual bank mode of STM32F76[5,7,9]xI and STM32F77[7,8,9]xI - flash programming for STM32WL33x is not working
	NXP S32K	- support new MCU S32K series : S32K11[6,8], S32K14[2,4,6,8], S32K31[0,1,2,4], S32K34[1,2,4,8], S32M24[1,2,3,4] and S32M27[4,6]
	Renesas RA	- support R7FA4L1x[B,D] and R7FA0E1x[5,7] (source file easyRA_v11.4.c is required)
ver 11.3 Jan/2025	Common	- DWARF5 support improvement
	ST STM32	- support for STM32WB05xZ, STM32WB06xC, STM32WB07xC and STM32WB09xE (source file easyStm32LL_v11.3.c is required)

		- support for STM32H523x[C,E], STM32H533xE and STM32C071x[8,B] **Bug Fix :** STM32WB09xE is not supported
	Renesas RA	- support for R7FA8E1xF and R7FA8E2xF
	Renesas RX	**Bug Fix** :monitoring failure of 8 bytes variable and pointer variable (bug from ver 11.1)
ver 11.2 May/2024	TI C28x	- TMS320F28P55xS series support (source file easy28x_bitfield_v11.2.c is required) **Bug Fix :** flash programming error for bank 4 of TMS320F28P65xDH
	ST STM32	- STM32U0 series support (source file easyStm32LL_v11.2.c is required) - support for STM32U5A5xI,STM32U5F7xJ, STM32U5F9xJ, STM32U5G7xJ and STM32U5G9xJ - support for STM32WB09xE, STM32WBA54x[E,G], STM32WBA55x[E,G] and STM32WL33x[8,B,C]
	Renesas RA	- RA2A2, RA8T1 MCU series support **Bug Fix :** no new project created for RA8D1 MCU
	Renesas RX	- RX23E-B series support
ver 11.1 Jan/2024	Common	- Writing to variable is not allowed if the variable is located in the flash **Bug Fix :** malfunction of plot window when 'Total plot period' is more than 71582 minutes
	ST STM32	- STM32U535, STM32U545, STM32U595, STM32U599, STM32U5A5 and STM32U5A9 series are supported
	Renesas RA	- RA2E3, RA4E2, RA4T1, RA6E2, RA6T3, RA8D1 , RA8M1 MCU series support (together with easyRA_v11.1.c and easyRA_v11.1.h) **Bug Fix :** flash programming not available for RA6M5 with flash area 1.5MB or higher
	Renesas RX	- RX26T support
	NXP LPC1xxx	- support flash programming of LPC1500 series - supportLPC1300, LPC1700 and LPC1800 (with onchip flash) series **Bug Fix :** wrong address recognition of 'array of union' variable
	TI AM2x	- changes related to RAM booting and flash programming (app image file changeable, SBL baudrate changeable, no SBL image file provided by easyDSP) **Bug Fix :** no "MulticoreImageGen.exe" file exits in the easyDSP/Util folder. Bug from v10.8 to v11.
ver 11 Sep/2023	TI C28x	- Support for TMS320F28P65x (source file v11 is required) - F2837xD, F2838xD : change of sharable memory management for CPU2 ram booting (source file v11 is required) **Bug Fix :** In case TMS320F2838xD CPU1 uses DriverLib libray : CM fails to flash boot if CPU2 is used (source file 'easy28x_driverlib_v11.c' is required)

	TI MSPM0	- Support for MSPM0 series
ver 10.9 Jun/2023	ST STM32	- S upport for STM32H5 and STM32WBA series with new source file 'easyStm32LL v10.9.c' **Bug Fix :** verifying flash failed for STM32H7, STM32L0, STM32L1, STM32L5 and STM32U5 in some case due to wrong flash programming
	NXP LPC1500	- supports NXP 1500 series (no support flash programming)
ver 10.8 Apr/2023	Common	- Multi dimensional array is supported upto 10 dimension. In the previous version, only up to 4 dimension. - Array window : when copying the selected cells to clipboard, easyDSP first fills the empty cells if any.
	TI C28x	- Support for TMS320F280015x with new source files (easy28x_bitfield_v10.8.c or easy28x_driverlib_v10.8.c) **Bug Fix :** for TMS320F280013x, flash programming doesn't work out in some case
	ST STM32	- supports STM32C0 MCU series with new source file 'easyStm32LL v10.8.c'
	Renesas RX	- supports RX MCU series
ver 10.7 Jan/2023	Common	- Watch window : variable row can be moved up and down - Watch/Memory/Tree/Array windows : optionally highlight the changed cell with yellow background color
	TI AM2x	- Support for AM263x
	TI TM4C	- Support for TM4C123x and TM4C129x
ver 10.6 Nov/2022	TI C28x	- Support for TMS320F280013x with new source files (easy28x_bitfield_v10.6.c or easy28x_driverlib_v10.6.c) - No need to run easyDSP as administrator **Bug Fix :** Symbol information is not extracted in multi core MCU from CPU2 (bug for version 10.5.1 only)
ver 10.5.1 Nov/2022	TI C28x	**Bug Fix :** Flash operation is not working with error message "The variables in flash API wrapper are not fully recognized!" (bug for version 10.3 and higher)
ver 10.5 Nov/2022	Common	- No more support for old style memory window - Memory Window : In case &var format is used as address input, if it is changed with code modification, the address of the window is automatically changed after MCU booting. **Bug Fix :** - Command Window : incomplete auto variable seeking for struc/union/bitfield variables
	ST STM32	- Source file is updated to easyStm32LL_v10.5.c. With this, 1. STM32G0x : In the RAM booting and Flash Programmer dialog, entering bootloader is improved 2. STM32H7 dual core (STM32H745x, STM32H747x, STM32H755x and STM32H757x) : Data cache usable

		3. If FIFO is available to USART, you can use it to speed up easyDSP communication
	Toshiba TXZ3	- supports Toshiba TXZ3 MCU series
ver 10.4 May/2022	Common	**Bug Fix :** - When using DWARF4 or DWARF5 debugging information format with ARM MCU, the address and bit location of bitfield variable is not correct in certain cases.
	TI C28x	**Bug Fix :** - For 2838x, the flash operation is not working unless all the CPU1, CPU2 and CM are used in the project. This is the bug of v10.3 and v10.3.1 only.
	Toshiba TX	- supports Toshiba TX MCU series
ver 10.3.1 Apr/2022	TI C28x	**Bug Fix :** - For 2838x, the easyDSP project is not created/open unless all the CPU1, CPU2 and CM are used in the project. This is the bug of v10.3 only.
ver 10.3 Apr/2022	Common	- Watch window : address column includes bit information in case ofbitfield variable (for ex, 0x1234@bit1-2) - Chart window : 1 dimmentional array variable only. count input by user is blocked. It's fixed to array count. - Tree window : mouse right click toggles the display mode (decimal => hex-decimal => binary => decimal....) - Memory window : versatile address input format and comment are enabled - Faster symbol information processing - Driver file updated to CDM212364_Setup.exe - Display mode (hex or dec or bin) for bitfield variable is changeable **Bug Fix** : - Member of anonymous structure/union variable is not properly displayed - Anonymous bitfield member is not properly displayed - Bitfield member with its size more than 4 bytes is not properly displayed
	TI C28x	- When using multiple easyDSP projects for multi core MCU such as 2837xD and 2838xS/D, If the output file of CPU2 or CM is reloaded as requested by CPU1, below message box is displayed.  - 32bit Windows is not supported for COFF debugging model - Register window : no more support - More stable operation of 'Flash API speed [bps]' function in flash dialog (introduced from v10.1) **Bug Fix :** - For 2837xD and 2838xS/D, the error message "Can't open *.bin file!" could

		show up when the output file of CPU2 or CM is updated after entering to flash dialog. - For 2837xD and 2838xS/D, the old out file of CPU2 and CM could be used for RAM booting or flash writing if there is no easyDSP project is open for CPU2 and CM. - For 2837xD with coff debugging model, CPU2 program is not updated in the flash dialog
	ST STM32	- easyDSP uses the hex file IDE created when ram booing and flash programming. please make IDE create hex file in every compiling time. Note that the other option available in the previous easyDSP which easyDSP itself makes hex file is not available now ! **Bug Fix** :Flash is programmed with the latest user program regardless of your choice if you use the hex file IDE created
	Infineon PSoC4	**Bug Fix** : Flash is programmed with the latest user program regardless of your choice
	Infineon XMC4	**Bug Fix** : Flash is programmed with the latest user program regardless of your choice
	Renesas RA	First release for Renesas RA MCU series
	Infineon XMC1	First release for Infineon XMC1 MCU series (only for monitoring. flash programming not supported)
ver 10.2 Jan/2022	TI C28x	**Bug Fix :** F2837xS : flash dialog box not open (bug of v10.1)
	Infineon PSoC4	First release for Infineon PSoC4 MCU series (RAM booting not supported)
	Infineon XMC4	First release for Infineon XMC4 MCU series (RAM booting not supported)
ver 10.1 Nov/2021	Common	- New style memory window (check futher) **Bug Fix :** - Character value (ex, 'A') can be assigned to non character type variable - In array window, character value (ex, 'A') can't be assigned to character type variable - floating value can be assgined to pointer variable to float or double or long double
	TI C28x	- F28003x : newly supported (must use the latest easyDSP source file version 10.1, CCSv11 and compiler version is 21.6.0.LTS) - F2802x, F2802x0, F2803x, F2805x, F2806x, F2807x, F2837xS, F2837xD, F28004x, F28002x, F2838xD and F2838xS : flash operation speed up (max. twice)  Please choose bps to speed up. Note some bps could be not working. - F2807x/F2837xS/F2837xD : supporting internal clock source - F2802x Rev.0 : No more support

		- F2838xS/D CM : 'Enables fast verifying' checkbox in RAM booting dialog is now disabled. - Multi core F2837xD and F2838xS/D MCU : When RAM booting or flash programing in easyDSP project for CPU1, the communication is paused in the easyDSP project for CPU2 and CM if the projects are open in the same PC. - new easyDSP DriverLib source file (easy28x_driverlib_v10.1.c) : supports F28003x, new pin mux naming of C2000Ware_4_00_00_00 and 32bit address support for Gen3 MCU - new easyDSP DriverLib source file (easy28x_cm_driverlib_v10.1.c) : enabled access to EtherCAT RAM area and ECC, address alignement and range check to prevent Hard Fault - new easyDSP BitField source file (easy28x_bitfield_v10.1.c) : supports F28003x and 32bit address support for Gen3 MCU **Bug Fix :** - struct/union variable recognition error (bug in v10) - system error happens when accessing TI OTP memory area in Memory window - F2838xS/D CM : failed in verifying RAM booting in some cases
	ST STM32	- No more support for HAL based easyDSP source file (due to more resource burden than LL based one) - LL based easyDSP source file improvement (address alignment check and others) : please use easyStm32LL_v10.1.c - STM32WB10xC and WB15xC : new support - STM32U5 series : new support **Bug Fix :** - used page of flash is not identified for some MCUs which has 128bytes page size
ver 10 May/2021	Common	**Bugs Fixed :** Invalid struct or union variable is registered in tree window
	TI C28x	- Improved auto bauding process for F2837xS, F2837xD and F2807x - supports class type for C++ - Improvements in flash dialog (except C2834x) 1. check if all used flash sectors are selected to be erased before "Erase>Program..." button is clicked 2. button for all flash operation (erase to reset) 3. update output file when operations to flash is requested (such as program, verify, select used or select not used), not when flash dialog is open. **Bugs Fixed :** - F2837xD and F2838xS/D: Even though updated out file is declined by user in the flashROM dialog, updated out file is programmed for CPU2 and CM - F2837xD and F2838xS/D: If *.out file is updated after entering to flashROM dialog or RAM booting dialog, updated out file is not programmed if easyDSP project for CPU2 or CM is not activated.
	ST STM32	- first release for ST STM32 series (dedicated easyDSP pod required) - supporting F0, F1, F2, F3, F4, F7, G0, G4, H7, L0, L1, L4, L5, WB and WL series
ver 9.5 Dec/2020	TI C28x	- No more legacy bitfield source file from easyDSP installation package - Timing of /BOOT pin of easyDSP pod is changed - For more stable CPU2 RAM booting of F2837xD/F2838xD, easyDSP source file

		(easy28x_BitField_v9.5.c/ easy28x_DriverLib_v9.5.c) is upgraded. Please check the help file. **Note** - For RAM booting of F2837xD/F2838xD CPU2 : please use "easy28x_driverlib_v9.5.c" and "easy28x_bitfield_v9.5.c" source files **Bug Fix :** - wrong symbol display at 0x0 address in Memory window (v9.3 and v9.4 only) - 2807x, 2837xS, 2837xD CPU1 : incorrect reserved RAM region check for boot-rom (v9.4 only)
ver 9.4 Oct/2020	TI C28x	- Chart window improvement : Speed up for chart window update (helpful for big size array) by enabling 'Enable fast reading' option. More window update frequency. Paused when communication is failed a lot. - Speed up for verifying RAM booting. Pls enable 'Enable fast verifying' option. - Better autobauding of flashAPI wrapper in the flashROM dialog of 28002x, 2838x. - speed up by skipping verifying of flashAPI wrapper booting in flashROM dialog (note : for 28002x, 2837x and 2838x, this function was applied from the previous version. It is applied now to all MCUs) - one time reading of 4 and 8 bytes variable in the bitfield based source files (easy28_bitfield_v9.4.c and easy28_gen2_bitfield_v9.4.c) - Change in the title of menu and its shortcut (Serial Booting, ALT+S -> Ram Booting, ALT+R) **Note** - 2838x CM : please use "easy2838x_cm_driverlib_v9.4.c" **Bug Fix :** - Chart window : in some cases, it is not updated properly after out file update - Tree window : not valid variable with * operator in variable list (bug of v9.3 only) - 2838x : When using 2838x CPU1 and CM, updated CM program is not reflected automatically to CM project after CM program is booted in CPU1 project - 2807x, 2837xS, 2837xD CPU1, 2837xD CPU2, 2838x CPU2 : incorrect reserved RAM region check for boot-rom - 2838x CM : failed address is not correct when verifying is failed - 2838x CM : flash rom writing error when section start address is 64bit aligned
ver 9.3 Jun/2020	TI C28x	- checking before RAM booting if user code overlaps with memory region for boot rom and easyDSP - New bitfield source now available for TMS320F280x, F281x and F28044 - bitfield source now available for TMS320F2838xS/D for CPU1 and CPU2 - value at address operator (*) is supported for pointer variable **Bug Fix :** - Error in flashrom operation due to skipping booting with flashAPI wrapper - time interval not working in watch window - F2838x CM section alignment check error in flashrom dialog
ver 9.2	TI C28x	- TMS320F2838x is supported with DriverLib only - TMS320F28002x is supported

Apr/2020		- set Rx input pin to pullup type to increase noise immunity - New bitfield source now available for TMS320F2802x, F2802x0, F2803x, F2805x and F2806x **Bug Fix :** - In some cases, bin file is not created - In some cases, dwarf version 4 is not properly supported - Windows are not updated after 'Reload *.out' menu execution - treat pointer to struct/uniton variable as struct/unition variable in Tree window - 28004x flash rom : 'select all' button not working in flash dialog window - 28004x flash rom : not working if clock source is not external 20MHz
ver 9.1 Mar/2020	TI C28x	- DriverLib based easyDSP source files (28004x, 2807x, 2837xS and 2837xD) and example main.c - new bitfield based easyDSP source files (28004x, 2807x, 2837xS, 2837xD, 2823x, 2833x and 2834x) and example main.c or main_gen2.c - output file reloading menu - supports ELF-based Embeded Application Binary Interface (EABI) - improved flashAPI wrapper booting in flash rom dialog of 2837xD, 2837xS, 2807x and 28004x **Bug Fix :** - pointer to struct variable is registered in Tree window - v9.03 only : error in flashAPI wrapper booting in flash rom dialog of 2837xS, 2807x and 28004x
ver 9.03 Jan/2020	TI C28x	**Bug Fix (Bugs only for ver 9.x) :** - auto bauding failure in case of 2837xS, 2837xD, 2807x and 28004x - project is not open if project folder and folder of *.out file is different
ver 9.02 Dec/2019	TI C28x	- When creating new project, user need to set debugging model (either coff or dwarf) of compiler in its project setting. When opening existing project which was created before easyDSP verion 9.02, coff is selected by default.
ver 9.01 Dec/2019	TI C28x	**Bug Fix :** - For some cases, easyDSP can't tell compiler option correctly.
ver 9 Dec/2019	TI C28x	- supports the latest TI compiler version greater than ver.15 - supports "--symdebug:dwarf" compiler option - No more support for "--symdebug:coff" Note that coming update could be not available for "--symdebug:coff" - when using "--symdebug:dwarf" compiler option, display variable type with its typedef name (ex, Uint32)
ver 1 to ver 9	TI C28x	- contact easydsp@gmail.com
ver. 1.0 Aug/1999	TI 3x	- First release

5. Limitation

Please kindly keep in mind some limitation when using easyDSP as belows.

Common

1. Only little endian is supproted.
2. easyDSP uses the interrupt service routine for its communication to MCU.
   Therefore if the allocated resource time for the interrupt service routine for easyDSP communication is limited due to the lack of resource, easyDSP could be not proplerly working.
3. Value at address operator (*) is supported to pointer variable to basic type only, and for C28x only. That is, not supported to for example, pointer to pointer, pointer to array and so on.
4. Arrow operator (->) is not supported.
5. Writing to 'bit field' type variable is not allowed.
6. Multi dimensional array is supported upto 10 dimension.

Limitation

Pleae check the limitation of easyDSP by MCU. o = supported, x = not supported.
Flash programming is not available in case the protection or security function is applied.
For details, please check the relevant menu for each MCU.

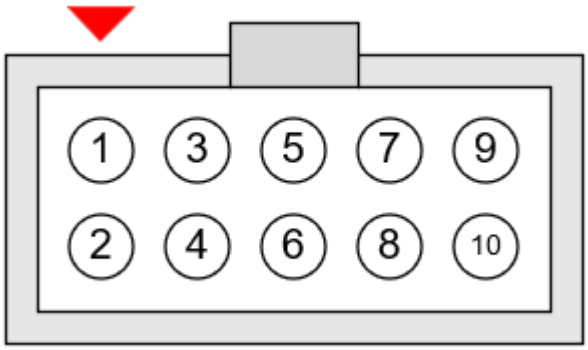
Vendor	MCU	Monitoring	RAM booting	Flash program	Other limitations
TI	C28x	o	o	o	1. no support for OTP
	AM263x	o	o (1)	o (1)	1. limited by SBL
	TM4C	o	x	o	1. no support to EEPROM
	MSPM0	o	x	o (1)	1. only MAIN flash
ST	STM32	o	o (4)	o (1,2)	1. No support to write to data memory, OTP memory and option bytes. 2. No support to Trust Zone and Secure MPU 3. Limitation from the bugs and limitations of MCU built-in bootloader. 4. RAM booting is not supported for dual core MCU.
Infienon	PSoC4	o	x	o (2)	1. No support for PSOC4000 MCU since UART is not available. 2. Flash programming feasible with single-application bootloader configuration only.
	XMC1	o	x	x	
	XMC4	o	x	o	
Renesas	RA	o	x	o (1), x (2)	1. For MCU with DLM, DLM state transition is not supported. 2. Flash programming is not supported for RA0 series.
	RX	o	x	o (1,2)	1. Protected area by area protection or trusted

					memory is not programable. 2. For RX64M, RX660, RX66T, RX71M and RX72T series, programming of option setting memory is not supported.
Toshiba	TX	o	x	o	
	TXZ3	o	x	o	
NXP	S32K S32M	o	x	o	no support to EEPROM
	LPC1x00	o	x	o	no support to EEPROM

6. Pod configuration

Pin Description

The signal pins of easyDSP pod are shown below . Its pin pitch is 2.54mm.
For easyDSP connector in your board, please use either BHS-01-10P or XG4C-1031 connector.
Note the arrow mark on the connector.



Pod type 1 and 2 : Pod for TI C28x MCU

#	name	Description
1	RX	Output pin connected to RX of MCU
2	GND	Ground pin. Connected to #10 pin internally to easyDSP pod.
3	TX	Input pin connected to TX of MCU
4	VDD	Voltage bias connected to VDDIO of MCU (ex : 3.3V)
5	/BOOT	Output pin with pseudo open collector. It becomes Low when entering bootrom by resetting MCU. Otherwise, no signal output from this pin.
6	reserved	Do not connect

7	reserved	Do not connect
8	reserved	Do not connect
9	/RESET	Output pin with pseudo open collector. It b ecomes Low when resetting MCU. Otherwise, no signal output from this pin.
10	GND	Ground pin. Connected to #2 pin internally to easyDSP pod.

Pod type 3 : Pod for Arm Cortex series and other cores (RX)

#	name	Description
1	RX	Output pin connected to RX of MCU
2	GND	Ground pin. Connected to #10 pin internally to easyDSP pod.
3	TX	Input pin connected to TX of MCU
4	VDD	Voltage bias connected to VDDIO of MCU (ex : 3.3V or 1.8V)
5	/BOOT	Output pin with pseudo open collector. It becomes Low when entering bootrom by resetting MCU. Otherwise, no signal output from this pin.
6	reserved	Do not connect
7	BOOT	Output pin with pseudo open emitter. It becomes high when entering bootloader by resetting MCU. Otherwise, no signal output from this pin.
8	reserved	Do not connect
9	/RESET	Output pin with pseudo open collector. It b ecomes Low when resetting MCU. Otherwise, no signal output from this pin.
10	GND	Ground pin. Connected to #2 pin internally to easyDSP pod.

/BOOT, BOOT pin

These pins determines how MCU will boot after reset, either boot with flash to execute user program or boot with bootmode to conduct RAM booting or flash programming.
These pins are not used at all (= no signal output) when MCU boot with flash.
They are active only when MCU boot with boot mode as below :

MCU	Used boot pin	boot pin operation

C28x XMC4 TX TXZ3 LPC1x00 S32	/BOOT	/BOOT pin becomes low when MCU reset. Around 1sec after MCU reset is released, /BOOT pin becomes open and no signal output.
STM32	BOOT	BOOT pin becomes high when MCU reset and keeps high during boot mode period. BOOT pin becomes open and no signal output when exiting boot mode (= exiting from Ram booting or flash dialog).
AM2x TM4C MSPM0	BOOT	BOOT pin becomes high when MCU reset. Around 1sec after MCU reset is released, BOOT pin becomes open and no signal output.
RA RX	/BOOT	/BOOT pin becomes low when MCU reset. RA : /BOOT pin becomes open and no signal output when entering "Command acceptance phase" during boot mode.
XMC1 PSOC4	not used	not used

You can use MCU pin that connects to /BOOT or BOOT pin in your application progam if you follow below guidline.
Please check the voltage level of the MCU pin at the beginning of your application program (input IO mode as reset default). Once the voltage level of the pin becomes high or low depending on used boot pin, you can set the MCU pin accordingly and start to use.

LEDs

There are two LEDs to indicate the status as below. Both LEDs should be ON during easyDSP operation (not blinking).
'DSP' or 'MCU' LED is on : MCU controller board is now power supplied (= #4 pin is live with 3.3V)
'USB' LED is on : easyDSP pod is well connected with easyDSP PC program. It's ON when easyDSP project is open, OFF when easyDSP project is closed.
Note) for optic cable easyDSP, DSP LED of PC side pod and USB LED for MCU side pod are not working.
no special meaning to the color of LED.

Connection to and Disconnection from PC and MCU

Don't make any physical connection or disconnection of easyDSP pod to/from PC and MCU during MCU operation. It makes unintentional reset to MCU.
In case you can not avoid connection/disconnection during MCU operation, connect PC first then MCU, disconnect MCU first and then PC. This will minimize the chance of unintentional reset to MCU.

Connection to PC

If possible, please connect easyDSP pod directly to PC (not via USB extension port). And please use the new USB cable to secure its connection quality.

Specification

Items	Pod type 1 : TI C28x MCU	Pod Type 2 : TI C28x MCU	Pod Type 3 : Arm Cortex-M

	standard pod	optic cable pod	and RX standard pod
Supply voltage range to VDD	min 3, typ 3.3, max 5 [V]	same to left	min 1.65, max 5 [V]
Recommended supply voltage to VDD	3.3V	3.3V	MCU VDDIO (ex, 3.3V or 1.8V)
Input voltage range	-0.5 .... VDD+0.5 [V]	same to left	same to left
Supply current to VDD	max 3mA	max 50mA	max 10mA
min. isolation voltage	2.0kVrms@1min	-	2.0kVrms@1min
Operating free-air temperature	5 .. 55 [°C]	same to left	same to left
Starage temperature range	-20 .. 65 [°C]	same to left	same to left
Relative humidity (non-condensing)	max 90% rH	same to left	same to left
Size (without cables)	82 x 56 x 21 mm^3	same to left but two pods	81 x 42.5 x 21 mm^3
Weight (without cables)	140 g	330 g	62g
USB interface	USB 2.0 Hi-Speed	same to left	same to left

7. How to use MCU

7.1 C28x

7.1.1 C28x programming

7.1.1.1 common

BitField and DriverLib

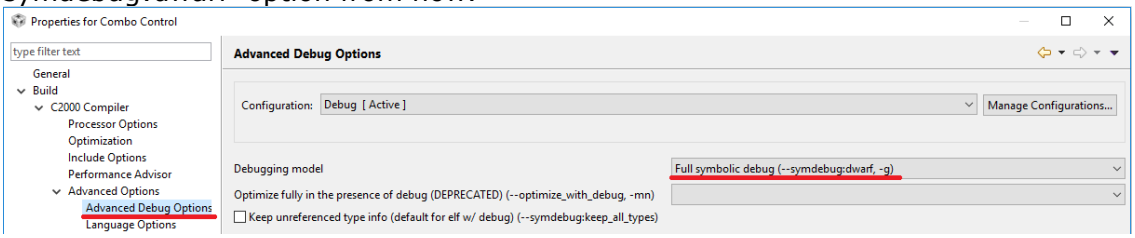
There are two folders in the 'source/C28x' directory of installed easyDSP.

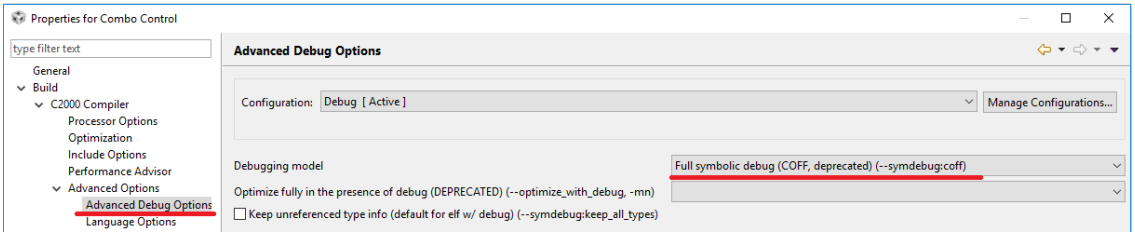
'BitField' folder : Bitfield based easyDSP source files.
'DriverLib' folder : DriverLib(C28x Peripheral Driver Library) based easyDSP source files
please refer to the TI link for further understanding of BitField/DriverLib. You can use only one out of two methods.
If you use the bitfield based functions in your project, then please use also bitfield based easyDSP source files, or vice versa.
Also check below which method is supported for which MCU.

	Bitfield	DriverLib
F28001x F28002x F28003x F28004x F2807x F2837x F2838x F28P55x F28P65x	O	O
C2834x F2823x F2833x F281x F280x F28044 F2802x0 F2802x F2803x F2805x F2806x	O	

Debugging model option

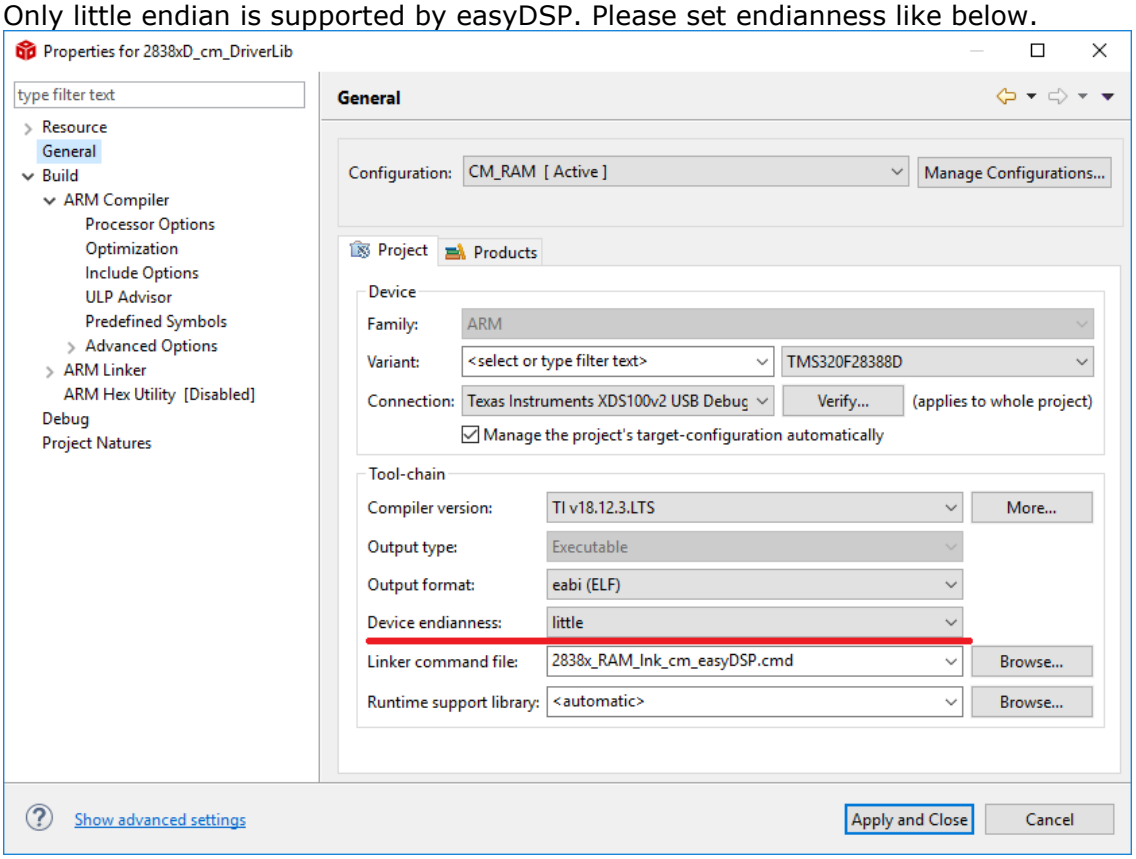
easyDSP supports below two debugging model options, --symdebug:dwarf and --symdebug:coff. Note that the latest TI C28x compiler (version 16 or above) doesn't support--symdebug:coff option. Accordingly further support for this option will be very limited. Recommend to use --symdebug:dwarf option from now.





Endianness option

Only little endian is supported by easyDSP. Please set endianness like below.



Section alignment when using Gen3 MCU

easyDSP uses TI's flash API to access onchip flashrom. TI flash API of Gen.3 MCU (for example. F2807x, F28001x, F28002x, F28003x, F28004x, F2837x, F2838x and F28Px) requires section alignment on the address (min. 4 words boundary or recommended 8 words boundary) depending on MCU. That is, the start address of the section should be either 0x*0, 0x*4, 0x*8 or 0x*C for C28x core and either 0x*0 or 0x*8 for Arm Cortex-M4 (ex, F2838x CM). As shown below linker command file example from TI, it is already applied as recommended value for default sections like .text **but you need to do it yourself for your own section** .

<linker command file excerpt of TMS320F28388 CPU1/CPU2>

```
SECTIONS
{
   codestart           : > BEGIN, ALIGN(8)
   .text               : >> FLASH1 | FLASH2 | FLASH3 | FLASH4, ALIGN(8)
   .cinit              : > FLASH4, ALIGN(8)
   .switch             : > FLASH1, ALIGN(8)
   .reset              : > RESET, TYPE = DSECT /* not used, */
   .stack              : > RAMM1

#if defined(__TI_EABI__)
   .init_array      : > FLASH1, ALIGN(8)
   .bss             : > RAMLS5
   .bss:output      : > RAMLS3
   .bss:cio         : > RAMLS5
   .data            : > RAMLS5
   .sysmem          : > RAMLS5
   /* Initalized sections go in Flash */
   .const           : > FLASH5, ALIGN(8)
#else
   .pinit           : > FLASH1, ALIGN(8)
   .ebss            : > RAMLS5
   .esysmem         : > RAMLS5
   .cio             : > RAMLS5
   /* Initalized sections go in Flash */
   .econst          : >> FLASH4 | FLASH5, ALIGN(8)
#endif
```

Linker option

It is recommended the entry point is set to the 'code_start' label (in TI's DSP28x_CodeStartBranch.asm with watch-dog disabled). This is done by linker option -e in the project build options, that is,-ecode_start. It prevents unintentional watch dog reset during c_int00 operation which could happen in long size program where it takes long time to initialize many variables.

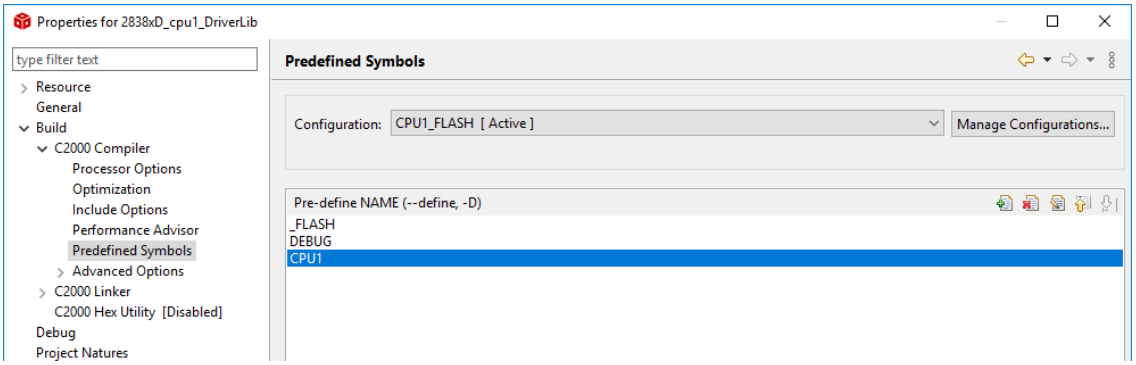
7.1.1.2 multi cores

Multi core MCU

Target MCUs are F28P65xD, F2827xD, F2838xS and F2838xD.

Predefined symbols

Predefined symbols such as CPU1, CPU2, CM and _FLASH are referred in easyDSP source files when multi-core MUC is used.
If target core is CPU2, CPU2 should be predefined. If target core is CM, CM should be predefined.
These symbols are usually predefined by CCS. But please check.



Using debugger

Don't use multi-core booting related functions (easyDSP_Boot_Sync) easyDSP is providing in case you use debugger. Debugger will load the memory of each core. please refer to #define USE_DEBUGGER of main.c in easyDSP source file folder.

easyDSP uses MCU resource for multi core Ram booting

Some MCU resource is used by easyDSP to implement CPU2/CM ram booting. Please check below table. You should not use these resource before CPU2/CM booting (calling of easyDSP_Boot_Sync() function) in your code. But you can use them after the booting.

MCU	F2837xD	F2838xS F2838xD	F28P65xD
Resource used by easyDSP during ram booting CPU2 and CM	IPC_FLAG0 IPC_FLAG5 IPC_FLAG31	IPC_FLAG0 IPC_FLAG5 IPC_FLAG6 IPC_FLAG30 IPC_FLAG31 CPU1 to CPU2 MSGRAM1 CPU1 to CM MSGRAM1	IPC_FLAG0 IPC_FLAG5 CPU1 to CPU2 MSGRAM0

Flash booting location of F2838x and F28P65xD for CPU2 and CM

In the source file of easyDSP, the flash booting location is fixed :
For F2838xD CPU2 and CM, it is set to sector 0.
For F28P65xD CPU2, it is set to bank 3.
In case you like to change its location, please modify below part in easyDSP_Boot_Sync() function in the easyDSP source file.

F2838x BitField :
ezDSP_Device_bootCPU2(BOOTMODE_BOOT_TO_FLASH_SECTOR0);
ezDSP_Device_bootCM(BOOTMODE_BOOT_TO_FLASH_SECTOR0);

F2838x DriberLib :
Device_bootCPU2(BOOTMODE_BOOT_TO_FLASH_SECTOR0);
Device_bootCM(BOOTMODE_BOOT_TO_FLASH_SECTOR0);

F28P65xD BitField : ezDSP_Device_bootCPU2(BOOTMODE_BOOT_TO_FLASH_BANK3_SECTOR0);
F28P65xD DriverLib : Device_bootCPU2(BOOTMODE_BOOT_TO_FLASH_BANK3_SECTOR0);

Restriction of memory use for RAM booting of F2838x and F28P65xD

RAM booting via SCI port for CPU2 and CM of F2838x and F28P65xD is not supported by TI. easyDSP uses workaround to boot CPU2 and CM via SCI. First, boot CPU1 via SCI with user program then boot CPU2/CM with small agent program (not user program) via 'IPC message copy to RAM' boot mode. Then this agent program downloads user program to CPU2 and CM via SCI. With this, there is some restriction of memory usage to CPU2 and CM for this agent operation. Please check below table and reflect this to command file accordingly.

	Restriction of memory usage in user program when ram booting of F2838x	Restriction of memory usage in user program when ram booting of F28P65xD
CPU1 user program	no restriction	no restriction
CPU2 user program	part of M1 RAM (0x400 - 0x7F7) can't be used as initialized section	part of M1 RAM (0x400 - 0x5FF) can't be used as initialized section
CM user program	part of S0 RAM (0x2000.0800 - 0x2000.0FFF) can't be used as initialized section	

Change in CPU2 RAM booting of F2837xD and F2838xD from easyDSP source file version 11 NEW

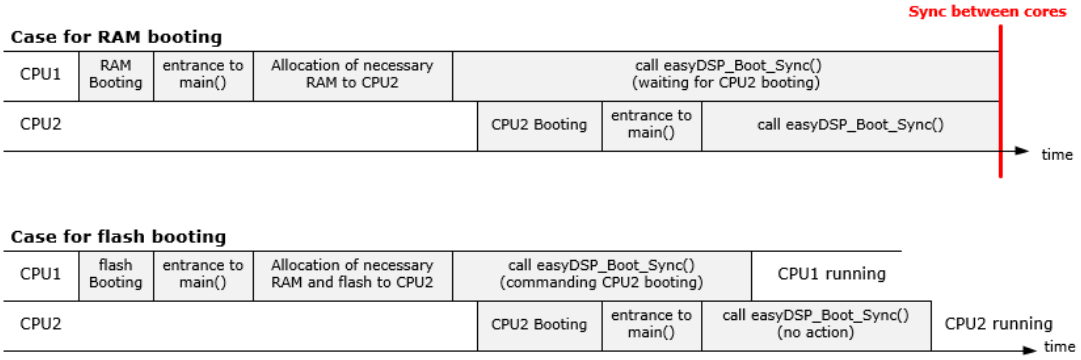
Before easyDSP source file version 11, for CPU2 ram booting of F2837xD and 2838xD, all the GSRAM (Global Shared RAM) are allocated to CPU2 during CPU2 ram booting and then allocated to CPU1 after ram booting in the easyDSP_SCIBootCPU2() function of easyDSP source file.
So, ram booting related code of CPU1 (.text section of easyDSP_SCIBootCPU2() function) should be located to LSRAM (Local Shared RAM). And if required from CPU2 user program, CPU1 should allocate GSRAM to CPU2 after CPU2 ram booting.

This way requires lots of restriction and caution and not any longer recommended.
In the source file version 11, GSRAM is allocated to neither CPU1 nor CPU2 in the easyDSP_SCIBootCPU2() function.
Instead, in the CPU1 program main.c, the required GSRAM is allocated to CPU2 before calling easyDSP_SCIBootCPU2().
With this, no more restriction and caution needed.

Booting sequence and syncronization of F2837xD and F28P65xD

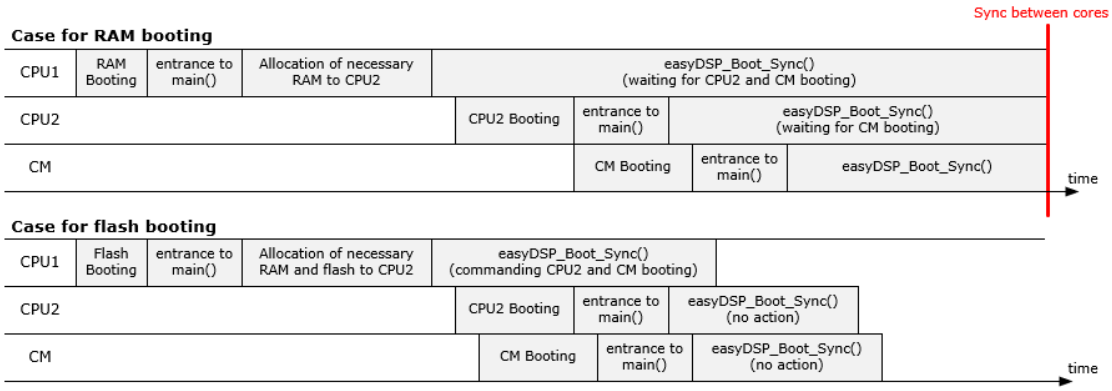
The flash booting is executed in a sequence of CPU1 and then CPU2 without any synchronization between.
The RAM booting is executed in same sequence with synchronization (i.e. the end of easyDSP_Boot_Sync() is synchronized).

Note that necessary memory should be allocated to CPU2 before CPU1 is calling easyDSP_Boot_Sync().



Booting sequence and syncronization of F2838x

The flash booting is executed in a sequence of CPU1, CPU2 and CM without any synchronization between.
The RAM booting is executed in same sequence with synchronization between (i.e. the end of easyDSP_Boot_Sync() is synchronized).
Note that necessary memory should be allocated to CPU2 and CM before CPU1 is calling easyDSP_Boot_Sync().



F2838x CPU2 and CM clock

When CPU1 boots CPU2 and CM, CPU1 set their clock frequency to 200MHz and 125MHz respectively.
If you like to change them, you should modify the related source file by yourself.

When out file has been changed

The output file (*.out) is changed whenever the user program is compiled. When you download the new output file by either RAM booting or flash programming in the easyDSP project connected to CPU1, the easyDSP project connected to another cores should be updated by new output file too.
In case easyDSP for multi cores are all connected to the same PC, this process is done automatically, meaning easyDSP project for CPU1 asks easyDSP project for CPU2 to load new output file.
In case they are open in different PC, you have to load new output file for another cores manually, by clicking 'MCU > Reload *.out' menu.

7.1.1.3 using BitField

SCI ISR (Interrupt Service Routine)

easyDSP uses an SCI interrupt to communicate with TMS320F28x. Therefore, the user program should include SCI ISR (Interrupt Service Routine) code which easyDSP provides. It depends on TMS320F28x type.
You can find these source files at the folder of easyDSP installation 'source\C28x\BitField'.
note) For F2838x CM, DriverLib based source file should be used.

C28x series	SCI ISR files
F28001x F28002x F28003x F28004x F2807x F2837x F2838xS CPU1 F2838xD CPU1 F2838xD CPU2 F28P55x F28P65x	easy28x_bitfield_v11.2.c easy28x_bitfield_v11.2.h
C2834x F2823x/2833x F2802x/F2802x0 F2803x F2805x F2806x F280x F281x F28044	easy28x_gen2_bitfield_v9.4.c easy28x_gen2_bitfield_v9.4.h

Name and its role of key functions in ISR code is
easyDSP_SCI_Init() : Initializes SCI
easy_RXINT_ISR() : ISR for RX_INT
easy_TXINT_ISR() : ISR for TX_INT
easyDSP_SPI_Flashrom_Init() : for external SPI flashrom booting of C2834x
easyDSP_Boot_Sync() : multi-core MCU (F2837xD, F2838xS, F2838xD) boot and synchronization

You SHOULD change some #define variables in the header file (not source file) accordingly to your target system.
For example, below selection is targeting for F2807x + CPUCLK 150MHz + LSPCLK = CPUCLK/4 + easyDSP communication @ 115200 bps.

```
#define F28P65xS                0
#define F28P65xD_CPU1           0
#define F28P65xD_CPU1_CPU2      0
#define F28002x                 0
#define F28003x                 0
#define F28004x                 0
#define F2807x                  0
#define F2837xS                 0
#define F2837xD_CPU1            0
#define F2837xD_CPU1_CPU2       0
#define F2838xS_CPU1            0
#define F2838xS_CPU1_CM         0
#define F2838xD_CPU1            0
```

```
#define F2838xD_CPU1_CPU2          0
#define F2838xD_CPU1_CM            0
#define F2838xD_CPU1_CPU2_CM       1

#define CPU_CLK          150000000L
#define LSP_CLK          (CPU_CLK/4)
#define BAUDRATE         115200L
```

Please note that in case of MotorWare™, LSP_CLK should be same to CLK_CLK.
All variables in the ISR have prefix 'ezDSP_'. Please don't change these variables during your easyDSP operation.

Interrupt Nesting

Interrupts are automatically disabled when an interrupt service routine begins. In other words, once easyDSP ISR has been executed, your higher priority ISR can't be executed until easyDSP ISR has been completed.
easyDSP source file provides buit-in interrupt nesting function assuming easyDSP SCI ISR has the lowest priority.
For further information about interrupt nesting, please check
http://processors.wiki.ti.com/index.php/Interrupt_Nesting_on_C28x

Run easyDP ISR fast on the flash

To run easyDSP ISR fast and stable when system is running on the flash, please use #pragma in the top-most part of easyDSP source file. Please refer to TI application note for 'ramfuncs' or '.TI.ramfunc' section operation.

in the part of header file easy28x_bitfield.h

```
#if (F2823x || F2833x || C2834x)
#pragma CODE_SECTION(easy_RXINT_ISR, "ramfuncs");
#else
#pragma CODE_SECTION(easy_RXINT_ISR, ".TI.ramfunc");
#endif
```

NOTE) ".TI.ramfunc" is used instead of "ramfuncs" in case the latest MCU (ex, 2837x, 2807x, 28004x) is used with the latest TI Support Library version (and compiler). Please check the file "F28x_SysCtrl.c" to understand which one is proper.
NOTE) Especially when your program runs on the flash and program/erase the flash at the same time with TI flash API, ISR of easyDSP should run on the ram, not on the flash. Any ISR routines that are executed during flash API function call must completely reside outside of the flash and must not expect to read data from the flash.

Single core programming

easyDSP requires appropriate interrupt settings to communicate with MCU. Below box shows its example. At first, please set up the other interrupts except SCI. Then, call easyDSP_SCI_Init(). In the call to the functions, related registers are set up for SCI communication and interrupts. Also please check main_gen2.c or main_gen3.c example file in the source/C28x/bitfield folder.

```
#include " easy28x_bitfield_v11.2.h"  or ....
#include " easy28x_gen2_bitfield_v9.4.h"  or ....
main(void) {
```

```
   // below function should be called after other interrupts settings and before while(1)
   easyDSP_SCI_Init();

   while(1) {
   }
}
```

C2834x programming for external SPI flash

Since 2834x doesn't have internal flash, easyDSP supports external flashs with SPI interface. They are AT25DF021(2M bit), AT25DF041(4M bit), AT26DF081(8M bit), AT25DF321(32M bit), M25P20(2M bit), M25P40(4M bit), M25P80(8M bit), M25P16(16M bit), M25P32(32M bit) manufactured by ATMEL or Numonyx. SPI-A port setting is necessary for this.
Also please check main_gen2.c example file in the source/C28x/bitfield folder.

```
#include "easy28x_gen2_bitfield_v9.4.h "

 main(void) {



   // SCI port setting for easyDSP

   easyDSP_SCI_Init();



//SPI-A port setting for external flash
easyDSP_SPI_Flashrom_Init();

   while(1) {
   }
}
```

F2837xD, F28P65xD, F2838xD multi core programming

The use of header file and easyDSP_SCI_Init() function is same to that of single core MCU.
In addtion, easyDSP_Boot_Sync() function is required to boot and synchronize CPU2 and CM.
This function should be called in all cores (CPU1, CPU2 and CM) program.
Pease check main_gen3.c example file in the source/C28x/bitfield folder.

```
#include "easy28x_bitfield_v11.2.h"
main(void) {

   InitSysCtrl();
```

```
    .....

    // if CPU1 program, allocate the necessary sharable memory to CPU2 and CM
    // before easyDSP_Boot_Sync() is called

    // call this after sharable memory allocation and before  easyDSP_SCI_Init()
    easyDSP_Boot_Sync();

    easyDSP_SCI_Init();

    while(1) {
    }
}
```

7.1.1.4 using DriverLib

ISR (Interrupt Service Routine) for SCI

easyDSP uses an SCI interrupt to communicate with TMS320F28x. Therefore, the user program should include SCI ISR (Interrupt Service Routine) code which easyDSP provides.
You can find these source files at the folder of easyDSP installation 'source\C28x\DriverLib'.

C28x series	SCI ISR files
F28001x F28002x F28003x F28004x F2807x F2837x F2838x CPU1 and CPU2 F28P55x F28P65x	easy28x_DriverLib_v11.2.c easy28x_DriverLib_v11.2.h
F2838x CM	easy28x_cm_DriverLib_v10.1.c easy28x_cm_DriverLib_v10.1.h

Name and its role of key functions in ISR code is
easyDSP_SCI_Init() : Initializes SCI
easyDSP_UART_Init() : Initializes UART of TMS320F2838x CM
easy_RXINT_ISR() : ISR for RX_INT
easyDSP_Boot_Sync(void) : Multi core MCU (F2837xD, F2838xS and 2838xD) booting and synchronization

You SHOULD change some #define variables in the early part of the source accordingly to your target system. For example, below selection is targeting for F2807x + easyDSP communication @ 115200 bps.

```
#define F28002x          0
#define F28003x          0
#define F28004x          0
#define F2807x           1
#define F28P65xS         0
```

```
#define F28P65xD_CPU1          0
#define F28P65xD_CPU1_CPU2   0
 #define F2837xS                  0
#define F2837xD_CPU1           0
#define F2837xD_CPU1_CPU2    0
#define F2838xD_CPU1           0
#define F2838xD_CPU1_CM       0
#define BAUDRATE                115200L
```

Please note that DEVICE_LSPCLK_FREQ constant in device.h file should be matching to your system since SCI baudrate setting of easyDSP is based on that.
All variables in the ISR have prefix 'ezDSP_ ' . Please don ' t change these variables during your easyDSP operation.

Interrupt Nesting

Interrupts are automatically disabled when an interrupt service routine begins. In other words, once easyDSP ISR has been executed, your higher priority ISR can't be executed until easyDSP ISR has been completed.
easyDSP source file provides buit-in interrupt nesting function assuming easyDSP SCI ISR has the lowest priority.
For further information about interrupt nesting, please check
http://processors.wiki.ti.com/index.php/Interrupt_Nesting_on_C28x

Run easyDP ISR fast and stable on the flash

To run easyDSP ISR fast and stable when system is running on the flash, please use #pragma in the easyDSP header file. Please refer to TI application note for '.TI.ramfunc' section operation.

in the header file, easy28x_driverlib.h

```
#pragma CODE_SECTION(easy_RXINT_ISR, ".TI.ramfunc");
```

NOTE) Especially when your program runs on the flash and program/erase the flash at the same time with TI flash API, ISR of easyDSP should run on the ram, not on the flash. Any ISR routines that are executed during flash API function call must completely reside outside of the flash and must not expect to read data from the flash.

Single core MCU programming

easyDSP requires appropriate interrupt settings to communicate with MCU. Below box shows its example. At first, please set up the other interrupts except SCI. Then, call easyDSP_SCI_Init(). In the call to the functions, related registers are set up for SCI communication and interrupts. Also please check main.c example file in the source/C28x/driverlib folder.

```
# include " easy28x_DriverLib_v11.2.h"
main(void) {
  Device_init();

   // below function should be called after other interrupts settings
   easyDSP_SCI_Init();

  while(1) {
  }
```

```
}
```

Multi core programming for CPU1 and CPU2 : F28P65xD, F2837xD, F2838xS and F2838xD

The use of header file and easyDSP_SCI_Init() function is same to that of single core MCU.
In addtion, easyDSP_Boot_Sync() function is required to boot and synchronize CPU2.
This function should be called in both CPU1 and CPU2 program. Pease check main.c example file in the source/C28x/DriverLib folder.

```
#include " easy28x_DriverLib_v11.2.h"
main(void) {

   Device_init();

    // called after Device_init() and before easyDSP_SCI_Init()
   easyDSP_Boot_Sync();

    easyDSP_SCI_Init();

   while(1) {
   }
}
```

Multi core programming for F2838x CM

The use of header file and easyDSP_UART_Init () function is similar to that of single core MCUs.
In addtion, easyDSP_Boot_Sync() function is required to boot and synchronize CM.
Pease check main_cm.c example file in the source/C28x/DriverLib folder.

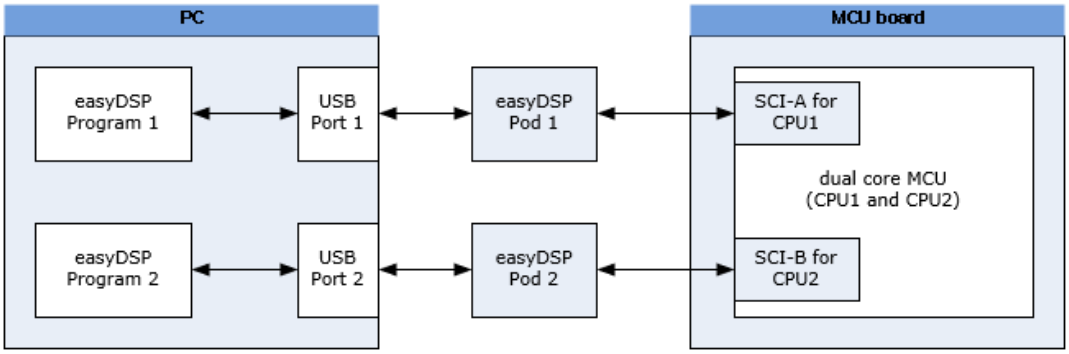
```
#include " easy28x_cm_DriverLib_v10.1.h"
main(void) {

   CM_init();

    // called after CM_init() and before easyDSP_UART_Init()
   easyDSP_Boot_Sync();

    easyDSP_UART_Init();

   while(1) {
   }
}
```

7.1.1.5 F2837xD and F28P65xD usage

How to connect easyDSP

We need two easyDSP pods and two easyDSP programs and connect them properly to each CPU1 and CPU2 for proper communication. easyDSP program can be executed with multiple instances with its program title like easyDSP, easyDSP(2).
Careful procedure should be taken to connect first easyDSP program (titled easyDSP) to CPU1 and then second easyDSP program (titled easyDSP(2)) to CPU2.

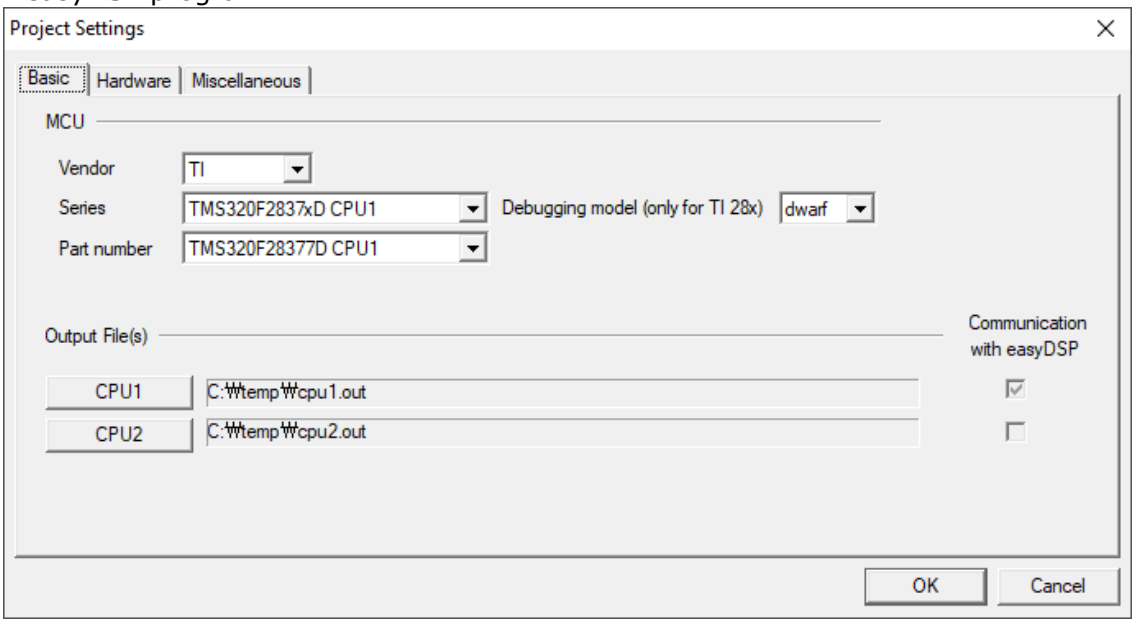
First, you connect single easyDSP pod to PC and then to SCI-A port of CPU1. Run easyDSP program and open the project for CPU1. Then the easyDSP program and its project is connected to CPU1. Then connect another easyDSP pod to PC and then to SCI-B port of CPU2. Run another easyDSP program and open the project for CPU2.
NOTE) RAM booting and flash rom operation is possible for both CPU1 and CPU2 even with single easyDSP pod and single easyDSP program. But in this case, the communication after booting with CPU2 is not supported.
NOTE) Please use the single PC to connect easyDSP for both CPU1 and CPU2. This enables the communication between two easyDSP programs and some mutual activities.



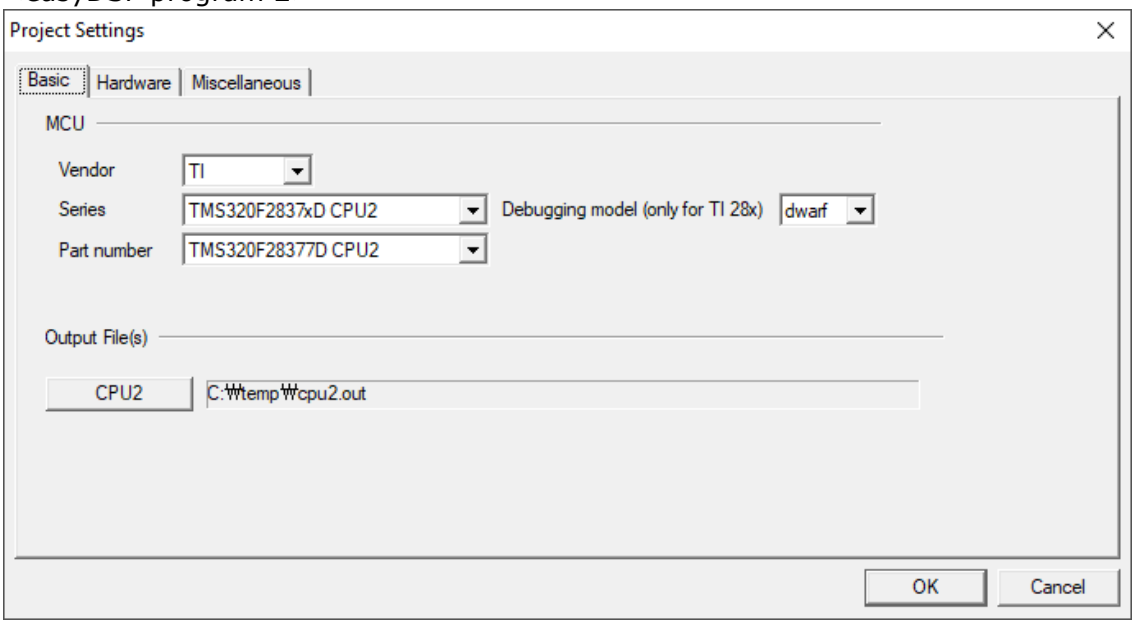
Project creation

easyDSP project for CPU1 requires two output files, one for CPU1 and another for CPU2. If you don't specify the output file for CPU2, then you can not boot CPU2. And the communication with easyDSP is fixed to CPU1.
easyDSP project for CPU2 requires the output file for CPU2 only. It should be same to the out file for CPU2 used in the easyDSP project for CPU1.

<easyDSP program 1>



<easyDSP program 2>



RAM booting and flash programming

RAM booting, flash programming and MCU reset for CPU1 and CPU2 are done by CPU1, accordingly done by easyDSP program connected to CPU1. The only thing that CPU2 does is verifying RAM booting of CPU2. Please check below table for the details.
If easyDSP for CPU1 and CPU2 are connected to the single PC, easyDSP for CPU2 pauses its communication when CPU1 is either RAM booting or flash programming.

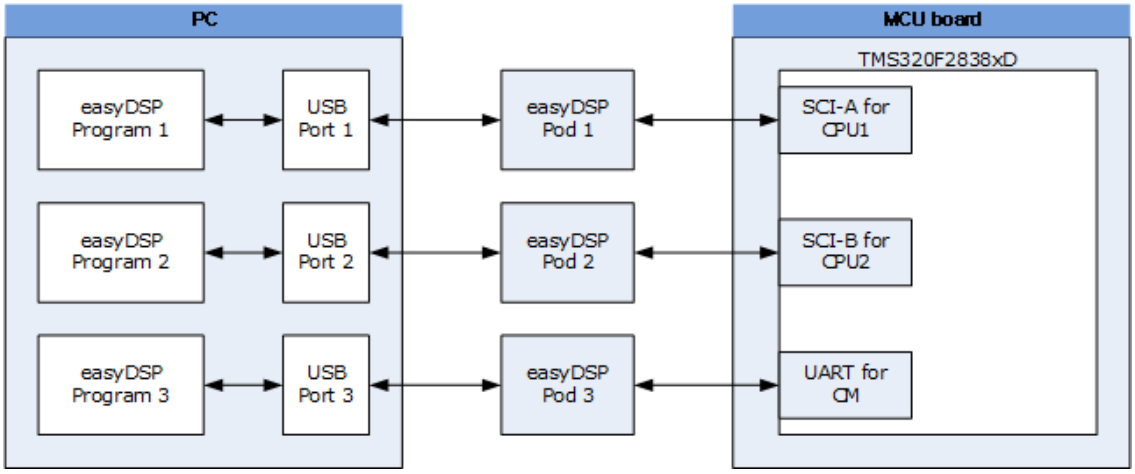
operation	easyDSP program 1	easyDSP program 2
CPU1, CPU2 RAM booting	supported	Not supported
Verifying CPU1, CPU2 RAM booting	supported only for CPU1	supported only for CPU2
CPU1, CPU2 flashrom operation	supported	Not supported
CPU reset	supported	Not supported

7.1.1.6 F2838x usage

How to connect easyDSP

We need three easyDSP pods and three easyDSP programs and connect them properly to each CPU1, CPU2 and CM. easyDSP program can be executed with multiple instances with its program title like easyDSP, easyDSP(2) and easyDSP(3).
Careful procedure should be taken to connect first easyDSP program (titled easyDSP) to CPU1 and then second easyDSP program (titled easyDSP(2)) to CPU2 and so on.
First, you connect single easyDSP pod to PC and then to SCI-A port of CPU1. Run easyDSP program and open the project for CPU1. Then the easyDSP program and its project is connected to CPU1.
Then connect another easyDSP pod to PC and then to SCI-B port of CPU2. Run another easyDSP program and open the project for CPU2.
Likewise, also for CM.
NOTE) RAM booting and flash rom operation is possible for CPU1, CPU2 and CM even with single easyDSP pod and single easyDSP program connected to CPU1.
But in this case, the communication after booting with CPU2 and CM is not supported.

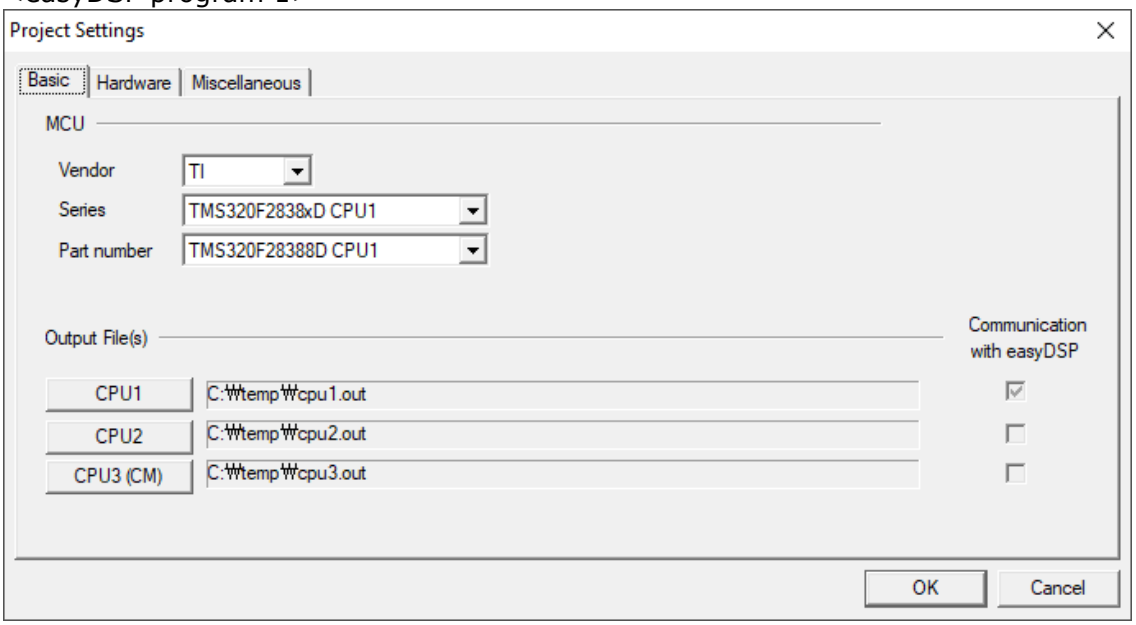
NOTE) Please use the single PC to connect easyDSP for all CPU1, CPU2 and CM. This enables the communication between easyDSP programs and some mutual activities.



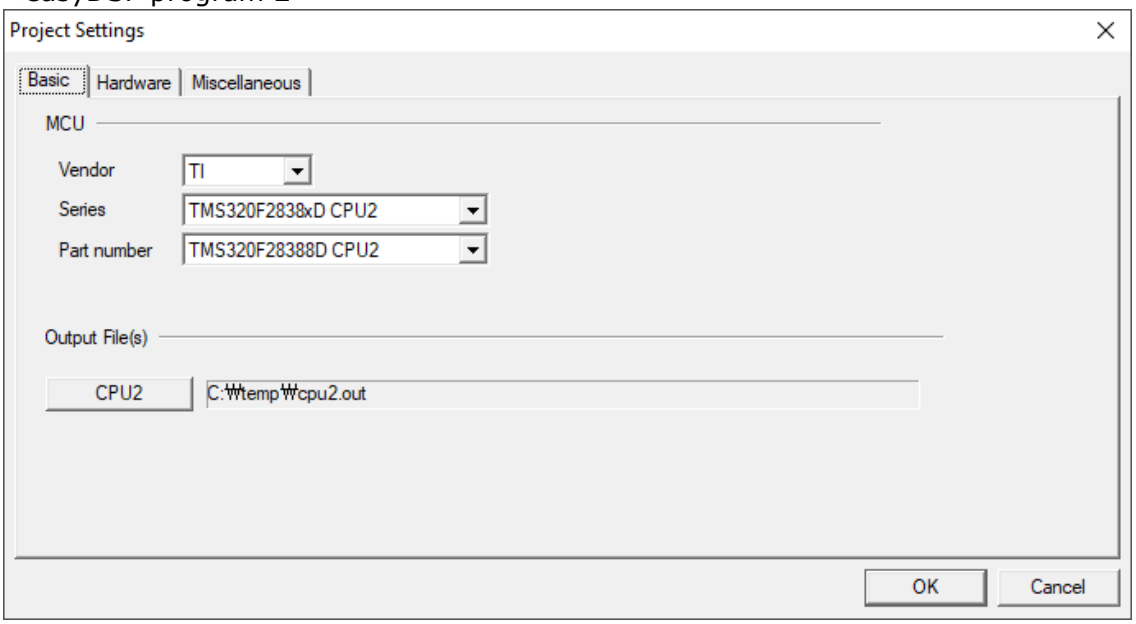
Project creation

easyDSP project for CPU1 requires max. three out files, one for CPU1, the other for CPU2 and finally last one for CM. If you don't use CPU2 or CM, please don't specify the out file of them. The communication with easyDSP is fixed to CPU1.
easyDSP project for CPU2 or CM requires the out file for CPU2 or CM only. It should be same out file to ones used in the easyDSP project for CPU1.

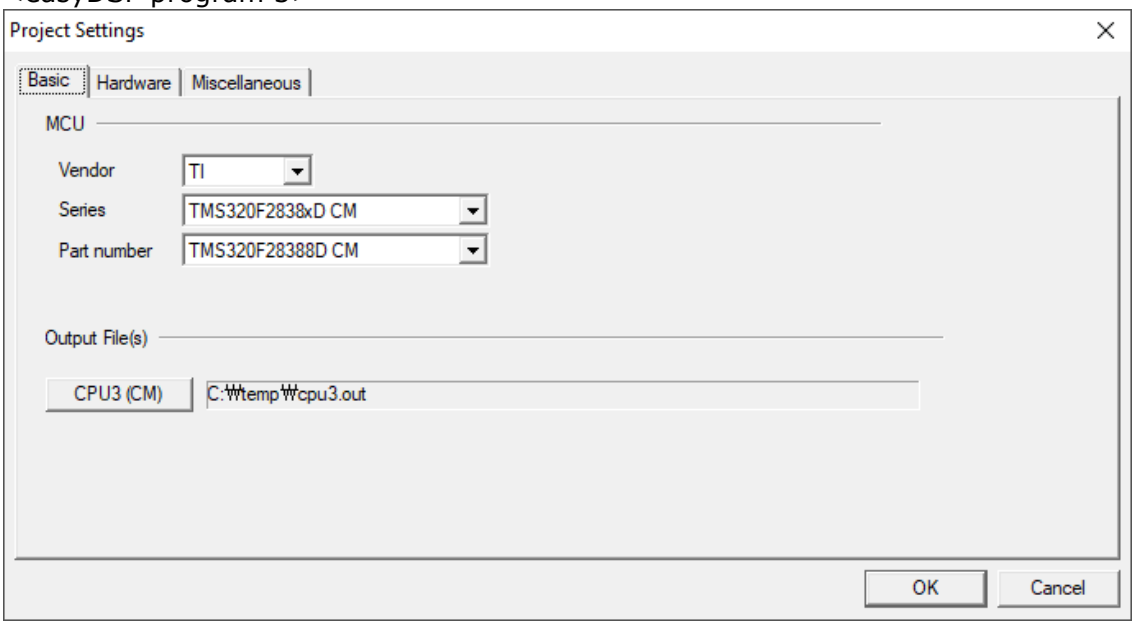
<easyDSP program 1>



<easyDSP program 2>



<easyDSP program 3>



RAM Booting and flash rom programming

RAM booting and flash programming for CPU1, CPU2 and CM are all done by CPU1, accordingly done by easyDSP program connected to CPU1. The verification of RAM booting can be done by each CPU.
Please check below table for the details.
If easyDSP for CPU1, CPU2 and CM are connected to the single PC, easyDSP for CPU2 and CM pause their communication when CPU1 is either RAM booting or flash programming.

operation	easyDSP program 1	easyDSP program 2	easyDSP program 3
CPU1, CPU2, CM RAM booting	Supported	Not supported	Not supported
Verifying CPU1, CPU2, CM RAM booting	Supported only for CPU1	Supported only for CPU2	Supported only for CPU2
CPU1, CPU2, CM flashrom	Supported	Not supported	Not supported

operation			
CPU reset	Supported	Not supported	Not supported

7.1.2 C28x board setting

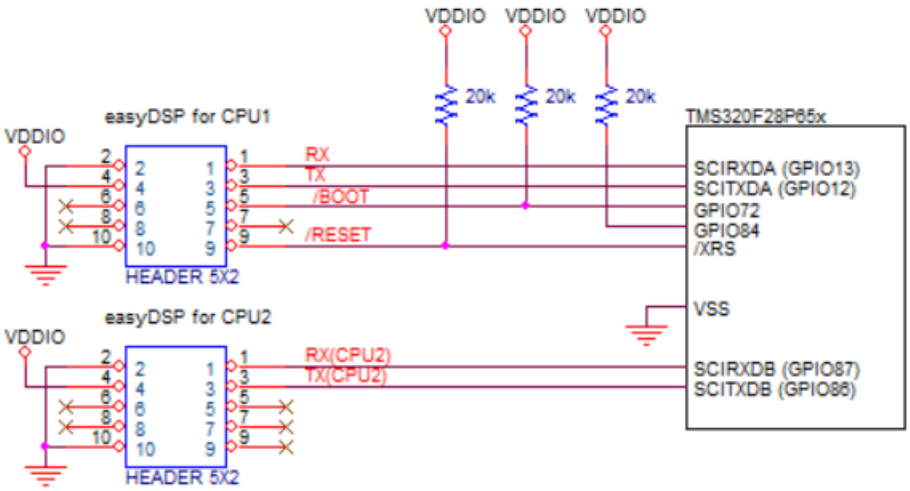
7.1.2.1 F28P65x

In this page, factory default is assummed. If you change User OTP (BOOTPIN_CONFIG, BOOTDEF), you should modify the configuration accordingly.

MCU check below two pins at the reset to decide the booting mode.

Boot Mode	GPIO72 (Default boot mode select pin 1)	GPIO84 (Default boot mode select pin 0)
Parallel IO	0	0
SCI / Wait Boot	0	1
CAN	1	0
Flash / USB	1	1

Since easyDSP uses two kinds boot modes, SCI boot mode (RAM boot) and flash boot mode. Below connection is recommended between easyDSP and MCU.



The easyDSP connected to CPU1 should use SCI-A (GPIO13 and 12 fixed).
In case of dual cores MCU (for example, F28P65xD), 2nd easyDSP is required to connect CPU2 via SCI-B. In the easyDSP source file (easy28x_DriverLib.c or easy28x_bitfield.c) , GPIO 86 and 87 is used for SCI-B. If another GPIO port is required for SCI-B, please change the hardware connection and modify the easyDSP source file (in the function of easyDSP_SCI_Init) accordingly by yourself.

For other considerations,
- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec.
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU

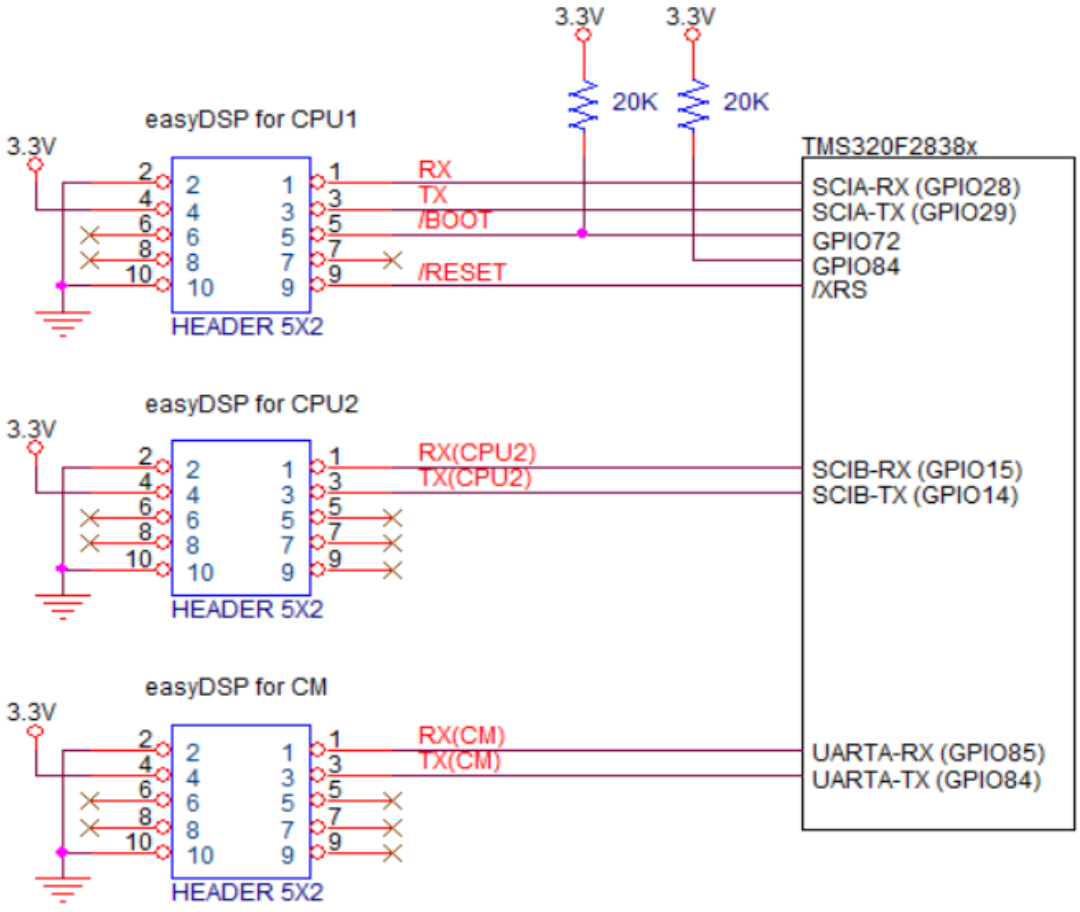
- /BOOT pin is connected to GPIO72 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod
- Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.2 F2838x

Defino series TMS320F2838xD check below two pins at the reset to decide the booting mode.

Boot Mode	GPIO72 (Default boot mode select pin 1)	GPIO84 (Default boot mode select pin 0)
Parallel IO	0	0
SCI / Wait Boot	0	1
CAN	1	0
Flash / USB	1	1

Since easyDSP uses two kinds boot modes, SCI boot mode (RAM boot) and flash boot mode. Below connection is recommended between easyDSP and MCU.
Note 1) GPIO28/29 should be used for SCIA
Note 2) factory default is assummed. Otherwise, the user should modify the configuration accordingly.



You need to use three easyDSP pods to communicate with CPU1, CPU2 and CM all.
The easyDSP connected to CPU1 should use SCI-A (GPIO28 and 29 fixed).

The easyDSP connected to CPU2 can use either SCI-B, SCI-C or SCI-D but easyDSP recommends to use SCI-B as default in its source file.
The easyDSP connected to CM should use UART. easyDSP uses GPIO84/85 in its source file.
In case you uses another GPIO pins for CPU2 and CM, the hardware connection and easyDSP source file (easyDSP_SCI_Init function in the file of easy28x_DriverLib.c or easy28x_bitfield.c) should be modified accordingly by yourself.

- Factory default setting is assumed (Don't change it)
- Power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec.
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO72 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

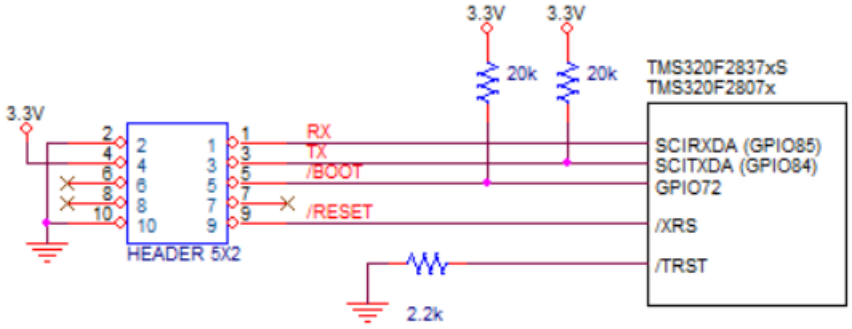
Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.3 F2837xS/2807x

Both piccolo series TMS320F2807x and defino series TMS320F2837xS check below three pins at the reset to decide the booting mode.

MODE	GPIO72	GPIO84	/TRST	Boot mode
Mode EMU	X	X	1	Emulation Boot
Mode 0	0	0	0	Parallel I/O
Mode 1	0	1	0	SCI (RAM boot)
Mode 2	1	0	0	Wait Boot Mode
Mode 3	1	1	0	Get Mode (factory default = boot to flash)

easyDSP uses two kinds boot mode. SCI boot mode for RAM booting, GetMode boot mode for flash rom booting.
Below connection is recommended between easyDSP and MCU.



- Factory default setting is assumed

- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- connect SCIRXDA = GPIO85, SCITXDA = GPIO84
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- TX/RX pins are directly connected to MCU pins
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO72 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

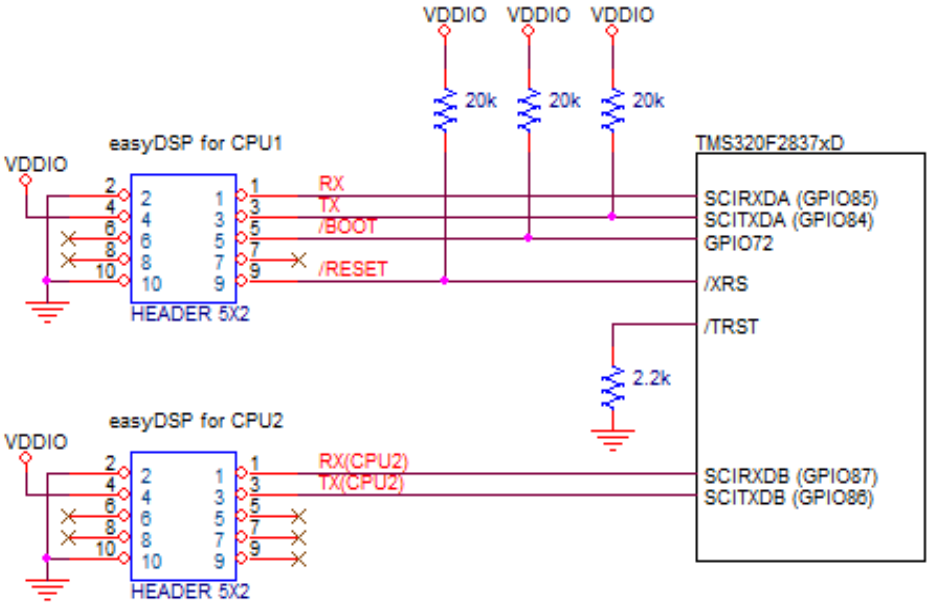
Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.4 F2837xD

Defino series TMS320F2837xD check below three pins at the reset to decide the booting mode.

MODE	GPIO72	GPIO84	/TRST	Boot mode
Mode EMU	X	X	1	Emulation Boot
Mode 0	0	0	0	Parallel I/O
Mode 1	0	1	0	SCI (RAM boot)
Mode 2	1	0	0	Wait Boot Mode
Mode 3	1	1	0	Get Mode (factory default = boot to flash)

easyDSP uses two kinds boot mode. SCI boot mode for RAM booting, GetMode boot mode for flash rom booting.
Below connection is recommended between easyDSP and MCU.
Note that GPIO84/85 should be used for SCIA. Please check 'How to use different port ?' session in case external memory interface is necessary.



You need to use two easyDSP pods to communicate with both CPU1 and CPU2.
one easyDSP connected to CPU1 should use SCI-A (GPIO84/85 fixed).
The other easyDSP connected to CPU2 can use either SCI-B, SCI-C or SCI-D but easyDSP recommends to use SCI-B GPIO 87/86 as default in its source file (easy28x_DriverLib.c or easy28x_bitfield.c) .
If another GPIO port is required in your system, please change the hardware connection and modify the easyDSP source file (in the function of easyDSP_SCI_Init) accordingly by yourself.

- Factory default setting is assumed (Don't change it)
- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO72 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins.
Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

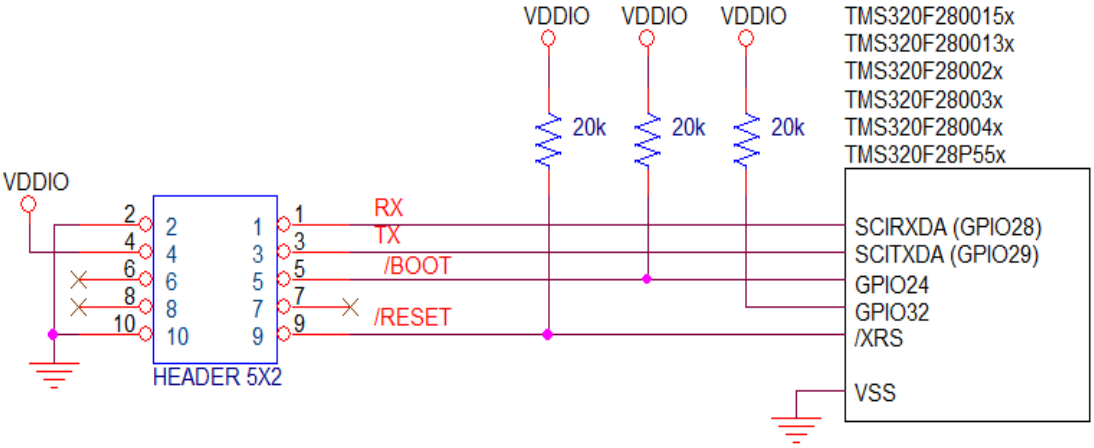
7.1.2.5 F28P55x/F28001x/28002x/28003x/28004x

Under factory default (OTP_BOOTPIN_CONFIG_KEY != 0x5A) and no emulator connected, MCU checks below two pins at reset to determine the booting mode.

MODE	GPIO24	GPIO32	Boot mode
Mode 0	0	0	Parallel I/O
Mode 1	0	1	SCI / Wait (RAM boot)

Mode 2	1	0	CAN
Mode 3	1	1	Flash (USB)

easyDSP uses two kinds boot mode, SCI boot mode for RAM booting, Flash boot mode for flash rom booting.
Therefore, below connection is recommended between easyDSP and MCU.



- Factory default setting is assumed
- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- SCIA_RX = GPIO28, SCIA_TX = GPIO29
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- TX/RX pins are directly connected to MCU pins
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO24 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

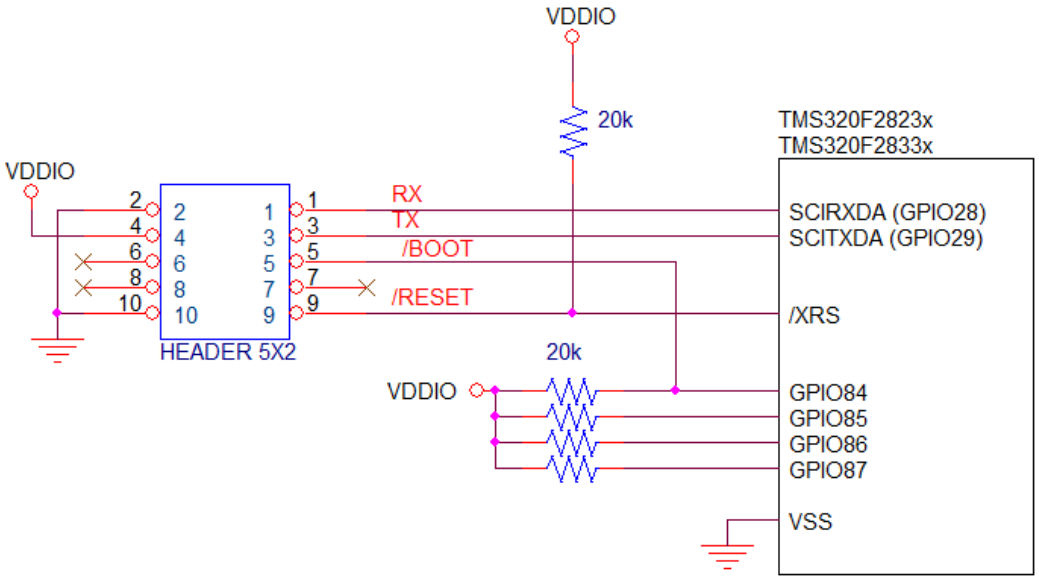
7.1.2.6 F2823x/2833x

Boot mode of TMS320F2823x/2833x at reset is decided based on the pin status of four pins.

MODE	GPIO87 XA15	GPIO86 XA14	GPIO85 XA13	GPIO84 XA12	Boot mode
F	1	1	1	1	Jump to Flash
E	1	1	1	0	SCI-A boot (RAM boot)
D	1	1	0	1	SPI-A boot

C	1	1	0	0	I2C-A boot
B	1	0	1	1	eCAN-A boot
A	1	0	1	0	McBSP-A boot
9	1	0	0	1	Jump to XINTF x16
8	1	0	0	0	Jump to XINTF x32
7	0	1	1	1	Jump to OTP
6	0	1	1	0	Parallel GPIO I/O boot
5	0	1	0	1	Parallel XINTF boot
4	0	1	0	0	Jump to SARAM
3	0	0	1	1	Branch to check boot mode
2	0	0	1	0	Branch to Flash, skip ADC calibration
1	0	0	0	1	Branch to SARAM, skip ADC calibration
0	0	0	0	0	Branch to SCI, skip ADC calibration

easyDSP activates both /BOOT and /RESET pins low for RAM booting. It activates only /RESET pin low for the menu 'DSP>Reset DSP'.
An easyDSP uses either 'Jump to Flash' mode or 'SCI-A boot' by setting GPIO84 pin as 1 or 0 while other three pins are fixed to 1. Therefore below circuit configuration is recommended.



- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to either GPIO84 or GPIO85 via 2kΩ resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /Reset pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

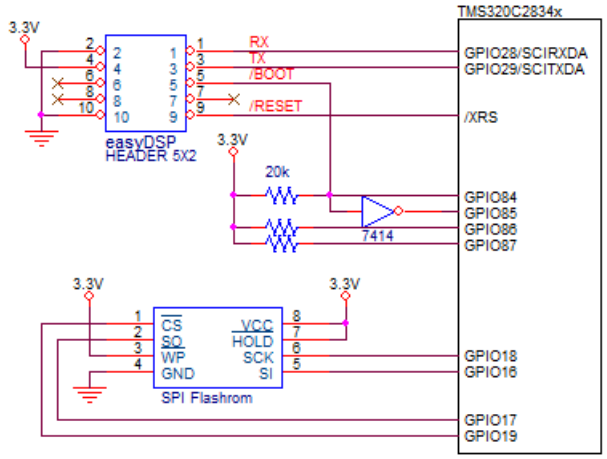
Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.7 C2834x

TMS320C2834x checks below four pins at the reset to decide the booting mode.

MODE	GPIO87 XA15	GPIO86 XA14	GPIO85 XA13	GPIO84 XA12	Booting mode
E	1	1	1	0	SCI-A boot (for RAM booting)
D	1	1	0	1	SPI-A boot (for flashrom booting)

easyDSP activates both /BOOT and /RESET pins low for RAM booting. And it activates only /RESET pin low for the menu 'DSP>Reset DSP'. So please connect easyDSP as below so that easyDSP can select appropriate RAM booting mode (SCI-A).
Blue box of above table is the recommendation for flashrom booting. Hardware preparation is your task.



(SCI-A boot @ RAM booting. SPI-A boot @ flashrom booting)

And please note belows.
- SPI-A is used for easyDSP. You can't use SPI-A for your purpose.
- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins.
Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

Caution !!

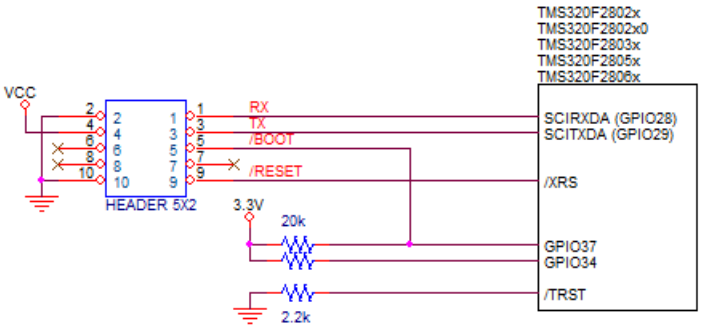
When you select menu 'MCU'>'Reset MCU', only /RESET pin is activated low. /BOOT is still high at that time.
Therefore don't use this menu if you are not ready to use SPI-A boot mode.

7.1.2.8 F2802x/2802x0/2803x/2805x/2806x

Piccolo series TMS320F2802x/2802x0/2803x/2805x/2806x checks below three pins at the reset to decide the booting mode.

MODE	GPIO37 TDO	GPIO34 CMP2OUT	/TRST	Boot mode
Mode EMU	X	X	1	Emulation Boot
Mode 0	0	0	0	Parallel I/O
Mode 1	0	1	0	SCI (RAM boot)
Mode 2	1	0	0	Wait
Mode 3	1	1	0	GetMode

easyDSP uses two kinds boot mode. SCI boot mode for RAM booting, GetMode boot mode for flashrom booting.
In case there is no emulator connected (that is /TRST=0), fix GIOP34 to '1' and connect /BOOT pin to GPIO37 as shown below connection.
cf) In case there is emulator connected, boot mode is decided based on the memory value at the specific address. Please refer to the TI manual for the details.



- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- connect SCIRXDA = GPIO28, SCITXDA = GPIO29
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO37 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

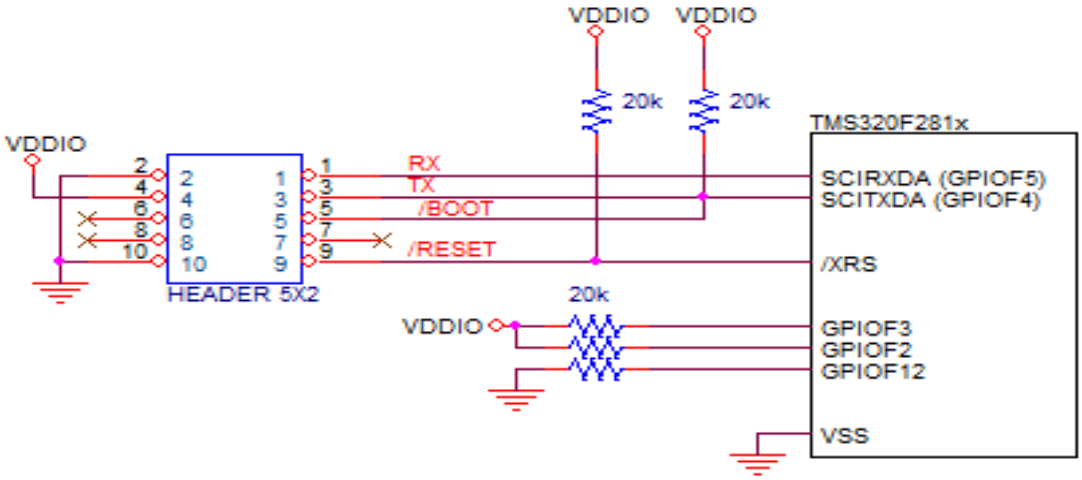
Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.9 F281x

TMS320F281x checks below four pins at the reset to decide the booting mode.

GPIOF4(SCITXDA)	GPIOF12(MDXA)	GPIOF3(SPISTEA)	GPIOF2(SPICLK)	Boot mode
1	x	x	x	**FLASH(0x3F7FF6)**
0	1	x	x	SPI boot
0	0	1	1	**SCI boot (SCI-A)** (RAM boot)
0	0	1	0	H0 SARAM(0x3F8000)
0	0	0	1	OTP (0x3D7800)

easyDSP uses two kinds boot mode. 'SCI' for RAM booting, 'Flash' for flashrom booting (yellow part in above table). Therefore, fix GPIOF2, GPIOF3 and GPIOF12 to '1', '1' and '0' respectively. And connect GPIOF4(SCITXDA) to /BOOT pin of easyDSP, as shown in below connection.



- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to SCITXDA via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

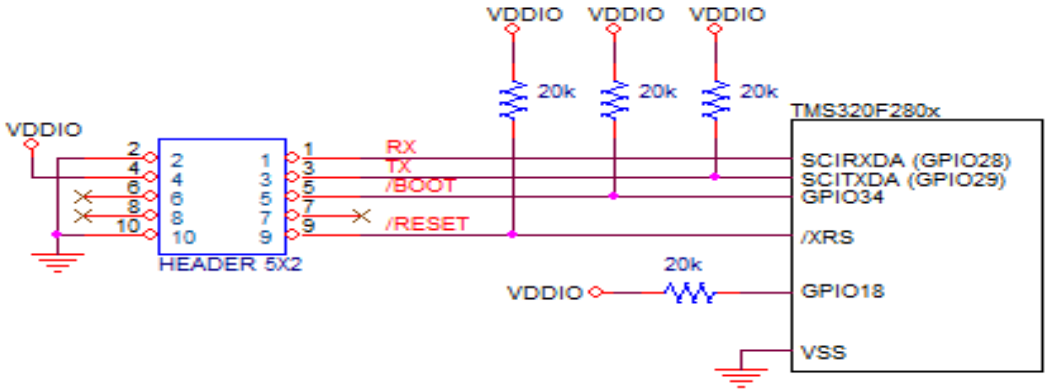
Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.2.10 F280x

TMS320F280x checks below four pins at the reset to decide the booting mode.

Boot mode	GPIO18 SPICLKA SCITXB	GPIO29 SCITXDA	GPIO34
Jump to Flash 0x3F 7FF6	1	1	1
Call SCI-A boot loader (RAM boot)	1	1	0
Call SPI-A boot loader	1	0	1
Call I2C-A boot loader	1	0	0
Call eCAN-A boot loader	0	1	1
Jump to M0 SARAM 0x00 0000	0	1	0
Jump to OPT	0	0	1
Parallel GPIO Loader	0	0	0

easyDSP uses two kinds boot mode. 'SCI-A' for RAM booting, 'Jump to Flash' for flashrom booting (yellow part in above table). Therefore, fix GPIO18, GPIO29 to '1'. And connect GPIO34 to /BOOT pin of easyDSP, as shown in below connection.



- power pin (#4) of easyDSP 5x2 header should be connected to 3.3V
- TX/RX pins are directly connected to MCU pins
- In case there is a reset IC between easyDSP /RESET and MCU /XRS, it should transfer easyDSP /RESET signal to MCU /XRS within 0.5sec
- In case you insert buffer IC between easyDSP header and MCU, place buffer IC directly to easyDSP header so that all resistors can be connected to directly MCU
- /BOOT pin is connected to GPIO34 via 2kΩ series resistor
- /RESET pin is connected to reset generation circuit of MCU board
  (Time duration of /RESET pin is around 500msec)
- In case you use pull-up resistor to each pin, the value of pull-up resistor should be higher than a few kilo ohm since there is 100Ω series resistor inside easyDSP pod

Please be careful when you use your own pull-up or pull-down resistor on the easyDSP signal pins. Please use appropriate filter circuit to your reset generation circuit to prevent unintentional reset generation.

7.1.3 How to use other SCI port than designated

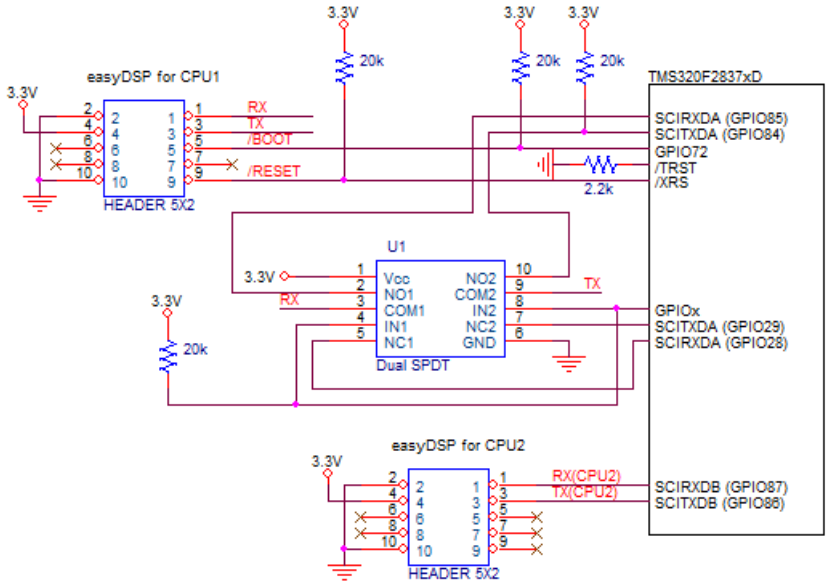
If you use different ports for easyDSP than recommended in previous section, you can do monitoring operation but can't do RAM booting and flash programming since MCU has dedicated port for its SCI booting. In case you really need to use different port, you can try below method. Here TMS320F28377D is taken as an example but the other MCU can be used in similar way.

How to use the other ports than GPIO85 and GPIO84 with TMS320F28377D for EMIF :

First step, SCI booting done by GPIO85/GPIO84 and later monitoring done by the other GPIOs. To do so, additional hardware is necessary to switch easyDSP connection from GPIO85/GPIO84 to the other GPIOs right after booting completion. Please refer to below circuit whereDual SPDT (NLAS4684 from Onsemi,TS3A24159 from TI) is used. FPGA can be used too.

http://www.onsemi.com/pub_link/Collateral/NLAS4684-D.PDF

http://www.ti.com/lit/ds/symlink/ts3a24159.pdf



To switch easyDSP connection, one more GPIO (here, GPIOx) is used. You can use any GPIO which you don't use in your application. The operation mechanism as below.

- After reset, GPIOx is input pin as reset default. The pull-up resistor on GPIOx decides SPDT connection, which makes easyDSP connected to GPIO85/84.- Once SCI booting is completed, it's user's task to switch easyDSP connection to the other ports. You can do as below.

- Makes GPIOx as output port and set its value to low, which makes easyDSP connection to GPIO28/29.

- The above operation can be done ineasyDSP_SCI_Init() in CPU1.

- Please change original coding as recommended below.

```
////////////////////////////////////////////////////////////////////////////
// ORIGINAL CODING : SCI-A GPIO setting : SCIRXDA = GPIO 85, SCITXDA = GPIO84
////////////////////////////////////////////////////////////////////////////
GPIO_SetupPinMux(84, GPIO_MUX_CPU1, 5);
GPIO_SetupPinMux(85, GPIO_MUX_CPU1, 5);
GPIO_SetupPinOptions(84, GPIO_OUTPUT, GPIO_ASYNC);
GPIO_SetupPinOptions(85, GPIO_INPUT, GPIO_ASYNC);
EALLOW;
GpioCtrlRegs.GPCPUD.bit.GPIO85 = 0;
GpioCtrlRegs.GPCPUD.bit.GPIO84 = 0;
EDIS;


////////////////////////////////////////////////////////////////////////////
// MODIFIED CODING : SCI-A GPIO setting : SCIRXDA = GPIO 28, SCITXDA = GPIO29
////////////////////////////////////////////////////////////////////////////
GPIO_SetupPinMux(29, GPIO_MUX_CPU1, 1);
GPIO_SetupPinMux(28, GPIO_MUX_CPU1, 1);
GPIO_SetupPinOptions(29, GPIO_OUTPUT, GPIO_ASYNC);
GPIO_SetupPinOptions(28, GPIO_INPUT, GPIO_ASYNC);
EALLOW;
GpioCtrlRegs.GPCPUD.bit.GPIO28 = 0;
GpioCtrlRegs.GPCPUD.bit.GPIO29 = 0;
EDIS;
// easyDSP connected to GPIO28/29 by using GPIO31
GPIO_SetupPinMux(31, GPIO_MUX_CPU1, 0);
GPIO_SetupPinOptions(31, GPIO_OUTPUT, GPIO_PUSHPULL);
GPIO_WritePin(31, 0);
```

/BOOT pin of easyDSP pod has pseudo open collector type, which means it becomes low during booting for flash programming or RAM booting but open after booting. So, no addtional measures are required when using GPIO72 as EMIF. But please note that easyDSP pod connection or disconnection during MCU operation is not recommended since it could make a unintended noise signal to GPIO72. NEW!

Using Get mode helps ? :

You might think to try Get mode since you can use SCI BOOT 1 in Get Mode after changing Zx-BOOTCTRL register. Since Zx-BOOTCTRL register is located in OTP area, you can not change its contens twice. Also you can not use flash booting.

7.1.4 C28x cautions

*** F ail to boot with big coding size ?**

It could happen likely with TMS320C2834x series since its code size is normally much bigger than that of other MCU series. Why? It's because it takes long long time to initialize variables in c_int00 routine and therefore after some time watch-dog makes unintentional reset to MCU. To prevent watch-dog reset during c_int00 routine operation, it is strongly recommended the entry point is set to the 'code_start' label (in TI's DSP28x_CodeStartBranch.asm) with watch-dog disabled. This is done by linker option -e in the project build options, that is, -ecode_start.

*** Operating XDS100 together with easyDSP ?**

XDS100v1 (TI or 3rd parties emulator) supports multiple FTDI devices only for CCS v4. Therefore when you use XDS100v1 with CCS v3.3, easyDSP can’t be used together.

*** If you use other SCI ports than easyDSP recommends to use ?**

For example, easyDSP recommends to use GPIO28, 29 for SCIRXDA and SCITXDA respectively when SCI-communicating with F28335. If you use GPIO36 and GPIO35 instead, you will face the booting failure. It's because TI does not support serial booting via these pins (GPIO36 and 35).

*** What if MCU is at the reset during easyDSP communication ?**

It depends. If the boot mode after the reset is flashrom booting, then the MCU will boot again with the flashrom. If the boot mode after the reset is RAM booting, then MCU will boot with the serial data which easyDSP send for communication. It finally causes fatal error and can damage your system.

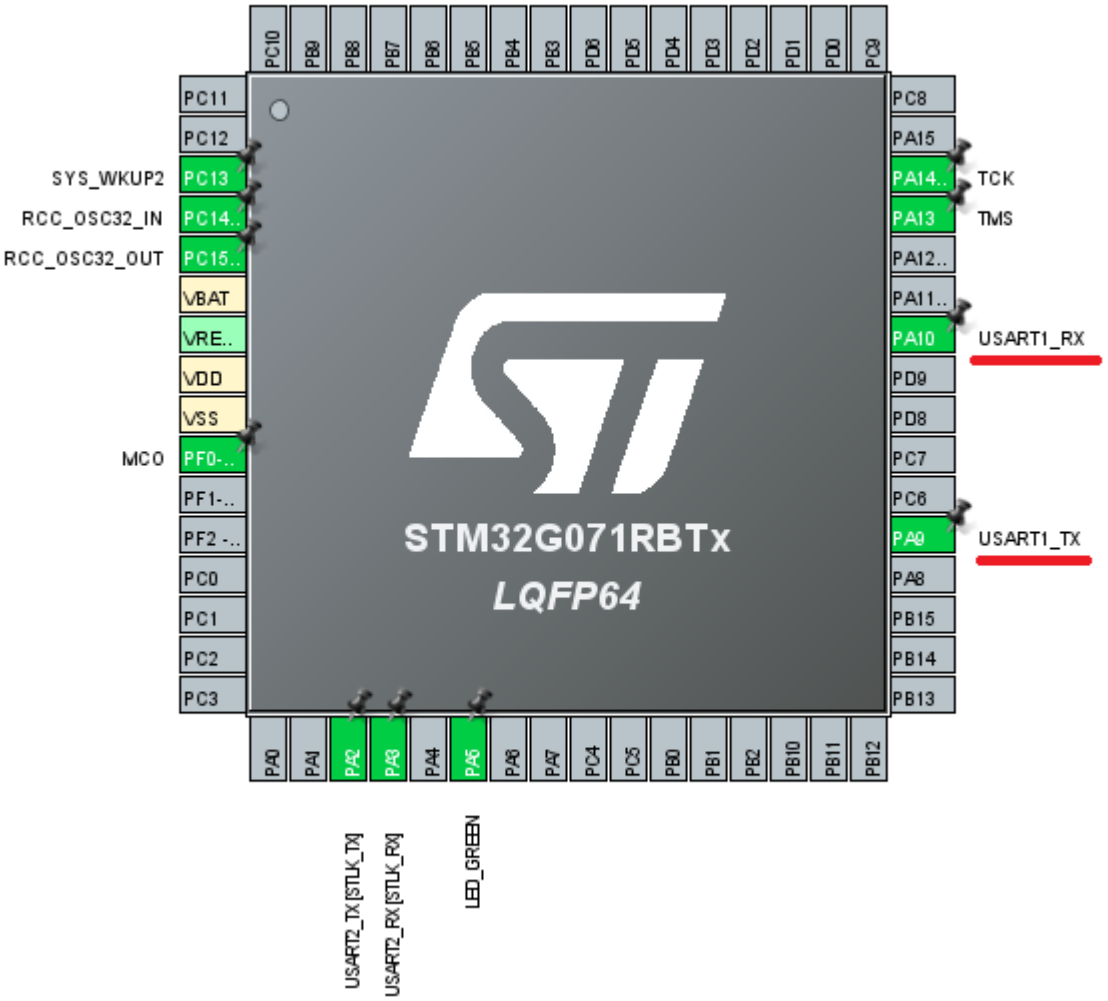
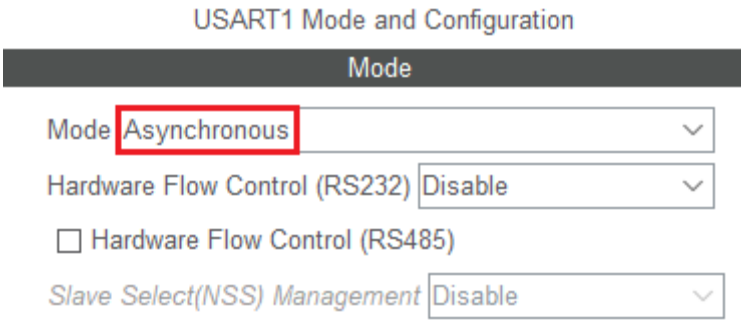
7.2 STM32

7.2.1 STM32 programming

STEP 1 : Selection of USART channel and its configuration

It will be explained based on STM32CubeMX.

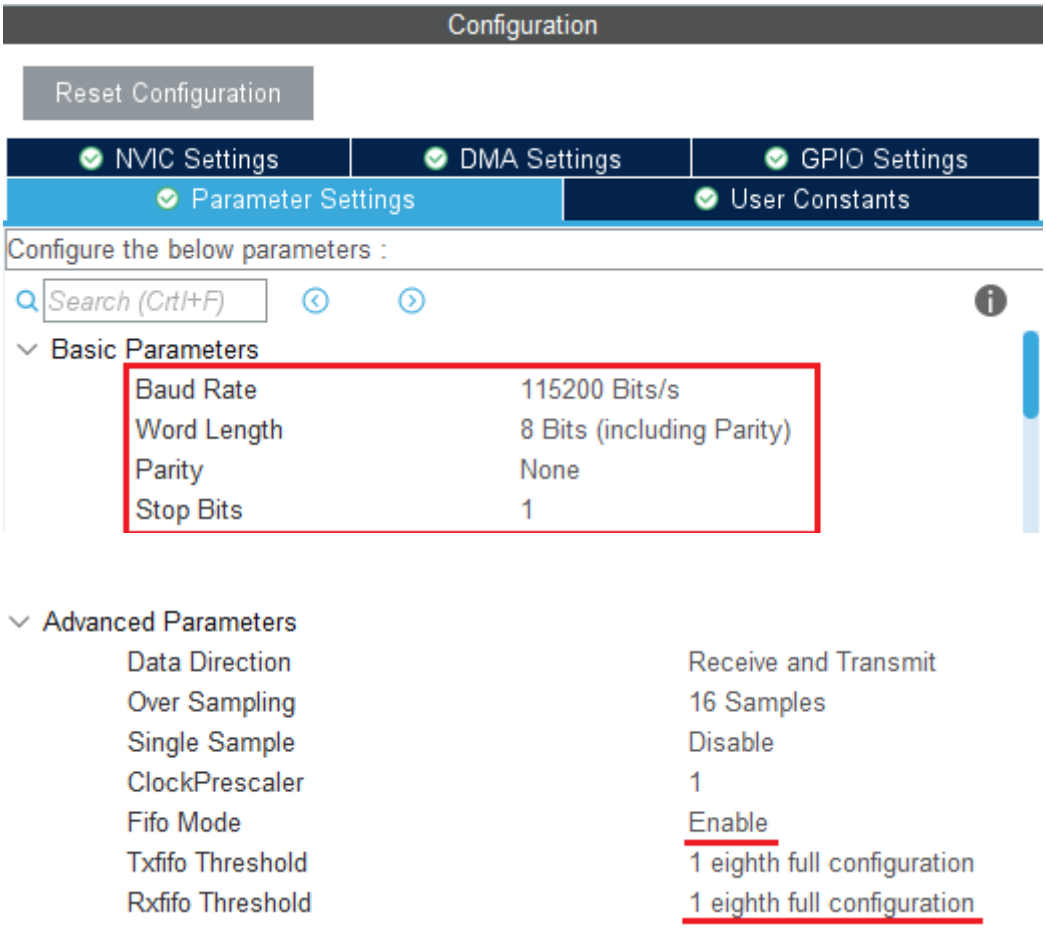
Steps	STM32CubeMX

Select USART channel to be connected to easyDSP. UART channel is not usable. Please refer to 'STM32 hardware > STEP1' in this help file.	 In this example, USART1 is selected.
Go to the selected USART in the 'connectivity' tab. Then set the mode with Asynchronous.	

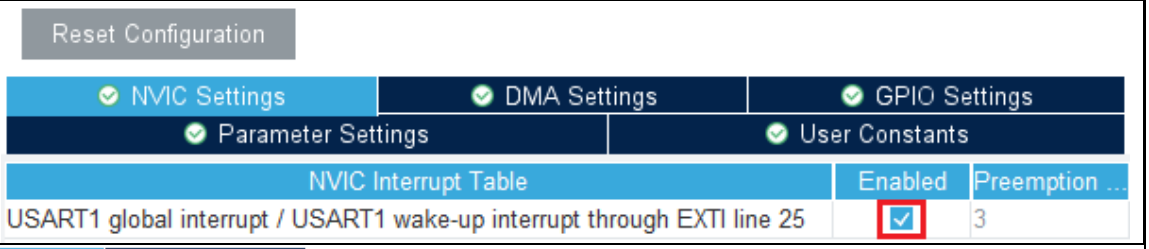
Set the communication with 8 bits, no parity, 1 stop bit .

Baud rate is selectable.

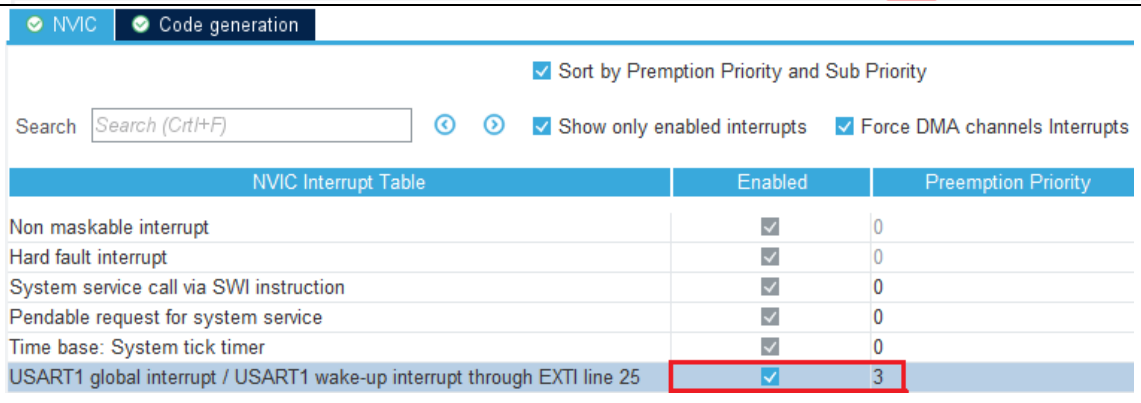
If MCU supports FIFO with 8 levels or more in USART, please enable it and set 'Rxfifo Threshold' to '1 eight full configuration'. Note that easyStmLL.c version 10.5 or lager is required. NEW .



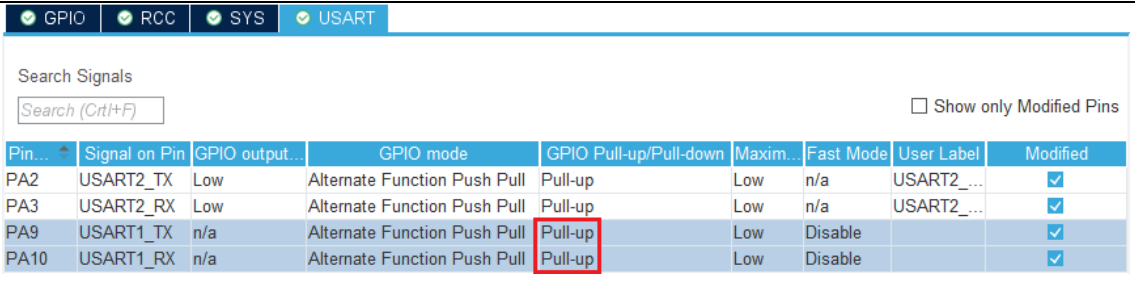
Enable interrupt

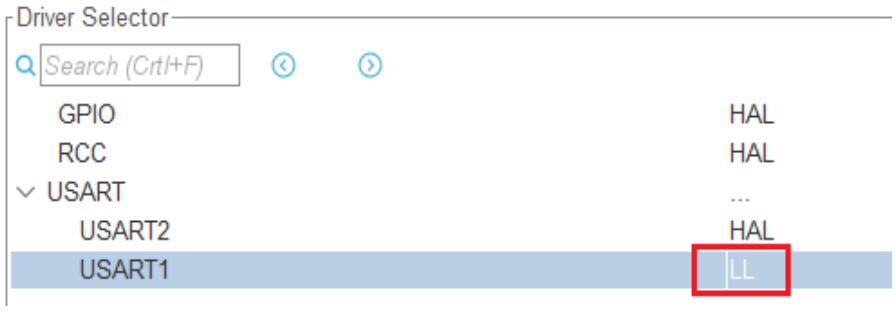


Go to 'system Core > NVIC' tab and set the priority of USART interrupt lowest. That is, the highest number of priority.



Go to ' System Core > GPIO > USART' tab, set the GPIO pin status with Pull-up.



Go to 'Project Manager > Advanced Settings > Driver Selector' tab and **choose LL** . easyDSP supports only LL based source file.	

STEP 2 : USART interrupt service routine based on LL

Thanks to smaller resource consumption than HAL, Only LL based easyDSP communication is supported.
For easyDSP to communicate with MCU via USART, source file for USART ISR (Interrupt Service Routine) should be included in your project.
Below is the source code based on LL and it's located in the folder 'Source > STM32' in the installed easyDSP.
easyStm32LL_v11.4.c
easyStm32LL_v11.4.h

Please check below step by step procedure to modify your application code.
For the additional settings for dual core MCU, please refer to this page.

steps	source code example
Define target MCU as 1 in the easyStm32LL.h file. No change to easyStm32LL.c file.	``` // // Select target MCU series : // Define 1 to target MCU. 0 to all others. // #define STM32C0XX 0 #define STM32F0XX 0 #define STM32F1XX 0 #define STM32F2XX 0 #define STM32F3XX 0 #define STM32F4XX 0 #define STM32F7XX 0 #define STM32G0XX 1 #define STM32G4XX 0 #define STM32H5XX 0 #define STM32H7XX 0 #define STM32L0XX 0 #define STM32L1XX 0 #define STM32L4XX 0 #define STM32L5XX 0 #define STM32U5XX 0 #define STM32WBXX 0 #define STM32WBAXX 0 #define STM32WLXX 0 ``` In this example, target MCU is STM32G0xx.

In the beginning of main.c, include easyStm32LL_vx.y.h where x.y is version.

After calling MX_USARTx_UART_Init(), call easyDSP_init(USARTz)

z = selected USART channel. In this example USART1 is used.

```
/* USER CODE BEGIN Includes */
#include "easyStm32LL_vx.y.h"   // x.y = version x.y
/* USER CODE END Includes */

int main(void)
{
    .
    .
    .
    .
    .
    .
    MX_USART1_UART_Init();
    .
    .
    .

    /* USER CODE BEGIN 2 */
    easyDSP_init(USART1);
    /* USER CODE END 2 */

    while (1)
    {

    }
}
```

In the beginning of stm32xxx_it.c file where ISR is defined, include easyStm32LL.h.

call ez_USARTx_IRQHandler() in the selected USART IRQ handler function.

```
/* USER CODE BEGIN Includes */
#include "easyStm32LL_vx.y.h"   // x.y = version x.y
/* USER CODE END Includes */

void USART1_IRQHandler(void)
{
    /* USER CODE BEGIN USART1_IRQn 0 */
    ez_USARTx_IRQHandler();
    /* USER CODE END USART1_IRQn 0 */
    /* USER CODE BEGIN USART1_IRQn 1 */

    /* USER CODE END USART1_IRQn 1 */
}
```

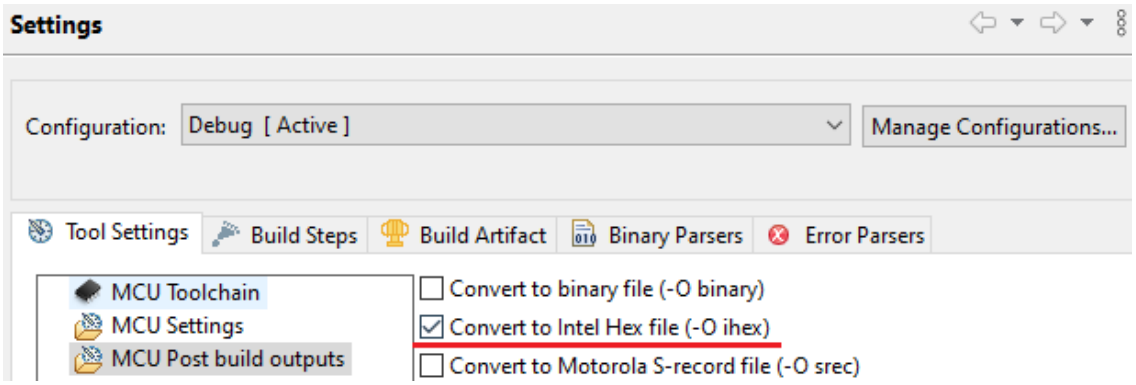
In this example, the ISR file is stm32g0xx_it.c.

STEP 3 : Dual core

The code of each CPU should be located in the different page of flash.

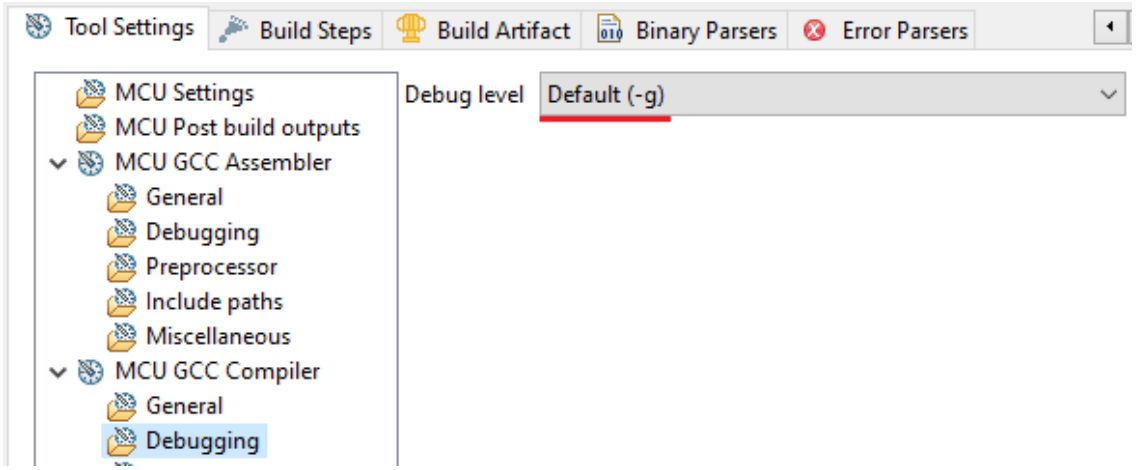
STEP 4 : IDE setting

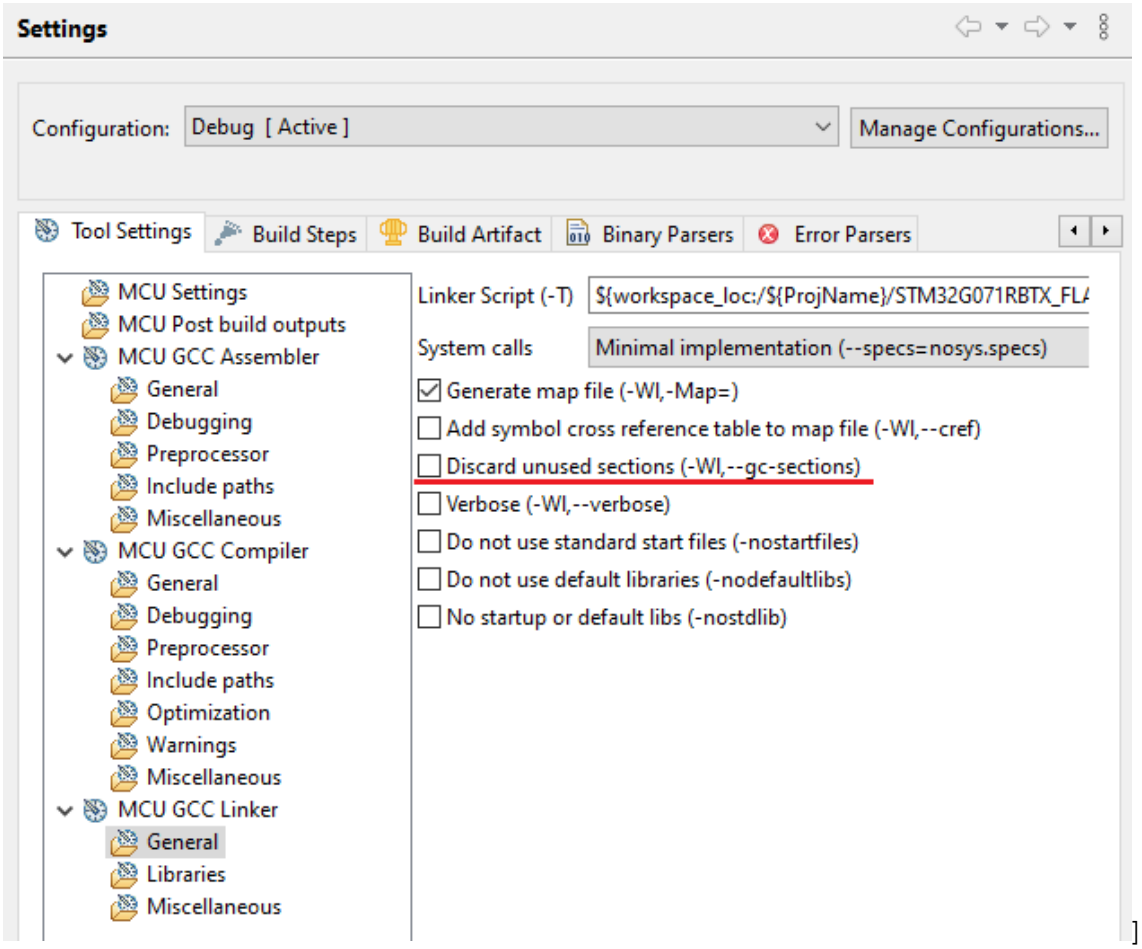
1. Hex file (intel format) is used for ram booting and flash programming. So it should exist and be created in every compiling time in the same folder to output file (ex *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming and ram booting. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Please set your IDE to create hex file in every compilation accordingly.
Example of STM32CubeIDE :



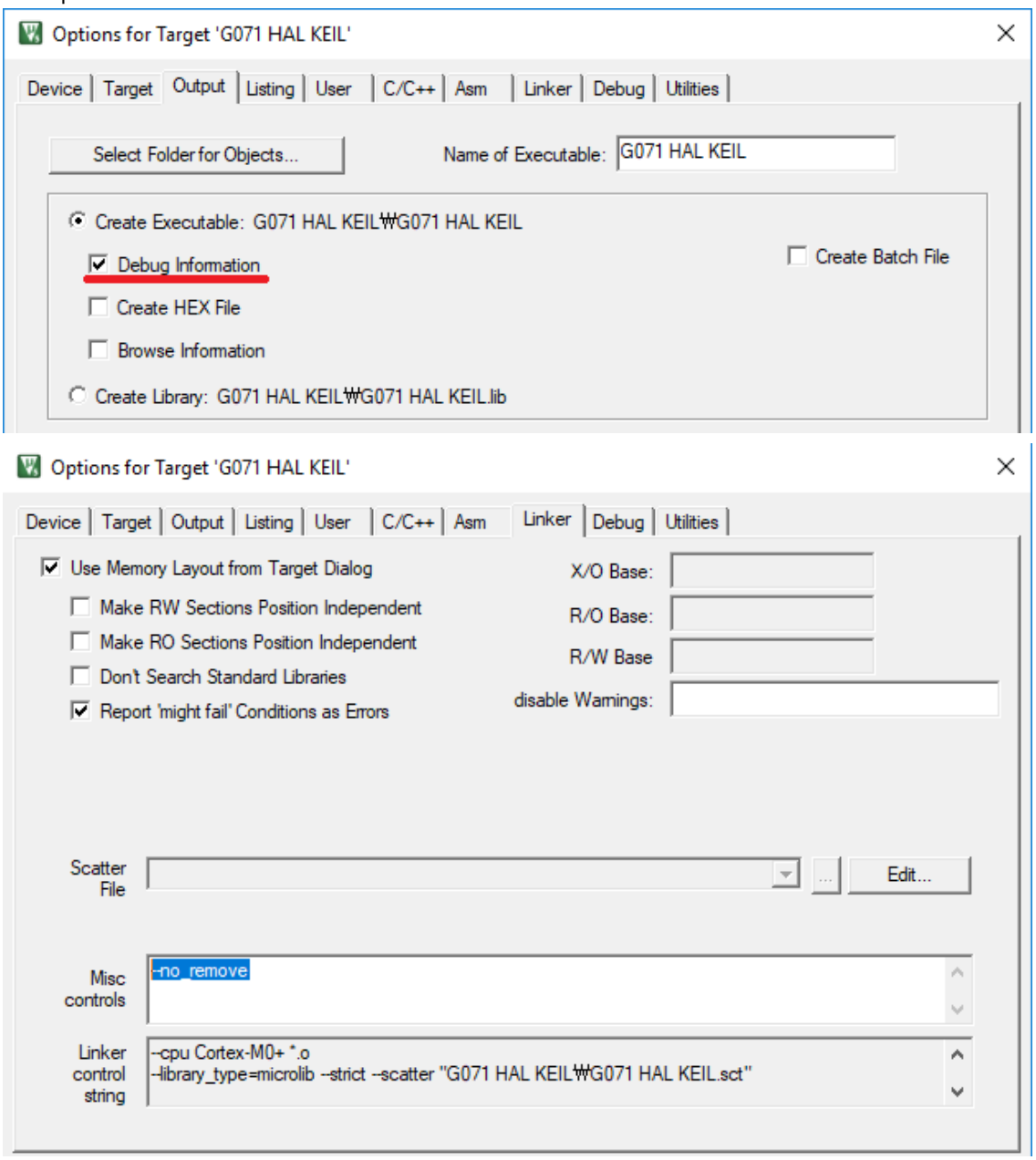
2. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly (for example, -g option). The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. As an example with Stm32CubeIde, uncheck the 'Discard unused sections' box.

Example of STM32CubeIDE :

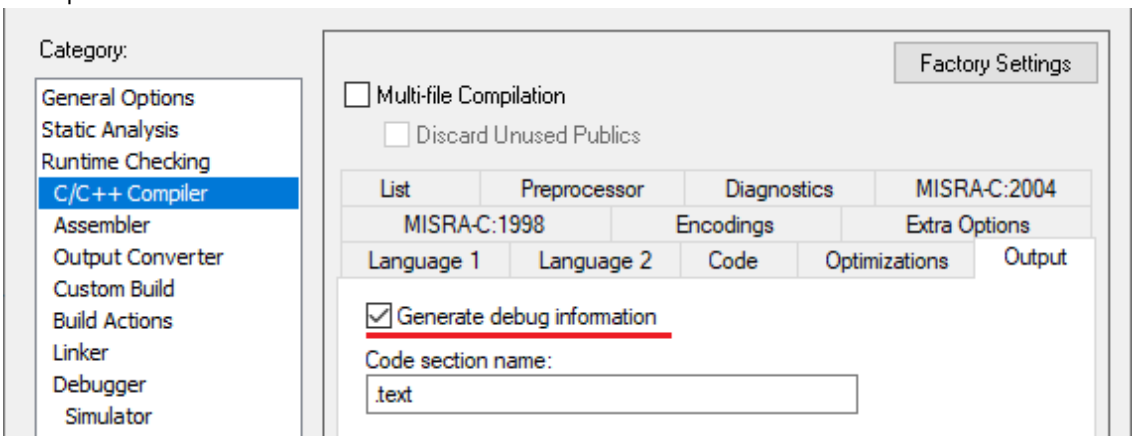


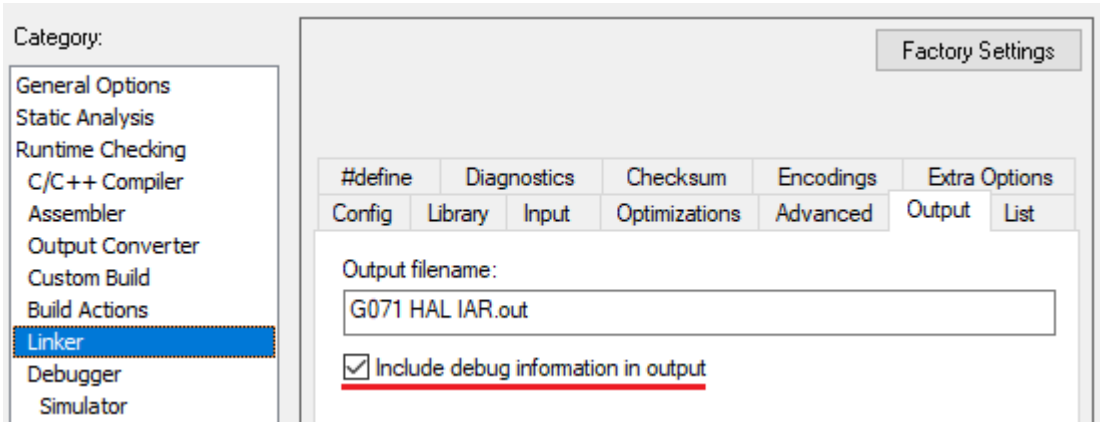

Settings
Configuration: Debug [Active]
Manage Configurations...
Tool Settings
Build Steps
Build Artifact
Binary Parsers
Error Parsers
MCU Settings
MCU Post build outputs
MCU GCC Assembler
General
Debugging
Preprocessor
Include paths
Miscellaneous
MCU GCC Compiler
General
Debugging
Preprocessor
Include paths
Optimization
Warnings
Miscellaneous
MCU GCC Linker
General
Libraries
Miscellaneous
Linker Script (-T)
${workspace_loc:/${ProjName}/STM32G071RBTX_FLA
System calls
Minimal implementation (--specs=nosys.specs)
Generate map file (-Wl,-Map=)
Add symbol cross reference table to map file (-Wl,--cref)
Discard unused sections (-Wl,--gc-sections)
Verbose (-Wl,--verbose)
Do not use standard start files (-nostartfiles)
Do not use default libraries (-nodefaultlibs)
No startup or default libs (-nostdlib)

Example of KEIL uVision :



Example of IAR Embedded Workbench :





7.2.2 STM32 hardware

STEP 1 : Selection of USART channel and its pins for boot mode operation

easyDSP uses USART communication to interface with MCU and also for flash programming under bootloader. So, first step should be choosing proper USART channel and its pins.
Please check ST's application note (AN2606 : STM32 microcontroller system memory boot mode) and choose USART channel and its pins on your needs. UART channel is not usable.
(Note : as of Apr 2025, no information about STM32WL3x in the AN2606. Please use USART1 Rx (PA15) and USART1 Tx (PA1) for QFN48 package or USART1 Rx (PB14) and USART1 Tx (PA1) for QFN32 package)
Note that USART channel should be supported by bootloader. For example, in case of STM32F413x, check the table below.

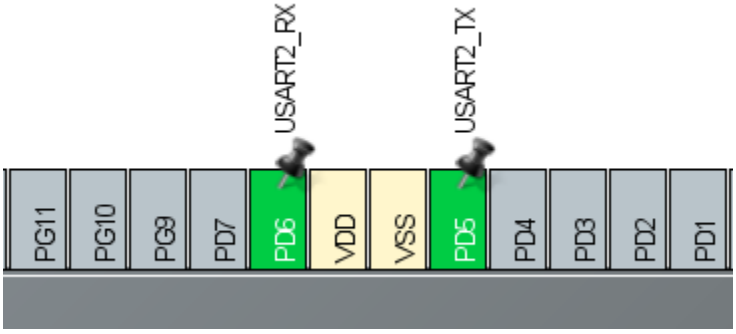
AN2606 **STM32F413xx/423xx devices bootloader**

Table 67. STM32F413xx/423xx configuration in system memory boot mode (continued)

Bootloader	Feature/Peripheral	State	Comment
USART1 bootloader	USART1	Enabled	Once initialized the USART1 configuration is: 8-bit, even parity and 1 Stop bit
	USART1_RX pin	Input	PA10 pin: USART1 in reception mode
	USART1_TX pin	Output	PA9 pin: USART1 in transmission mode
USART2 bootloader	USART2	Enabled	Once initialized the USART2 configuration is: 8-bit, even parity and 1 Stop bit
	USART2_RX pin	Input	PD6 pin: USART2 in reception mode
	USART2_TX pin	Output	PD5 pin: USART2 in transmission mode
USART3 bootloader	USART3	Enabled	Once initialized the USART3 configuration is: 8-bit, even parity and 1 Stop bit
	USART3_RX pin	Input	PB11 pin: USART3 in reception mode
	USART3_TX pin	Output	PB10 pin: USART3 in transmission mode

If you choose USART2, then you should usePD5 and PD6 pin.

Accrodingly set the PD5 and PD6 as USART2 in the STM32CubeMX.



Caution-1 : Below MCU-USART-Pin combination is not recommended due to its restriction.

MCU	USART	Pin	Limitation
STM32F03xx4/6	USART1	PA14 PA15	SWD not available during bootloader operation because PA14(SW_CLK) is used by bootloader.
STM32F030xC STM32F05xxx STM32F030x8 STM32F04xxx STM32F070x6 STM32F070xB STM32F071xx STM32F072xx STM32F09xxx	USART2	PA14 PA15	SWD not available during bootloader operation because PA14(SW_CLK) is used by bootloader.

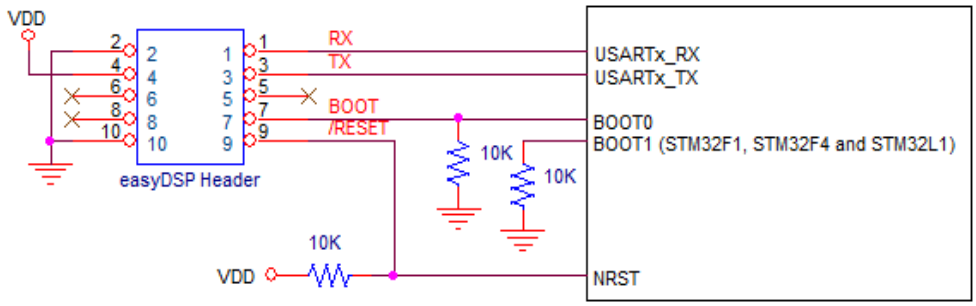
Caution 2 : Due to bugs in the bootloader (esp. with old version), please don't use below MUC-BL ID-USART combinations.
Please check AN2606 for its details.
Please note that the other combination than this could be not working due to undocumented bugs.

MCU	BL ID	USART
STM32F105xx/107xx	V2.0 (0x20)	USART1,USART2
STM32F412xx	V9.0 (0x90)	USART3
STM32G05xxx/061xx	V5.0 (0x50)	USART2
STM32H74xxx STM32H75xxx	V13.2 (0xD2)	USART2
STM32L552xx STM32L562xx	V13.0 (0xD0)	USART3
STM32L47xxx/48xxx	V9.2 (0x92)	USART2
STM32L496xx/4A6xx	V9.3 (0x93)	USART2, USART3
STM32L4P5xx/Q5xx	V9.0 (0x90)	USART2, USART3
STM32L4Rxx/4Sxx	V9.2 (0x92)	USART2, USART3
STM32L4RxG/4SxG	V9.2 (0x92)	all USARTx

STEP 2 : easyDSP pod connection

Connect easyDSP pod to the USARTx selected in step 1.
In case of STM32F1, STM32F4 and STM32L1, pulldown to BOOT1 pin.
easyDSP pod VDD pin is connected to MCU VDD pin.
easyDSP pod TX and RX pin is pulled up with 100k Ohm resistor inside of easyDSP pod.

In case there is a reset IC between easyDSP /RESET and MCU NRST, it should transfer easyDSP /RESET signal to MCU within 0.5sec.



Note)
STM32WB0 and STM32WL33xx : PA10 pin is BOOT0 pin.
STM32H74xxx/75xxx : don't pulldown PB15 pin.
STM32G03xx/04xxx : don't pulldown PA3 pin if the version of bootloader is either v5.1 or v5.2.
STM32C011xx : On WLCSP12, SO8N, TSSOP20 and UFQFN20 packages, USART1 PA9/PA10 IOs are remapped on PA11/PA12.
STM32C031xx : On TSSOP20 and UFQFN28 packages, USART1 PA9/PA10 IOs are remapped on PA11/PA12.

STEP 3 : MCU option byte

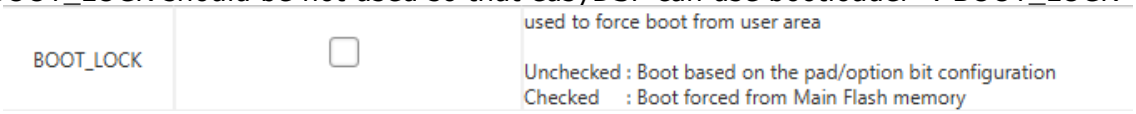
The option byte of MCU should be set properly before using easyDSP. Since easyDSP can't change it, It's your task to change option byte by using Stm32CubeProgrammer.

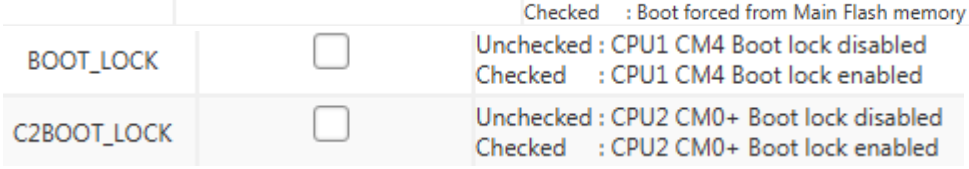
For easyDSP to access the memory, no protection or security should be active such as
- RDP (Readout Protect)
- WRP (Write Protect)
- PCROP (Proprietary code read-out protection)
- Securable memory

easyDSP contols BOOT0 pin to determine MCU boot mode after reset, either boot from flash (BOOT0 pin low) or boot from system memory (BOOT0 pin high). Option bytes in the MCU should be set accordingly.

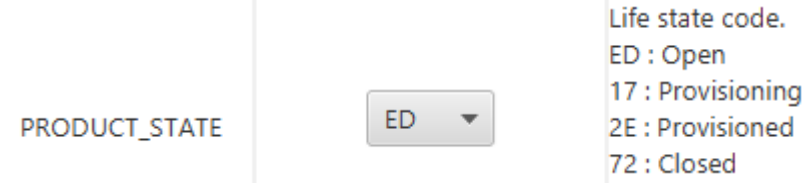
Below captures from Stm32CubeProgrammer could be different slightly depending MCU type.

- BOOT_LOCK should be not used so that easyDSP can use bootloader : BOOT_LOCK = unchecked

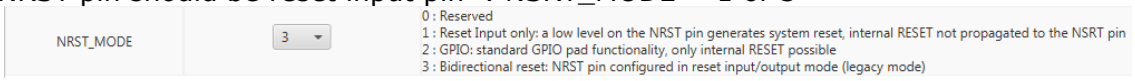




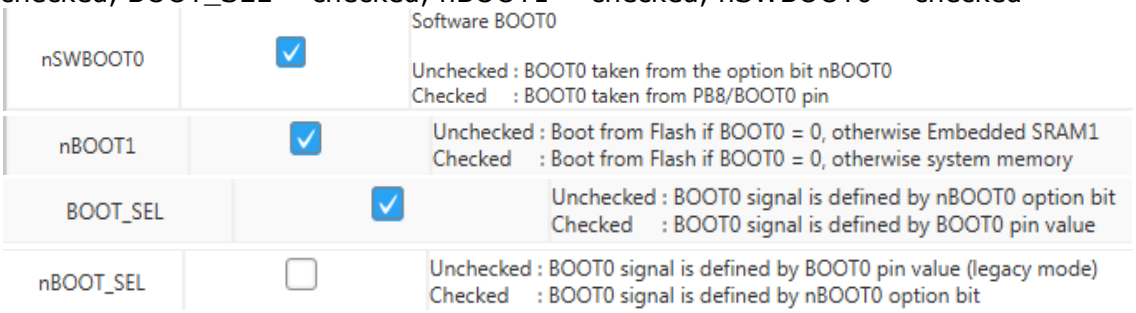
- If MCU has product state, it should be OPEN for flash programming.



- NRST pin should be reset input pin : NSRT_MODE = 1 or 3

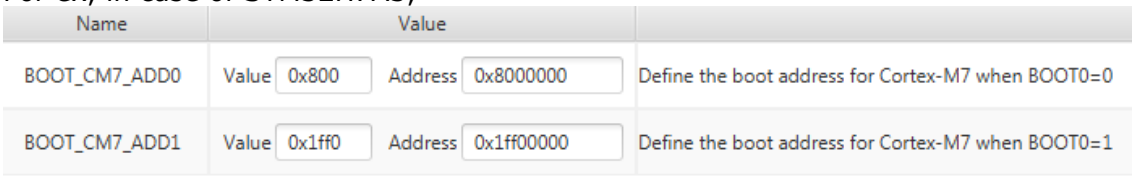


- Boot mode should be determined by BOOT0 pin which is controlled by easyDSP : nBOOL_SEL = unchecked, BOOT_SEL = checked, nBOOT1 = checked, nSWBOOT0 = checked

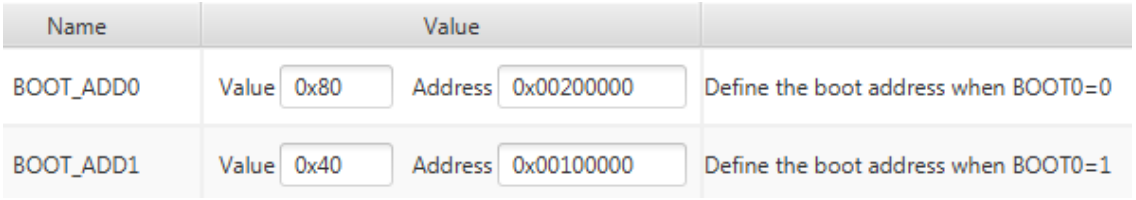


- If different boot areas can be selected through the BOOT pin and the boot base address programmed in the BOOT_ADD0 and
BOOT_ADD1 option bytes, the BOOT_ADD0 and BOOT_ADD! should be the address of flash and system memory respectively.

For ex, in case of STM32H7A3,



in case of STM32F767



- In case of STM32H7 dual core MCU, both cores are boot-enabled.

In case of STM32WL dual core :

7.2.3 STM32 dual core

Target MCU

STM32H745x, STM32H747x, STM32H755x, STM32H757x (CPU1 = Arm Cortex-M7, CPU2 = Arm Cortex-M4)
STM32WL55xx, STM32WL54xx (CPU1 = Arm Cortex-M4, CPU2 = Arm Cortex-M0+)

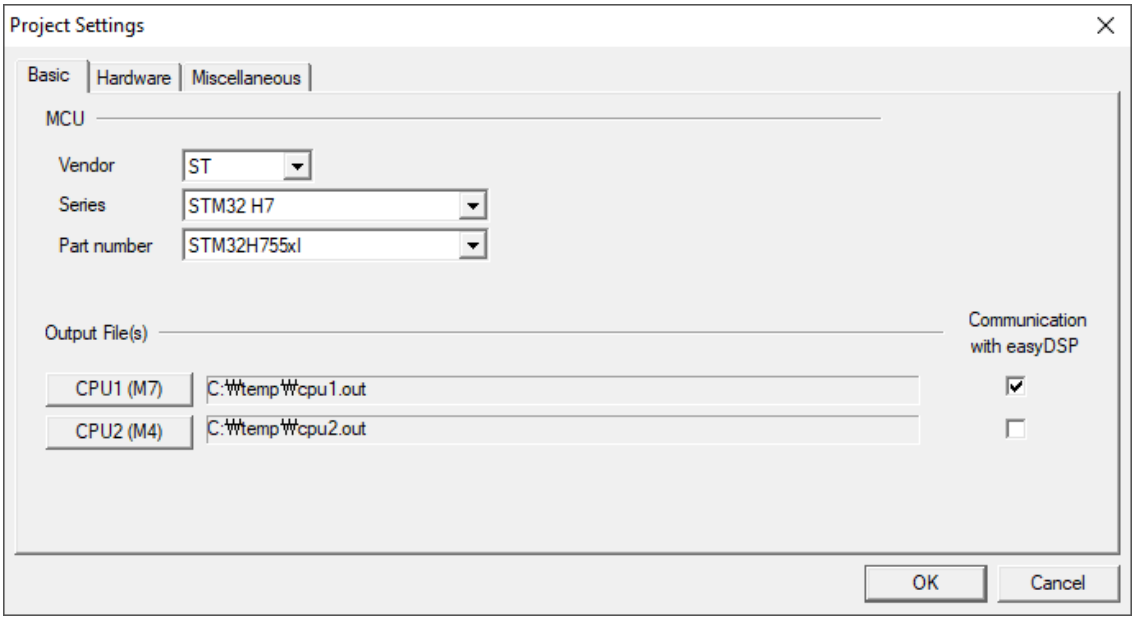
Common

MCU cores are classified with 4 kinds in terms of easyDSP.
Yellow core : core that easyDSP pod is connected to and easyDSP communicates with
Orange core : core that easyDSP pod is not connected to but easyDSP communicates with
Blue core : core that easyDSP doesn't communicate with
Gray core : core that doesn't run

	Connected to easyDSP pod	Communicated with easyDSP	Running core
core	**Yes**	**Yes**	**Yes**
core	No	**Yes**	**Yes**
core	No	No	**Yes**
core	No	No	No

STM32 dual core MCU has 2 cores. Please choose core type either yellow or orange core based on your application.
Since blue and gray core has no operation with easyDSP, no easyDSP related setting is required for them.

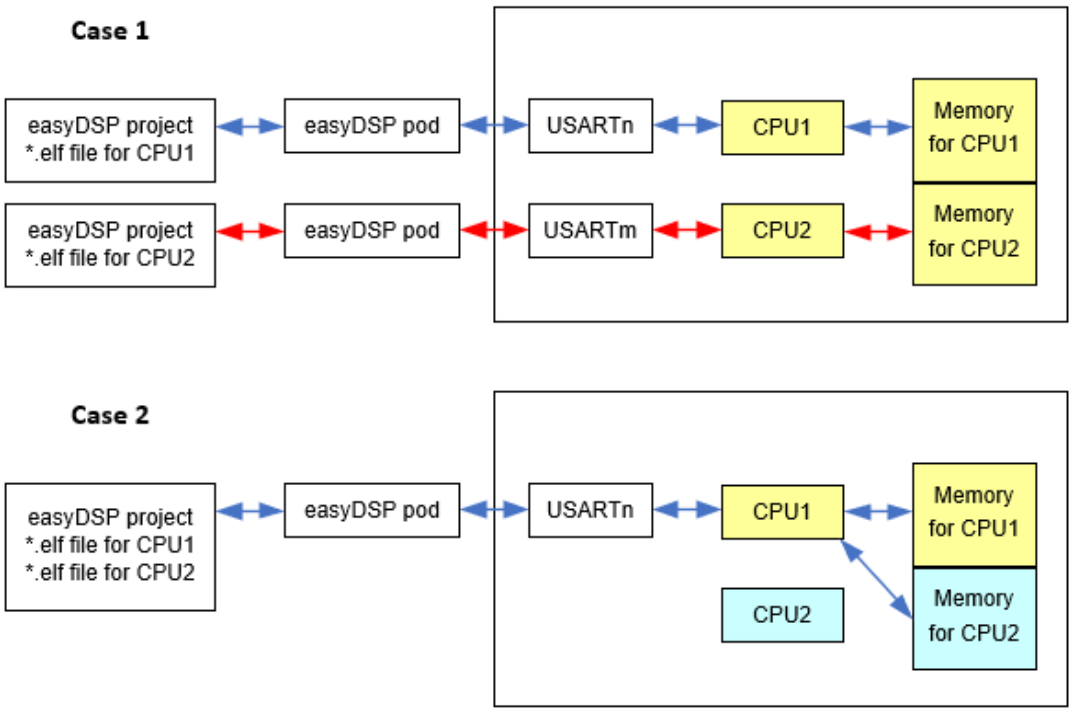
In the project settings, you can designate the output file of the running cores. If two cores are running in the user program, two output files can be specified. These output files are used when flash programming.
Also check the core which easyDSP is communicating with (monitoring).
Below example shows the case that two cores are running (and therefore easyDSP supports flash programming of two cores) and easyDSP is monitoring only CPU1.



When easyDSP monitors two cores CPU1 and CPU2, to devide the variable name of each core, easyDSP adds prefix to the original name, "1:" to CPU1 variables, "2:" to CPU2 variables.
For example, if the name of variable is "var1" in your CPU1 program, easyDSP displays it as "1:var1".

STM32WL dual core

easyDSP offers two options as below. The arrow in the picture means the data flow between easyDSP and CPU.
easyDSP project should be created for all the yellow cores.



Case 1 :

Each CPU has a own connection to easyDSP pod. For each CPU, please set accordingly to what is described in the previous pages .
If you register optional output file, each easyDSP project can flash for both CPU1 and CPU2. If not, each easyDSP project can flash only one CPU.

Settings	CPU1	CPU2
easyDSP project	register CPU1 output file regieter CPU2 output file (optional) check CPU1 check box	register CPU2 output file regieter CPU1 output file (optional) check CPU2 check box
main.c	call easyDSP_init(USARTn)	call easyDSP_init(USARTm)
stm32h7xx_it.c	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()

Case 2 :

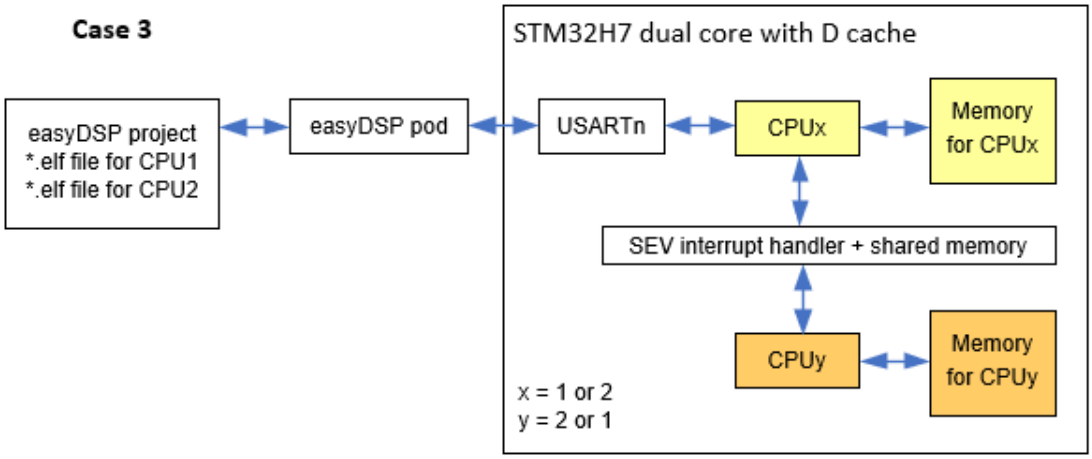
easyDSP is connected to CPU1 and makes an access to all the memory via CPU1. CPU2 can't be used for this purpose.
Therefore like single core MCU, easyDSP related settings are same to what is described in the previous pages . There is no easyDSP related setting to CPU2.

Settings	CPU1
easyDSP project	register CPU1 and CPU2 output files check CPU1 and CPU2 check boxes

main.c	call easyDSP_init(USARTn)
stm32h7xx_it.c	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()

STM32H7 dual core

Depending on data cache usage (Stm32CubeMx > System Core > CORTEX_M7 > Parameter Settings > Cortex Interface Settings > CPU DCache), easyDSP offers three different connections.
The arrow in the picture means the data flow between easyDSP and CPU.



Case 1 :

Each CPU has a connection to easyDSP. This configuration can be used independent of data chache usage.
For each CPU, please set accordingly to what is described in the previous pages .
If you register optional output file, each easyDSP project can flash for both CPU1 and CPU2. If not, each easyDSP project can flash only one CPU.

Settings	CPU1	CPU2
easyDSP project	register CPU1 output file register CPU2 output file (optional) check CPU1 check box	register CPU2 output file register CPU1 output file (optional) check CPU2 check box
easyStm32LL.h	EZ_DUAL_CORE = 1 EASYDSP_IS_CONNECTED_TO_THIS_CORE = 1 EZ_USE_SEV_INT = 0	EZ_DUAL_CORE = 1 EASYDSP_IS_CONNECTED_TO_THIS_CORE = 1 EZ_USE_SEV_INT = 0
main.c	call easyDSP_init(USARTn)	call easyDSP_init(USARTm)
stm32h7xx_it.c	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()

Case 2 :

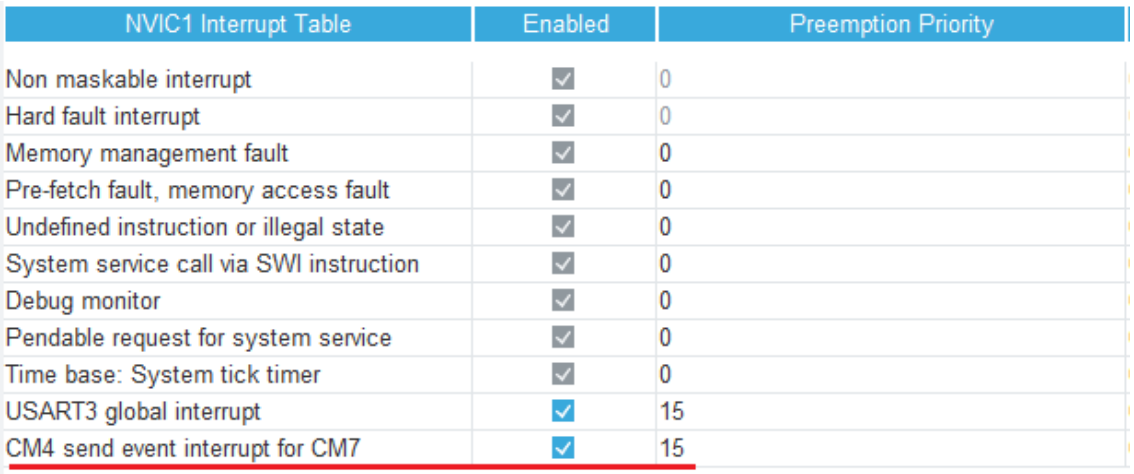
If data cache is not used, easyDSP can access all the memory via CPU1. CPU2 can't be used for this purpose. Therefore like single core MCU, easyDSP related settings are same to what is described in the previous pages .
There is no easyDSP related setting to CPU2.

Settings	CPU1
easyDSP project	register CPU1 and CPU2 output files check CPU1 and CPU2 check boxes
easyStm32LL.h	EZ_DUAL_CORE = 1 EASYDSP_IS_CONNECTED_TO_THIS_CORE = **1** EZ_USE_SEV_INT = 0
main.c	call easyDSP_init(USARTn)
stm32h7xx_it.c	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler()

Case 3 :

If data cache is enabled, easyDSP uses SEV interrupt and dedicated shared memory to avoid cache coherence issue.
easyDSP pod can be connected to either CPU1 or CPU2. Please select the proper CPU for easyDSP pod connection based on your application.

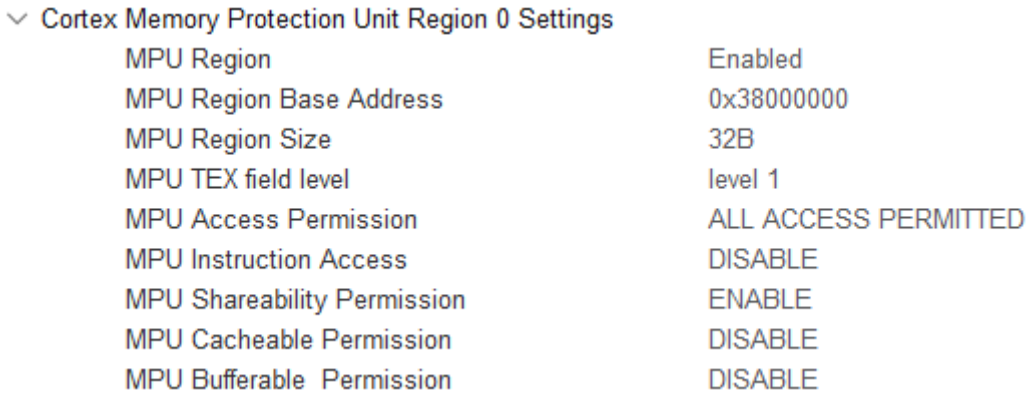
SEV interrupt should be enabled with the lowest priority in the STM32CubeMx > System Core > NVIC1 and NVIC2.



NVIC1 Interrupt Table	Enabled	Preemption Priority
Non maskable interrupt	☑	0
Hard fault interrupt	☑	0
Memory management fault	☑	0
Pre-fetch fault, memory access fault	☑	0
Undefined instruction or illegal state	☑	0
System service call via SWI instruction	☑	0
Debug monitor	☑	0
Pendable request for system service	☑	0
Time base: System tick timer	☑	0
USART3 global interrupt	☑	15
CM4 send event interrupt for CM7	☑	15

NVIC2 Interrupt Table	Enabled	Preemption Priority
Non maskable interrupt	☑	0
Hard fault interrupt	☑	0
Memory management fault	☑	0
Pre-fetch fault, memory access fault	☑	0
Undefined instruction or illegal state	☑	0
System service call via SWI instruction	☑	0
Debug monitor	☑	0
Pendable request for system service	☑	0
Time base: System tick timer	☑	0
USART1 global interrupt	☑	15
CM7 send event interrupt for CM4	☑	15

The shared memory could be located anywhere but the location of SRAM4 is recommended. Note that
1. This memory area (32 bytes from start address) should not be used by both CPU1 and CPU2. Please take care of linker script file.
2. The start address should be aligned to 32 bytes. For example, 0x38000000 or 0x38000020
3. This memory are should be non cacheable. MPU settings are necessary in the Stm32CubeMx > System Core > CORTEX_M7.



Finally include easyDSP source file to both CPU1 and CPU2 projects and set properly as below table.

Settings	CPUx (easyDSP pod is connected to)	CPUy (easyDSP pod is not connected to)
easyDSP project	register CPU1 and CPU2 output files check CPU1 and CPU2 check boxes	no easyDSP project
easyStm32LL.h	EZ_DUAL_CORE = 1 EASYDSP_IS_CONNECTED_TO_THIS_CORE = **1** EZ_USE_SEV_INT = 1 EZ_SHARED_MEM_ADDRESS = user defined	EZ_DUAL_CORE = 1 EASYDSP_IS_CONNECTED_TO_THIS_CORE =**0** EZ_USE_SEV_INT = 1 EZ_SHARED_MEM_ADDRESS = user defined
main.c	call easyDSP_init(USARTn)	call easyDSP_init(**0**)
stm32h7xx_it.c	call USARTx_IRQHandler() in the ez_USARTx_IRQHandler() call CMx_SEV_IRQHandler() in the ez_SEV_IRQHandler()	call CMx_SEV_IRQHandler() in the ez_SEV_IRQHandler()

7.2.4 STM32 RAM booting

You can skip this page if you don't use RAM booting.

easyDSP is supporting RAM booting using boot loader of MCU.
Therefore, all the differences from RAM booting with debugger comes from bootloader.
Please note that ram booting using boot loader has some limitation such as limited RAM area and some bugs in boot loader.
Please refer to below guideline for its implementation.

<table>
<tr><th>Steps</th><th>Example or further explanation</th></tr>
<tr><td>1. Limitations</td><td>
1. Below MCU can't support RAM booting.
STM32F04xxx
STM32F070x6
STM32L01xxx/02xxx
STM32L031xx/041xx

2. If bootloader of MCU is not the latest one, RAM booting is blocked. Please check the MCU and bootloader version in the table. If the latest bootloader is in the MCU, no limitation. For its details, please check the latest version of AN2606 (STM32 microcontroller system memory boot mode).
<table>
<tr><th>MCU</th><th>Bootloader version</th></tr>
<tr><td>STM32H74xxx
STM32H75xxx</td><td>V13.2 (0xD2)</td></tr>
<tr><td>STM32L552xx
STM32L562xx</td><td>V13.0 (0xD0)</td></tr>
<tr><td>STM32L47xxx
STM32L48xxx</td><td>V10.1 (0xA1)
V9.0 (0x90)</td></tr>
<tr><td>STM32F100xx
STM32F101xx
STM32F102xx
STM32F103xx
(except STM32F101xF,
STM32F101xG, STM32F103xF,
STM32F103xG)</td><td>V2.0 (0x20)</td></tr>
</table>
3. no RAM booting supported for dual core MCU (H745, H747, H755, H757, WL5x)
</td></tr>
</table>

2. Modification of RAM memory map in the linker script file

User code can't reside in the RAM area which MCU bootloader is using.
Also there is a memory area which is not accessible in the bootload mode.

So, linker script file should be modified so that user code reside in the RAM properly.
Please check the RAM area usable for RAM booting in the latest AN2606(STM32 microcontroller system memory boot mode) .

Table 145. Bootloader device-dependent parameters (continued)

STM32 Series	Device	PID	BL ID	RAM	System memory
F4	STM32F40xxx/41xxx	0x413	0x31	0x20002000 - 0x2001FFFF	0x1FFF0000 - 0x1FFF77FF
			0x90	0x20003000 - 0x2001FFFF	
	STM32F42xxx/43xxx	0x419	0x70	0x20003000 - 0x2002FFFF	
			0x91		
	STM32F401xB(C)	0x423	0xD1	0x20003000 - 0x2000FFFF	
	STM32F401xD(E)	0x433	0xD1	0x20003000 - 0x20017FFF	
	STM32F410xx	0x458	0xB1	0x20003000 - 0x20007FFF	
	STM32F411xx	0x431	0xD0	0x20003000 - 0x2001FFFF	
	STM32F412xx	0x441	0x90	0x20003000 - 0x2003FFFF	
	STM32F446xx	0x421	0x90	0x20003000 - 0x2001FFFF	
	STM32F469xx/479xx	0x434	0x90	0x20003000 - 0x2005FFFF	
	STM32F413xx/423xx	0x463	0x90	0x20003000 - 0x2004FFFF	

This example is based on STM32F413.

In STM32F413ZHTX_RAM.ld file, RAM area is defined as below.

```
/* Memories definition */
MEMORY
{
  RAM    (xrw)    : ORIGIN = 0x20000000,   LENGTH = 320K
  FLASH  (rx)     : ORIGIN = 0x8000000,    LENGTH = 1536K
}
```

But first 12k byte is used by bootloader and user code can't use this area.
Therefore please modify RAM area to start from 0x20003000.

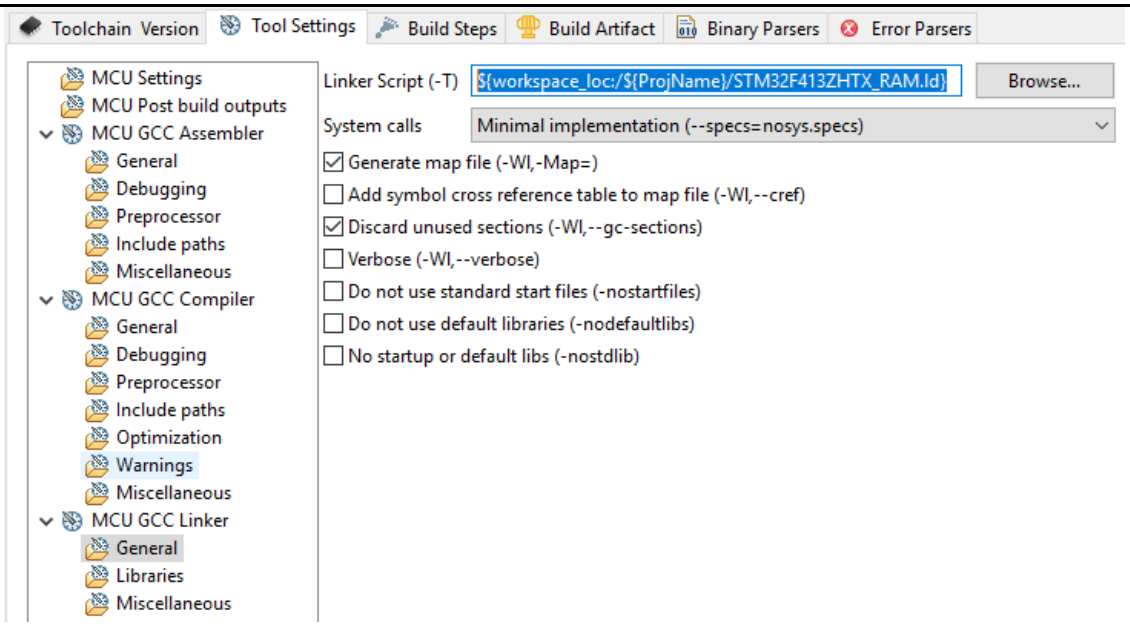
```
/* Memories definition for RAM booting*/
MEMORY
{
  RAM    (xrw)    : ORIGIN = 0x20003000,   LENGTH = 308K
  FLASH    (rx)   : ORIGIN = 0x8000000,    LENGTH = 1536K
}
```

3. Locate ISR vector table in the first address of RAM memory

For RAM booting, easyDSP assumes ISR vector table is located in the first address of RAM memory.
So, the vector table should be located in the first address of RAM memory. In case of Stm32CubeIde, this condition is met by placing .isr_vector in the first part of SECTIONS. Since this is default feature of linker script file Stm32CubeIde generates, you don't need to do any additional job if you use Stm32CubeIde.
In case you use another Ide, please make sure this condition is implemented.

```
/* Sections */
SECTIONS
{
  /* The startup code into "RAM" Ram type memory */
  .isr_vector :
  {
    . = ALIGN(4);
    KEEP(*(.isr_vector)) /* Startup code */
    . = ALIGN(4);
  } >RAM
```

4. register the modified linker script file in the linker option.



5. Change of vector table address

Again, this example is based on STM32F413.

system_stm32f4xx.c BEFORE change :
VECT_TAB_OFFSET is defined as 0x00 for flashrom booting.

```
/* #define VECT_TAB_SRAM */
#define VECT_TAB_OFFSET  0x00 /*!< Vector Table base offset field.
                                   This value must be a multiple of 0x200. */
```

system_stm32f4xx.c AFTER change :
Since the user code starts from 0x20003000, VECT_TAB_OFFSET should be changed to 0x3000.
Please define VECT_TAB_SRAM and set the VECT_TAB_OFFSET to 0x3000.
Note) you need to define USER_VECT_TAB_ADDRESS in some MCU cases (ex, STM32L5, STM32U3)

Below is the recommendation. You can easily switch between RAM booting and flash booting by defining VECT_TAB_SRAM or not respectively.

```
#ifdef VECT_TAB_SRAM
#define VECT_TAB_OFFSET  0x3000
#else
#define VECT_TAB_OFFSET  0x00 /*!< Vector Table base offset field.
                                   This value must be a multiple of 0x200. */
#endif
```

You might need to consider further for the specific MCU. Please check "Miscellaneous Configuration" part of system_stm32yyxx.c file.

6. Others	Depending on the MCU and its bootloader version, further consideration is necessary : case1 : Bootlader version 9.0 with STM32H74x/H75x stack pointer in the STM32H743ZITX_RAM.ld file as shown below `_estack = ORIGIN(RAM_D1) + LENGTH(RAM_D1);  /* end of "RAM_D1" Ram type memory */` should be changed to below by adding -16. `_estack = ORIGIN(RAM_D1) + LENGTH(RAM_D1) - 16; /* Application stack pointer must be lower than (RAM end @ - 16 bytes) */` case 2 : STM32WB55 Below three lines should be inserted at the end of STM32WB55RGVX_RAM.ld file. MAPPING_TABLE (NOLOAD) : { *(MAPPING_TABLE) } >RAM_SHARED MB_MEM1 (NOLOAD) : { *(MB_MEM1) } >RAM_SHARED MB_MEM2 (NOLOAD) : { _sMB_MEM2 = . ; *(MB_MEM2) ; _eMB_MEM2 = . ; } < /FONT > case 3 :STM32WBA NEW stack pointer in the STM32WBA52CGUX_RAM.ld file as shown below `_estack = ORIGIN(RAM) + LENGTH(RAM);` should be changed to below by adding -16. `_estack = ORIGIN(RAM) + LENGTH(RAM) - 16;`

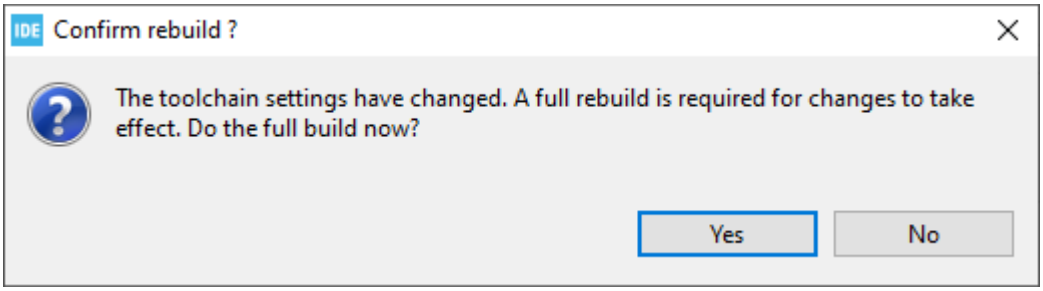
7.2.5 STM32 cautions

Some communication IO pins are set to output pin during bootloader operation

Sometimes MCU enters into bootloader operation. For example, RAM booting and flash operation of easyDSP are executed in the bootloader operation of MCU. Some MCU enters bootloader after reset if the flash of MCU is empty.
Special care should be taken for your board design considering that some communication IO pins are set as output pin during bootloader operation. You can identify these pins with ST's application note (AN2606 : STM32 microcontroller system memory boot mode). In your board design, there should be no damage even under bootloader operation which sets some IO pins the output. For example, if these IO pins are connected to directly VDD or GND, the damage could be caused.

Full rebuild of STM32CubeIDE

STM32CubeIDE requests full rebuild if the project setting has a major change. In this case, all files in the compiler's output folder will be deleted. If your easyDSP project is located in the compiler's output folder, all easyDSP files also will be deleted.



USART baud rate

If the allowable resource for USART interrupt is limited, high baud rate could make overrun error.

Bank mode in the MCU name

In case of some STM32 MCU, single or dual bank is specified in the MCU name only when bank mode should be specified. That is, there is no bank mode in the STM32 MCU name either when bank mode is fixed (single or dual) in the MCU or when there is no need for understanding bank mode for easyDSP operation.

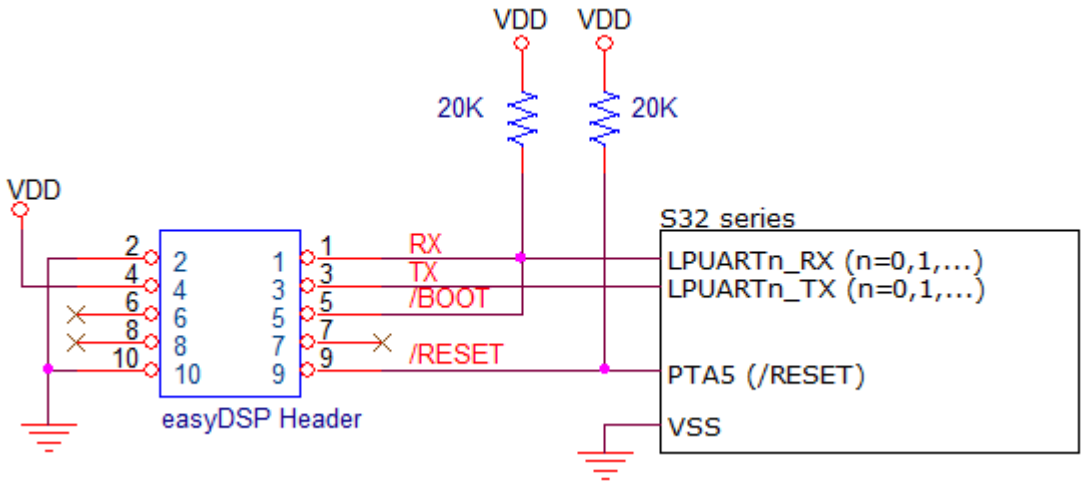
7.3 S32

7.3.1 S32K1 + SDK

This page assumes that the user uses S32 Configuration Tools and S32K1 SDK API.

STEP 1 : Hardware

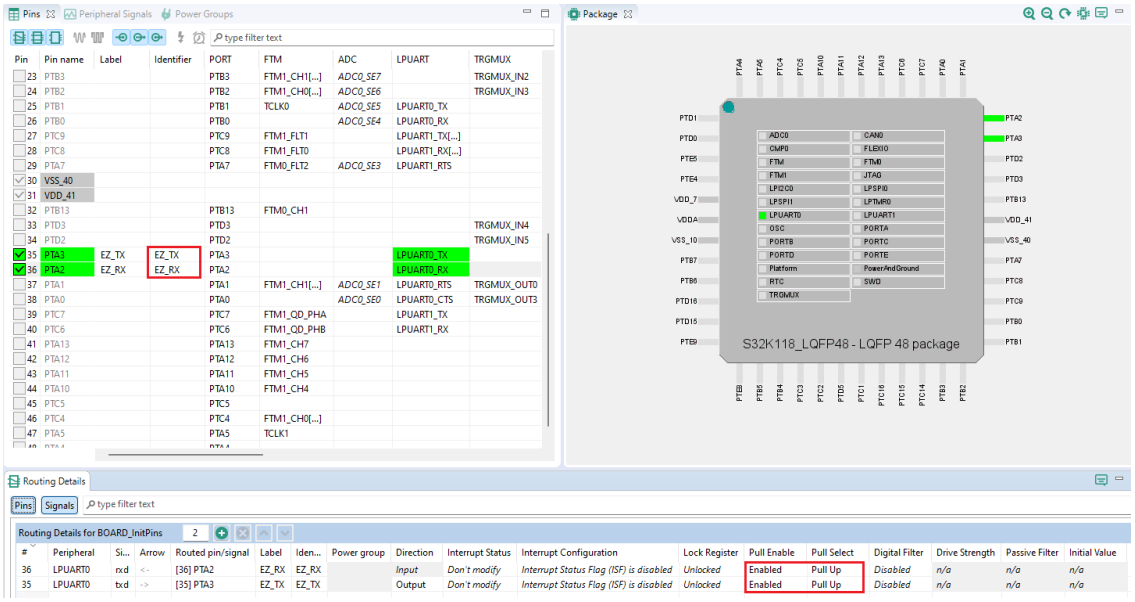
Please select the UART channel and pins according to your board. No constraints to selectable channel and pin.
Then connect them to easyDSP like below.
In case flash programming is not used, no need to connect /BOOT and /RESET pins.



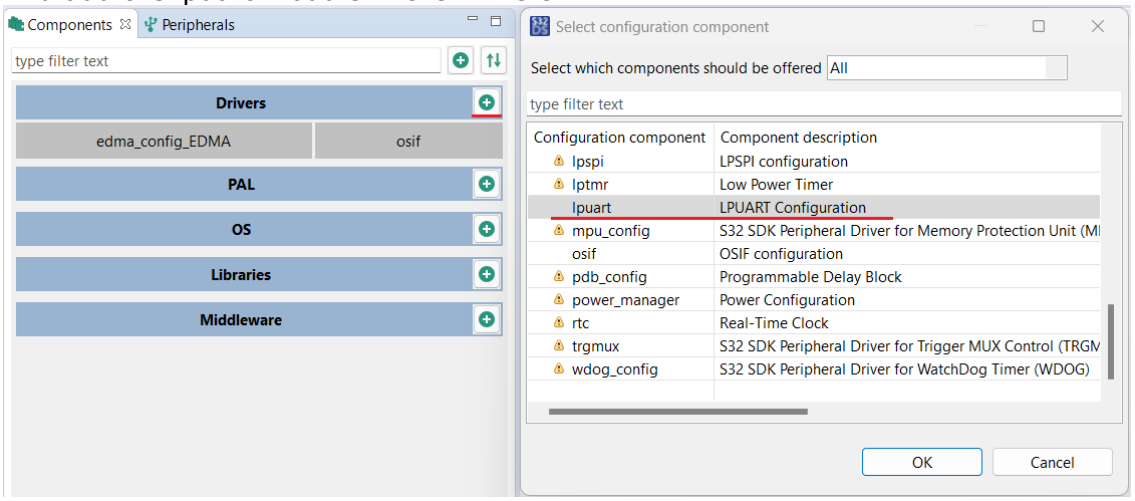
Other considerations :
- In case there is a reset IC between easyDSP /RESET and MCU /RESET, it should transfer the signal within 0.5sec.
- TX and RX pin of easyDSP header is pulled up with 100k Ohm resistor inside of easyDSP pod.

STEP 2 : S32 Configuration Tools

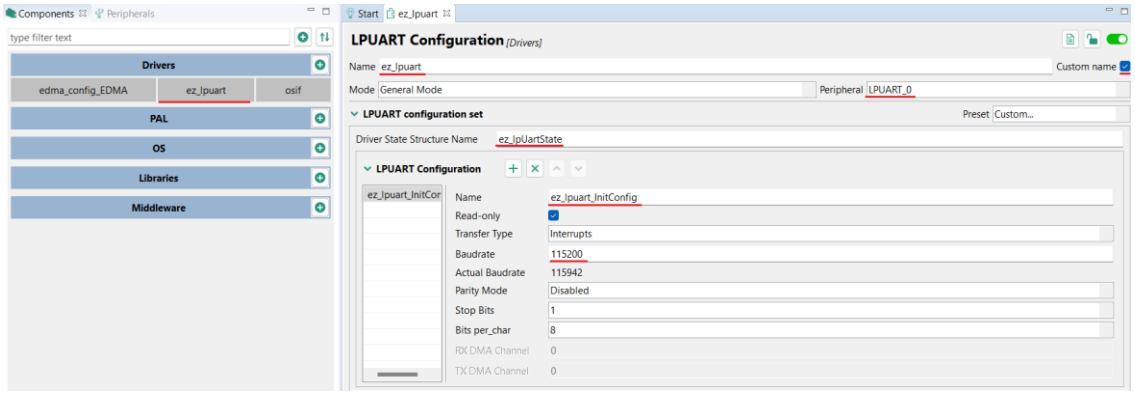
As explained in STEP1, please select the UART channel and pins. And set the configuration tool (Pins tab) accordingly.
Also kindly set the identifier as 'EZ_TX' and 'EZ_RX' respectively for TX and RX pins.
In below example, PTA2 and PTA3 are chosen as RX and TX respectively with LPUART0.
Also set the pin properties as shown in Rounting Details tab. Note that pull-up should be set.



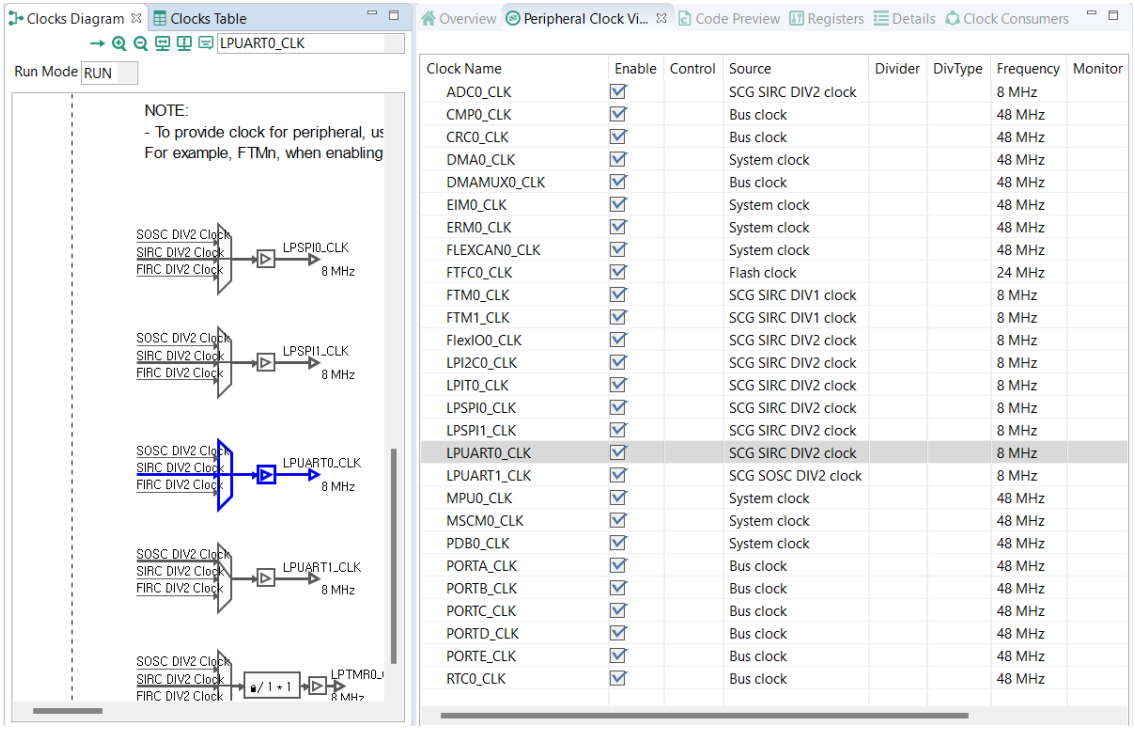
And add the lpuart module in the Drivers.



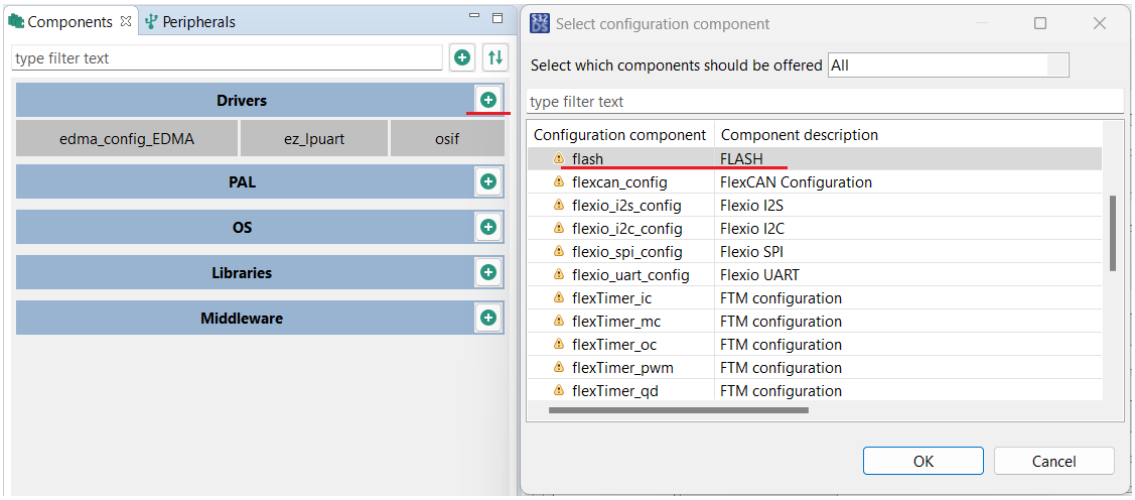
And set the module properties. Its name should be set same to below. The UART channel is set as STEP2. In this example, it is set as LPUART0 as same as STEP2.
Also set communication properties as shown. The baudrate should be same one to one in the easyDSP project setting.

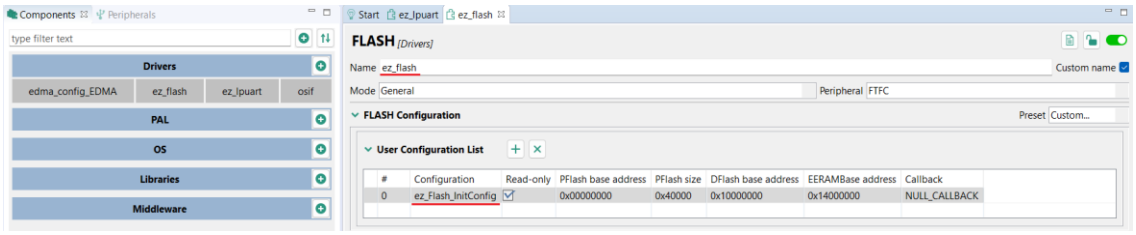


Also make sure the clock to the UART channel is set properly and enabled. Please refer to below example.



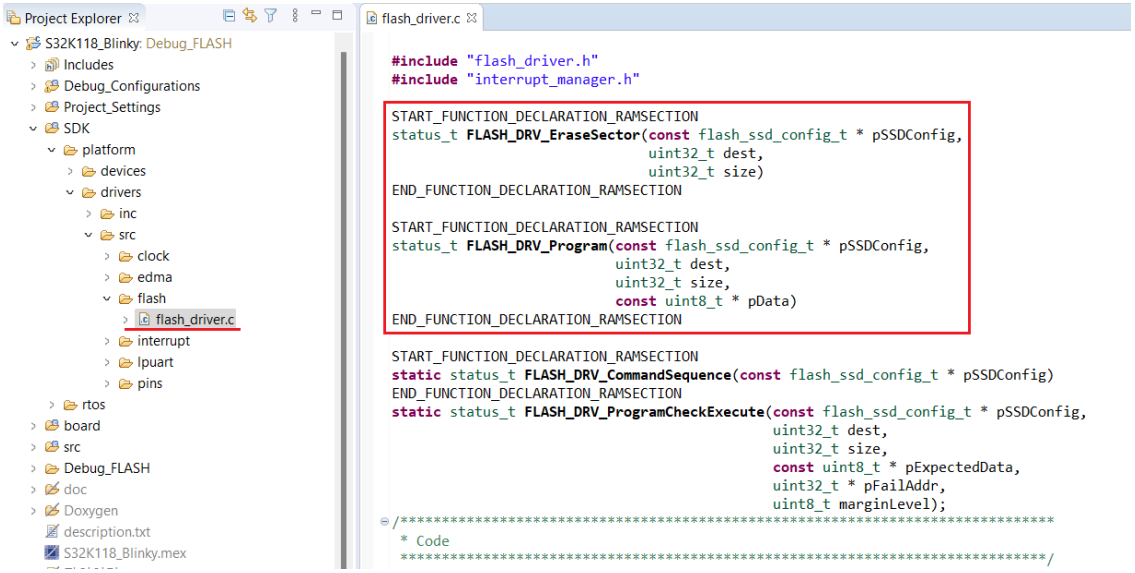
So far, the setting is for the communication with easyDSP for monitoring variables.
If you like to use the easyDSP bootloader for flash programming, the following process is also required because easyDSP bootloader uses flash driver. Please add flash component in the Drivers and change the names as shown below.





STEP 3 : Source code correction for easyDSP bootloader

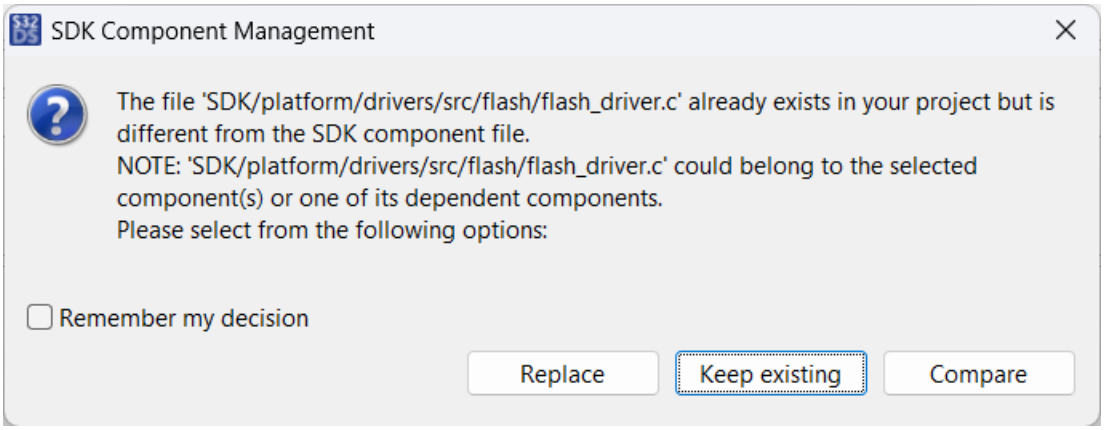
Please skip this step if you don't program flash with easyDSP.
You can find the source file flash_driver.c which is generated by Configuration Tool in the below location. easyDSP uses two functions. To make them run in the ram, first declare them as in the red box in the beginning of the file,



then add the macro like below at the location of function definition in the middle of the file.

```
START_FUNCTION_DEFINITION_RAMSECTION
status_t FLASH_DRV_EraseSector(const flash_ssd_config_t * pSSDConfig,
                               uint32_t dest,
                               uint32_t size)
{
    .... // contents of this function
}
END_FUNCTION_DEFINITION_RAMSECTION


START_FUNCTION_DEFINITION_RAMSECTION
status_t FLASH_DRV_Program(const flash_ssd_config_t * pSSDConfig,
                           uint32_t dest,
                           uint32_t size,
                           const uint8_t * pData)
{
    .... // contents of this function
}
END_FUNCTION_DEFINITION_RAMSECTION
```

In case the Configuration Tool detects the correction of this file and ask like below, please choose 'Keep existing'.



STEP 4 : Calling easyDSP functions

Three files are provided for easyDSP communication and flash programming (easyS32K1_SDK.h, easyS32K1_SDK_comm.c and easyS32K1_SDK_boot.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\S32).

In case you use the easyDSP bootloader to program flash, define EZ_BOOTLOADER_USE as 1 in the easyS32K1_SDK.h file. In case you don't use the easyDSP bootloader for flash programming, define BOOTLOADER_USE as 0.

```
/*****************************************************************************
 In case you use the bootloader provided by easyDSP to program flash,
 define EZ_BOOTLOADER_USE as 1
*****************************************************************************/
#define EZ_BOOTLOADER_USE 1
```

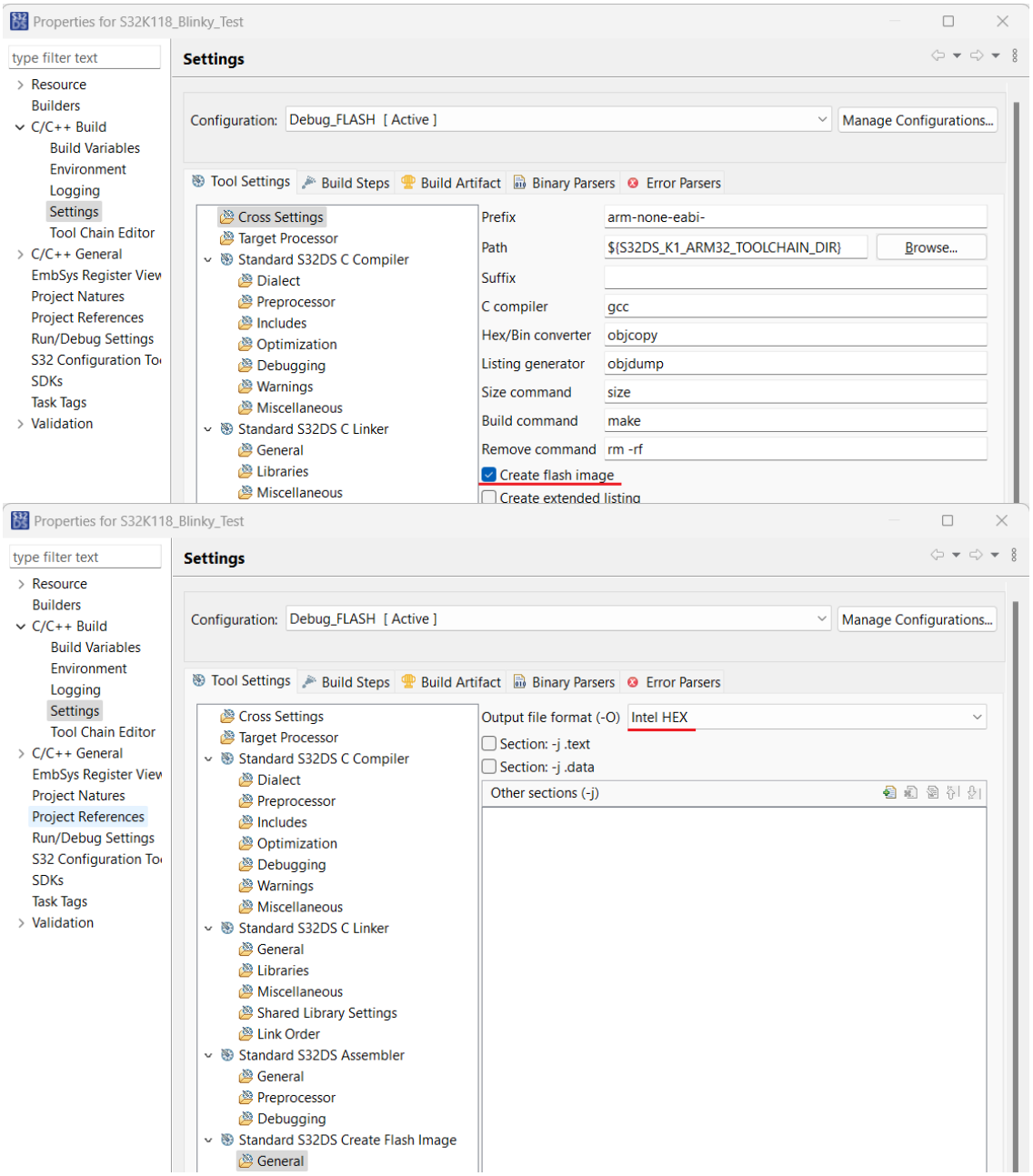
Please include easyS32K1_SDK.h in the main.c. And in the main(), call easyDSP_init() after the initialization of MCU.
In the easyDSP_init() function, all necessary setting for easyDSP monitoring are done.

In case you use easyDSP for flash programming, call easyDSP_boot() after setting of clock and pins.

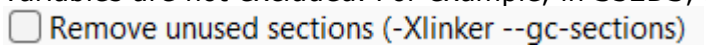
```
#include "easyS32K1_SDK.h"

int main(void)
{
    /* Initialize and configure clocks - see clock manager component for details */
    CLOCK_SYS_Init(g_clockManConfigsArr, CLOCK_MANAGER_CONFIG_CNT,
                   g_clockManCallbacksArr, CLOCK_MANAGER_CALLBACK_CNT);
    CLOCK_SYS_UpdateConfiguration(0U, CLOCK_MANAGER_POLICY_AGREEMENT);

    /* Initialize pins - See PinSettings component for more info */
    PINS_DRV_Init(NUM_OF_CONFIGURED_PINS0, g_pin_mux_InitConfigArr0);

#if EZ_BOOTLOADER_USE
    // Right after clock and pin setting, call easyDSP_boot() to enable flash programming
    easyDSP_boot();
#endif

    // reset of initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

STEP 5 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder of output file (for example, *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time. Please refer to the setting of S32DS below.

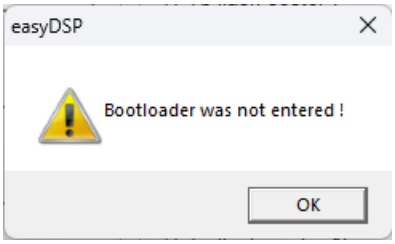


2. For easyDSP monitoring, the debug information should be included in the output file (for example, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in S32DS, no check in the check box in the linker option.



STEP 6 : Limitation of easyDSP bootloader

1. To program flash, the bootloader should be provided since there is no ROM bootloader in this MCU. The bootloader easyDSP provides is the function (name : easyDSP_boot) and it resides in the user program. Therefore it can program flash only when it is already programmed in the flash. In case flash is empty or flash doesn't have easyDSP bootloader, you can't enter into the bootloader and will see the message below. In this case, you have to use the debugger to program flash. And in same principle, you have to use debugger to program easyDSP bootloader into flash at the beginning.



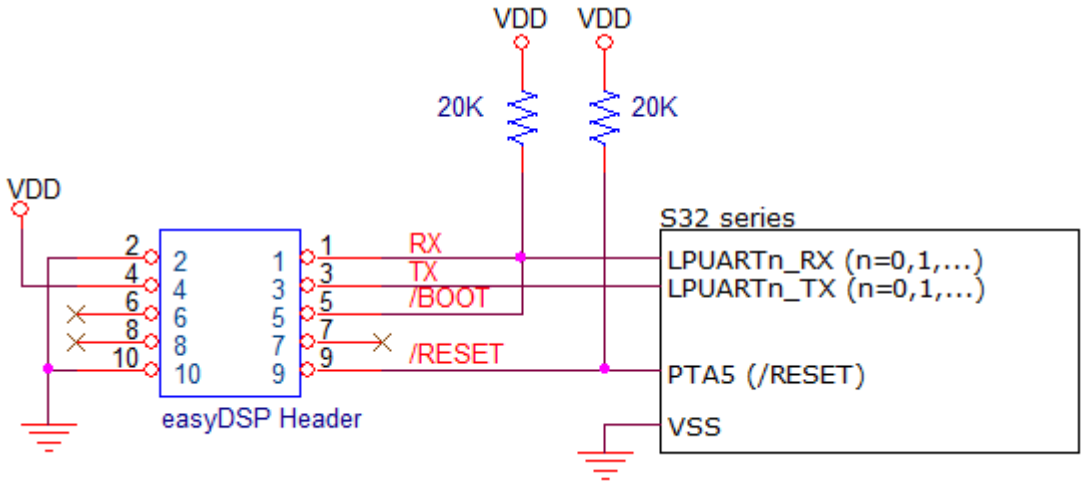
2. easyDSP bootloader runs on RAM and it uses about 1.25kB RAM memory space (for -O1 optimization option).

7.3.2 S32K/S32M + RTD

It is assumed that the user uses S32 Configuration Tools and RTD (Real-Time Drivers).

STEP 1 : Hardware

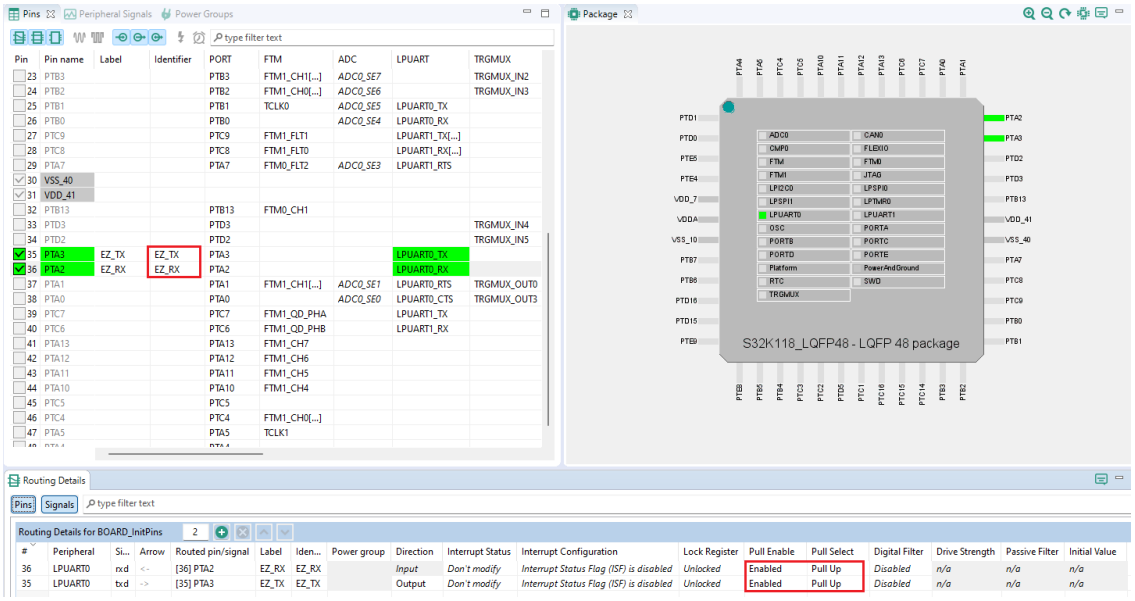
Please select the UART channel and pins according to your board.
No constraints to selectable channel and pin except LPUART1 is not usable for S32M.
Then connect them to easyDSP like below.
In case flash programming is not used, no need to connect /BOOT and /RESET pins.



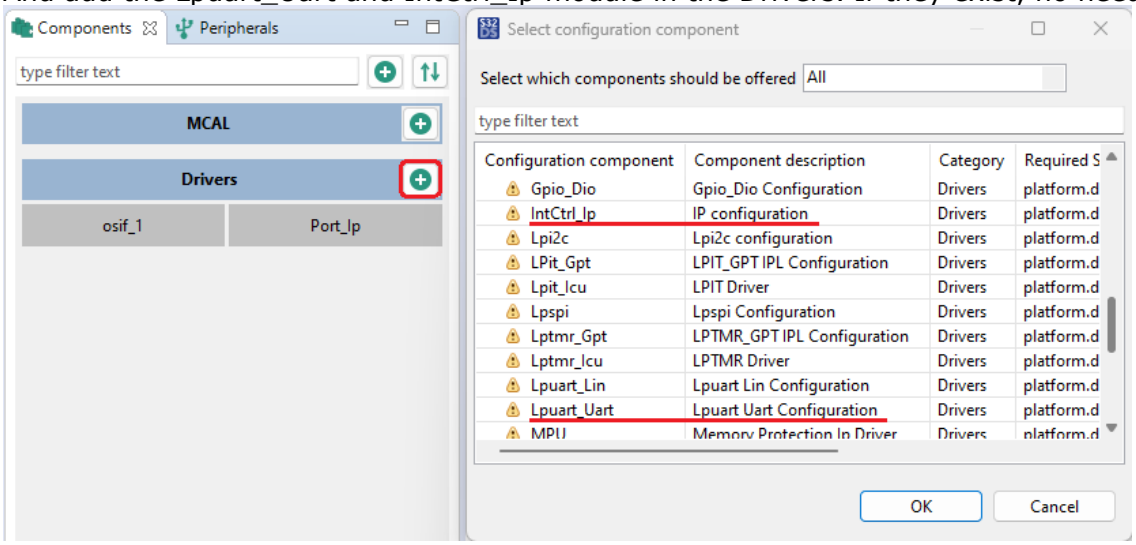
Other considerations :
- In case there is a reset IC between easyDSP /RESET and MCU /RESET, it should transfer the signal within 0.5sec.
- TX and RX pin of easyDSP header is pulled up with 100k Ohm resistor inside of easyDSP pod.

STEP 2 : S32 Configuration Tools for easyDSP monitoring

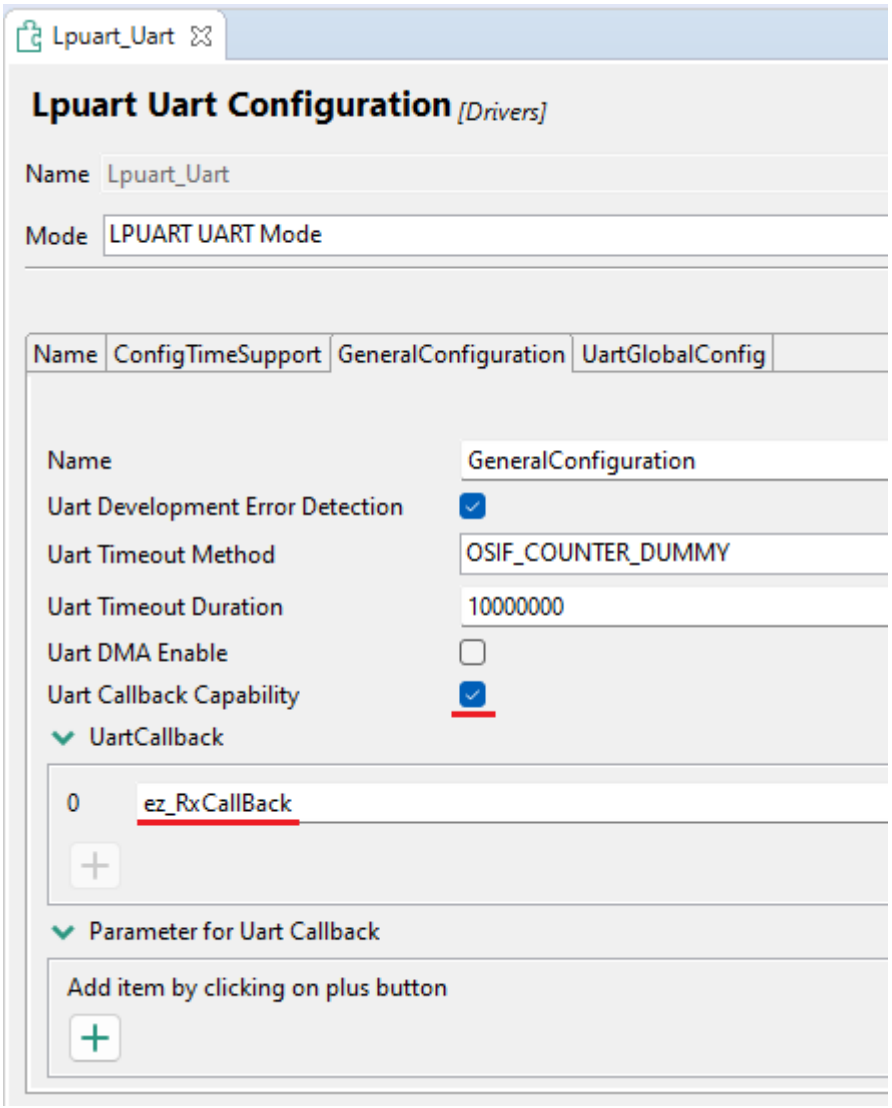
As explained in STEP1, please select the UART channel and pins. And set the configuration tool (Pins tab) accordingly.
Also kindly set the identifier as 'EZ_TX' and 'EZ_RX' respectively for TX and RX pins.
In below example, PTA2 and PTA3 are chosen as RX and TX respectively with LPUART0.
Also set the pin properties as shown in Rounting Details tab. Note that pull-up should be set.

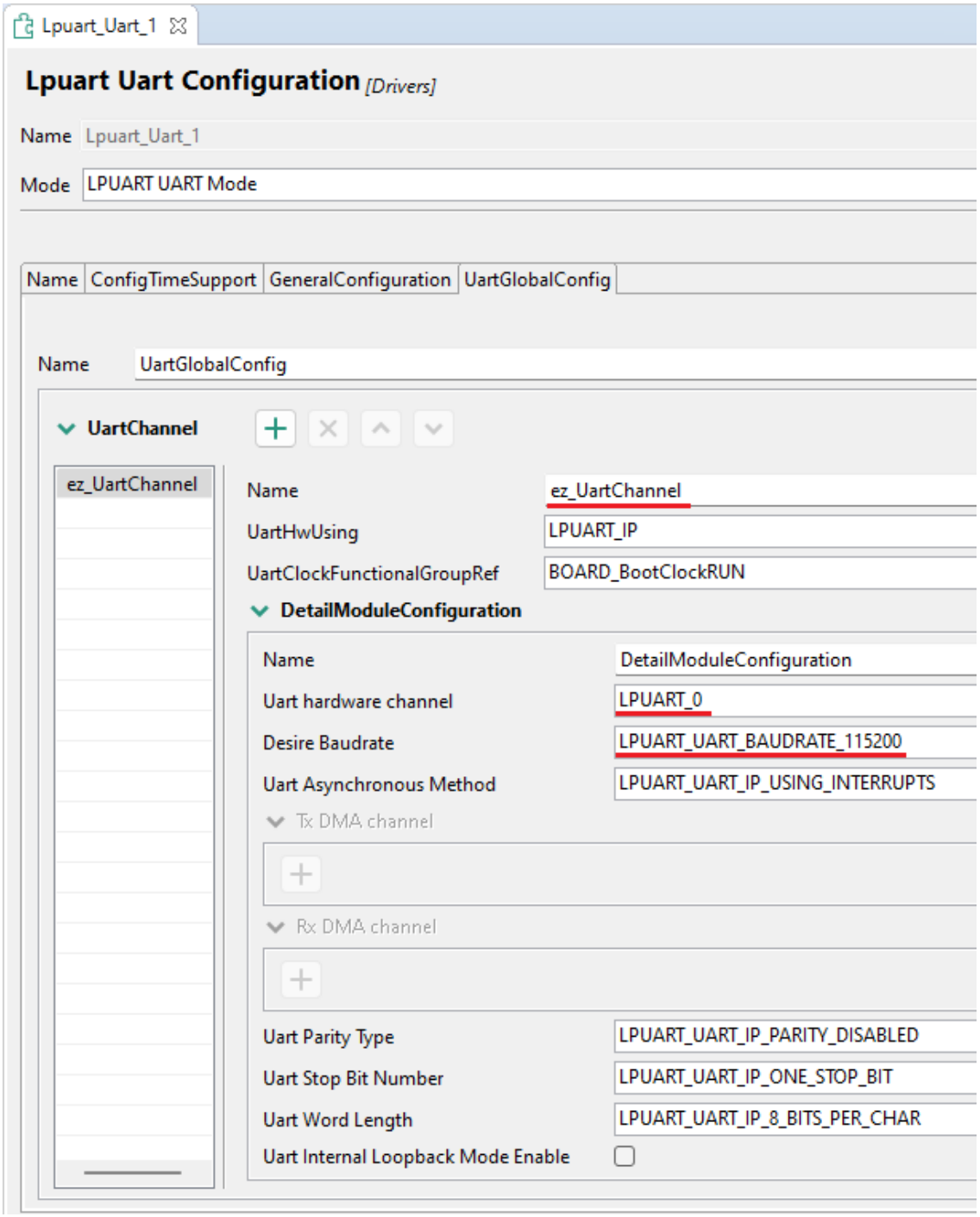


And add the Lpuart_Uart and IntCtrl_Ip module in the Drivers. If they exist, no need to add again.

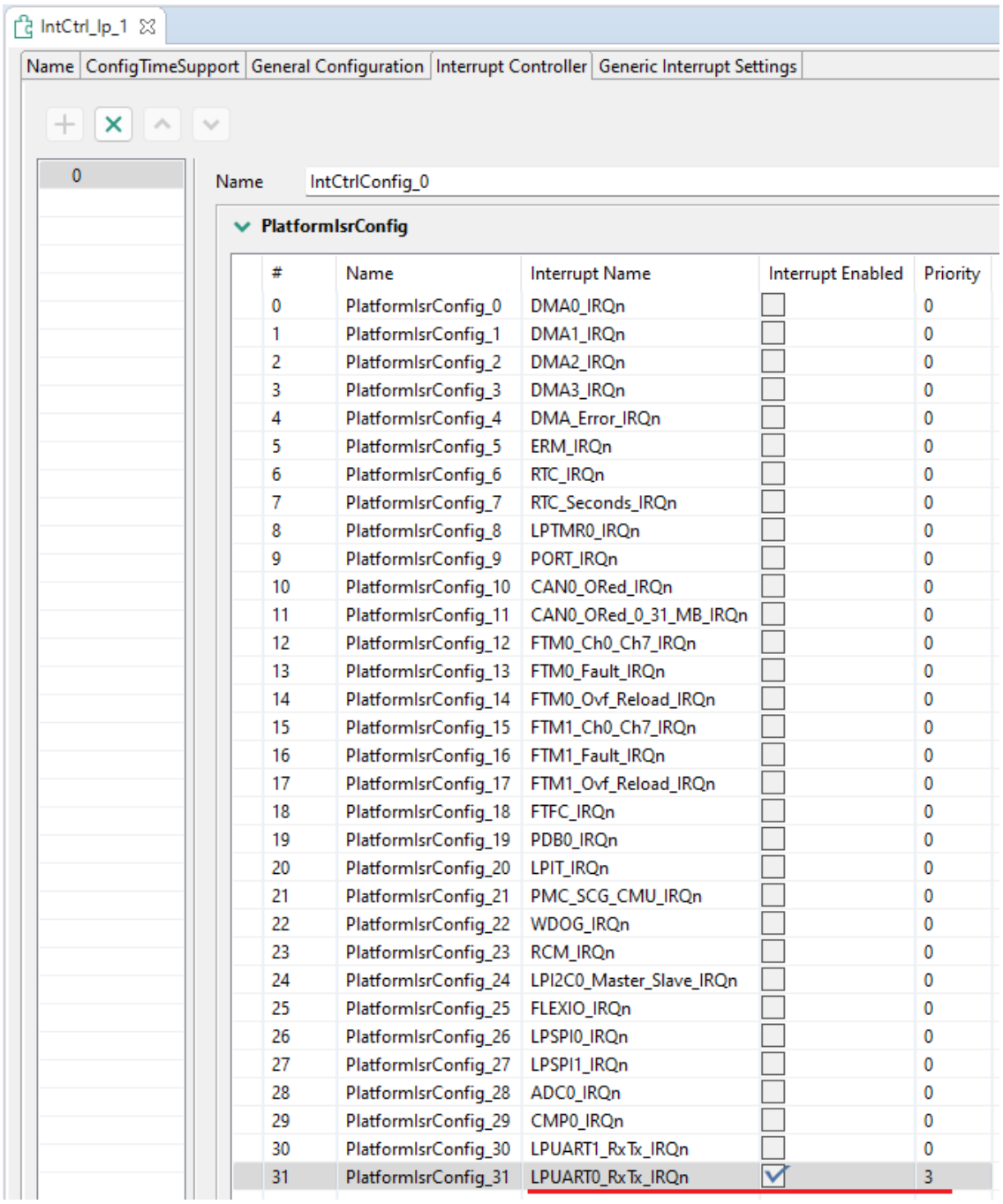


And set the Lpuart_Uart module properties.
Please enable 'Uart Callback Capability' in the tab 'GeneralConfiguration' and set the name of callback as 'ez_RxCallBack'.
Also set the various properties in the tab 'UartGlobalConfig'. In this example, LPUART0 is selected as STEP1 and 2. The baudrate should be same one to one in the easyDSP project setting.

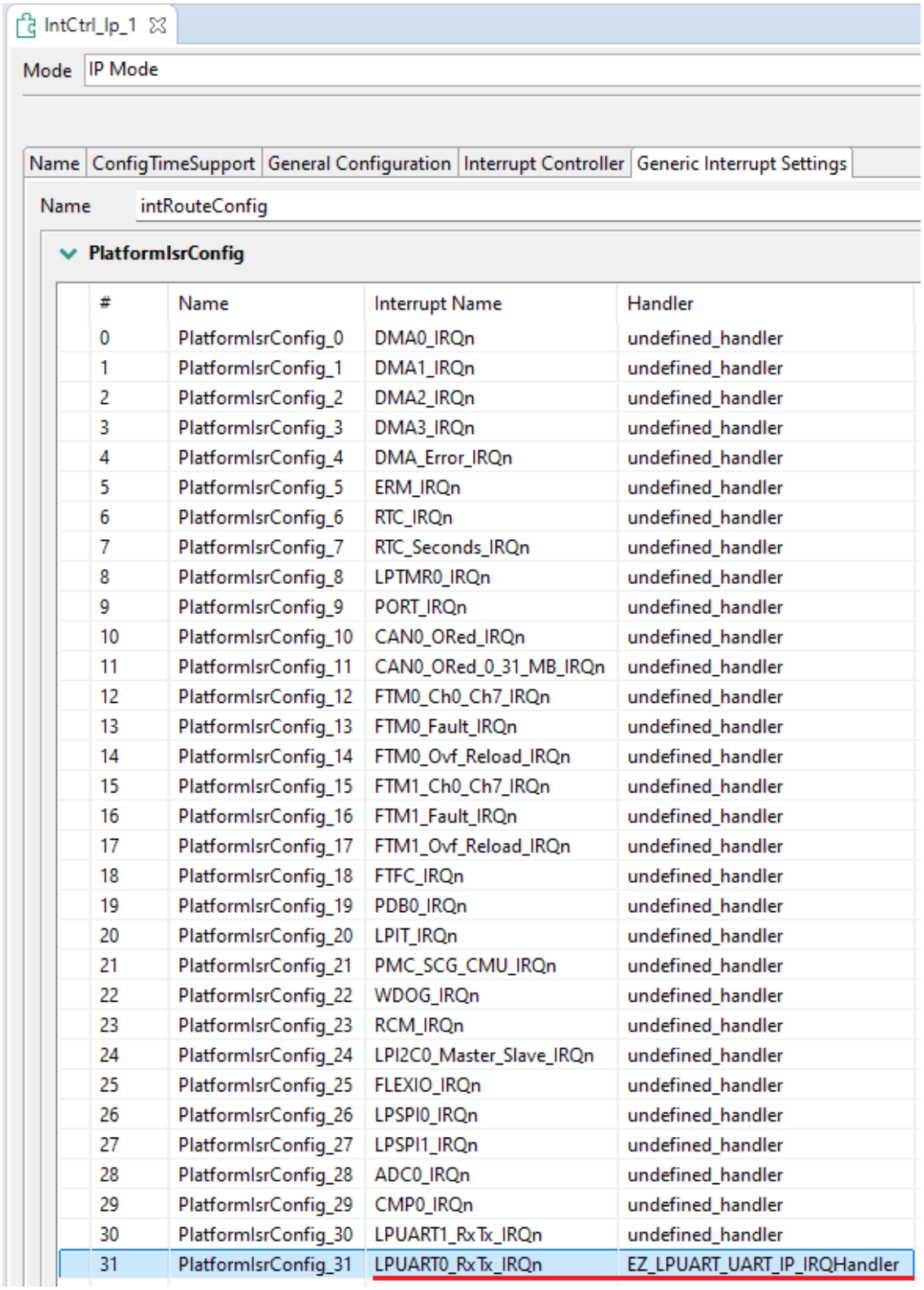

Lpuart_Uart
Lpuart Uart Configuration [Drivers]
Name Lpuart_Uart
Mode LPUART UART Mode
Name
ConfigTimeSupport
GeneralConfiguration
UartGlobalConfig
Name GeneralConfiguration
Uart Development Error Detection
Uart Timeout Method OSIF_COUNTER_DUMMY
Uart Timeout Duration 10000000
Uart DMA Enable
Uart Callback Capability
UartCallback
0 ez_RxCallBack
Parameter for Uart Callback
Add item by clicking on plus button



And set the IntCtrl_Ip module properties. In the tab 'Interrupt Controller', please enable the interrupt of target LPUART channel and set its priority lowest (highest value). In the tab 'Generic Interrupt Setting', set its interrupt handler as 'EZ_LPUART_UART_IP_IRQHandler'. For some MCU, the setting of these tabs are combined to single tab.

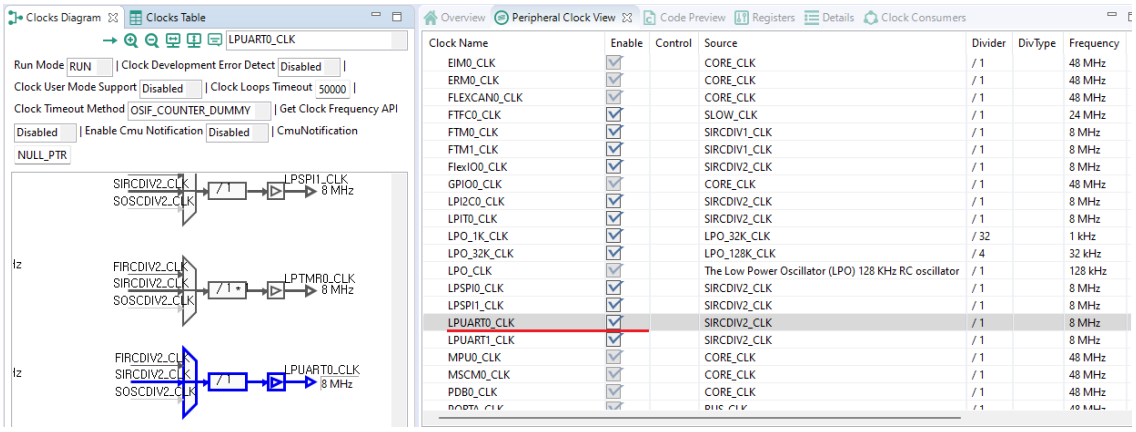


#	Name	Interrupt Name	Interrupt Enabled	Priority
0	PlatformIsrConfig_0	DMA0_IRQn	☐	0
1	PlatformIsrConfig_1	DMA1_IRQn	☐	0
2	PlatformIsrConfig_2	DMA2_IRQn	☐	0
3	PlatformIsrConfig_3	DMA3_IRQn	☐	0
4	PlatformIsrConfig_4	DMA_Error_IRQn	☐	0
5	PlatformIsrConfig_5	ERM_IRQn	☐	0
6	PlatformIsrConfig_6	RTC_IRQn	☐	0
7	PlatformIsrConfig_7	RTC_Seconds_IRQn	☐	0
8	PlatformIsrConfig_8	LPTMR0_IRQn	☐	0
9	PlatformIsrConfig_9	PORT_IRQn	☐	0
10	PlatformIsrConfig_10	CAN0_ORed_IRQn	☐	0
11	PlatformIsrConfig_11	CAN0_ORed_0_31_MB_IRQn	☐	0
12	PlatformIsrConfig_12	FTM0_Ch0_Ch7_IRQn	☐	0
13	PlatformIsrConfig_13	FTM0_Fault_IRQn	☐	0
14	PlatformIsrConfig_14	FTM0_Ovf_Reload_IRQn	☐	0
15	PlatformIsrConfig_15	FTM1_Ch0_Ch7_IRQn	☐	0
16	PlatformIsrConfig_16	FTM1_Fault_IRQn	☐	0
17	PlatformIsrConfig_17	FTM1_Ovf_Reload_IRQn	☐	0
18	PlatformIsrConfig_18	FTFC_IRQn	☐	0
19	PlatformIsrConfig_19	PDB0_IRQn	☐	0
20	PlatformIsrConfig_20	LPIT_IRQn	☐	0
21	PlatformIsrConfig_21	PMC_SCG_CMU_IRQn	☐	0
22	PlatformIsrConfig_22	WDOG_IRQn	☐	0
23	PlatformIsrConfig_23	RCM_IRQn	☐	0
24	PlatformIsrConfig_24	LPI2C0_Master_Slave_IRQn	☐	0
25	PlatformIsrConfig_25	FLEXIO_IRQn	☐	0
26	PlatformIsrConfig_26	LPSPI0_IRQn	☐	0
27	PlatformIsrConfig_27	LPSPI1_IRQn	☐	0
28	PlatformIsrConfig_28	ADC0_IRQn	☐	0
29	PlatformIsrConfig_29	CMP0_IRQn	☐	0
30	PlatformIsrConfig_30	LPUART1_RxTx_IRQn	☐	0
31	PlatformIsrConfig_31	LPUART0_RxTx_IRQn	☑	3



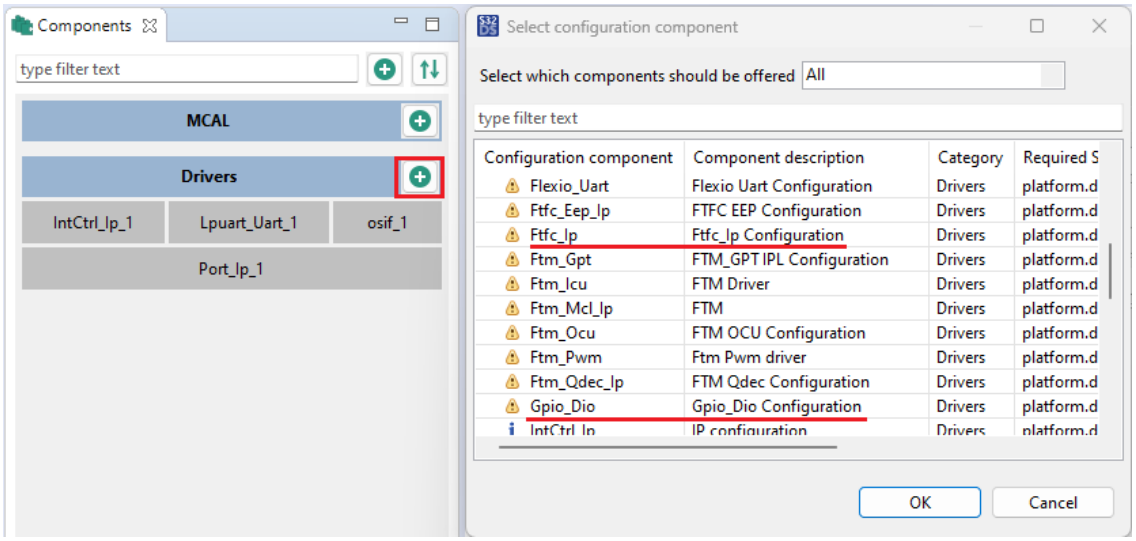
#	Name	Interrupt Name	Handler
0	PlatformIsrConfig_0	DMA0_IRQn	undefined_handler
1	PlatformIsrConfig_1	DMA1_IRQn	undefined_handler
2	PlatformIsrConfig_2	DMA2_IRQn	undefined_handler
3	PlatformIsrConfig_3	DMA3_IRQn	undefined_handler
4	PlatformIsrConfig_4	DMA_Error_IRQn	undefined_handler
5	PlatformIsrConfig_5	ERM_IRQn	undefined_handler
6	PlatformIsrConfig_6	RTC_IRQn	undefined_handler
7	PlatformIsrConfig_7	RTC_Seconds_IRQn	undefined_handler
8	PlatformIsrConfig_8	LPTMR0_IRQn	undefined_handler
9	PlatformIsrConfig_9	PORT_IRQn	undefined_handler
10	PlatformIsrConfig_10	CAN0_ORed_IRQn	undefined_handler
11	PlatformIsrConfig_11	CAN0_ORed_0_31_MB_IRQn	undefined_handler
12	PlatformIsrConfig_12	FTM0_Ch0_Ch7_IRQn	undefined_handler
13	PlatformIsrConfig_13	FTM0_Fault_IRQn	undefined_handler
14	PlatformIsrConfig_14	FTM0_Ovf_Reload_IRQn	undefined_handler
15	PlatformIsrConfig_15	FTM1_Ch0_Ch7_IRQn	undefined_handler
16	PlatformIsrConfig_16	FTM1_Fault_IRQn	undefined_handler
17	PlatformIsrConfig_17	FTM1_Ovf_Reload_IRQn	undefined_handler
18	PlatformIsrConfig_18	FTFC_IRQn	undefined_handler
19	PlatformIsrConfig_19	PDB0_IRQn	undefined_handler
20	PlatformIsrConfig_20	LPIT_IRQn	undefined_handler
21	PlatformIsrConfig_21	PMC_SCG_CMU_IRQn	undefined_handler
22	PlatformIsrConfig_22	WDOG_IRQn	undefined_handler
23	PlatformIsrConfig_23	RCM_IRQn	undefined_handler
24	PlatformIsrConfig_24	LPI2C0_Master_Slave_IRQn	undefined_handler
25	PlatformIsrConfig_25	FLEXIO_IRQn	undefined_handler
26	PlatformIsrConfig_26	LPSPI0_IRQn	undefined_handler
27	PlatformIsrConfig_27	LPSPI1_IRQn	undefined_handler
28	PlatformIsrConfig_28	ADC0_IRQn	undefined_handler
29	PlatformIsrConfig_29	CMP0_IRQn	undefined_handler
30	PlatformIsrConfig_30	LPUART1_RxTx_IRQn	undefined_handler
31	PlatformIsrConfig_31	LPUART0_RxTx_IRQn	EZ_LPUART_UART_IP_IRQHandler

Also make sure the clock to the UART channel is set properly and enabled. Please refer to below example.

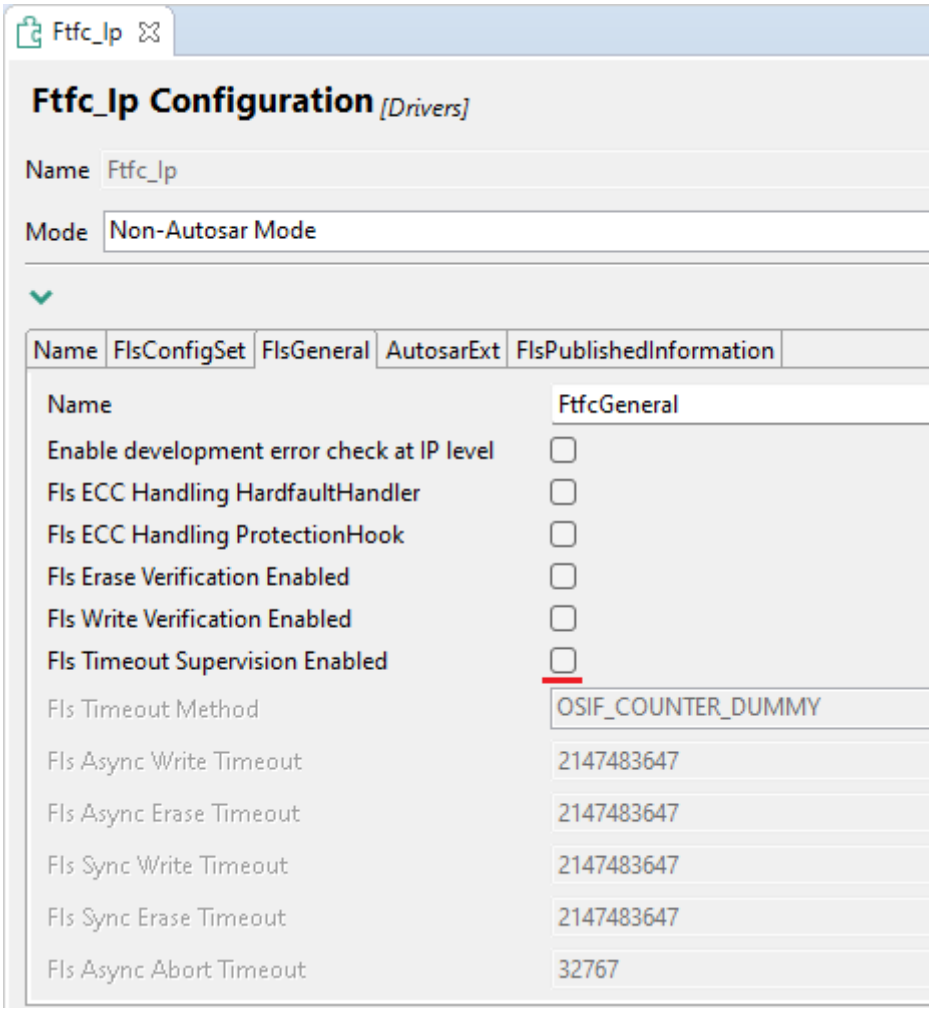


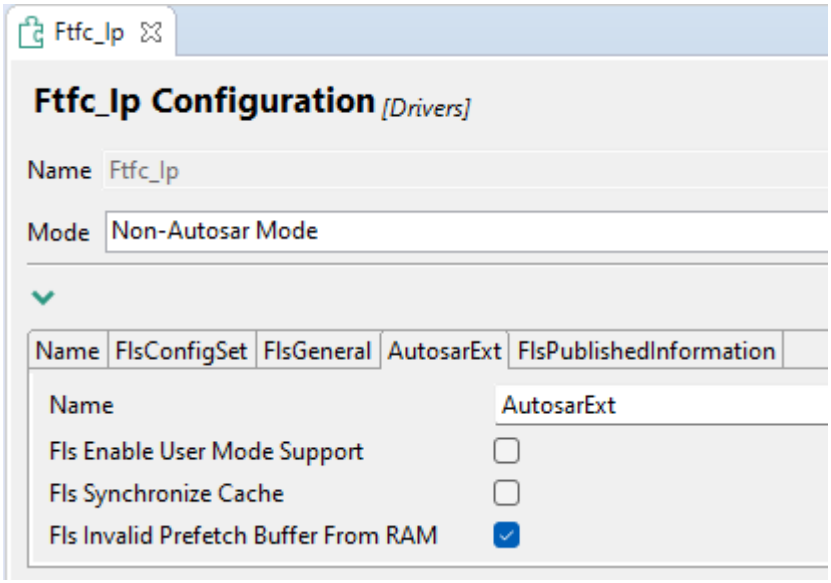
STEP 3-1 : S32 Configuration Tools for easyDSP boot loader of S32K1x

So far until STEP 2, the setting is for the communication with easyDSP for monitoring variables.
If you like to use the easyDSP bootloader for flash programming of S32K1x, the following process is also required because easyDSP bootloader uses flash driver.
Please add Ftfc_Ip and Gpio_Dio component in the Drivers.



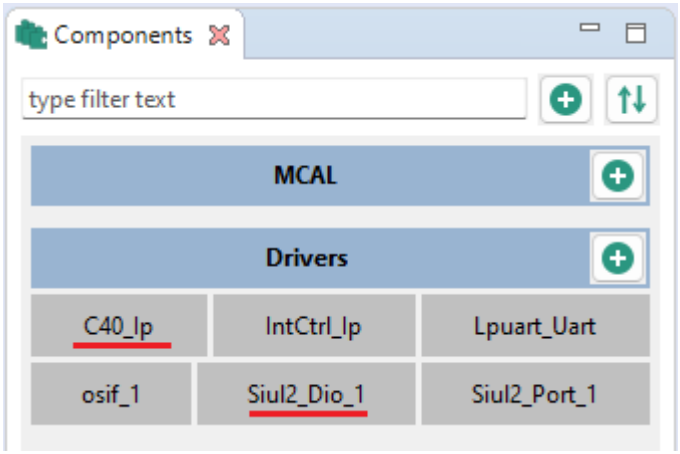
For Gpio_Dio component, the default setting is ok.
For Ftfc_Ip component, please disable 'Fls Timeout Supervision Enabled' button.



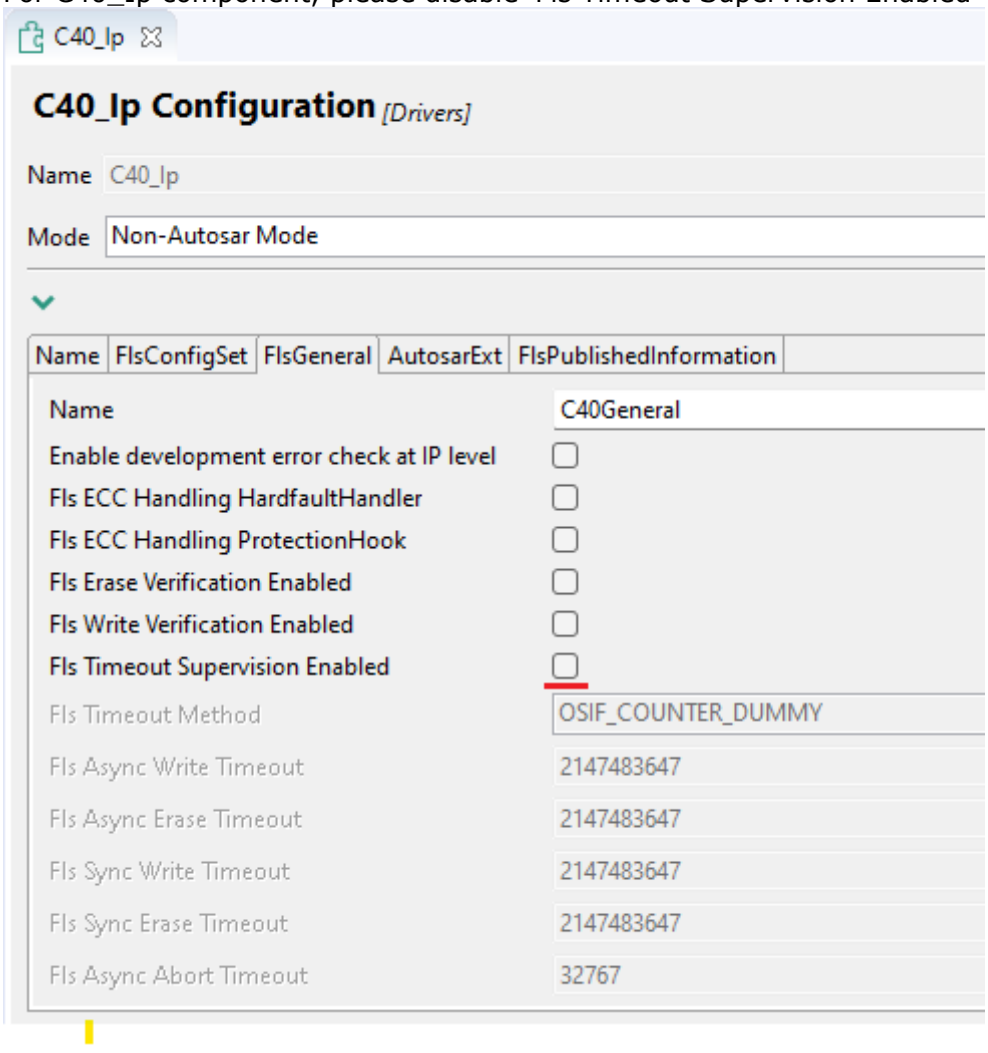


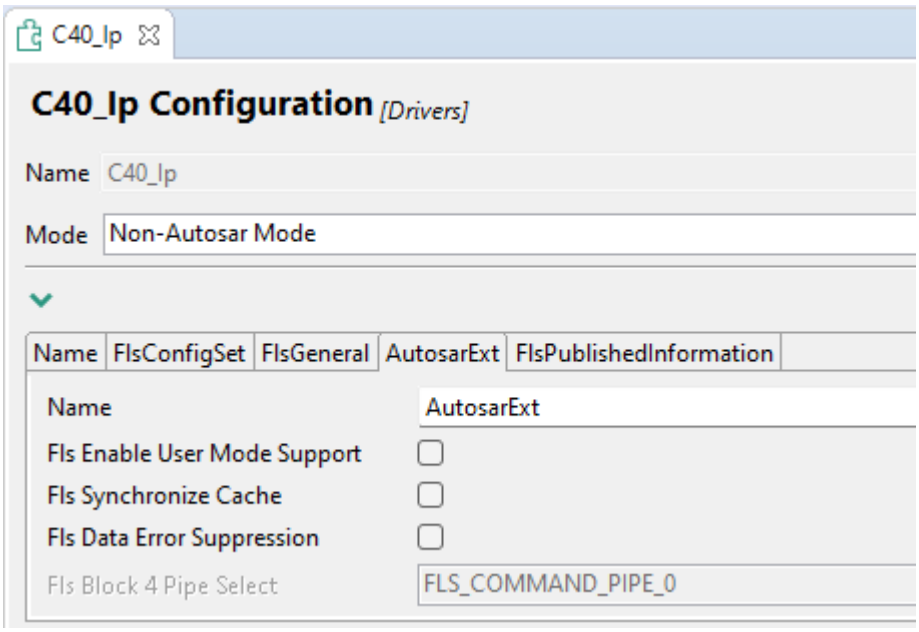
STEP 3-2 : S32 Configuration Tools for easyDSP boot loader of S32K3x

If you like to use the easyDSP bootloader for flash programming of S32K3x, please add C40_Ip and Siu2_Dio components in the Drivers.



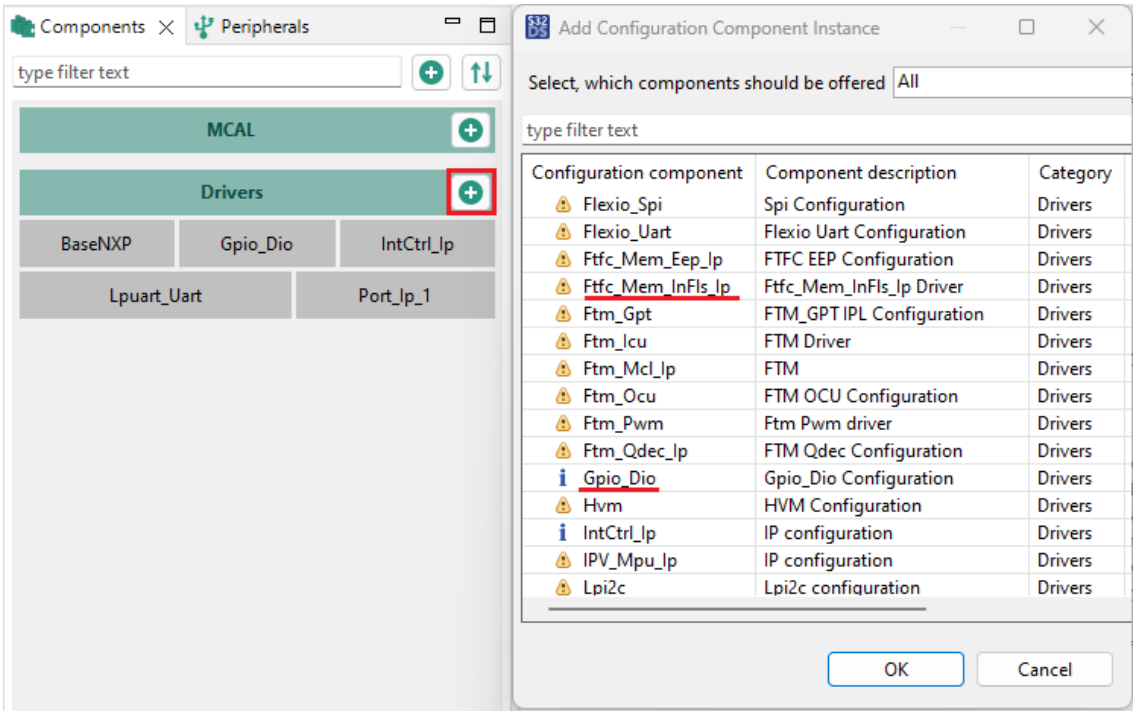
For Siu2_Dio component, the default setting is ok.
For C40_Ip component, please disable 'Fls Timeout Supervision Enabled' button.





STEP 3-3 : S32 Configuration Tools for easyDSP boot loader of S32M24x

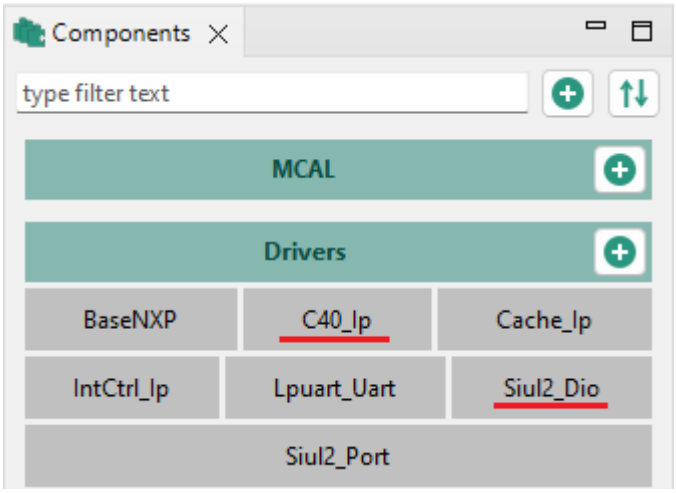
If you like to use the easyDSP bootloader for flash programming of S32M24x, please add Ftfc_Mem_InFls_Ip and Gpio_Dio component in the Drivers.



For Gpio_Dio component, the default setting is ok.
For Ftfc_Mem_InFls_Ip component, the default setting is ok. Please note that you have to disable 'Mem Timeout Supervision Enabled' button in 'MemGeneral' tab and 'Mem Synchronize Cache' button in 'MemAutosarExt' tab.

STEP 3-4 : S32 Configuration Tools for easyDSP boot loader of S32M27x

If you like to use the easyDSP bootloader for flash programming of S32M27x, please add C40_Ip and Siu2_Dio components in the Drivers.



For Siu2_Dio component, the default setting is ok.
For C40_Ip component, the default setting is ok. Please note that you have to disable 'Mem Timeout Supervision Enabled' button in 'MemGeneral' tab and 'Mem Synchronize Cache' button in 'MemAutosarExt' tab.

STEP 4-1 : Source code correction for easyDSP bootloader of S32K1x

From STEP 3-1, the relavant codes are generated and you can find Ftfc_Fls_Ip.h and Ftfc_Fls_Ip.c files in the folder RTD>include and RTD>src respectively.
easyDSP bootloader uses these flash API functions and they should run on the ram, not on the flash.
To make these functions run on the ram :
First, in the file Ftfc_Fls_Ip.h, find the location of function declaration, and change like below red boxes.

```
/*==================================================================================================
*                                       FUNCTION PROTOTYPES
==================================================================================================*/
//#define FLS_START_SEC_CODE    // commented
#define FLS_START_SEC_RAMCODE   // applied for code in ram
#include "Fls_MemMap.h"

/**
 * @brief        Initializes the FTCF module
 *
 * @details      This function will initialize ftfc module and clear all error flags.
 *
 * @param[in]    Ftfc_Fls_Ip_pInitConfig   Pointer to the driver configuration structure.
 * @return       Ftfc_Fls_Ip_StatusType
 * @retval       STATUS_FTFC_FLS_IP_SUCCESS            Initialization is success
 * @retval       STATUS_FTFC_FLS_IP_ERROR_TIMEOUT      Errors Timeout because wait for the Done bit long time
 *
 */
Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_Init(const Ftfc_ConfigType * Ftfc_Fls_Ip_pInitConfig);

...
...
...
...
...
...

//#define FLS_STOP_SEC_CODE     // commented
#define FLS_STOP_SEC_RAMCODE    // applied for code in ram
#include "Fls_MemMap.h"


#ifdef __cplusplus
}
#endif

/** @} */

#endif /* FTFC_FLS_IP_H */
```

Second, in the file Ftfc_Fls_Ip.c, find the location of static function declaration, and change like below red boxes.

```
//#define FLS_START_SEC_CODE    // commented by easyDSP
#define FLS_START_SEC_RAMCODE   // added by easyDSP
#include "Fls_MemMap.h"

static boolean Ftfc_Fls_Ip_CheckValidRange(uint32 startAddress, uint32 length);
static Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_ReadPreCheck(uint32 u32SrcAddress, const uint8 *pDestAddressPtr, uint32 u32Length);
static Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_ComparePreCheck(uint32 u32SrcAddress, uint32 u32Length);
static Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_SectorErasePreCheck(uint32 u32SectorStartAddress);
static Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_WritePreCheck(uint32 u32DestAddress, const uint8 *pSourceAddressPtr, uint32 u32Length);

...
...
...

static Ftfc_Fls_Ip_StatusType Ftfc_Fls_Flash_AbortSuspended(void);
static void Ftfc_Fls_Ip_CalculateDFlashBitSize(void);

#if (STD_ON == FTFC_FLS_IP_SYNCRONIZE_CACHE)
static void Ftfc_Fls_SynchronizeCache(uint32 address, uint32 length);
#endif

//#define FLS_STOP_SEC_CODE     // commented by easyDSP
#define FLS_STOP_SEC_RAMCODE    // added by easyDSP
#include "Fls_MemMap.h"
```

Third, again in the file Ftfc_Fls_Ip.c, find the location of Ftfc_Fls_Ip_SectorErase function definition, and disable Ftfc_Fls_Ip_SectorErasePreCheck function.

```
Ftfc_Fls_Ip_StatusType Ftfc_Fls_Ip_SectorErase(uint32 u32SectorStartAddress)
{
    Ftfc_Fls_Ip_StatusType eRetVal;
    boolean bAddressValid  = FTFC_ADDRESS_VALID(u32SectorStartAddress);
    boolean bSectorAligned = FTFC_SECTOR_ALIGNED(u32SectorStartAddress);

    DEV_ASSERT_FTFC(bAddressValid);
    DEV_ASSERT_FTFC(bSectorAligned);
    /* Unused variables */
    (void)bAddressValid;
    (void)bSectorAligned;

    /* Check(if erase suspended is possible) if any ongoing erase suspended and abort it */
    eRetVal = Ftfc_Fls_Flash_AbortSuspended();

    if (STATUS_FTFC_FLS_IP_SUCCESS == eRetVal)
    {
        /* Pre-check before starting erase operation */
        //eRetVal = Ftfc_Fls_Ip_SectorErasePreCheck(u32SectorStartAddress); // commented by easyDSP
    }
    .
    .
    .
    .
```

In case the Configuration Tool detects the correction of this file and ask to revert it, don't revert it.

STEP 4-2 : Source code correction for easyDSP bootloader of S32K3x

From STEP 3-2, the relavant codes are generated and you can find C40_Ip.h and C40_Ip.c files in the folder RTD>include and RTD>src respectively.
easyDSP bootloader uses these flash API functions and they should run on the ram, not on the flash.
To make these functions run on the ram :
First, in the file C40_Ip.h, find the location of function declaration, and change like below red boxes.

```
/*==================================================================================================
*                                        FUNCTION PROTOTYPES
==================================================================================================*/
//#define FLS_START_SEC_CODE    // commented by easyDSP
#define FLS_START_SEC_RAMCODE   // added by easyDSP
#include "Fls_MemMap.h"

/**
 * @brief        Initializes the C40 module
 *
 * @details      This function will initialize c40 module and clear all error flags.
 *
 * @param[in]    InitConfig   Pointer to the driver configuration structure.
 * @return       C40_Ip_StatusType
 * @retval       STATUS_C40_IP_SUCCESS            Initialization is success
 * @retval       STATUS_C40_IP_ERROR_TIMEOUT      Errors Timeout because wait for the Done bit long time
 *
 */
C40_Ip_StatusType C40_Ip_Init(const C40_ConfigType * InitConfig);

...
...
...
...


/**
 * @brief    Set synch/Asynch at IP layer base on the bAsynch of HLD
 *
 * @details  This function will change C40_Ip_Async value at IP layer. Its param base on the bAsynch of HLD.
 *           Thanks for this param, writting and erasing will operate at synch or Asynch mode.
 *
 * @pre     The module has to be initialized
 *
 */
void C40_Ip_SetAsyncMode(const boolean Async);

//#define FLS_STOP_SEC_CODE     // commented by easyDSP
#define FLS_STOP_SEC_RAMCODE    // added by easyDSP
#include "Fls_MemMap.h"
```

Second, in the file C40_Ip.c, find the location of static function declaration, and change like below red boxes.

```
/*==================================================================================================
                                      LOCAL FUNCTION PROTOTYPES
==================================================================================================*/
//#define FLS_START_SEC_CODE    // commented by easyDSP
#define FLS_START_SEC_RAMCODE   // added by easyDSP
#include "Fls_MemMap.h"

static inline uint32 C40_Ip_ReadData32(uint32 Address);
static inline uint16 C40_Ip_ReadData16(uint32 Address);
static inline uint8 C40_Ip_ReadData8(uint32 Address);

...
...
...

static inline boolean C40_Ip_ValidUTestAddress(uint32 Address);
static inline boolean C40_Ip_ValidAddress(uint32 Address);
static inline boolean C40_Ip_ValidRangeAddress(uint32 StartAddress,
                                               uint32 Length
                                              );

//#define FLS_STOP_SEC_CODE     // commented by easyDSP
#define FLS_STOP_SEC_RAMCODE    // added by easyDSP
#include "Fls_MemMap.h"
```

In case the Configuration Tool detects the correction of this file and ask to revert it, don't revert it.

STEP 4-3 : Source code correction for easyDSP bootloader of S32M24x

From STEP 3-1, the relavant codes are generated and you can find Ftfc_Fls_Ip.h and Ftfc_Fls_Ip.c files in the folder RTD>include and RTD>src respectively.
easyDSP bootloader uses these flash API functions and they should run on the ram, not on the flash.
To make these functions run on the ram :
First, in the file Ftfc_Fls_Ip.h, find the location of function declaration, and change like below red boxes.

STEP 4-4 : Source code correction for easyDSP bootloader of S32M27x

From STEP 3-2, the relavant codes are generated and you can find C40_Ip.h and C40_Ip.c files in the folder RTD>include and RTD>src respectively.
easyDSP bootloader uses these flash API functions and they should run on the ram, not on the flash.
To make these functions run on the ram :
First, in the file C40_Ip.h, find the location of function declaration, and change like below red boxes.

STEP 5 : Calling easyDSP functions

Three files are provided for easyDSP communication and flash programming (easyS32_RTD.h, easyS32_RTD_comm.c, easyS32_RTD_boot.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\S32).

In the file of easyS32_RTD.h, you should set some macros. First, the target LPUART channel for easyDSP. In this example below, it is set as LPUART0. Second, i n case you use the easyDSP bootloader to program flash, define EZ_BOOTLOADER_USE as 1.

```
/*****************************************************************************
 Select UART channel for easyDSP communication
*****************************************************************************/
#define EZ_UART_CH      0           // LPUART0 for easyDSP

/*****************************************************************************
 In case you use the boot loader provided by easyDSP to program flash,
 define EZ_BOOTLOADER_USE as 1. Otherwise, define as 0.
*****************************************************************************/
#define EZ_BOOTLOADER_USE 1
```

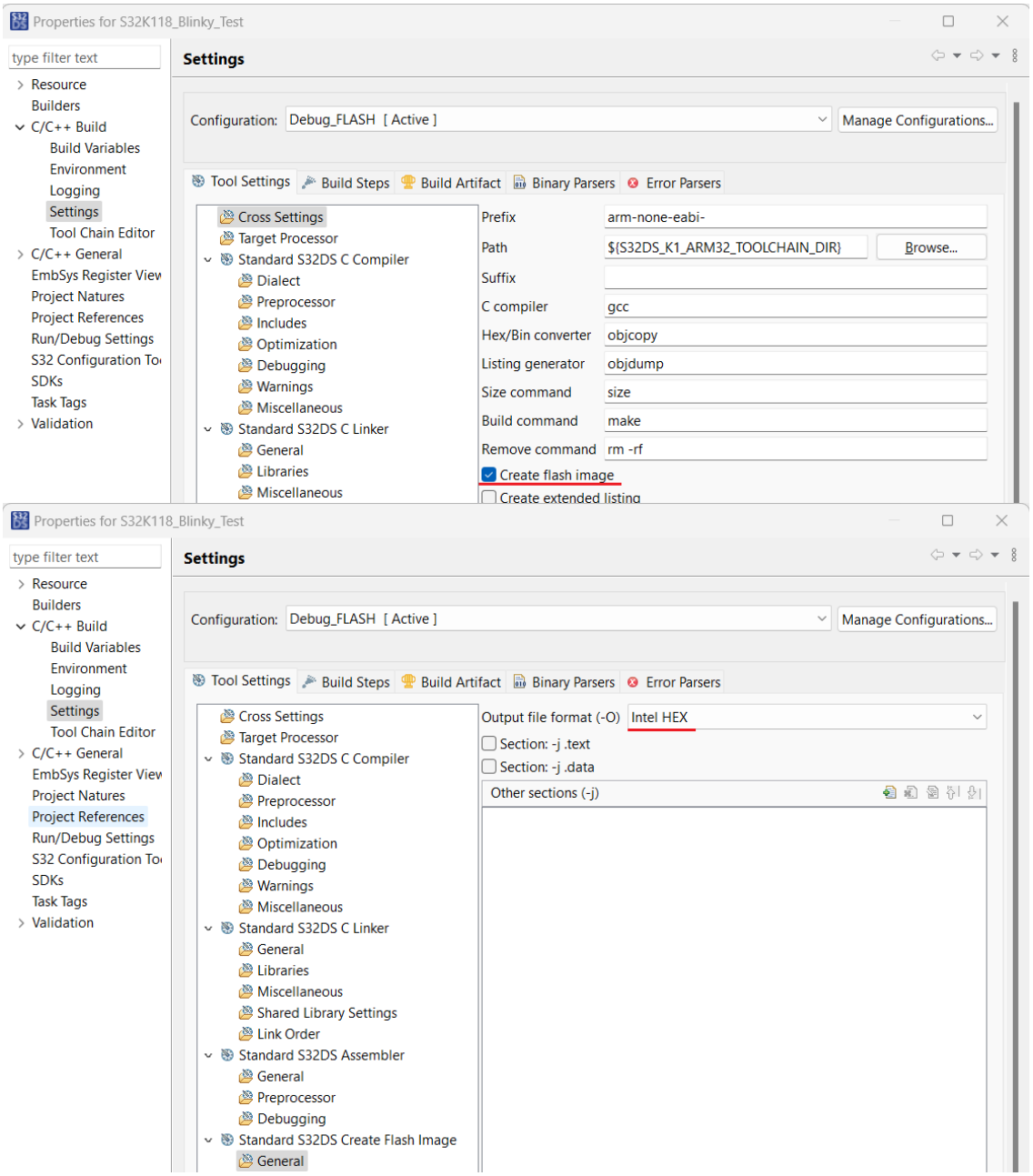
Please include easyS32_RTD.h in the main.c. And in the main(), call easyDSP_init() after the initialization of MCU. In the easyDSP_init() function, all necessary setting for easyDSP monitoring are done.
Note that the clock, pins and interrupt should be set properly for easyDSP monitoring.
In case you use easyDSP for flash programming, call easyDSP_boot() right after setting of clock and

pins.

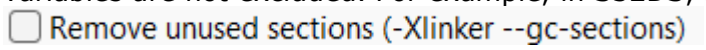
```
#include "easyS32_RTD.h"

int main(void)
{
    // Init clock
    Clock_Ip_Init(&Clock_Ip_aClockConfig[0]);
#if defined (FEATURE_CLOCK_IP_HAS_SPLL_CLK)
    // Busy wait until the System PLL is locked
    while (CLOCK_IP_PLL_LOCKED != Clock_Ip_GetPllStatus());
    Clock_Ip_DistributePll();
#endif

    // Initialize all pins in case of S32K1
    Port_Ci_Port_Ip_Init(NUM_OF_CONFIGURED_PINS0, g_pin_mux_InitConfigArr0);

    // Initialize all pins in case of S32K3
    Siul2_Port_Ip_Init(NUM_OF_CONFIGURED_PINS0, g_pin_mux_InitConfigArr0);

#if EZ_BOOTLOADER_USE
    // Right after clock and pin setting, call easyDSP_boot() to enable flash programming
    easyDSP_boot();
#endif

    // Initialize IRQs
    IntCtrl_Ip_Init(&IntCtrlConfig_0);
    IntCtrl_Ip_ConfigIrqRouting(&intRouteConfig);

    // reset of initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

STEP 6 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder of output file (for example, *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time. Please refer to the setting of S32DS below.

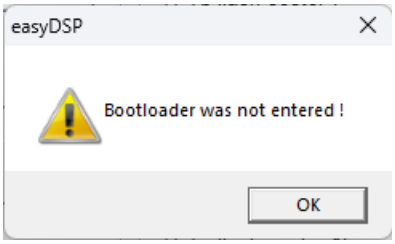


2. For easyDSP monitoring, the debug information should be included in the output file (for example, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in S32DS, no check in the check box in the linker option.



STEP 7 : Limitation of easyDSP bootloader

1. To program flash, the bootloader should be provided since there is no ROM bootloader in this MCU. The bootloader easyDSP provides is the function (name : easyDSP_boot) and it resides in the user program. Therefore it can program flash only when it is already programmed in the flash. In case flash is empty or flash doesn't have easyDSP bootloader, you can't enter into the bootloader and will see the message below. In this case, you have to use the debugger to program flash. And in same principle, you have to use debugger to program easyDSP bootloader into flash at the beginning.



2. easyDSP bootloader runs on RAM and it uses some RAM memory space. It is about 2.4K bytes for S32K1, 4.8K bytes for S32K3 at the optimization option -O1.

7.4 AM263x

7.4.1 AM263x software

STEP 1 : Core selection

MCU cores are classified with 4 types in terms of easyDSP.
Yellow core : core that easyDSP pod is connected to and easyDSP communicates with
Orange core : core that easyDSP pod is not connected to but easyDSP communicates with
Blue core : core that easyDSP doesn't communicate with
Gray core : core that doesn't run

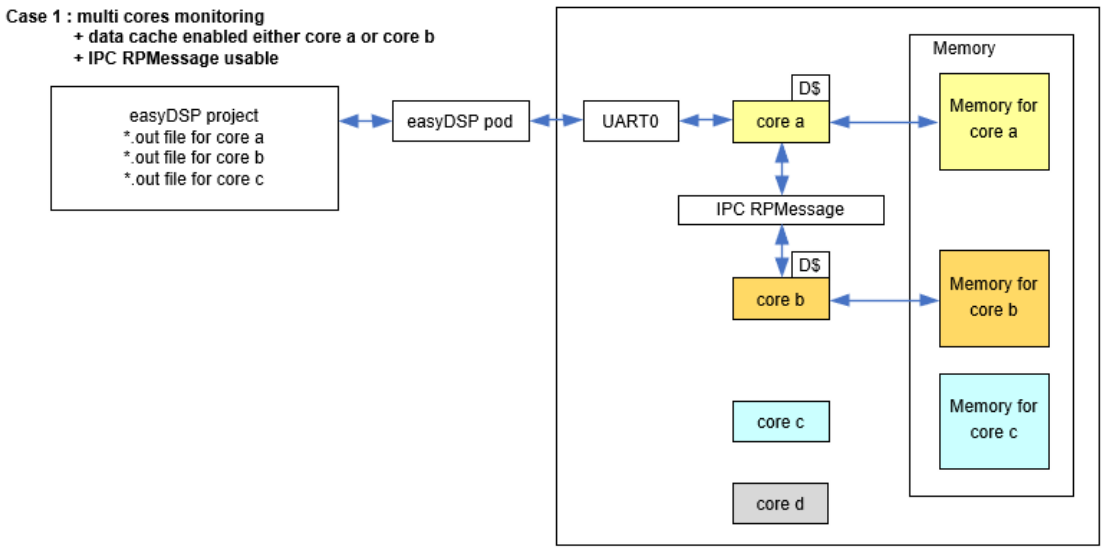
	Connected to easyDSP pod	Communicated with easyDSP	Running core
core	**Yes**	**Yes**	**Yes**
core	No	**Yes**	**Yes**
core	No	No	**Yes**
core	No	No	No

AM263x has max 4 cores. Please choose core type either yellow or orange core based on your application. Any core of AM263x could be yellow or orange core.
Since blue and gray core has no operation with easyDSP, no easyDSP related setting is required for them.
Together with data cache usage, several cases are available as below.

Case 1 :

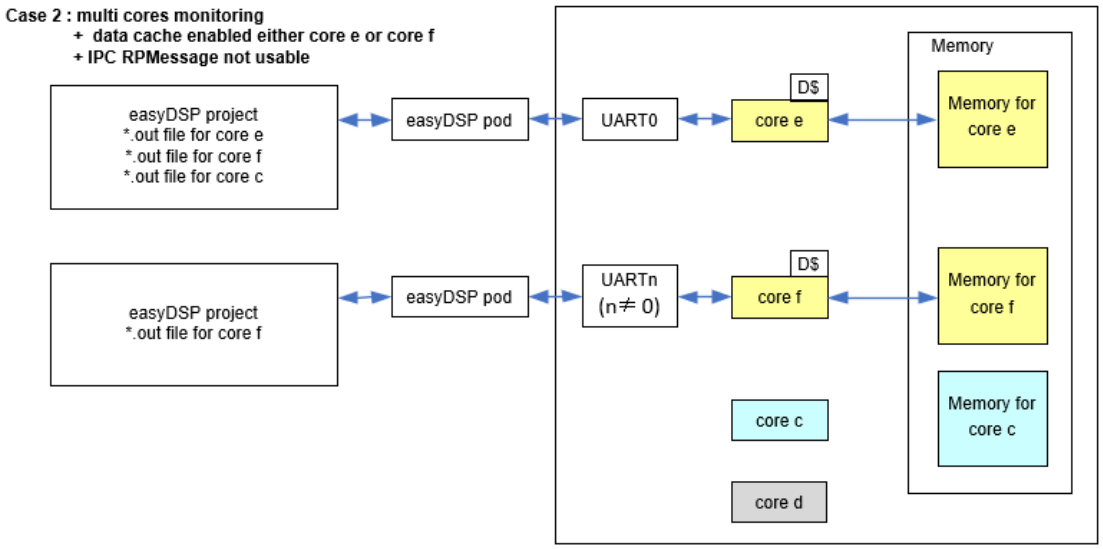
It is the case that easyDSP monitors multi cores (core a and b) and at least one of them uses data cache and IPC RPMessage is usable for core to core communication.
easyDSP pod is connected to core a via UART0, the variable of core a is accessed by core a.
To avoid cache coherence issue, the variable (actually its memory location) of core b is accessed by core b via core to core communication by IPC RPMessage. Please refer to the arrow for data flow

between easyDSP and cores.



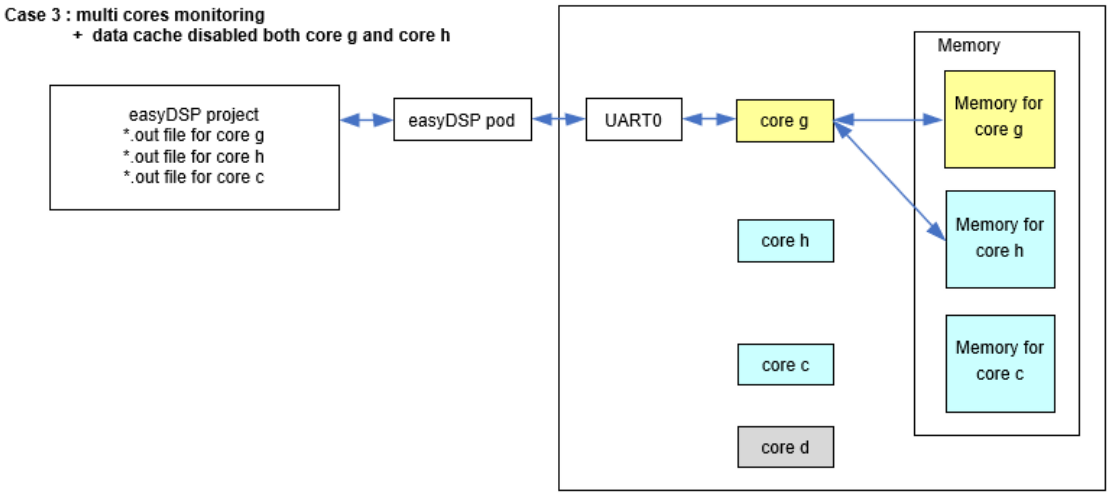
Case 2 :

In the case 1 but IPC RPMessage is not usable, easyDSP pod should be connected to each core.



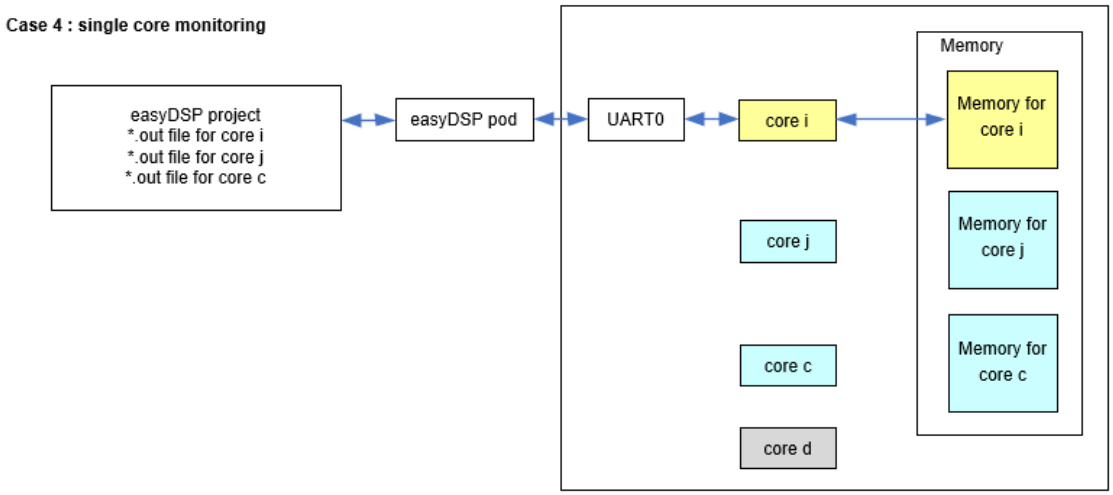
Case 3 :

It is the case that easyDSP monitors multi cores and data cache is disabled in these cores.
All the variables (and their memory location) are accessed by the core easyDSP pod is connected to.



Case 4 :

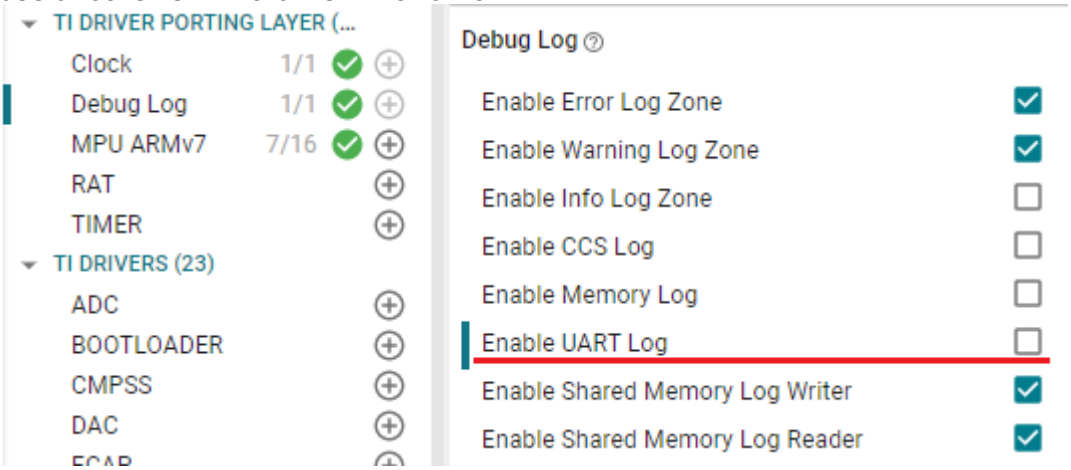
It is the case that easyDSP monitors single core. In this case, we don't care whether the data cache is enabled or not.



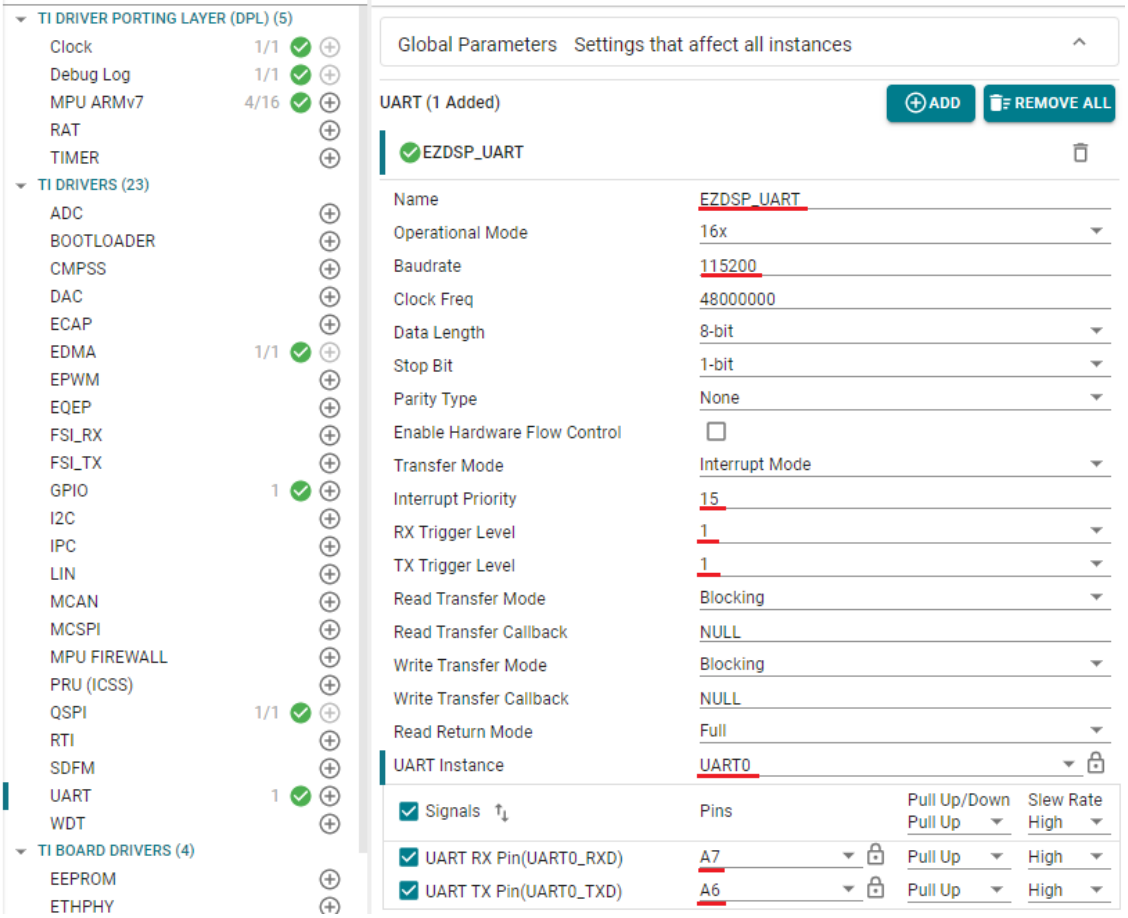
STEP 2 : SysConfig setting

easyDSP uses the code generated by SysConfig. Below figures are made based on SysConfig 1.13.0.

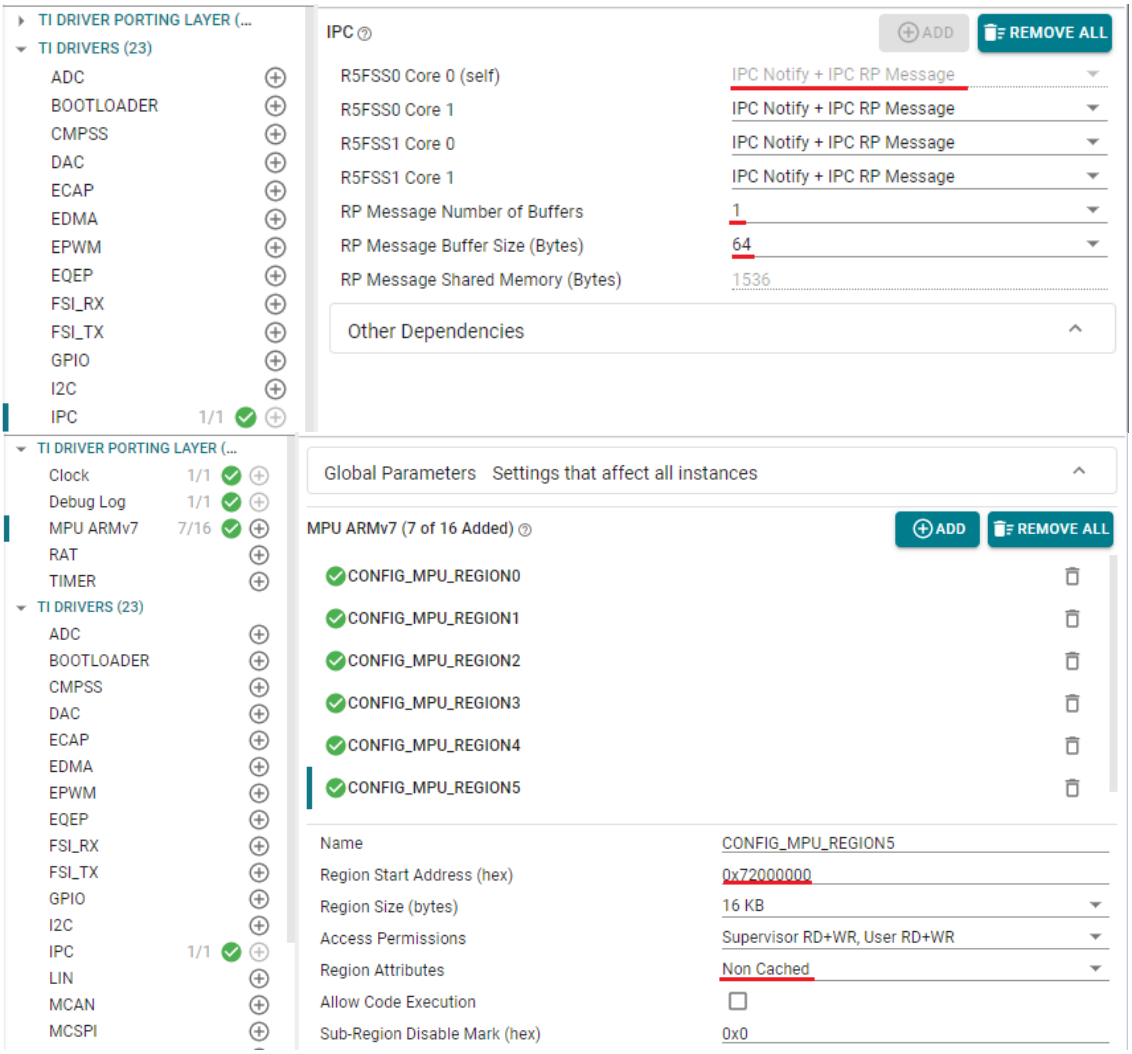
Since easyDSP communicates with MCU via UART0, please disable 'Debug Log > Enable UART Log' or use another UART than UART0 for it.



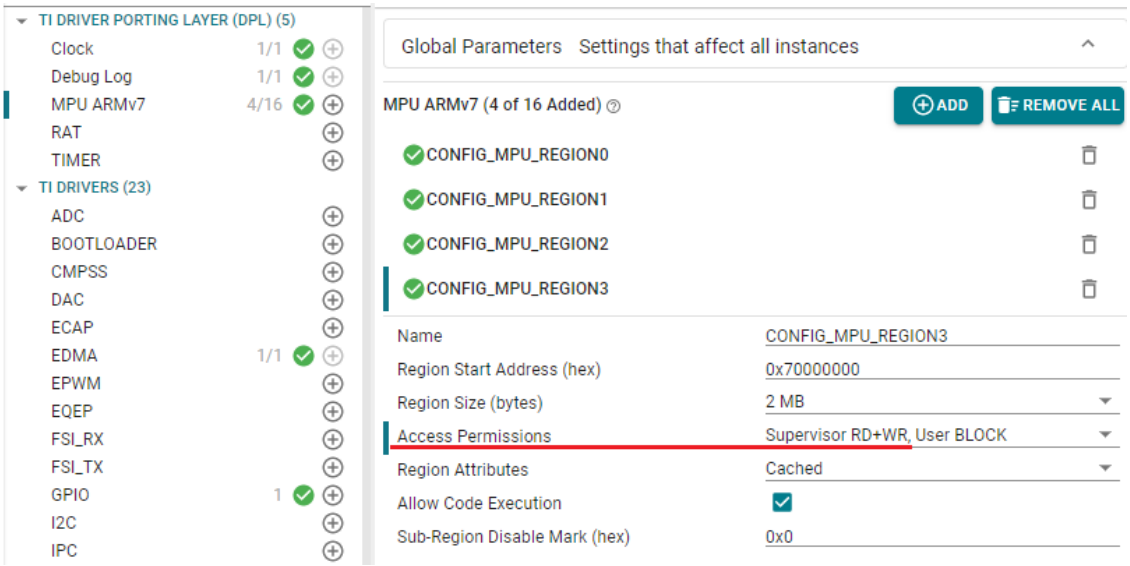
UART related setting is required for all the cores easyDSP pod is connected to, that is, yellow cores. The name of UART module should be 'EZDSP_UART'. The baudrate is selectable but it should be same to that of easyDSP project setting. The data format should be 8bit data, one stop bit and no parity bit. The priority of UART interrupt should be as low as possible such as 15. TX and RX pins are that of UART0 MUXMODE 0. Exceptionally, UART of core f in STEP1 could be other UART than UART0. Please check below for details.



IPC setting is required for all the cores using IPC RPMessage (core a and b in STEP1).
'IPC Notify + IPC RP Message' should be used. And 'RP Message Number of Buffers' should be min.1 and 'RP Message Buffer Size' should be min 64. They are increased in case IPC RPMessage is also used for other purpose than easyDSP. Also no cache should be used for the shared buffer location (memory 16KB from 0x72000000).



'Supervion RD+WR' is required for the memory area that easyDSP can access so that easyDSP reads/writes the memory location.



STEP 3 : easyDSP project and MCU project

According to STEP1, easyDSP project should be generated to all the yellow cores, and user MCU project should be modified for all the yellow and orange cores.

For the yellow and orage cores, please include easyDSP header and source file (easyAM_v*.*.h, easyAM_v*.*.c) into user MCU project. The suffix of file name will different by its version. You can find these file in the folder easyDSP is installed (\source\AM2x). And set the #define directives based on your application.

```
////////////////////////////////////////////////////////////////////////////////////////////////
// Specify whether easyDSP pod is connected to this core
// Define 1 if easyDSP pod is connected to this core
// Define 0 if easyDSP pod is not connected to this core
////////////////////////////////////////////////////////////////////////////////////////////////
#define EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE       1

////////////////////////////////////////////////////////////////////////////////////////////////
// Specify whether easyDSP communicates with single core or multi cores
// Define 1 if easyDSP communicates with multi cores
// Define 0 if easyDSP communicates with single core
////////////////////////////////////////////////////////////////////////////////////////////////
#define EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES     1

////////////////////////////////////////////////////////////////////////////////////////////////
// If easyDSP communicates with multi cores, Specify data cache is enabled or not in that cores
// Define 1 if data cache is enabled in the at least one core easyDSP communicates with
// Define 0 if data cache is disabled in all the cores that easyDSP communicates with
////////////////////////////////////////////////////////////////////////////////////////////////
#if EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES
#define D_CACHE_IS_ENABLED     1
#endif

////////////////////////////////////////////////////////////////////////////////////////////////
// If easyDSP communicates with multi cores with data cache enabled, Specify IPC RPMessage end point
// It should range from 0 to 63
////////////////////////////////////////////////////////////////////////////////////////////////
#if EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES
#if D_CACHE_IS_ENABLED
#define MAIN_CORE_SERVICE_END_PT    (12U)
#define REMOTE_CORE_SERVICE_END_PT  (13U)
#endif
#endif
```

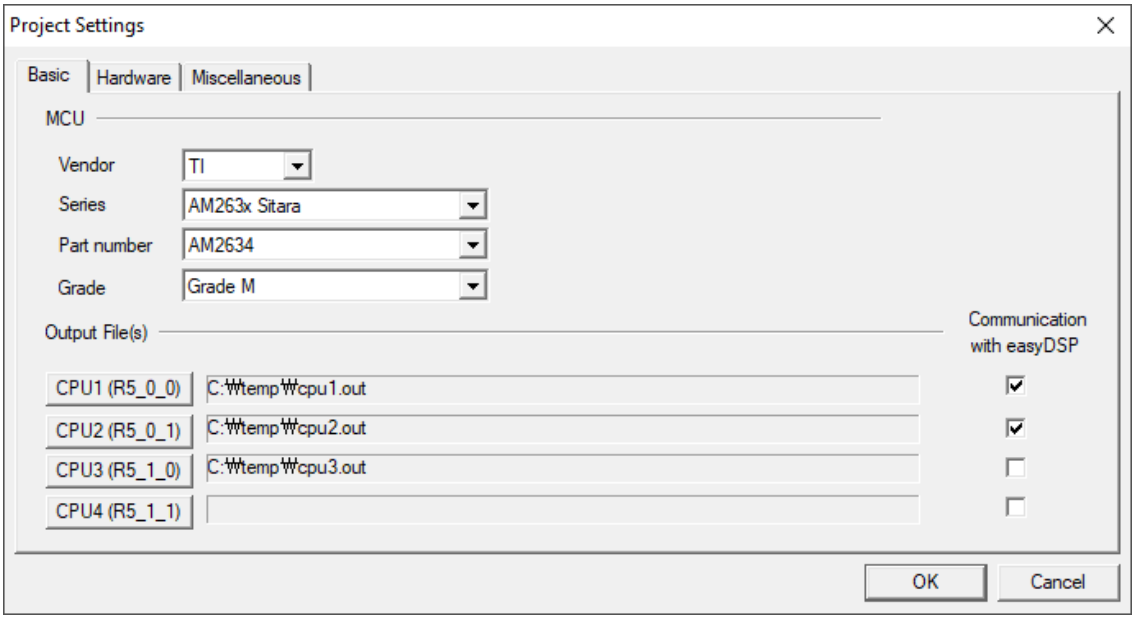
And call easyDSP_init() function in the proper location after some initialization functions.

```
#include "easyAM_v*.*.h"
int main()
{
    System_init();
    Board_init();
    Drivers_open();
    Board_driversOpen();

    .
    .
    .
    .

    easyDSP_init();
    .
    .

}
```

Below is the detailed explanation by cases.

Case 1 :

If core a, b, c and d are CPU1, 2, 3 and 4 respectively, the easyDSP project is set as below.
The output files of all the running cores are registered. And CPU1 and CPU2 are checked as cores communicating with easyDSP.

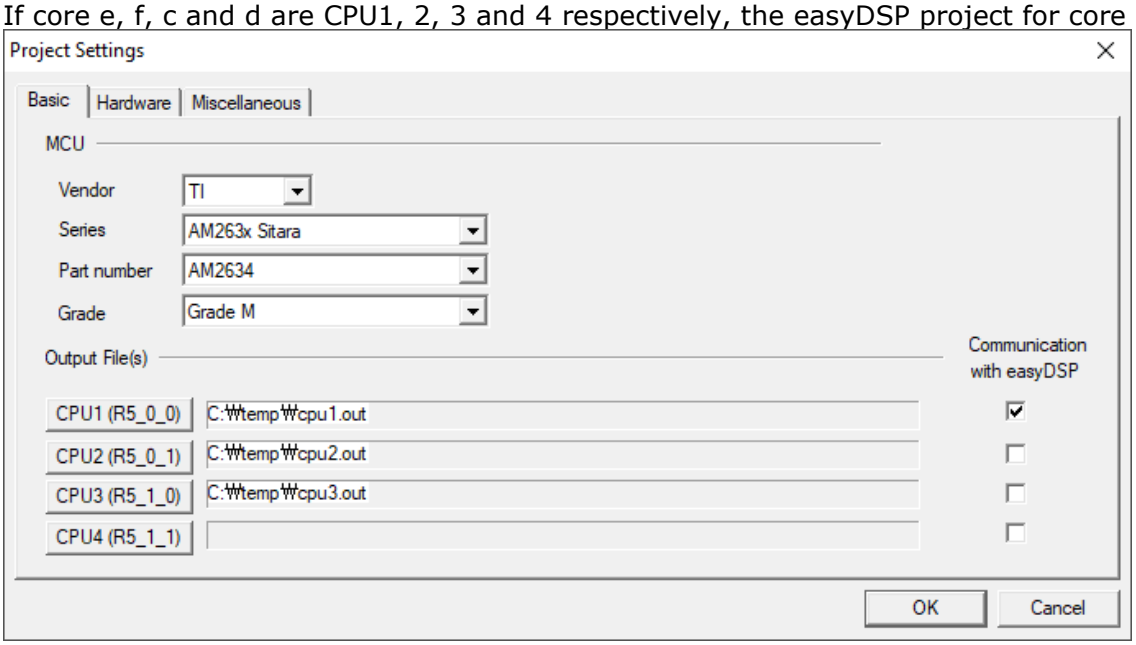


The setting in the header file as below. Also two end points (m and n) should be set for IPC RPMessage.

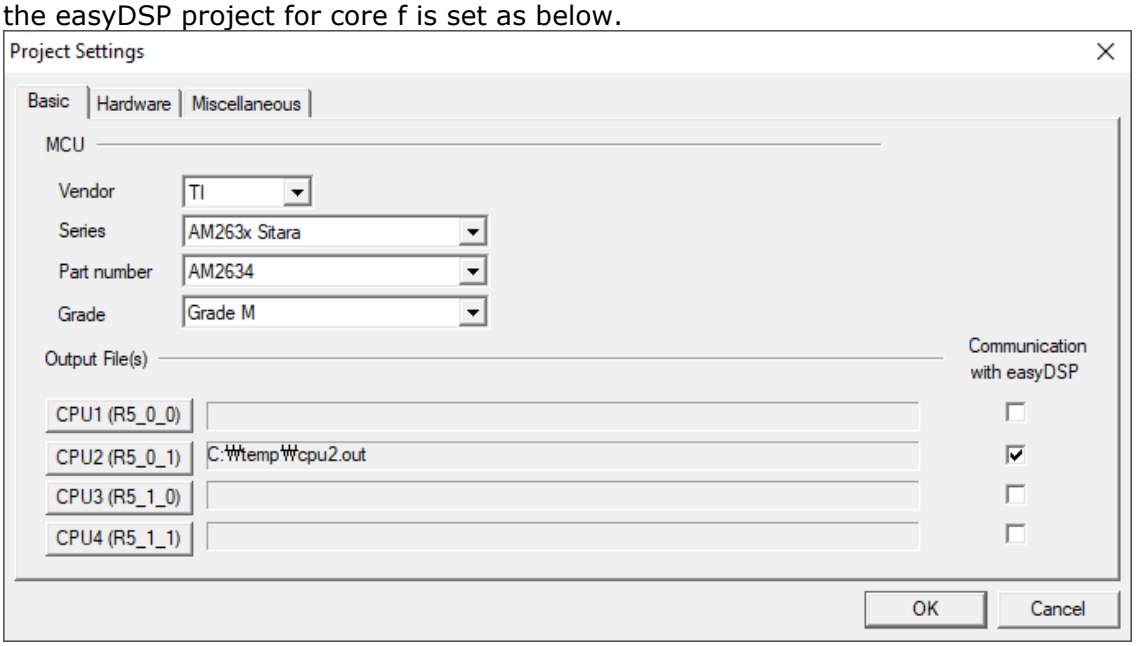
	Yellow core	Orange core
setting in easyAM.h	EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE =**1** EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES =**1** D_CACHE_IS_ENABLED =**1** MAIN_CORE_SERVICE_END_PT = m REMOTE_CORE_SERVICE_END_PT = n	EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE = **0** EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES = **1** D_CACHE_IS_ENABLED = **1** MAIN_CORE_SERVICE_END_PT = m REMOTE_CORE_SERVICE_END_PT = n

Case 2 :

If core e, f, c and d are CPU1, 2, 3 and 4 respectively, the easyDSP project for core e is set as below.

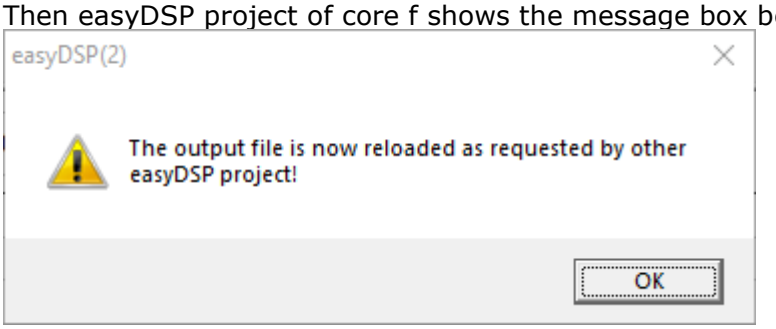


the easyDSP project for core f is set as below.



To do RAM booting and flash programming, easyDSP pod should be connected to the core via UART0. Therefore register all the output files of running cores to easyDSP project of core e (connected to easyDSP pod via UART0) so that easyDSP project of core e can perform RAM booting and flash programming.
On the other hand, don't perform RAM boooting and flash programming in the easyDSP project of core f.

In case that user program of core f is updated and downloaded to core f by easyDSP project of core e, the easyDSP project of core f needs to reload its output file to update its symbolic information.
This is done automatically if both easyDSP projects (core e and core f) are running in the single PC.
Then easyDSP project of core f shows the message box below.



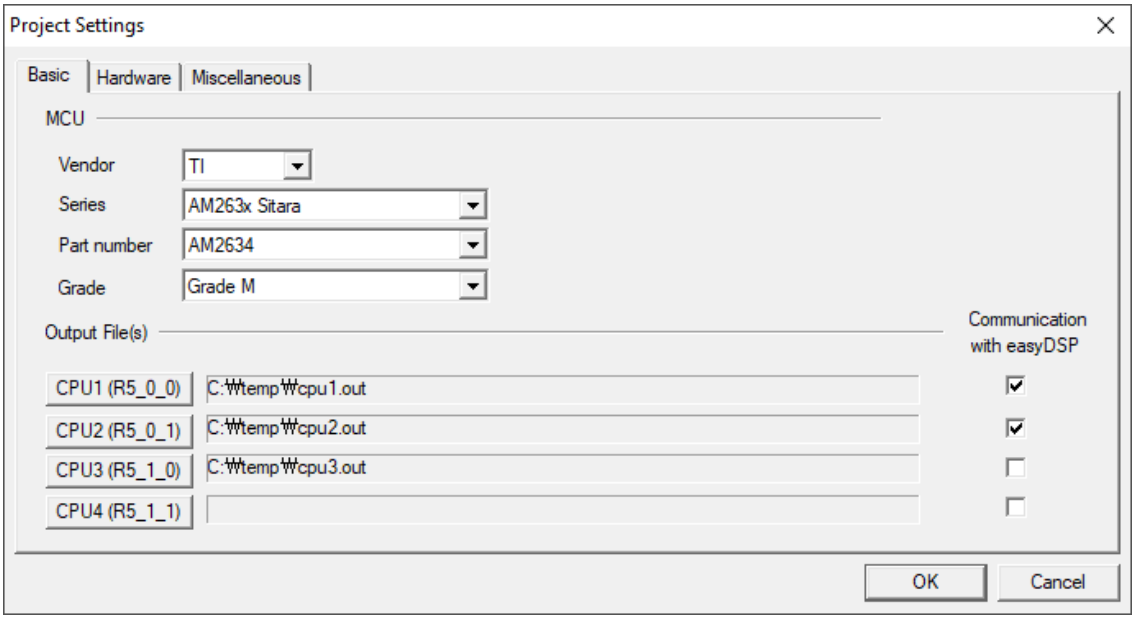
If both easyDSP projects run in the separate PC, then user need to do manually by executing the menu 'MCU > Reload *.out' in the easyDSP project of core f.

The setting in the header file as below.

	Yellow core
setting in easyAM.h	EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE = **1** EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES = **0**

Case 3 :

If core g, h, c and d are CPU1, 2, 3 and 4 respectively, the easyDSP project for core g is set as below. The output files of all the running cores are registered. And CPU1 and CPU2 are checked as cores communicating with easyDSP.

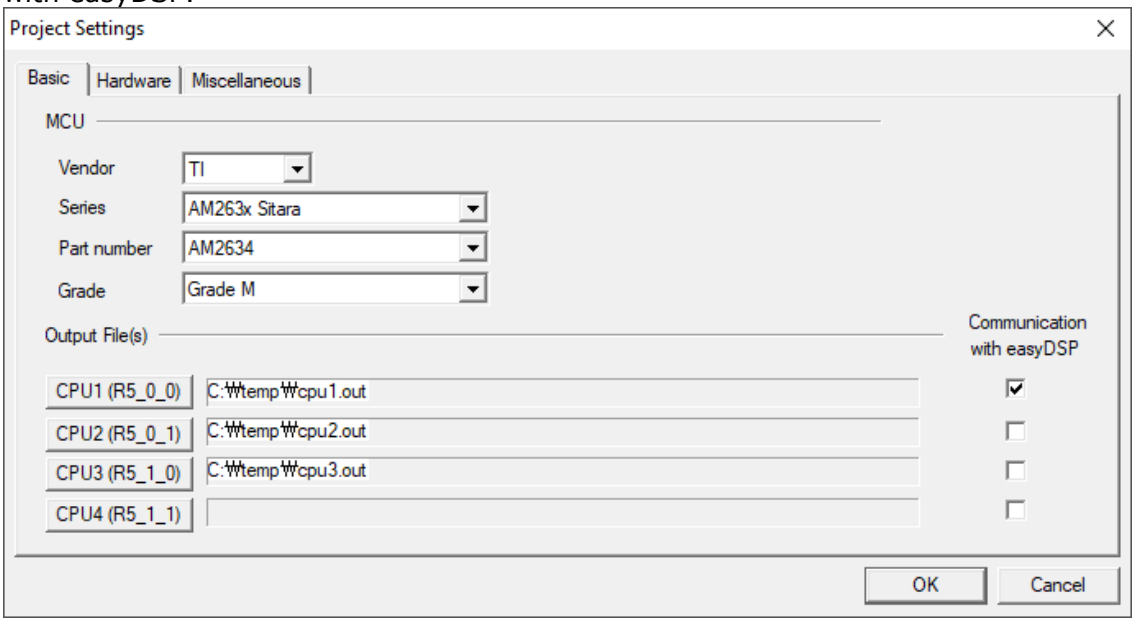


The setting in the header file as below.

	Yellow core
setting in easyAM.h	EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE =**1** EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES =**1** D_CACHE_IS_ENABLED = **0**

Case 4 :

If core i, j, c and d are CPU 1, 2, 3 and 4 respectively, the easyDSP project for core i is set as below. The output files of all the running cores are registered. And CPU1 is checked as core communicating with easyDSP.



The setting in the header file as below.

	Yellow core
setting in	EASYDSP_POD_IS_CONNECTED_TO_THIS_CORE = **1**

easyAM.h	EASYDSP_IS_COMMUNICATING_WITH_MULTI_CORES =**0**

STEP 4 : linker.cmd

In the linker.cmd file, the start address of RAM should be same to or larger than 0x7004.0000 for all cores, as it is in the TI example project.

```
MEMORY
{
     .
     .
     .

     OCRAM      : ORIGIN = 0x70040000 , LENGTH = 0x40000

     .
     .
     .
}
```

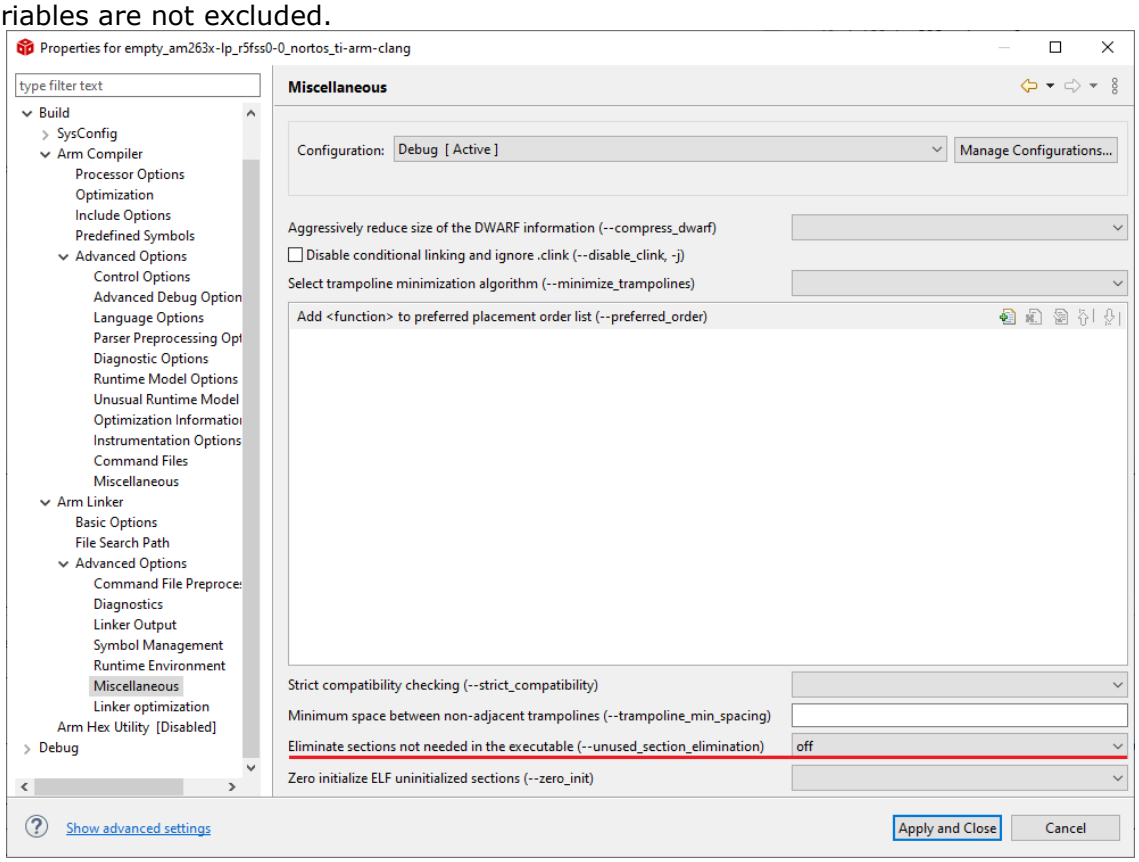
STEP 5 : Variable name

Note that the variable name in the easyDSP is changed when easyDSP is communicating with multi cores.
This is not to mix the variable name from different cores. The variable name 'var' of CPUx (x= 1,2,3 or 4) is changed to 'x:var'. < /FONT>

STEP 6 : IDE setting

1. **Make sure that rprc file (*.rprc) is generated in every compilation with the same name and in the same folder to the output file.** This is the default setting of TI CCS. rprc file is used for RAM booting and flash programming.
2. The debugging information should be included in the output file. This is the default setting of TI CCS. Otherwise, easyDSP can not recognize the variable.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker option. If necessary, you can set the linker option so that the unused

variables are not excluded.



7.4.2 AM263x hardware

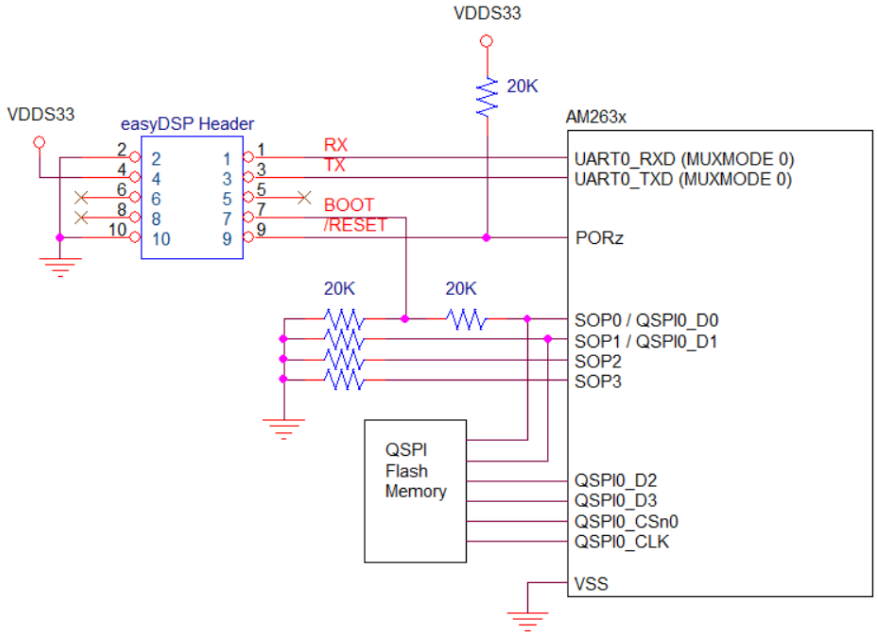
Connection to easyDSP

easyDSP uses 'UART' boot mode for RAM booting and flash programming, and uses 'QSPI(4S) - Quad Read Mode' boot to run user program in the flash.

Boot Mode	SOP3	SOP2	SOP1	SOP0
QSPI (4S) - Quad Read Mode	0	0	0	0
UART	0	0	0	1
QSPI (1S) - Single Read Mode	0	0	1	0
QSPI (4S) - Quad Read UART Fallback Mode	0	1	0	0
QSPI (1S) - Single Read UART Fallback Mode	0	1	0	1
DevBoot	1	0	1	1

According to the table above, SOP1, SOP2 and SOP3 pins should be low while SOP0 pin is connected to BOOT pin of easyDSP header so that easyDSP can control MCU boot mode.
It is highly recommended to connect RX and TX pins of easyDSP header to MCU UART0 (MUXMODE 0). Otherwise RAM booting and flash programming is not supported.
In case RX and TX pins of easyDSP header are connected to UART other than UART0 (MUXMODE 0), don't connect BOOT and /RESET pin of easyDSP header.

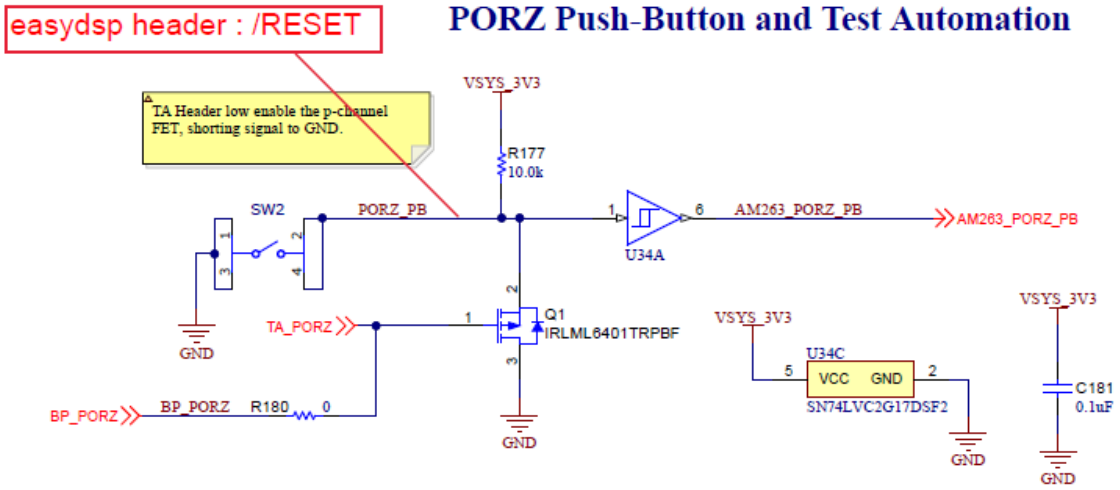
The flash should be connected to MCU QSPI0 and its 'Sector Erase' command should work with 64kB block such as part number S25FL128SAGNFI000 which is used in TI evaluation board.
#4 pin of easyDSP header is connected to MCU VDDS33.

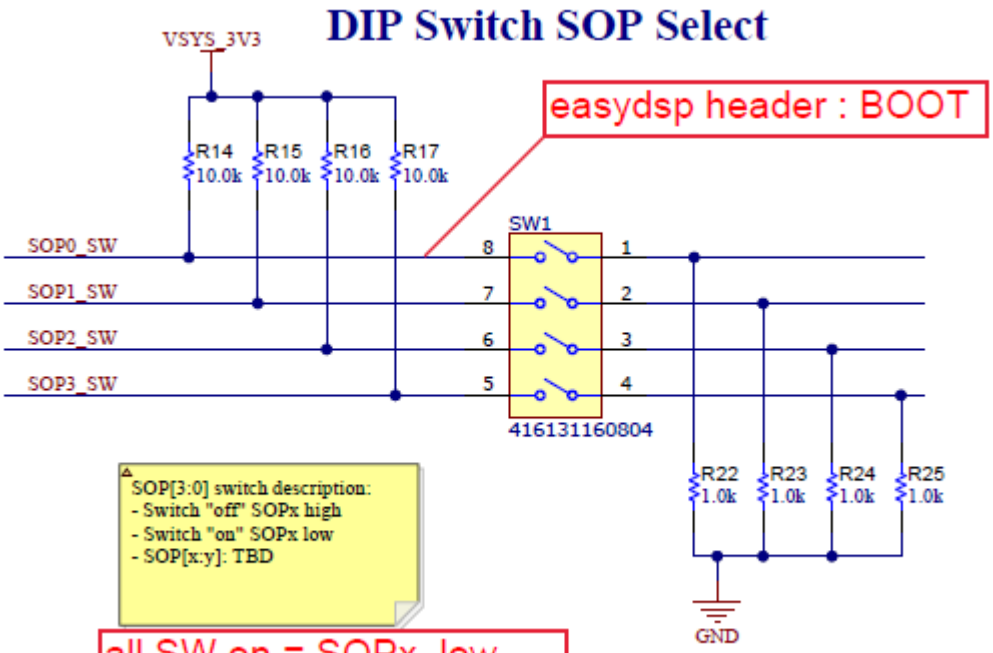


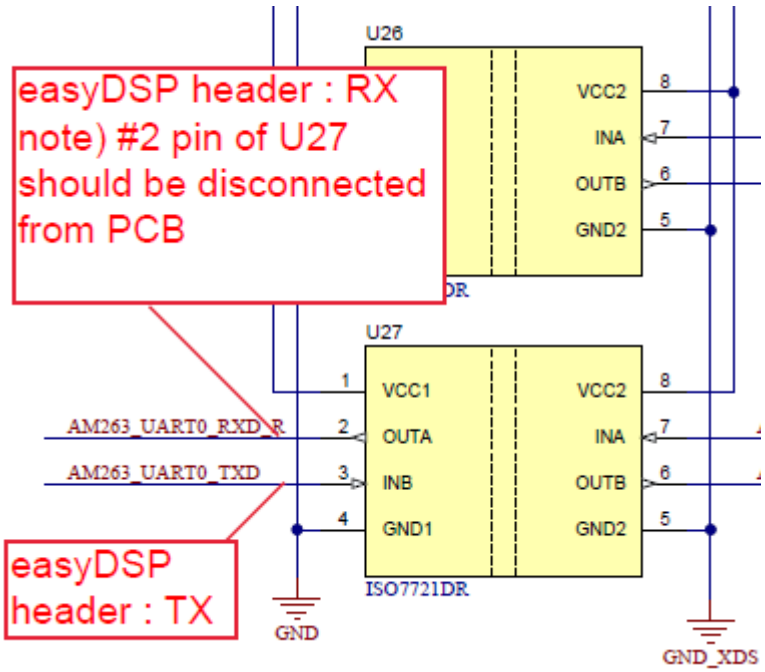
Note :
- 25MHz XTAL clock source is required.
- MCU captures SOPx pin status ~1ms after PORz release and decides boot mode. So, kindly make sure there would be no signal output from any circuitry connected to SOPx pin ~2ms after PORz release.
- TX and RX pin of easyDSP header is pulled up with 100k Ohm resistor inside of easyDSP pod.
- In case there is a reset IC between easyDSP /RESET and MCU PORz, it should transfer easyDSP /RESET signal to MCU within 0.5sec.

easyDSP connection to AM263x Launchpad

The manual work to connect easyDSP to TI AM263x Launchpad is shown below. Note that all the switches of SW1 should be ON and #2 pin of U27 should be detached from PCB.


easydsp header : /RESET
PORZ Push-Button and Test Automation
TA Header low enable the p-channel FET, shorting signal to GND.
VSYS_3V3
R177
10.0k
SW2
PORZ_PB
U34A
AM263_PORZ_PB
AM263_PORZ_PB
GND
TA_PORZ
Q1
IRLML6401TRPBF
VSYS_3V3
U34C
VCC
GND
SN74LVC2G17DSF2
VSYS_3V3
C181
0.1uF
BP_PORZ
BP_PORZ
R180
0
GND
GND
GND


DIP Switch SOP Select
VSYS_3V3
easydsp header : BOOT
R14
10.0k
R15
10.0k
R16
10.0k
R17
10.0k
SW1
SOP0_SW
SOP1_SW
SOP2_SW
SOP3_SW
416131160804
R22
1.0k
R23
1.0k
R24
1.0k
R25
1.0k
GND
SOP[3:0] switch description:
- Switch "off" SOPx high
- Switch "on" SOPx low
- SOP[x:y]: TBD
all SW on = SOPx low


easyDSP header : RX
note) #2 pin of U27
should be disconnected
from PCB
U26
VCC2
INA
OUTB
GND2
U27
VCC1
OUTA
INB
GND1
VCC2
INA
OUTB
GND2
AM263_UART0_RXD_R
AM263_UART0_TXD
ISO7721DR
easyDSP
header : TX
GND
GND_XDS

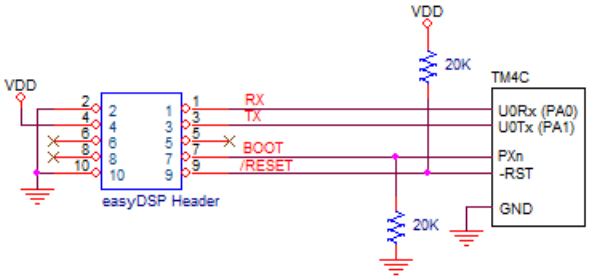
7.5 TM4C

TM4C setting

STEP 1 : Hardware

easyDSP uses MCU's ROM boot loader to access the flash memory. So the UART0 channel (PA0/PA1) that is used in the ROM boot loader should be used for easyDSP.
Otherwise, easyDSP can support only monitoring, not flash programming. Also the source file easyTM4C.c should be modified accordingly by you.
PXn pin acts as a boot pin and you can select it in the easyTM4C.h file. But caution should be taken when selecting boot pin :

1. PC0-3, PD7 and PE7 can't be used for TM4C129x MCU
2. PC0-3, PD7 and PF7 can't be used for TM4C123x MCU
3. In case other circuitry is connected to this pin than easyDSP BOOT pin, this circuit should not issue the output signal until ~1sec after MUC reset release.



Other considerations :
- In case there is a reset IC between easyDSP /RESET and MCU -RST, it should transfer easyDSP /RESET signal to MCU -RST within 0.5sec.
- TX and RX pin of easyDSP header is pulled up with 100k Ohm resistor inside of easyDSP pod.

STEP 2 : Modification of easyDSP header file

Two files are provided for easyDSP communication (easyTM4C.h and easyTM4C.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\TM4C).
In the file, please set a target MCU, MCU clock, baudrate of easyDSP communication and boot pin. The baud rate should be same to that of easyDSP project.

```
////////////////////////////////////////////////////////////////////////////////
// step 1 : set target MCU
//          if TM4C129x is used, set EZ_USE_TM4C129x as 1
//          if TM4C123x is used, set EZ_USE_TM4C123x as 1
////////////////////////////////////////////////////////////////////////////////
#define EZ_USE_TM4C129x     0
#define EZ_USE_TM4C123x     1

////////////////////////////////////////////////////////////////////////////////
// step 2 : set the system clock frequency
//          for example, 120000000L for TM4C129x, 80000000L for TM4C123x
////////////////////////////////////////////////////////////////////////////////
#define EZ_SYS_CLK_FREQ     80000000L

////////////////////////////////////////////////////////////////////////////////
// step 3 : set the baud rate for UART communication with easyDSP
//          it should be same to the baudrate of easyDSP project
////////////////////////////////////////////////////////////////////////////////
#define EZ_BUAD_RATE        230400

////////////////////////////////////////////////////////////////////////////////
// step 4 : boot pin (PXn) selection
//          don't use PC0-3, PD7, PE7 for TM4C129x
//          don't use PC0-3, PD7, PF0 for TM4C123x
//          below example sets PB5 as a boot pin
////////////////////////////////////////////////////////////////////////////////
#define EZ_SYSCTL_PERIPH_GPIOX  SYSCTL_PERIPH_GPIOB
#define EZ_GPIO_PORTX_BASE      GPIO_PORTB_BASE
#define EZ_GPIO_PIN_n           GPIO_PIN_5
```

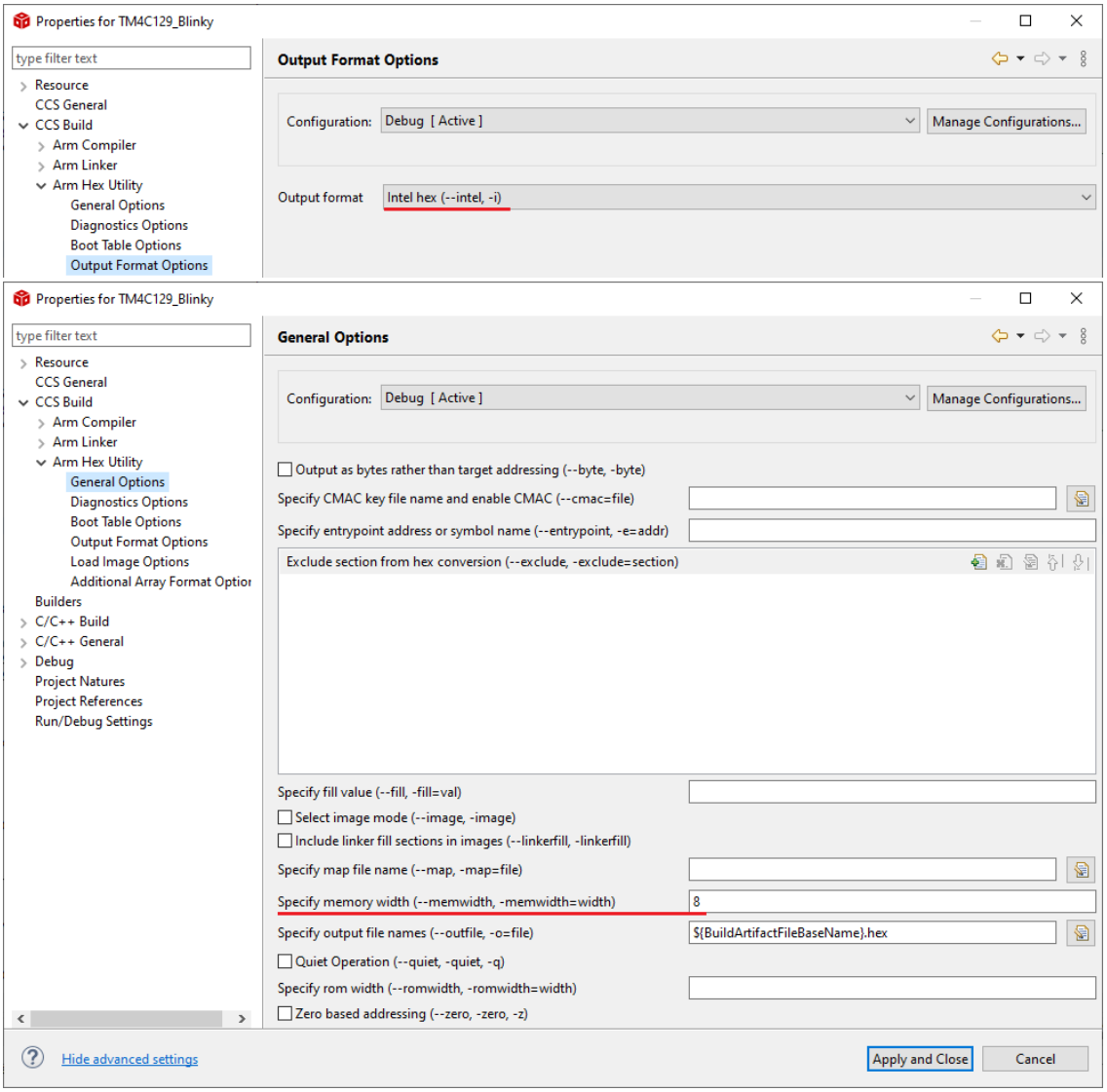
STEP 3 : Calling easyDSP functions

Please include easyTM4C.h in the main.c. And in the main(), call easyDSP_boot() very begining and call easyDSP_init() after the initialization of MCU.
In the easyDSP_boot() function, it is decided which code will be executed, either user program in the flash or ROM boot loader, depending on the status of boot pin. In case you don't use flash programming by easyDSP, no need for this function.
In the easyDSP_init() function, all necessary setting for easyDSP monitoring are done.

```
#include "easyTM4C.h"

int main(void)
{
    // the very beginning, call easyDSP_boot() to enable ROM boot loader if required
    easyDSP_boot();

    // initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

STEP 4 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder of output file (ex *.out) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time.
   Please refer to the setting of CCS. Especially for CCS, memory width should be 8.

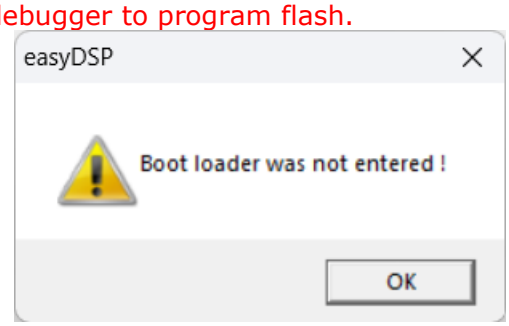


2. For easyDSP monitoring, the debug information should be included in the output file (ex, *.out). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded.
4. To compile inline functions in the easyTM4C.c, plase enables c99 mode in the compiler options if necessay.

STEP 5 : Other setting

1. To allow easyDSP to access the flash, the protection feature of flash should be disabled so that the flash may be written, erased, executed or read.
2. EN bit of BOOTCFG register of MCU should be 1. With this, the booting mechanism is decided by easyDSP_boot() function.
3. easyDSP can perform flash programming only when either all the flash is empty or easyDSP source file is programmed in the flash.
   For the other situation than above, you will face the error message below and you should use

debugger to program flash.



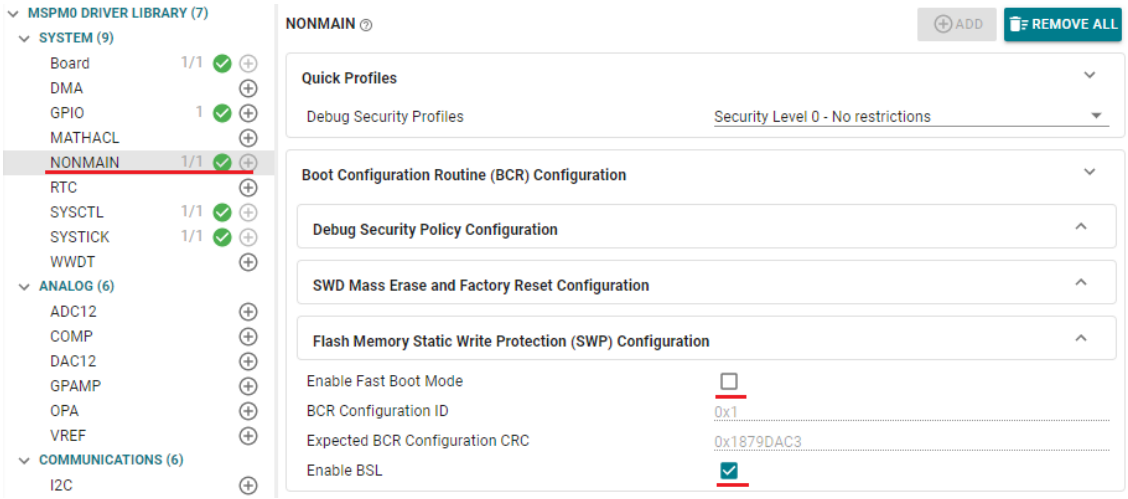
7.6 MSPM0

MSPM0 Setting NEW

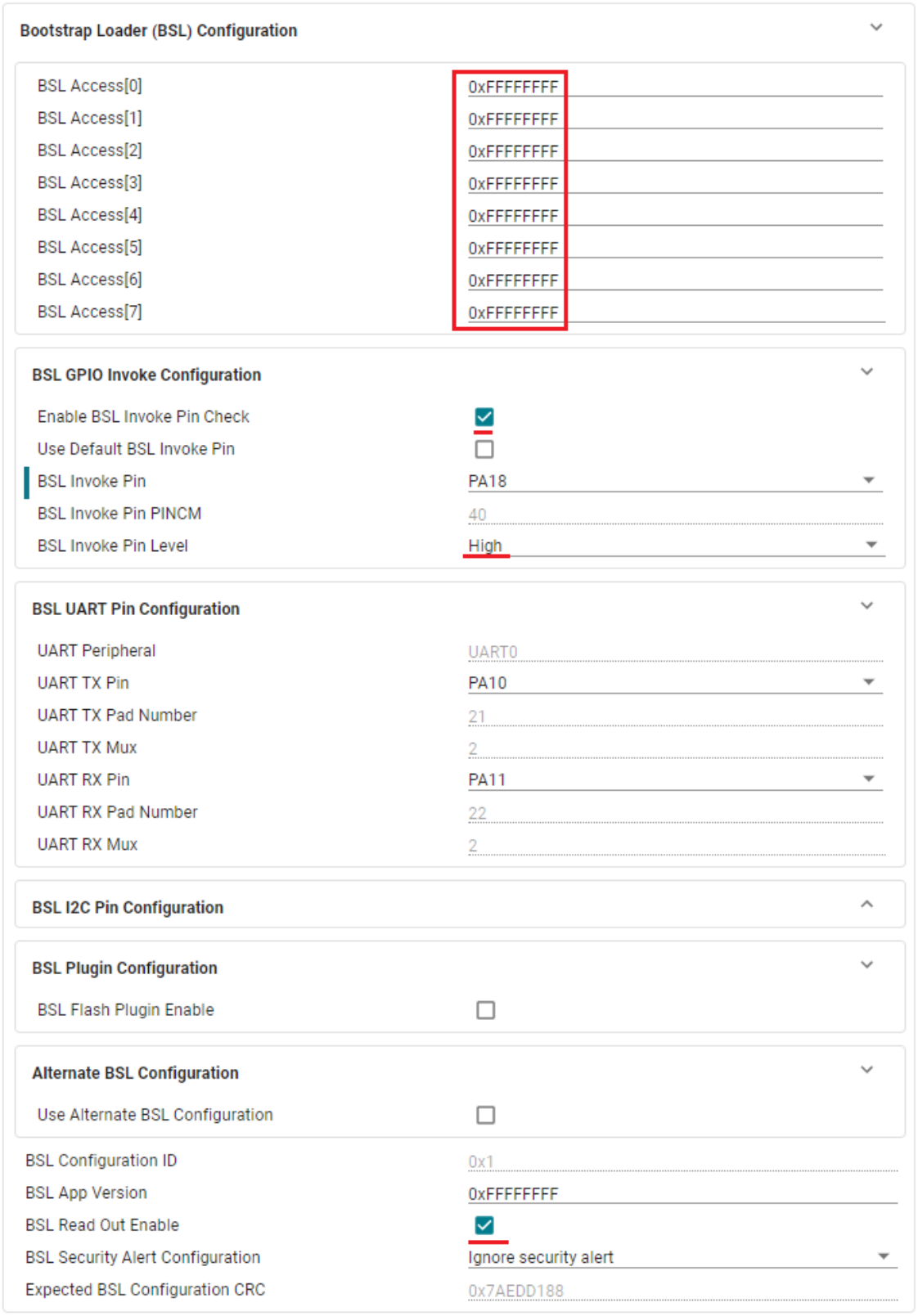
STEP 1 : SysConfig - NONMAIN

easyDSP uses the code generated by SysConfig. Below figures are made based on SysConfig 1.16.1.
At first, you can set the NONMAIN area such as BCR and BSL configuration.
If you use TI factory default, you can skip this step 1. If not, please check below.

First, set the BCR configuration.
Fast Boot Mode is disabled. And BSL is enabled.



Second, set the BSL configuration.
If necessary, set the 32 byte password for entering to bootstrap mode. It's all 0xFF by TI factory default.
BSL Invoke Pin Check should be enabled.
You can use default BSL invoke pin or you can change it to another pin but BSL invoke pin level should be high in any case.
If necessary, set the UART pin.
Finally enable BSL read out.



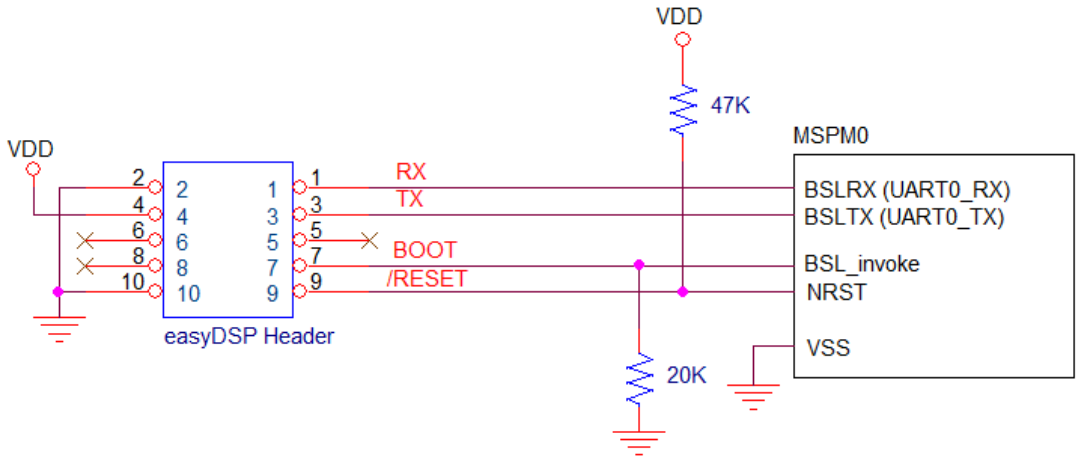
Note : Since easyDSP can't program NONMAIN flash memory region (such as BCR and BSL configuration area), please use the debugger or any other tool to program NONMAIN flash.

STEP 2 : Hardware

As confitured in STEP 1 or by TI factory default, connect BSL_invoke, BSLRX and BSLTX to easyDSP header.
If you use TI factory default (No change to NONMAIN flash in STEP 1), refer to the target MCU

datasheet to identify pin number of those pins. For instance, BSLRX, BSLTX and BSL_invoke has pin number 26, 27 and 22 respectively for MSPM0L1306xRHB. For instance, BSLRX, BSLTX and BSL_invoke has pin number 57, 56 and 11 respectively for MSPM0G3507SPM.

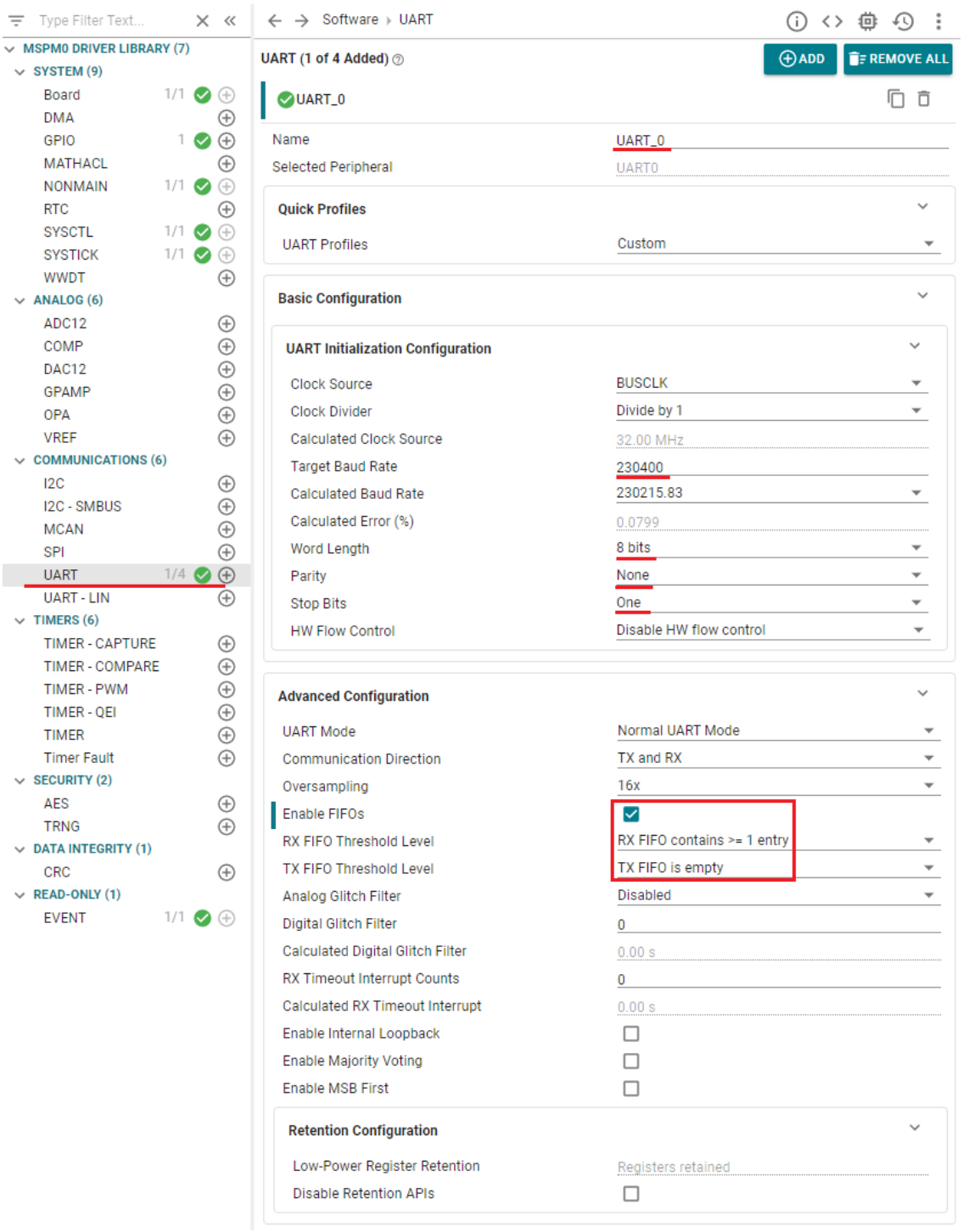
For your information, BSL_RX and BSL_TX belong to UART0.



Other considerations :
- Direct connection between easyDSP /RESET and MCU NRST.
- RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.
- In case pull-up resistor is attached, resistor value should be higher than several k Ohm.

STEP 3 : SysConfig - UART

Since BSL_RX and BSL_TX use UART0, create UART0 peripheral with the name of 'UART_0'.
The target baud rate is selectable but it should be same to that of easyDSP project setting.
The data format should be 8bit data, one stop bit and no parity bit.
FIFO should be enabled with its RX and TX FIFO threshold level as below.



Receive and Transmit interrupt should be enabled with the lowest priority level.
It is recommended to have pull-up resistor for TX and RX pins.
Finally as configured in step 1, RX and TX pins are set.

Extend Configuration

Enable Extend Features ☐

Interrupt Configuration

Enable Interrupts: Receive, Transmit

Interrupt Priority: Level 3 - Lowest

DMA Configuration

Configure DMA RX Trigger: None

Configure DMA TX Trigger: None

Pin Configuration

TX Pin

Direction: Output

IO Structure: High-Drive

Enable pin configuration ☑

Digital IOMUX Features

Internal Resistor: Pull-Up Resistor

Invert: Disabled

Drive Strength Control: High

High-Impedance: Disabled

RX Pin

Direction: Input

IO Structure: High-Drive

Enable pin configuration ☑

Digital IOMUX Features

Internal Resistor: Pull-Up Resistor

Invert: Disabled

Hysteresis Control: Disabled

Wakeup Logic: Disabled

PinMux Peripheral and Pin Configuration

UART Peripheral: UART0

RX Pin: PA11/57

TX Pin: PA10/56

Other Dependencies

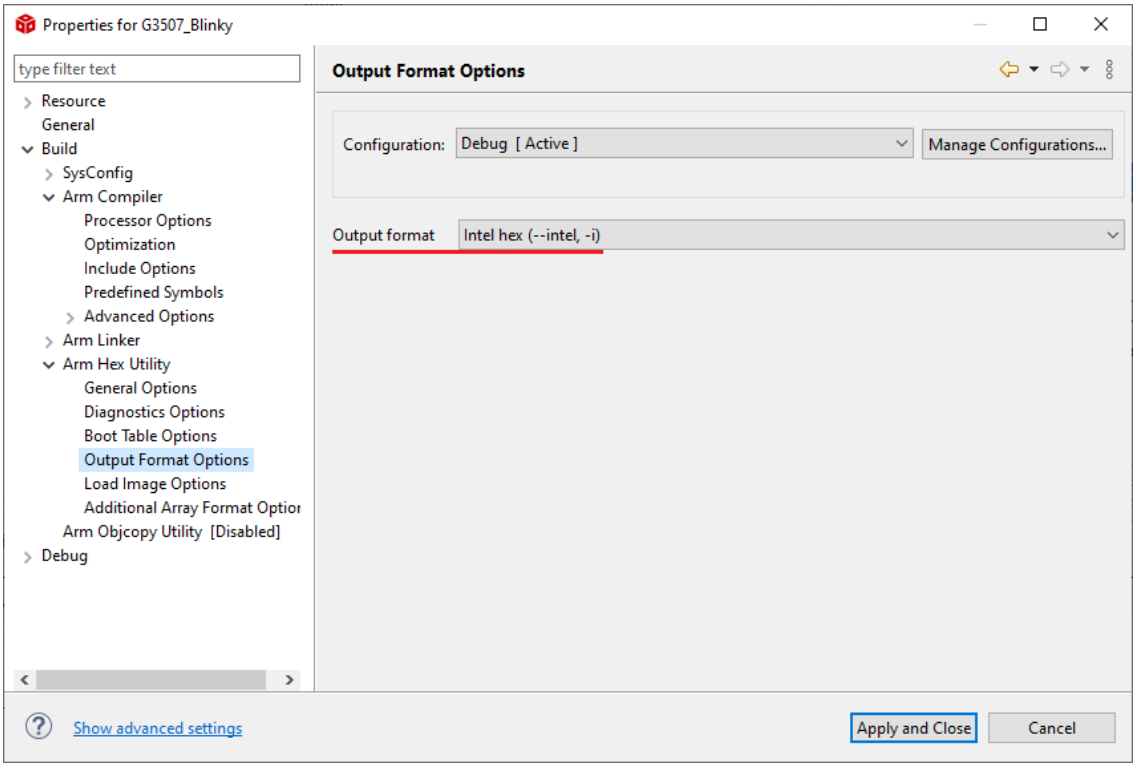
STEP 4 : easyDSP source file

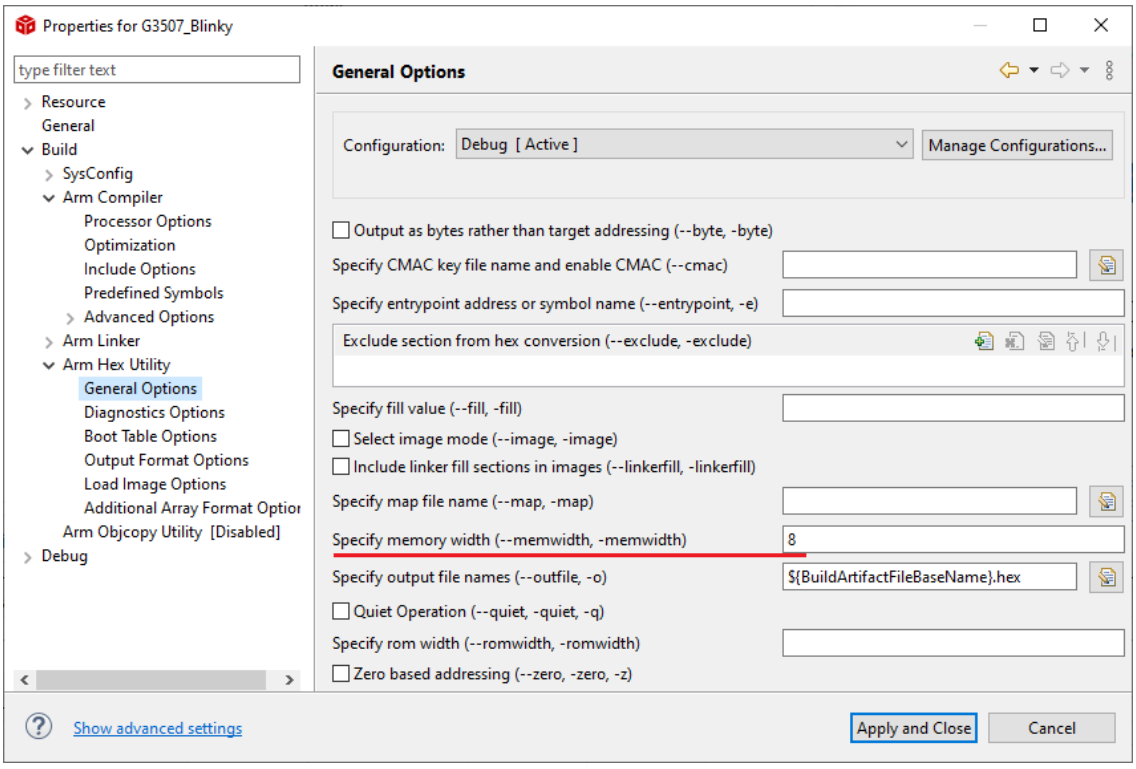
Please include driverlib from TI in your project since easyDSP uses it for UART communication.
Two files are provided for easyDSP communication (easyMSPM0.h, easyMSPM0.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\MSPM0).
Please include easyMSPM0.h in the main.c. And in the main(), call easyDSP_init() after the initialization of MCU.
In the easyDSP_init() function, all the setting for easyDSP monitoring are done.

```
#include "easyMSPM0.h"

int main(void)
{
    // initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

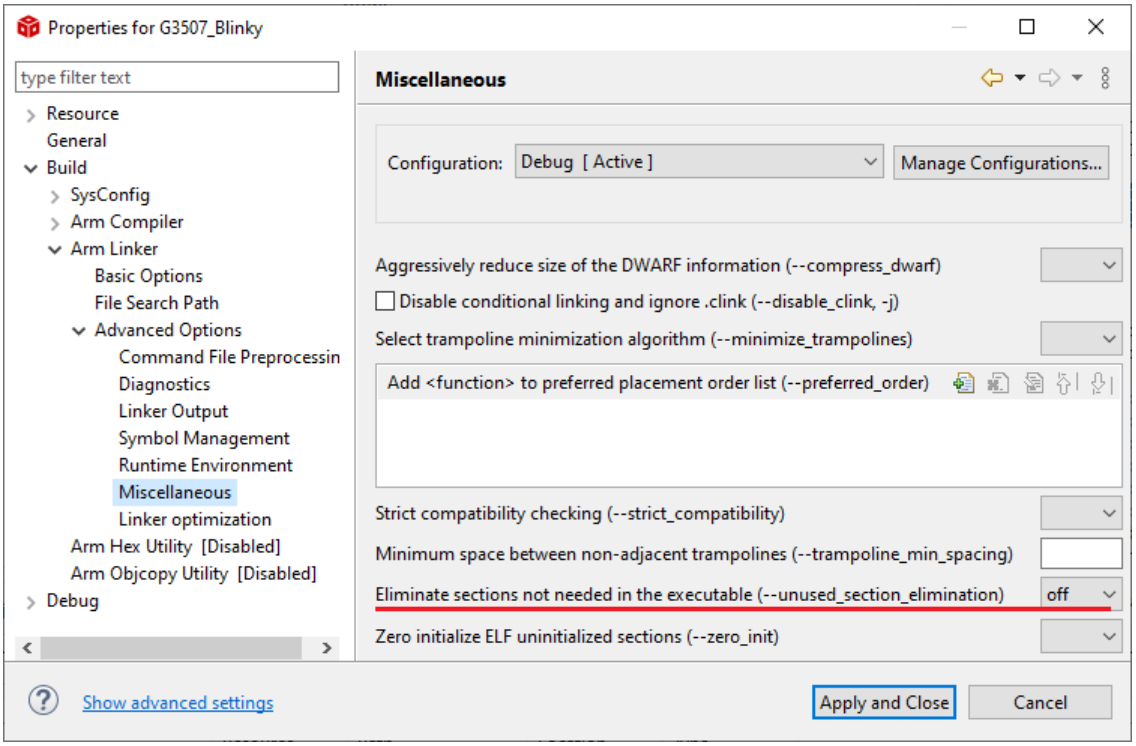
STEP 5 : IDE

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder of output file (ex *.out) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time.
   Please refer to the setting of CCS. Especially for CCS, memory width should be 8.

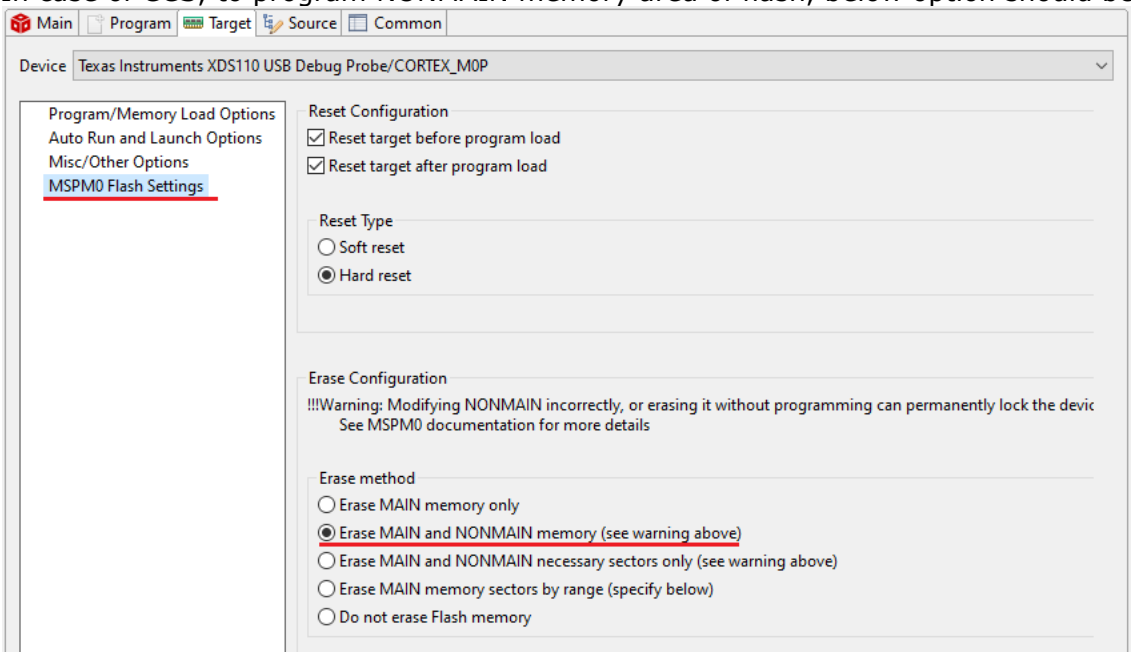




2. For easyDSP monitoring, the debug information should be included in the output file (ex, *.out). And the option of assembler, compiler and linker should be set accordingly.
3. Depending on compiler's optimization level and linker setting, the unused variables could be excluded from the debug information and not shown in the easyDSP.
    If you like to avoid this, don't use compiler optimization and set the linker option properly. Like below in case of CCS.



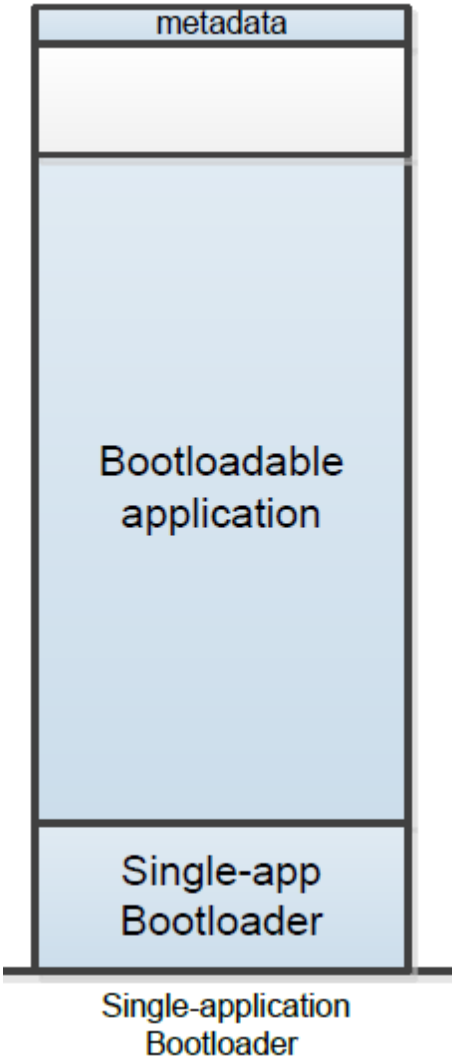
4. In case of CCS, to program NONMAIN memory area of flash, below option should be set.



7.7 PSoC4

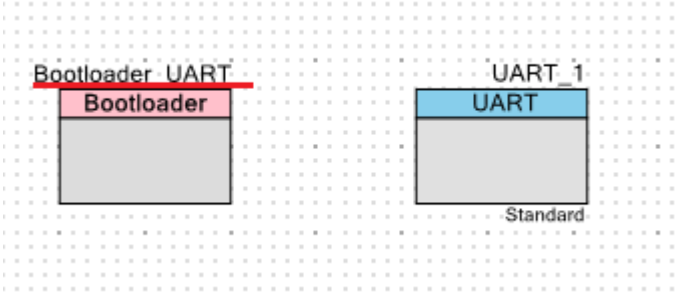
7.7.1 PSoC4 software

Single-application bootloader configuration is required for easyDSP to access onchip flash of MCU. In other configuration, easyDSP can monitor the variables but can not program flash.
Below software setting is explained based on PSoC Creator 4.4.
It is assumed that you are already familiar with bootloader and bootloadable. If not please check the manual from Infineon.

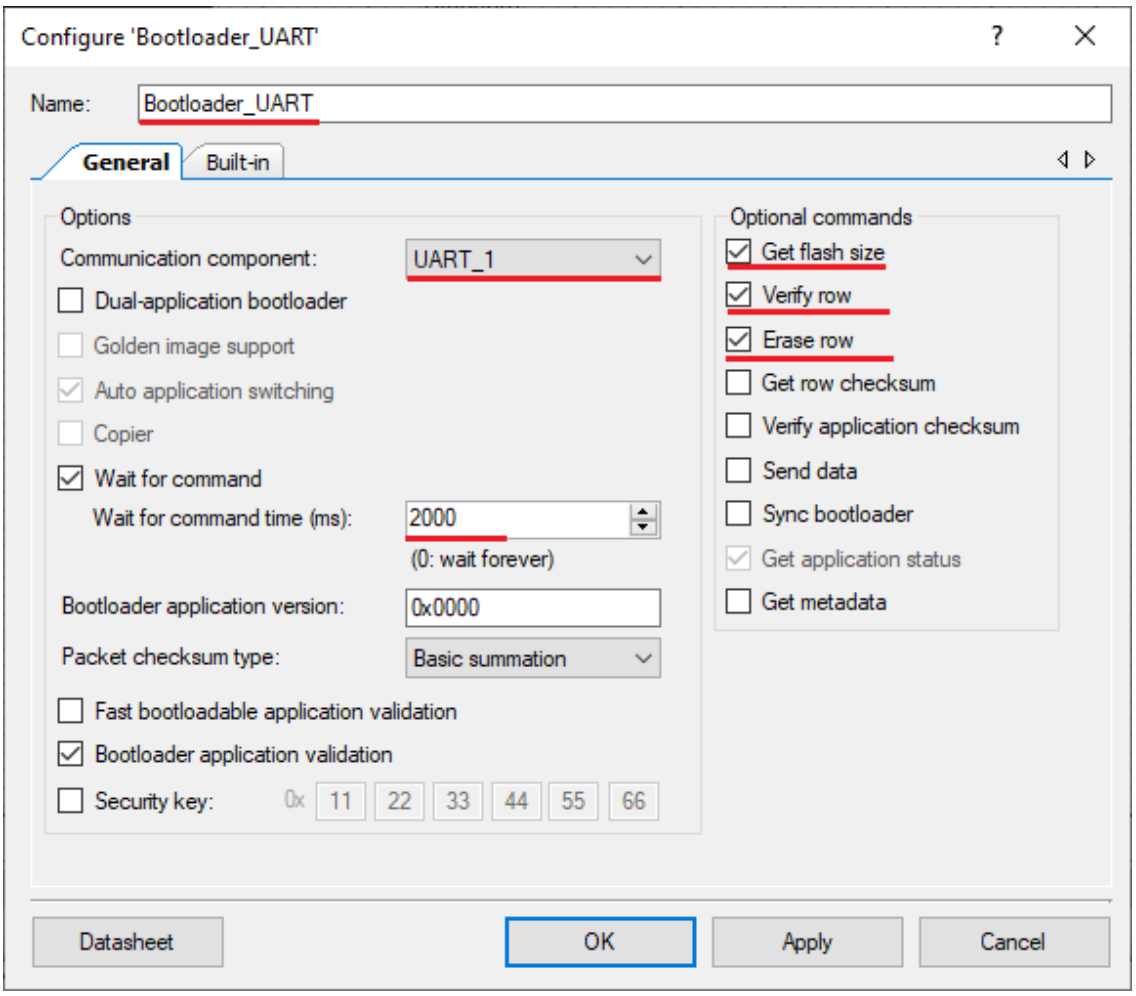


STEP 1 : Bootloader project

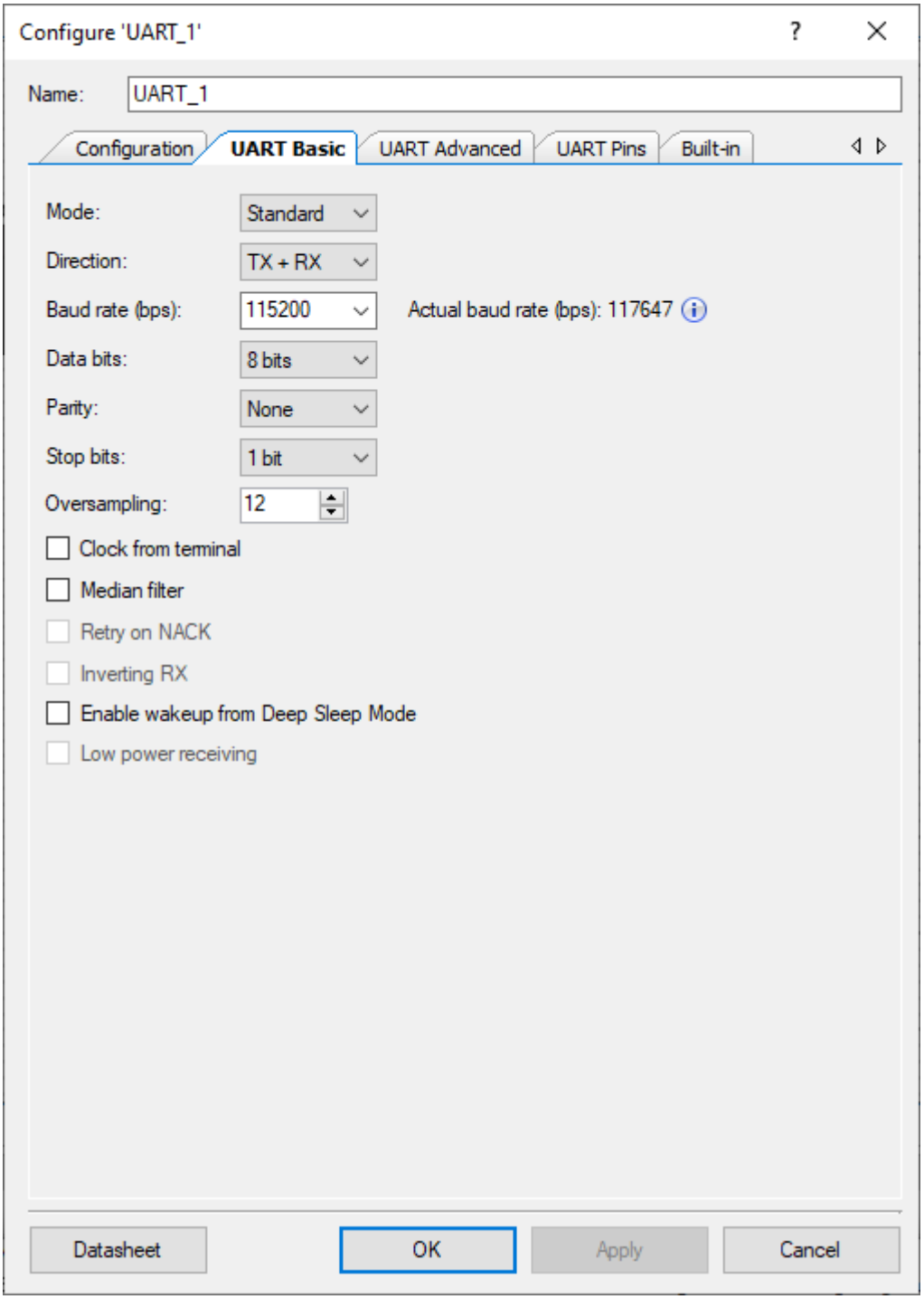
Please make a schematic as below by dragging the compoents from component catalog.
And change the name of bootloader component to Bootloader_UART.
You can add other components if necessary (ex, LED).

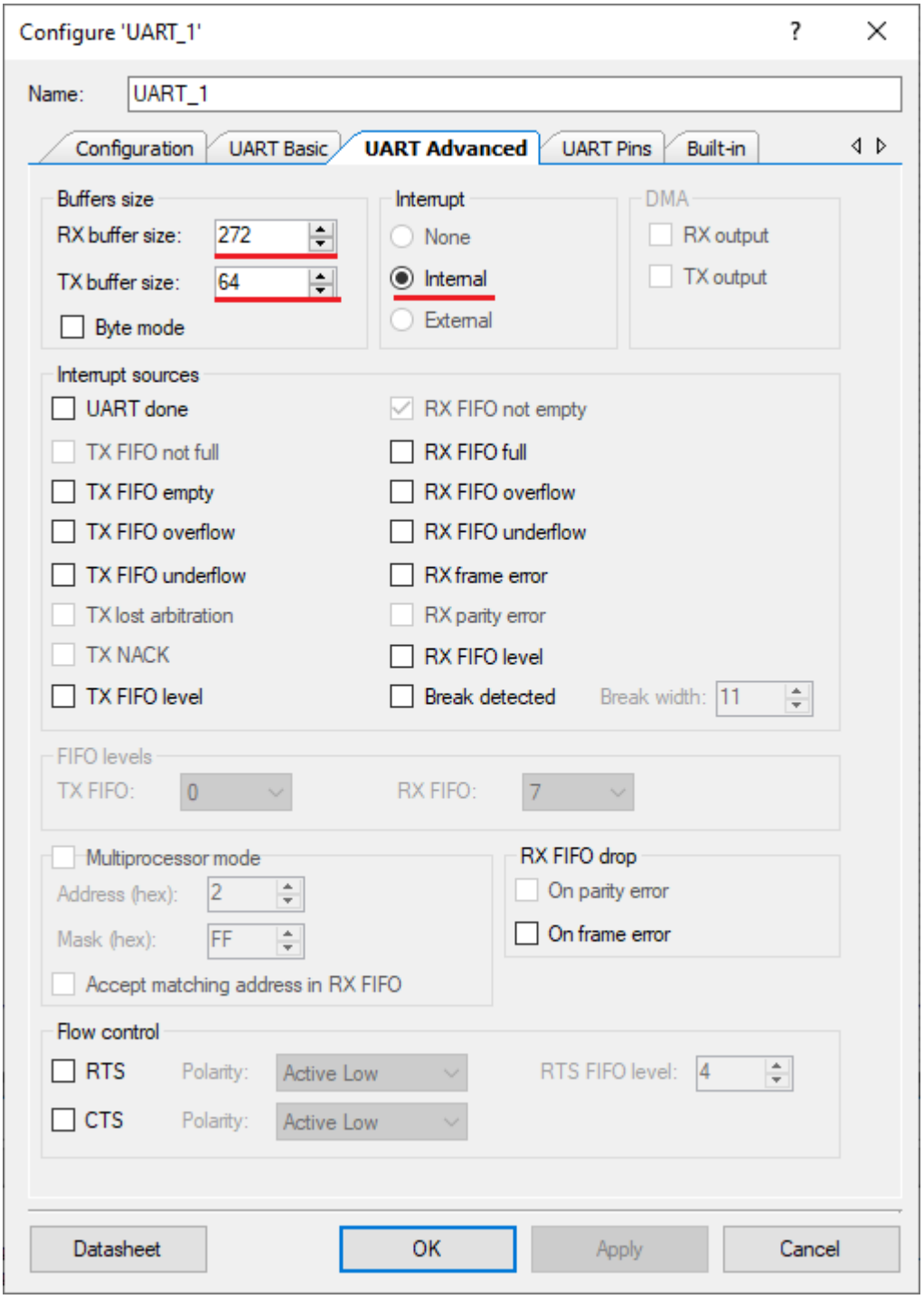


First set the 'Bootloader_UART' component as below capture. Note that 'Wait for command time' should be more than 2000ms.
If required, you can set the security key.

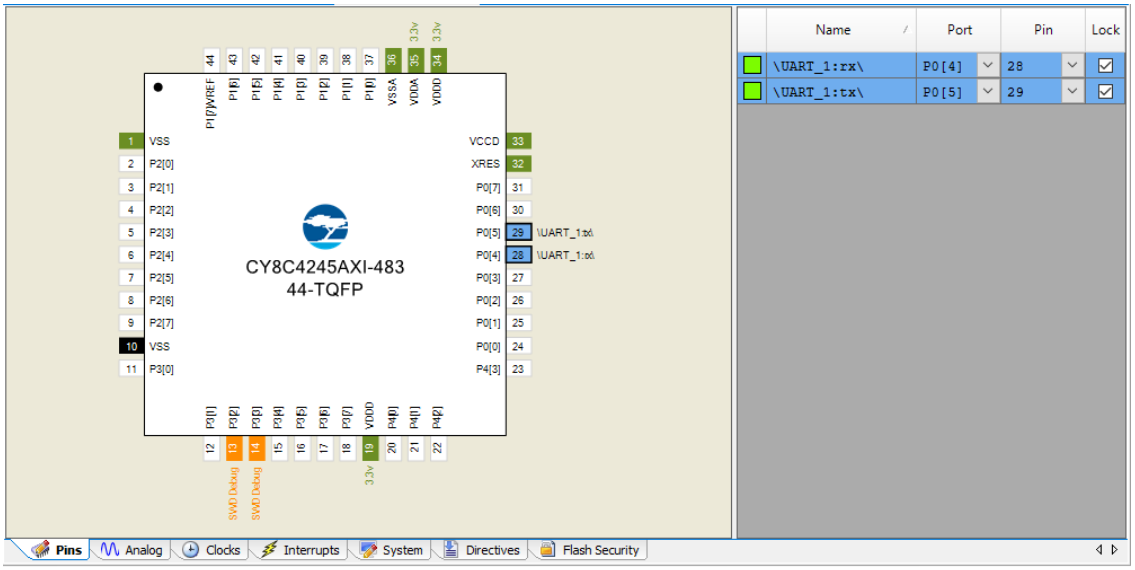


Second set the UART component as below capture. Use 'UART Basic' tab as its default. Note that 115200bps, 8bits, one stop and no parity is used.
In 'UART Advanced' tab, buffer size should be changed.


Configure 'UART_1'
Name:
UART_1
Configuration
UART Basic
UART Advanced
UART Pins
Built-in
Mode:
Standard
Direction:
TX + RX
Baud rate (bps):
115200
Actual baud rate (bps): 117647
Data bits:
8 bits
Parity:
None
Stop bits:
1 bit
Oversampling:
12
Clock from terminal
Median filter
Retry on NACK
Inverting RX
Enable wakeup from Deep Sleep Mode
Low power receiving
Datasheet
OK
Apply
Cancel



Please select UART pins according to your design. In this example, P0.4 and P0.5 are used.



Finally call Bootloader_UART_Start() function in the beginning of main().
With this, all set for bootloader project.

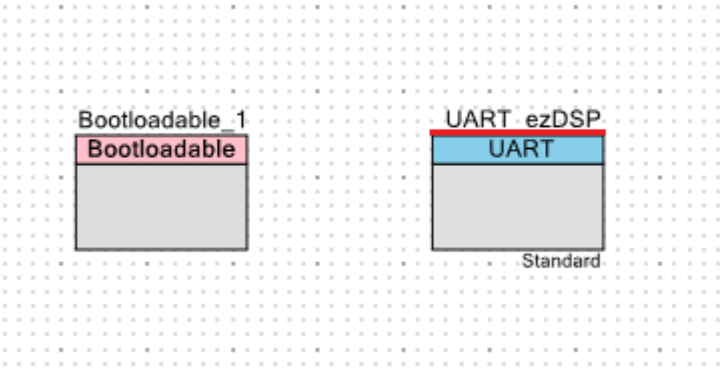
```
int main(void)
{
    Bootloader_UART_Start();
    //CyGlobalIntEnable; /* Enable global interrupts. */

    /* Place your initialization/startup code here (e.g. MyInst_Start()) */

    for(;;)
    {
        /* Place your application code here. */
    }
}
```

STEP 2 : MCU flash programming with bootloader project

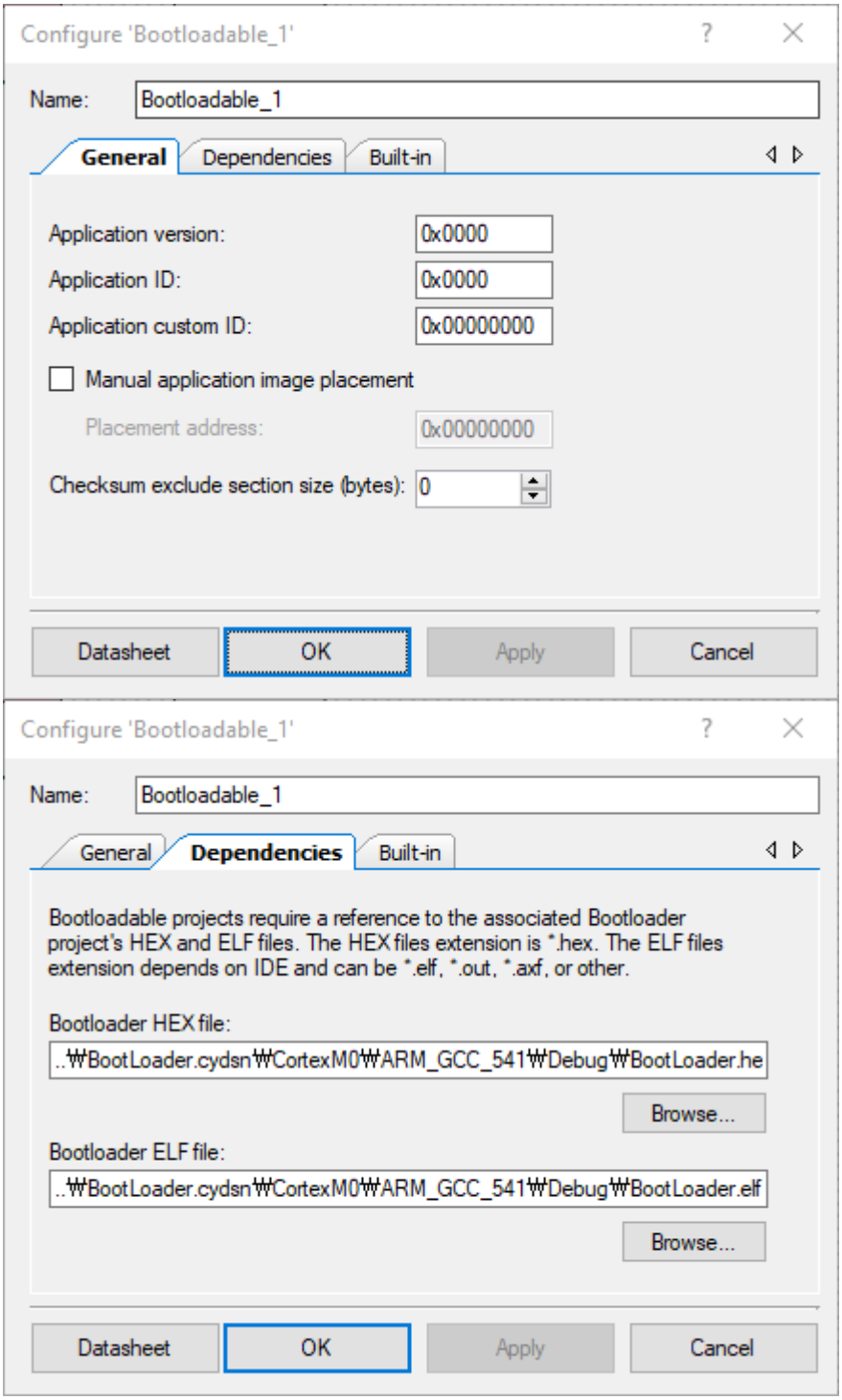
You have to program bootloader project to MCU after compiling bootloader project. If necessary, flash are for bootloader project can be protected.
easyDSP can't program the flash for bootloader project.
Once bootloader project is programmed to flash, easyDSP can program bootloadable project.

STEP 3 : Bootloadable project

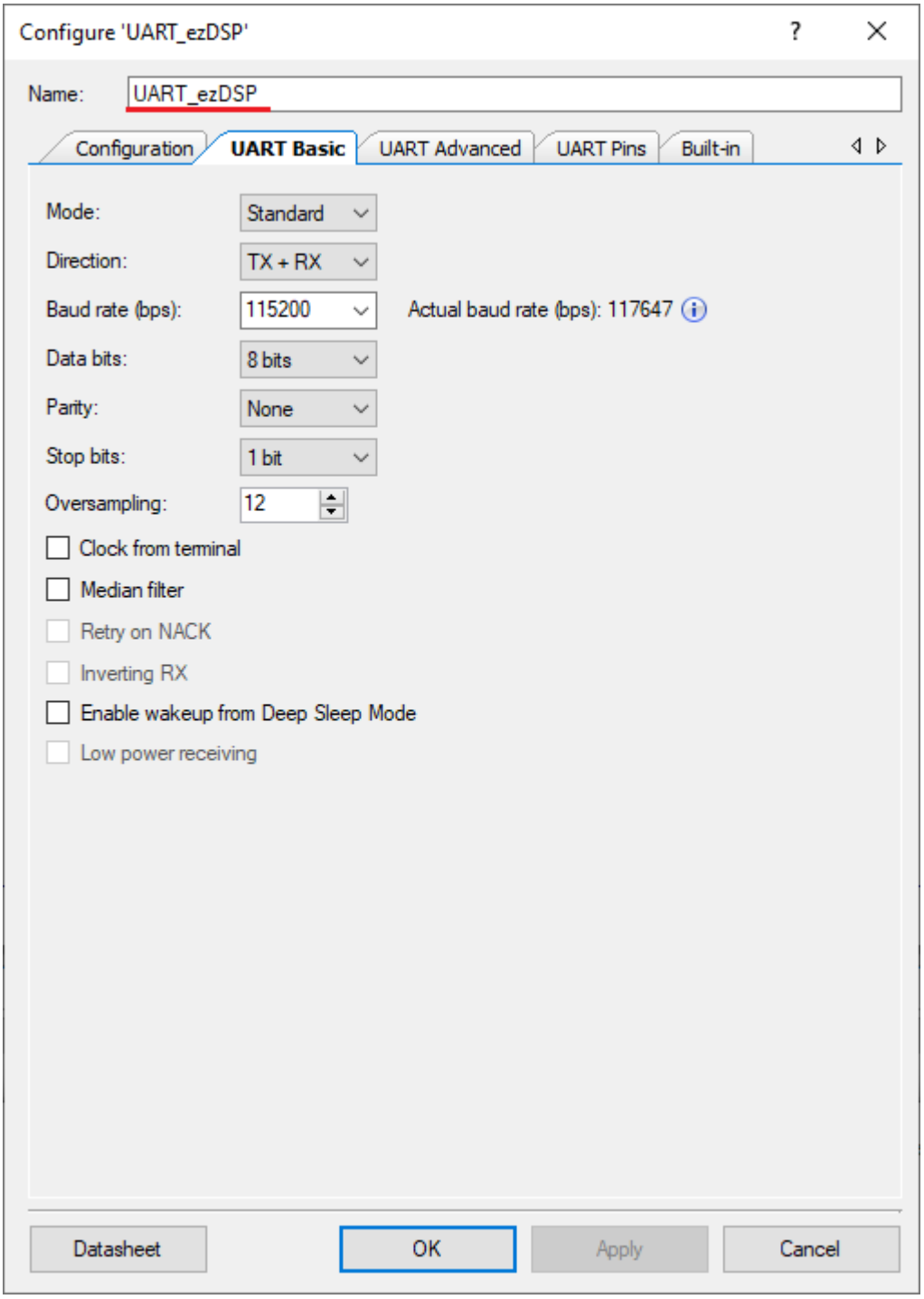
Please make the schematic like below from component catalog. Please change the name of UART component to UART_ezDSP.
You can also add other components according to your program (not shown here).

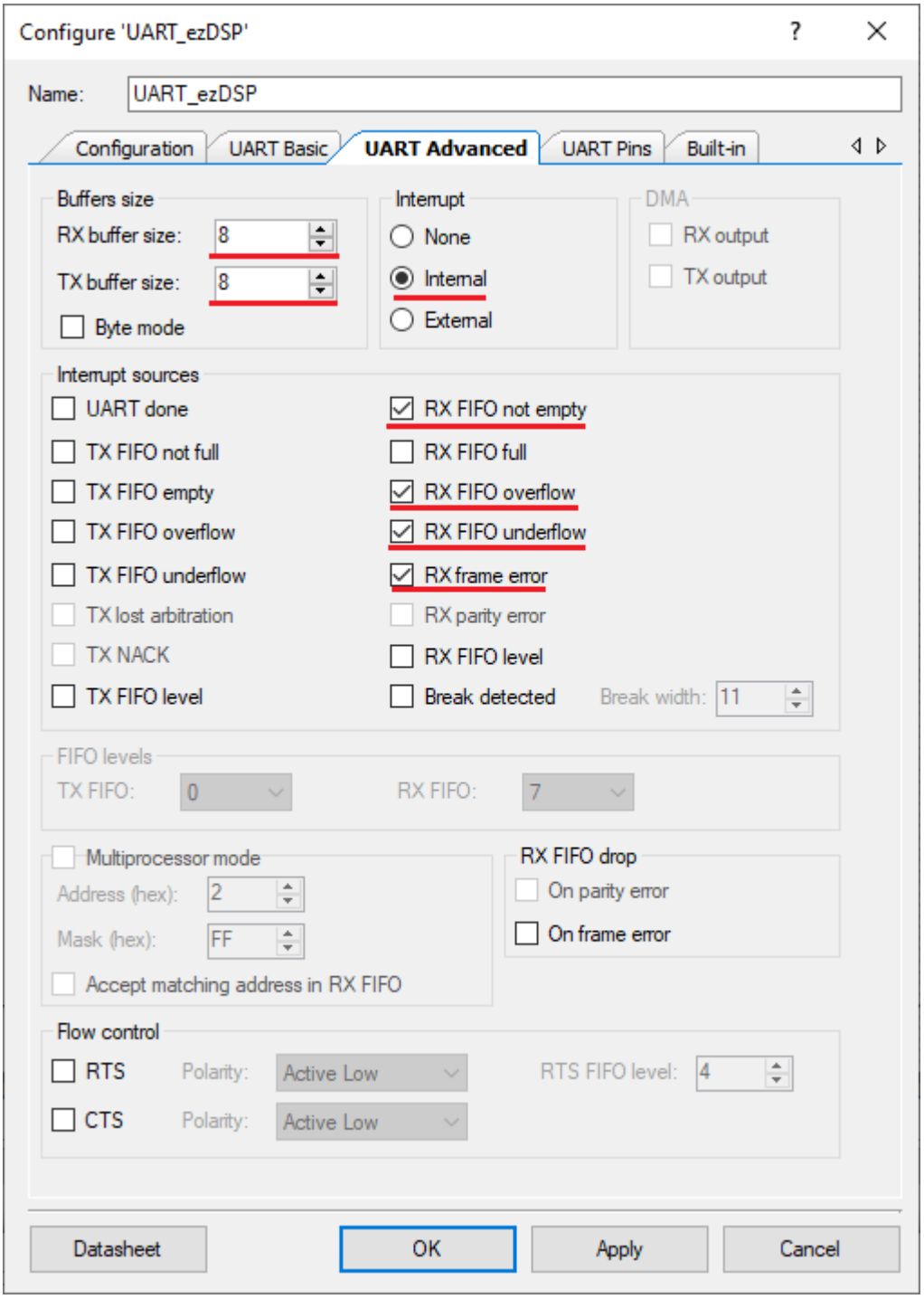


Setting of each component as below :
First for Bootloader component. Please use 'General' tab as it is. Also register Bootloader project hex or elf file to 'Dependencies' tab.

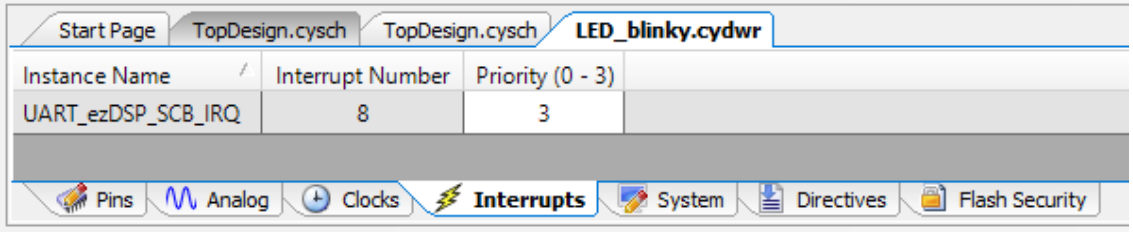


Second for UART component.
Please set the communication speed (bps) in the 'UART Basic' tab. It should be same to bps setting of easyDSP project. But it could be different from bps of bootloader project above. Also note to use 8bits, no parity, 1 bit stop bit. Also set the parameters of ' UART Advanced' tab as below.

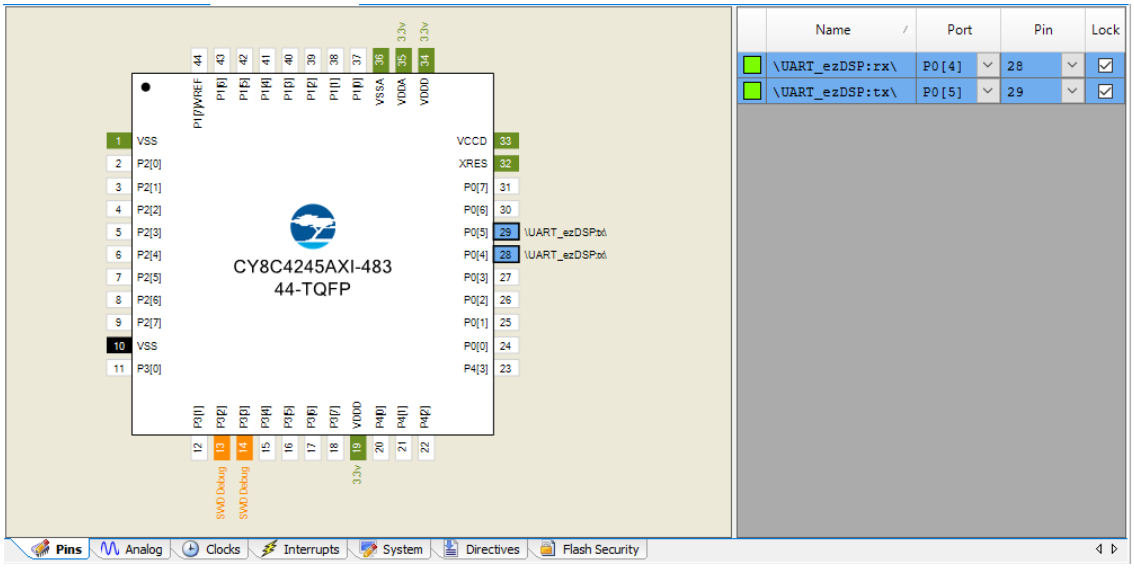

Configure 'UART_ezDSP'
Name:
UART_ezDSP
Configuration
UART Basic
UART Advanced
UART Pins
Built-in
Mode:
Standard
Direction:
TX + RX
Baud rate (bps):
115200
Actual baud rate (bps): 117647
Data bits:
8 bits
Parity:
None
Stop bits:
1 bit
Oversampling:
12
Clock from terminal
Median filter
Retry on NACK
Inverting RX
Enable wakeup from Deep Sleep Mode
Low power receiving
Datasheet
OK
Apply
Cancel



Priority of UART interrupt is recommended to be low not to interrupt higher priority interrupt routine.



UART pins should be same to pins of bootloader project. In this example, P0.4 and P0.5 are used.



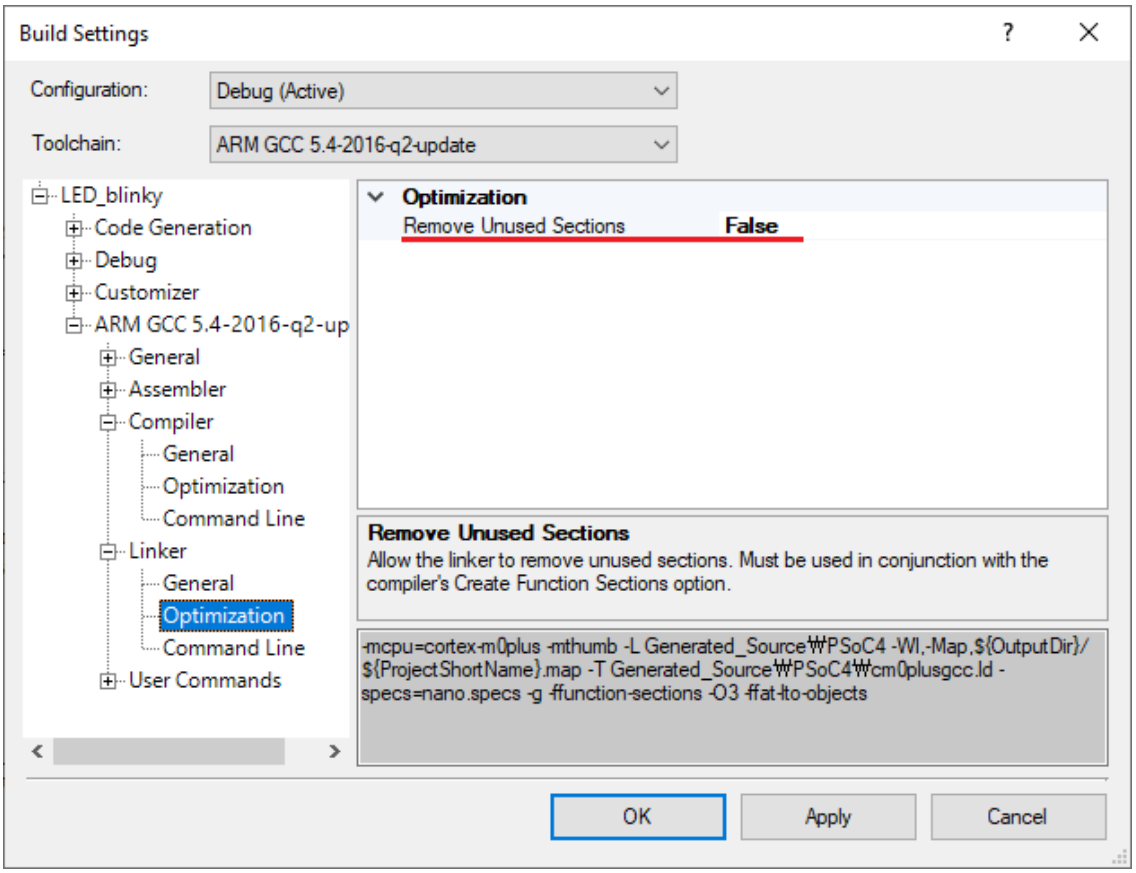
Source files (easyPSoC4.h and easyPSoC4.c) are provided for easyDSP communication. Please include them in your project. You can find them in the folder of easyDSP installation (\source\PSoC).

Finally call easyDSP_init() function in the main(). Withi this, you are ready to use easyDSP.

```
#include "project.h"
#include "easyPSoC4.h"

int main(void)
{
    CyGlobalIntEnable; /* Enable global interrupts. */

    /* Place your initialization/startup code here (e.g. MyInst_Start()) */
    easyDSP_init();

    for(;;)
    {
        /* Place your application code here. */
    }
}
```

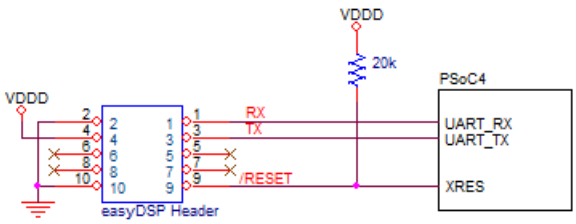
STEP 4 : IDE setting

1. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
2. *.cyacd file is used for flash programming. So it should exist in the same folder to output file.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in PSoC4 creator, set the 'Remove Unused Sections' false.



7.7.2 PSoC4 hardware

Please connect easyDSP header RX and TX pin to the selected UART pins of MCU.
Also connect easyDSP header #4 pin to VDDD.
RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.



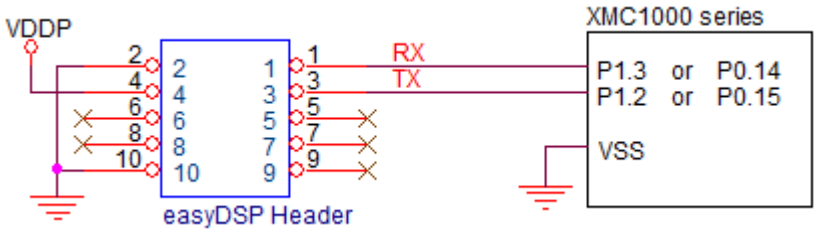
- In case there is a reset IC between easyDSP /RESET and MCU XRES, it should transfer easyDSP /RESET signal to MCU XRES within 0.5sec.
- In case pullup resistor is attached, resistor value should be higher than several k Ohm.

7.8 XMC1

STEP 1 : Hardware

Please connect easyDSP header RX and TX pins to directly UART pins (either P1.3/P1.2 or P0.14/P0.15 pair).
RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.

Also connect easyDSP header #4 pin to VDDP.



STEP 2 : Modification of easyXMC1.h file

Two files are provided for easyDSP communication (easyXMC1.h and easyXMC1.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\XMC).
Since XMC Peripheral Library is used in the files, this library should be included in your project.

And modify easyXMC1.h file according to your target USIC channel and baudrate.
The baud rate should be same to that of easyDSP project.

Also allocate 8 receive FIFO buffer and 8 transmit FIFO buffer to the channel of USIC easyDSP uses while avoiding conflict to FIFO buffer of the other channel of USIC module.

```
////////////////////////////////////////////////
// Select channel (0 or 1) of USIC0 :
// define 1 to target channel. 0 to another.
////////////////////////////////////////////////
#define USE_USIC0_CH0       0       // use USIC0 channel 0 with pins P0.14 + P0.15
#define USE_USIC0_CH1       1       // use USIC0 channel 1 with pins P1.3 + P1.2

////////////////////////////////////////////////
// Set UART configuration
////////////////////////////////////////////////
#define EZ_BUAD_RATE        230400U     // baud rate for UART communication for easyDSP
#define EZ_TX_BUFFER_START  0           // FIFO Buffer Partitioning for channel 0 of USIC0.
#define EZ_RX_BUFFER_START  8           // FIFO Buffer Partitioning for channel 0 of USIC0.
```

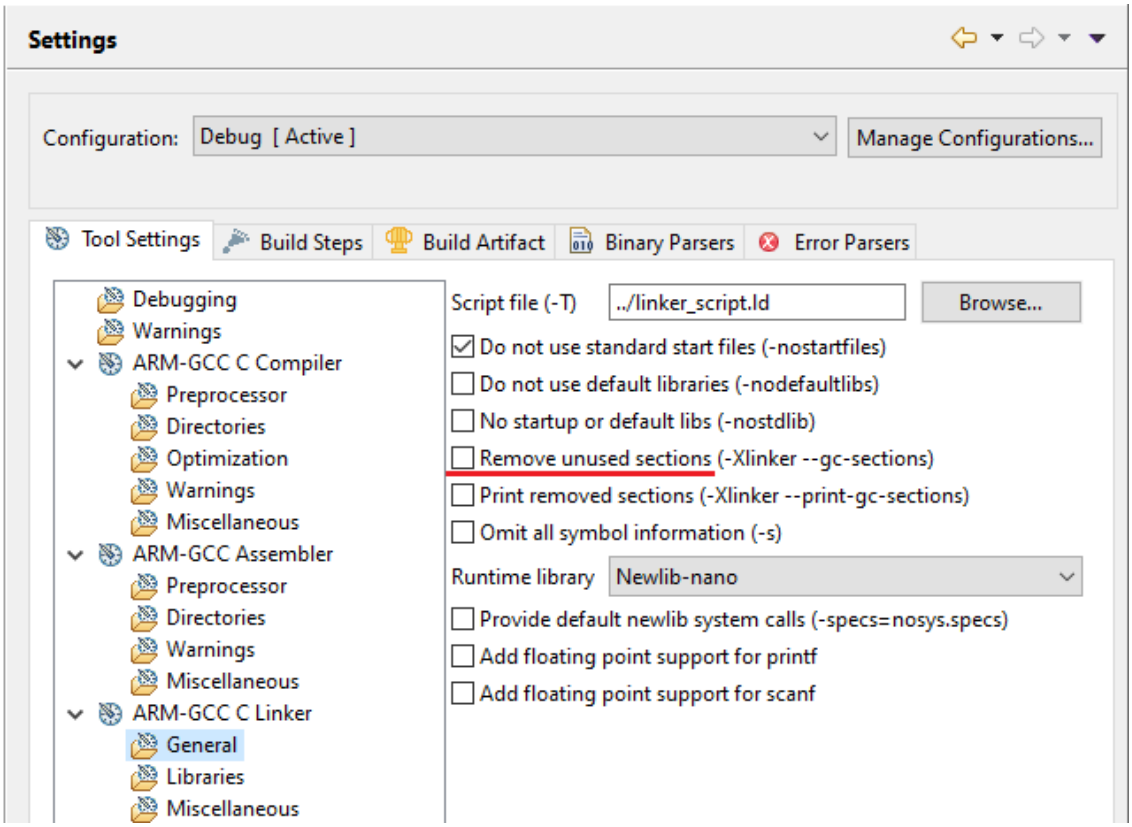
STEP 3 : Calling easyDSP_init()

Pleae include easyXMC1.h in the top of main.c and call easyDSP_init() in the main().

```
#include "easyXMC1.h"

int main(void)
{




    easyDSP_init();

    while(1);
}
```

STEP 4 : IDE setting

1. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
2. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in the Dave, set the 'Remove Unused Sections' unclicked.



7.9 XMC4

STEP 1 : Hardware

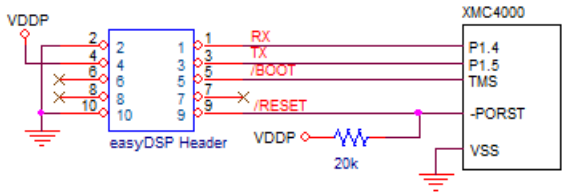
When XMC4 encounters Power On Reset (PORST) as the reset type, it gets to choose from one of four boot modes based on what is read off the boot pins (JTAG TCK and TMS).

TCK	TMS	Boot mode
0	1	Normal
0	0	ASC BSL
1	1	BMI
1	0	CAN BSL

Since the easyDSP supports only two boot modes (Normal and ASC BSL), TCK pin should be low (0) and TMS pin should be selectable (0 or 1) by easyDSP -BOOT pin during power on reset.
Internally to MCU, TCK pin has weak pull-down and TMS pin has weak pull-up. So, external pull down/up resistor is optional.

Please connect easyDSP header RX and TX pins to directly P1.4 and P1.5 respectively.
Connection to other UART pins than P1.4 and P1.5 will bring no operation.
RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.

Also connect easyDSP header #4 pin to VDDP.



Other considerations :
- In case there is a reset IC between easyDSP /RESET and MCU -PORST, it should transfer easyDSP /RESET signal to MCU -PORST within 0.5sec.
- In case pull-up resistor is attached, resistor value should be higher than several k Ohm.

STEP 2 : Modification of easyXMC4.h file

Two files are provided for easyDSP communication (easyXMC4.h and easyXMC4.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\XMC).
Since XMC Peripheral Library is used in the files, this library should be included in your project.

And modify easyXMC4.h file according to your target MCU and easyDSP communication baudrate. The baud rate should be same to that of easyDSP project.

Also allocate 8 receive FIFO buffer and 8 transmit FIFO buffer to the channel of USIC easyDSP uses while avoiding conflict to FIFO buffer of the other channel of USIC module.

```
////////////////////////////////////////////////
// Select other configuration
////////////////////////////////////////////////

#define EZ_BUAD_RATE        230400U     // baud rate for UART communication for easyDSP
#define EZ_TX_BUFFER_START  0           // FIFO Buffer Partitioning for channel 0 of USIC0.
#define EZ_RX_BUFFER_START  8           // FIFO Buffer Partitioning for channel 0 of USIC0.
```

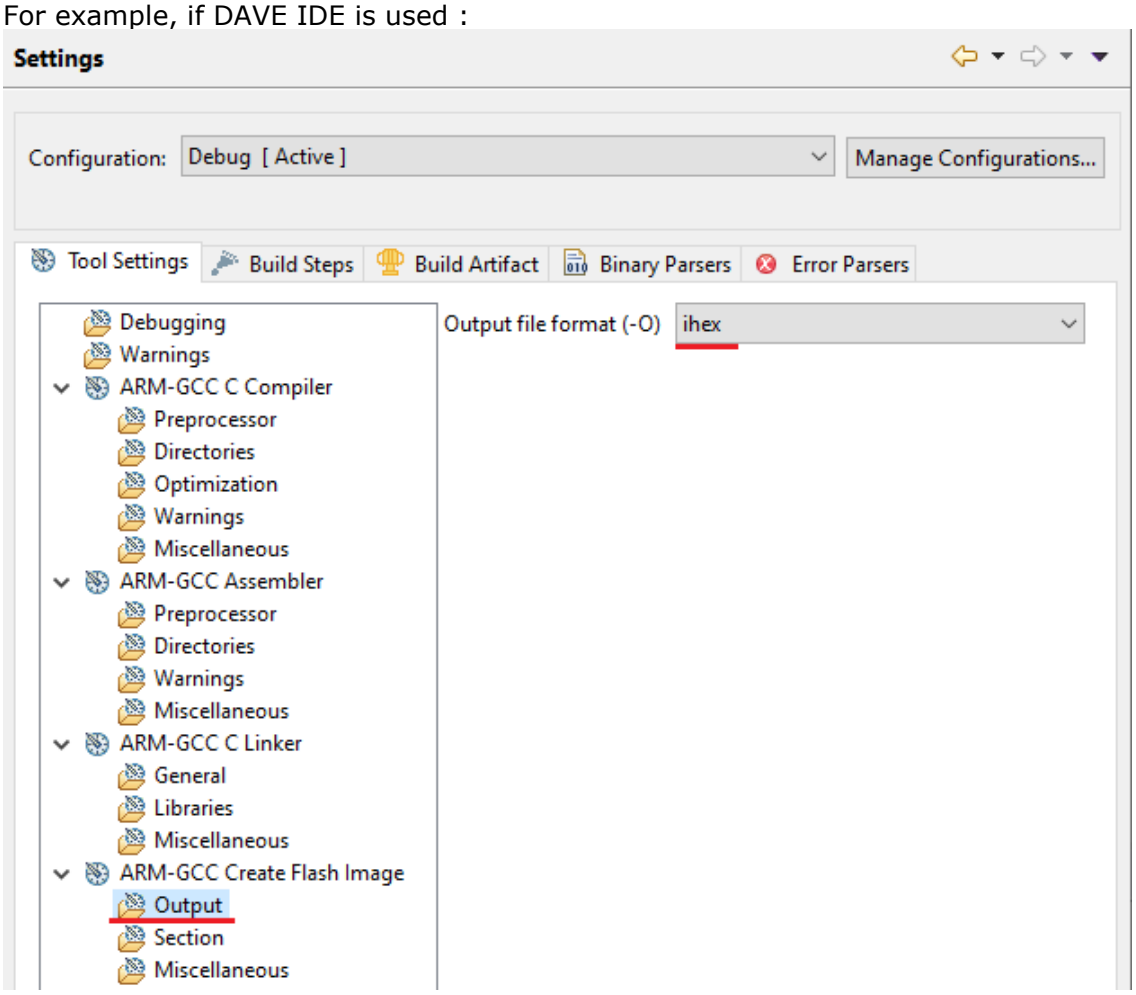
STEP 3 : Calling easyDSP_init()

Pleae include easyXMC4.h in the top of main.c and call easyDSP_init() in the main().

```
#include "easyXMC4.h"

int main(void) {



    easyDSP_init();

    /* Infinite loop */
    for(;;) {
    }
}
```

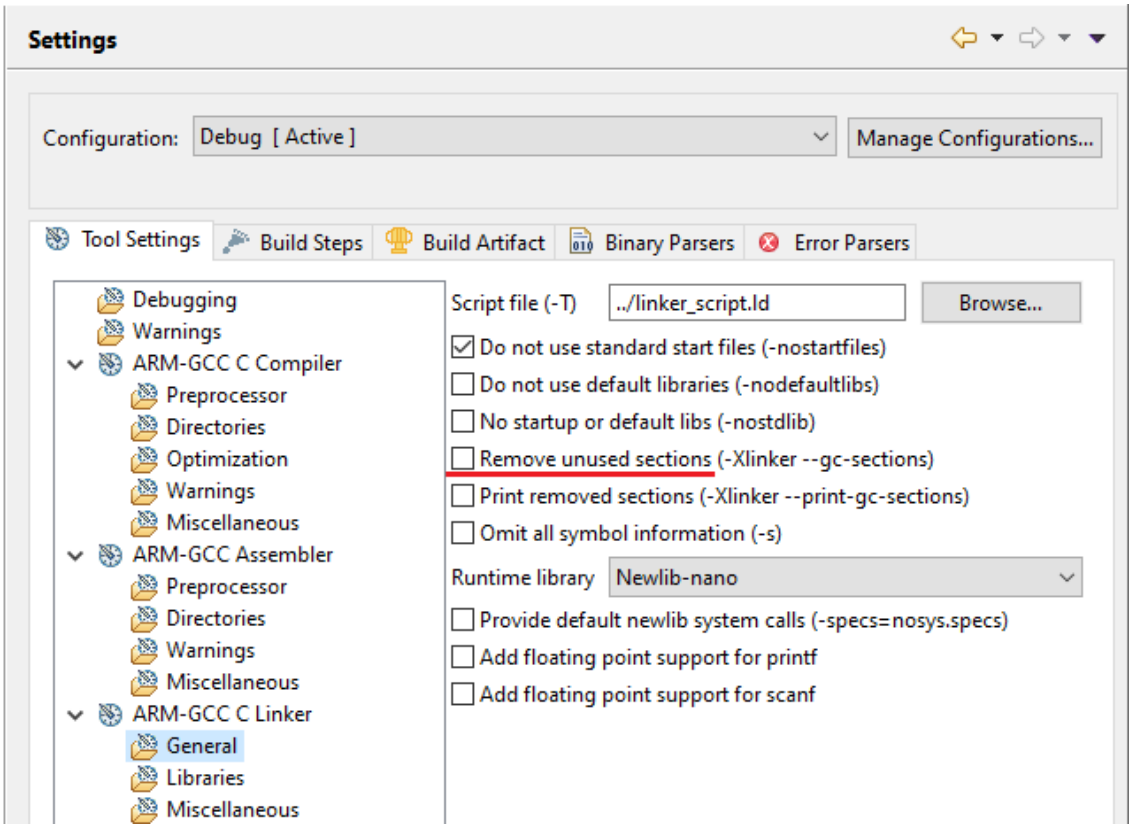
STEP 4 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file (ex *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compilation.
For example, if DAVE IDE is used :



2. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's

optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in the Dave, set the 'Remove Unused Sections' unclicked.

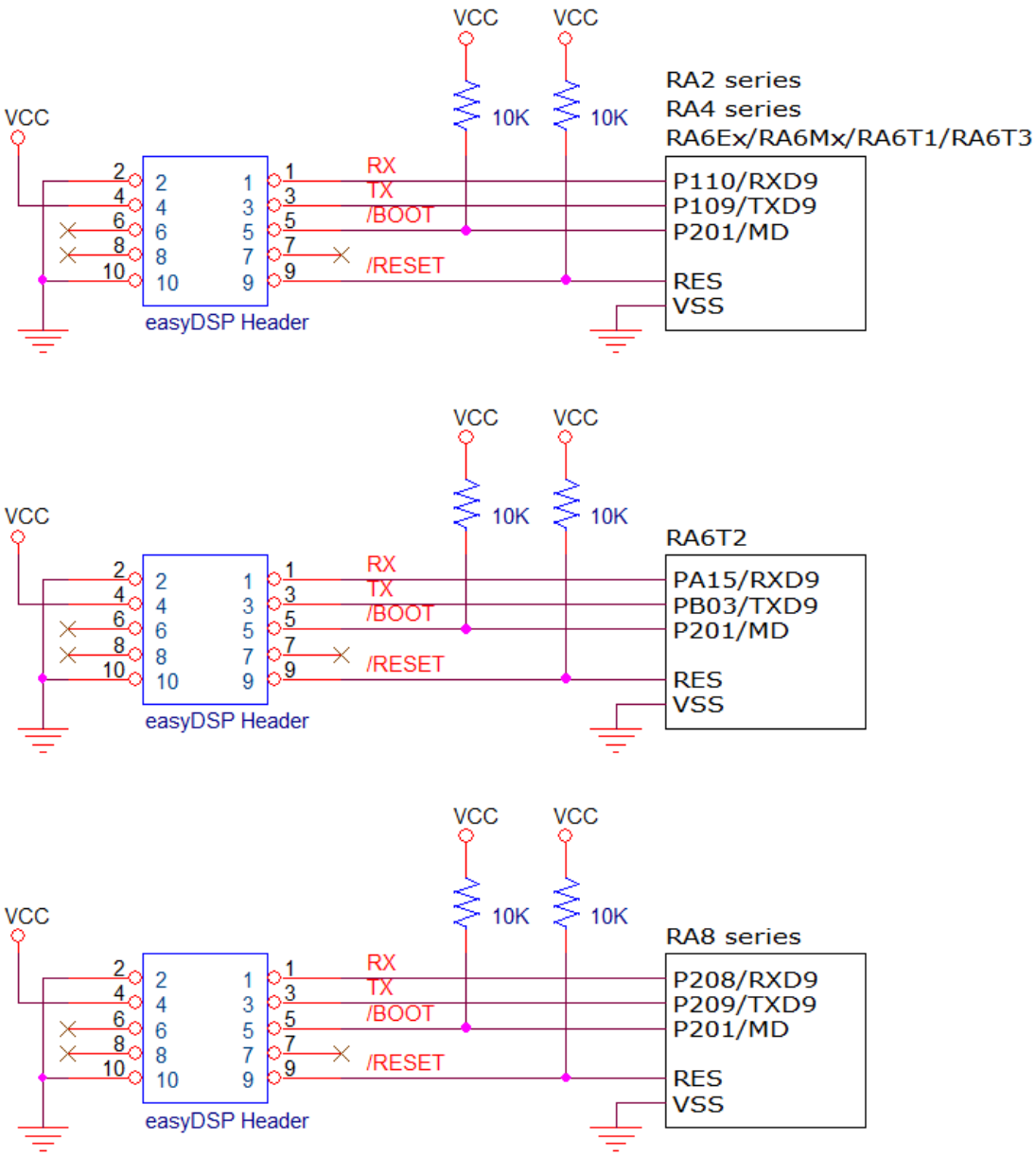


7.10 RA

7.10.1 RA hardware

Connection to easyDSP

Direct connection of SCI9 RXD9 and TXD9 of MCU to easyDSP pod is recommended. Please note that SCI9 should be used to program flash by easyDSP.
RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.
Also connect easyDSP header #4 pin to VCC.
Other considerations :
- In case there is a reset IC between easyDSP /RESET and MCU RES, it should transfer easyDSP /RESET signal to MCU RES within 0.5sec.
- In case pull-up resistor is required, resistor value should be higher than several k Ohm.



In case you can't use SCI9, you can use the other SCI channel but only monitoring is available (flash programming not feasible). In this case let /BOOT and /RESET pins be open.

Compatibility to Debugger

easyDSP uses RXD9 and TXD9 pin of MCU which overlaps with some debugger pins such as JTAG TDO, JTAG TDI and SWD SWO in case of some of RA4, RA6 and RA8 MCU. Therefore, in this case, you have to use SWD without SWO.

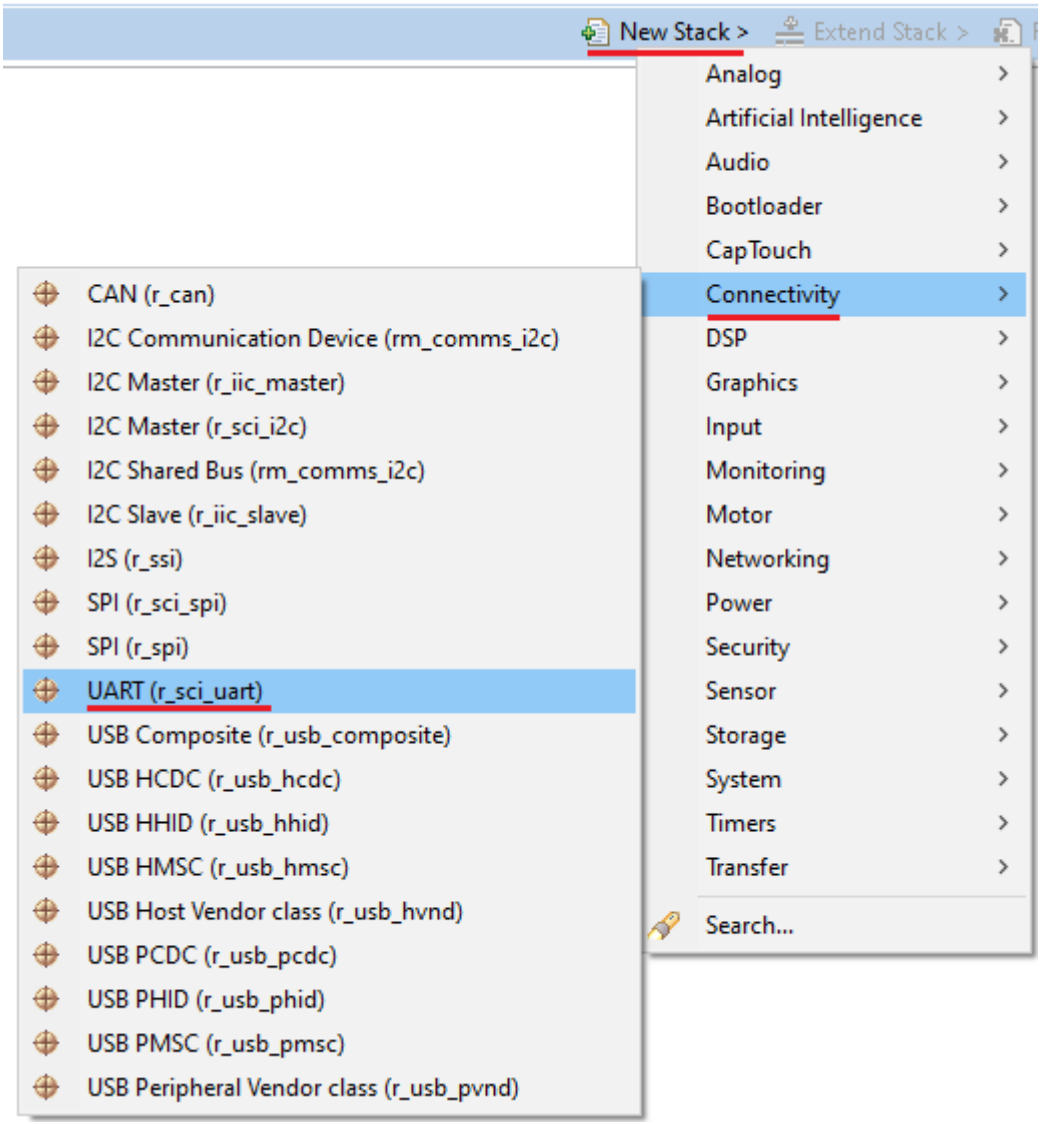
7.10.2 RA sofrware

RA software (excluding RA0)

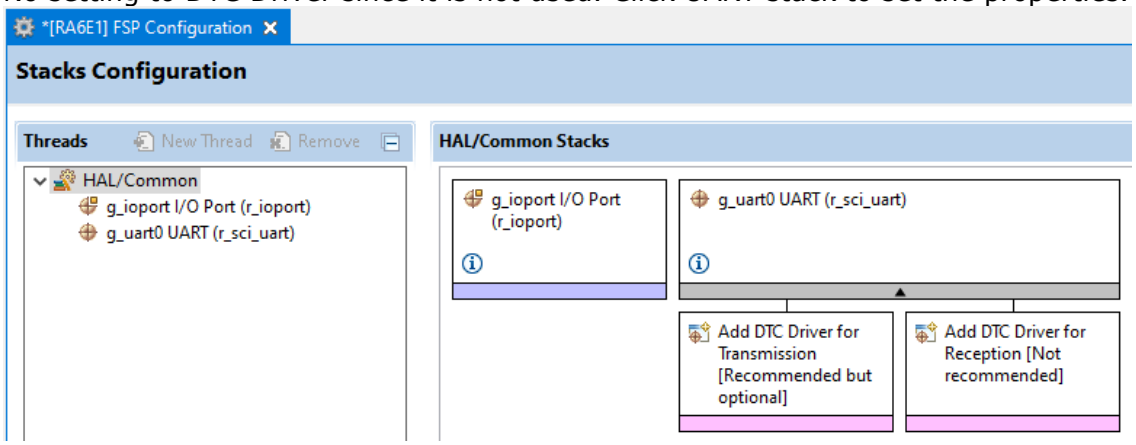
easyDSP provides the source file for its communication based on FSP(Flexible Software Package). Hereafter, FSP setting will be explained based on version 3.5.0.

STEP 1 : FSP setting

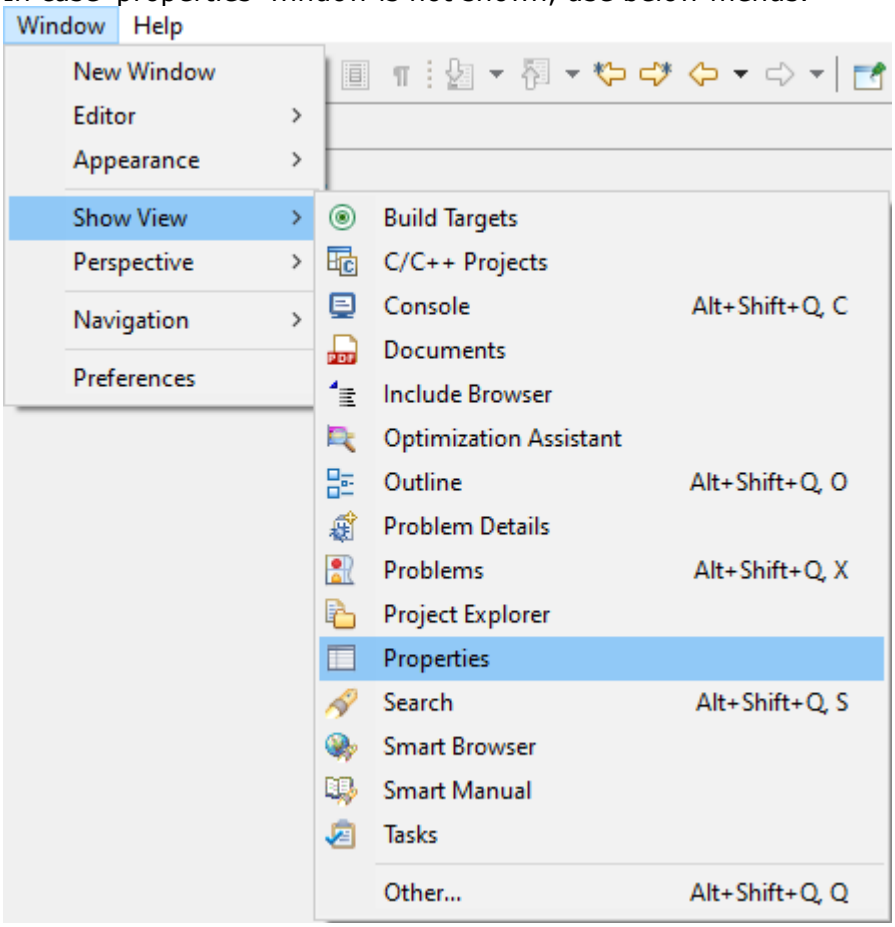
First, activate FSP by clicking 'configuration.xml' file.
Then go to the Stacks tab and generate UART stack. Depending on MCU type, either r_sci_uart or r_sci_b_uart module should be used.



No setting to DTC Driver since it is not used. Click UART stack to set the properties.

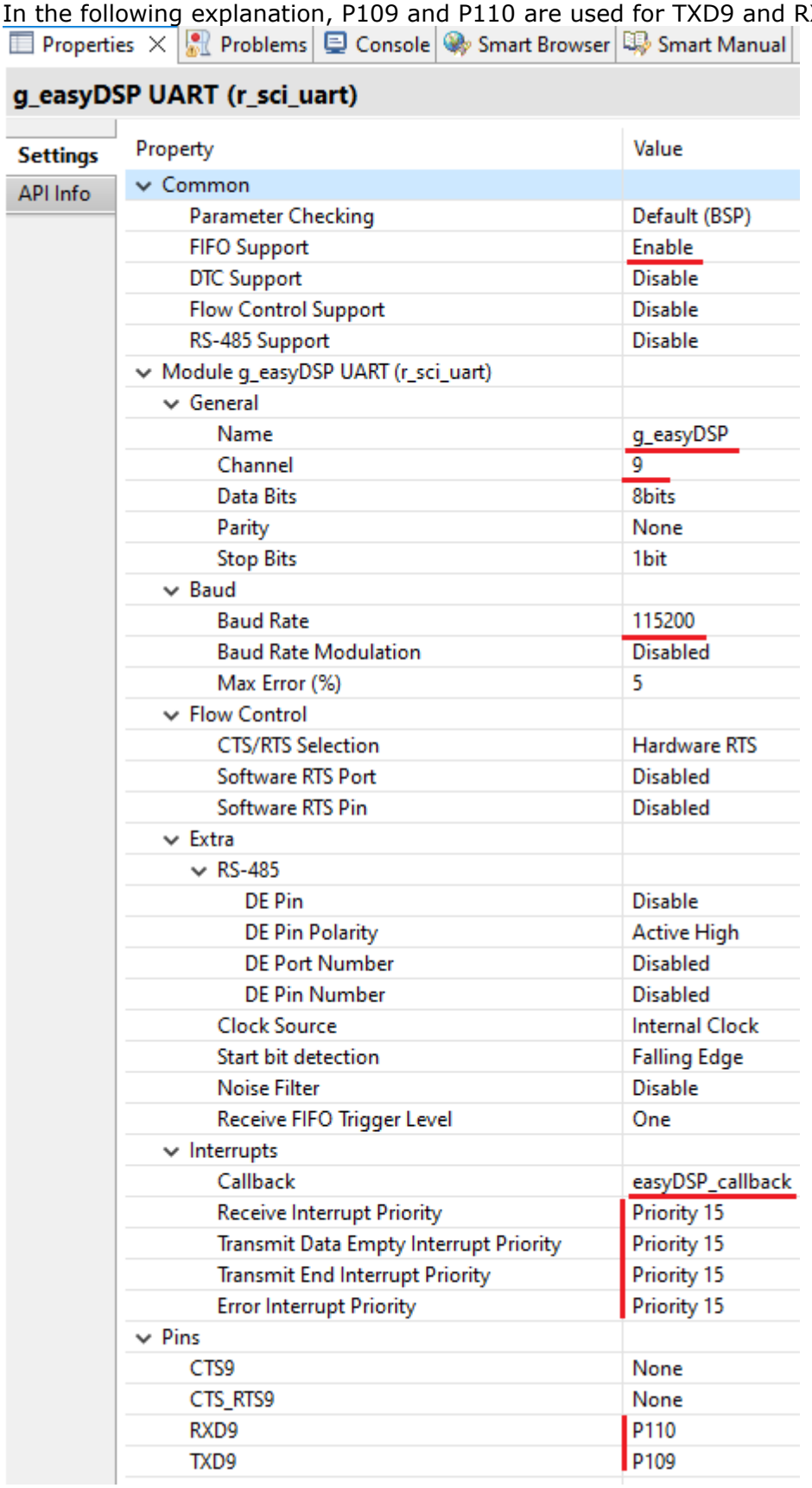


In case 'properties' window is not shown, use below menus.



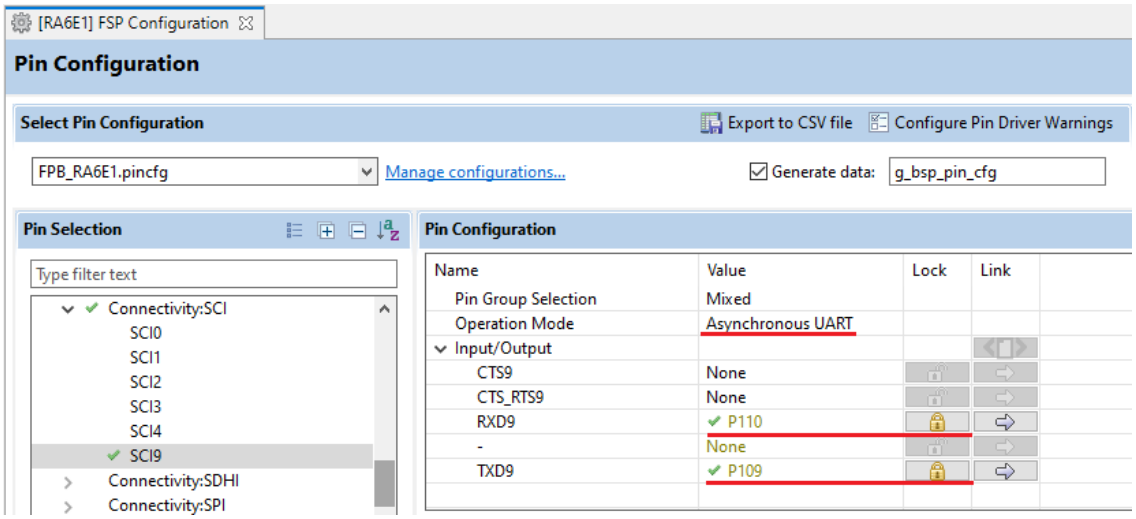
All the necessary change is shown in red at below picture :
First, enable FIFO if target MCU supports FIFO for this SCI channel.
Also, change its module name to 'g_easyDSP'. And set the channel # to 9 in order to use SCI9 and select baud rate properly. Later in your easyDSP projec setting, the same baudrate should be used.
Then change callback name to 'easyDSP_callback' and set its intterupt priority to lowest one.
TXD9 and RXD9 pins should be selected according to hardware setting (check RA hardware setting) .

In the following explanation, P109 and P110 are used for TXD9 and RXD9 respectively .

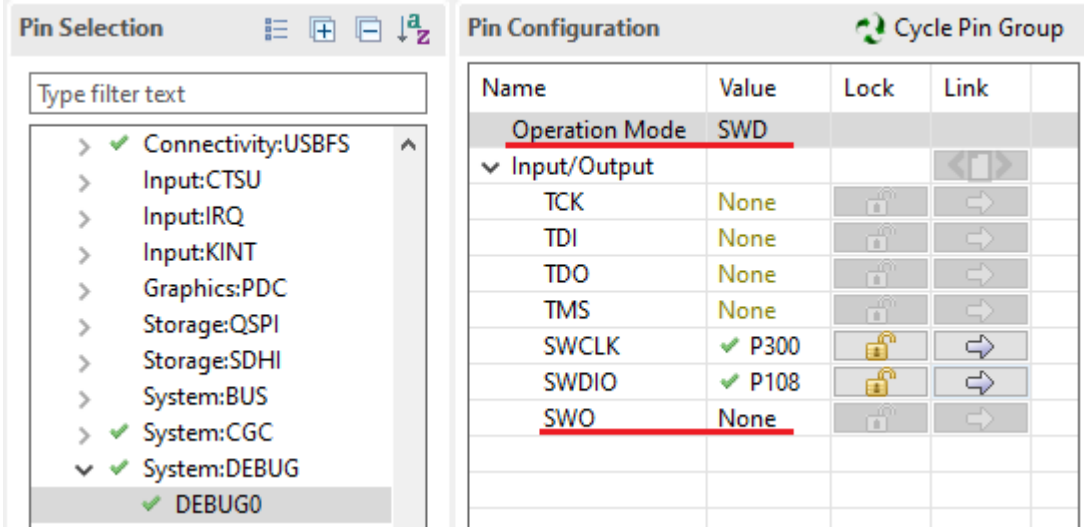


Property	Value
Common	
Parameter Checking	Default (BSP)
FIFO Support	Enable
DTC Support	Disable
Flow Control Support	Disable
RS-485 Support	Disable
Module g_easyDSP UART (r_sci_uart)	
General	
Name	g_easyDSP
Channel	9
Data Bits	8bits
Parity	None
Stop Bits	1bit
Baud	
Baud Rate	115200
Baud Rate Modulation	Disabled
Max Error (%)	5
Flow Control	
CTS/RTS Selection	Hardware RTS
Software RTS Port	Disabled
Software RTS Pin	Disabled
Extra	
RS-485	
DE Pin	Disable
DE Pin Polarity	Active High
DE Port Number	Disabled
DE Pin Number	Disabled
Clock Source	Internal Clock
Start bit detection	Falling Edge
Noise Filter	Disable
Receive FIFO Trigger Level	One
Interrupts	
Callback	easyDSP_callback
Receive Interrupt Priority	Priority 15
Transmit Data Empty Interrupt Priority	Priority 15
Transmit End Interrupt Priority	Priority 15
Error Interrupt Priority	Priority 15
Pins	
CTS9	None
CTS_RTS9	None
RXD9	P110
TXD9	P109

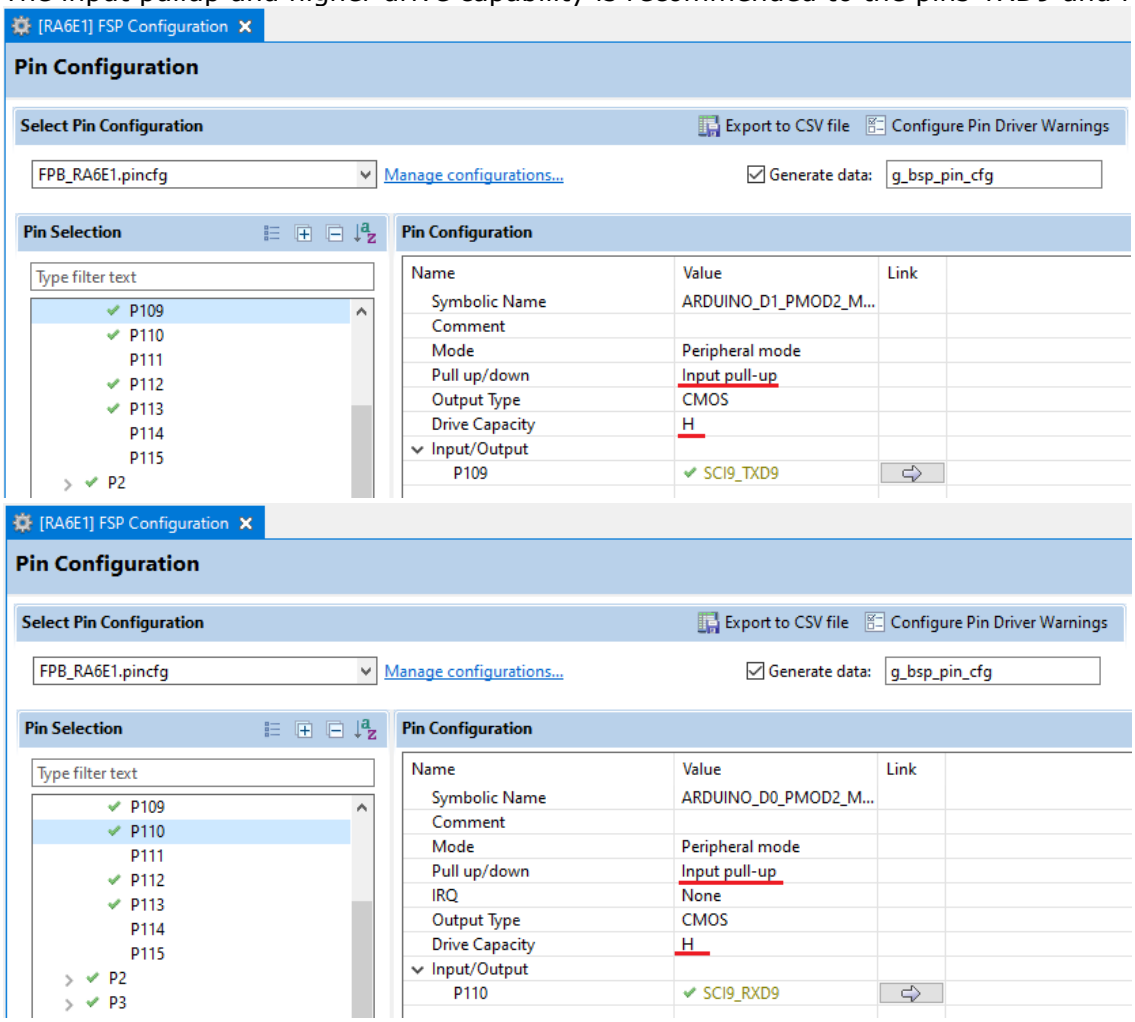
Move to Pins tab and set the pin configuration so that the operation Mode is 'Asyncronous UART' and TXD9 is P109 and RXD9 is P110.



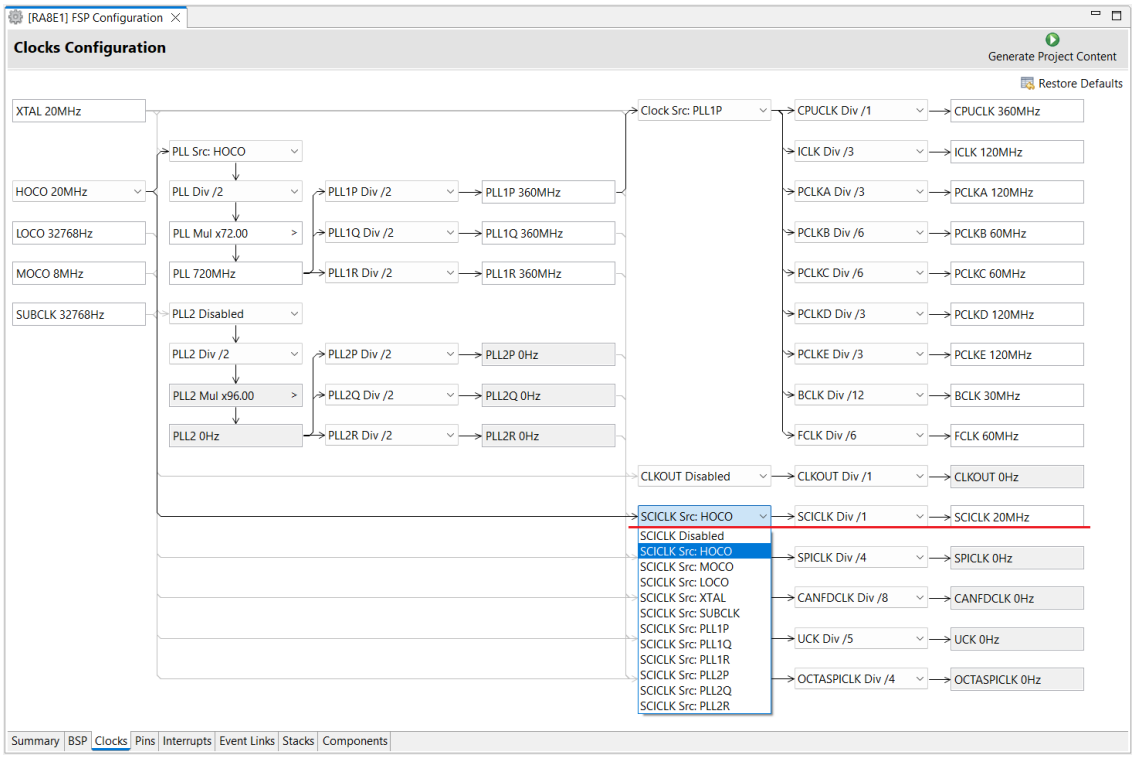
In case of some RA4, RA6 and RA8 MCU series, TXD9 and RXD9 overlaps with some debugger pins. Please set the debugger operation mode to SWD without SWO use.



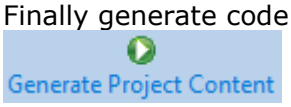
The input pullup and higher drive capability is recommended to the pins TXD9 and RXD9.



some MCUs (for example, RA8E1) can enable/disable the clock input to SCI. In this case, the clock should be enabled in the 'Clocks' tab.



Finally generate code.



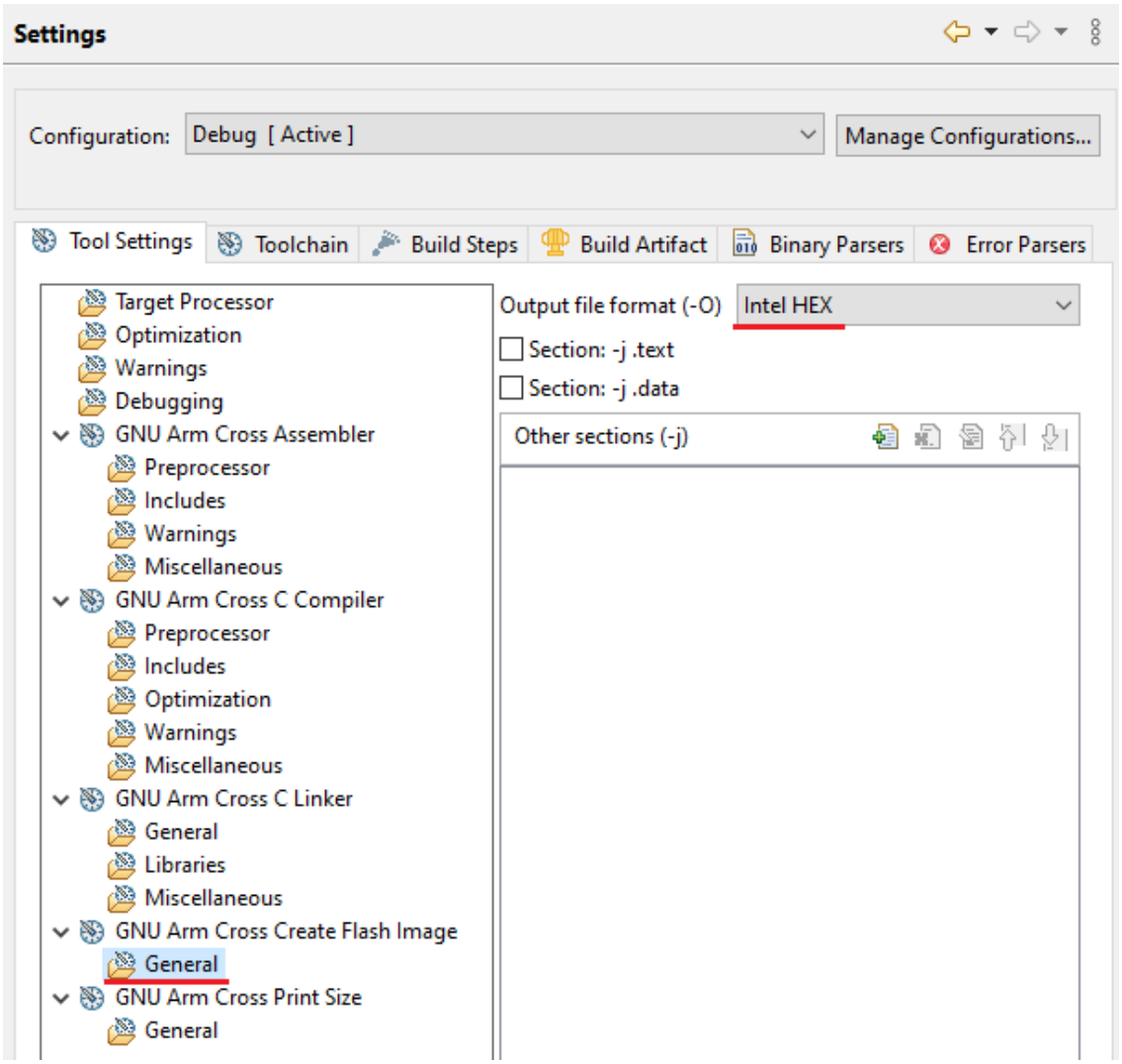
STEP 2 : Calling easyDSP_init()

Two files are provided for easyDSP communication (easyRA_v11.4.h and easyRA_v11.4.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\RA). Pleae include easyRA_v11.4.h in the hal_entry.c and call easyDSP_init() function.

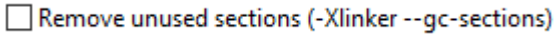
```
#include "easyRA_v11.4.h"

void hal_entry(void)
{

    .
    .
    .
    .
    .
    .

    easyDSP_init();
}
```

STEP 3 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file (ex *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compilation.
For example, if you use e2 studio IDE :



2. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker option. If necessary, you can set the linker option so that the unused variables are not excluded. For example, in the e2Studio, set the 'Remove Unused Sections' unclicked.



7.10.3 RA0

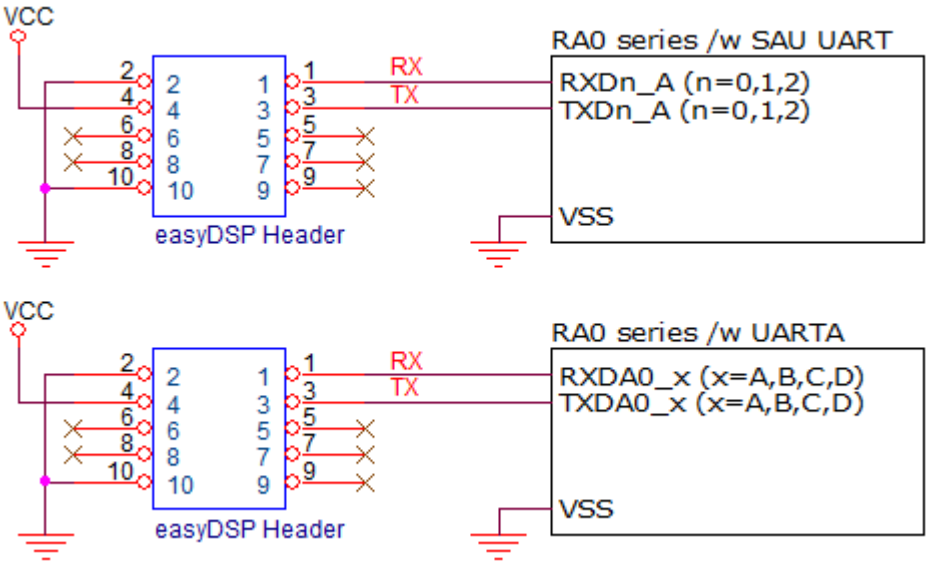
Connection to easyDSP

You can use either SAU or UARTA for easyDSP communication.

RX and TX pins of easyDSP pod are connected to MCU directl.

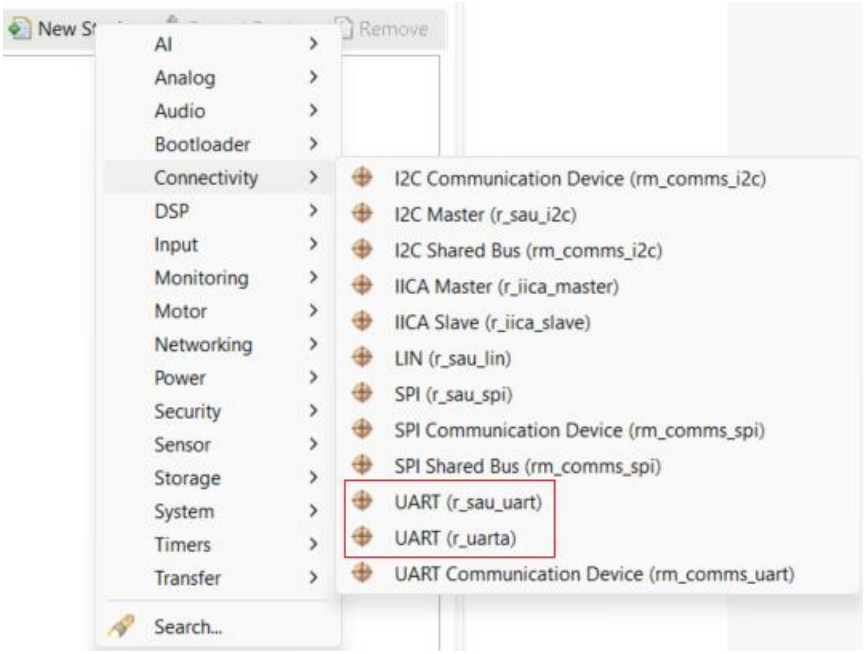
No other connection is required since the flash programming is not supported for RA0 series.

RX and TX pins of easyDSP pod are pulled up with 100kOhm resistor in the pod.

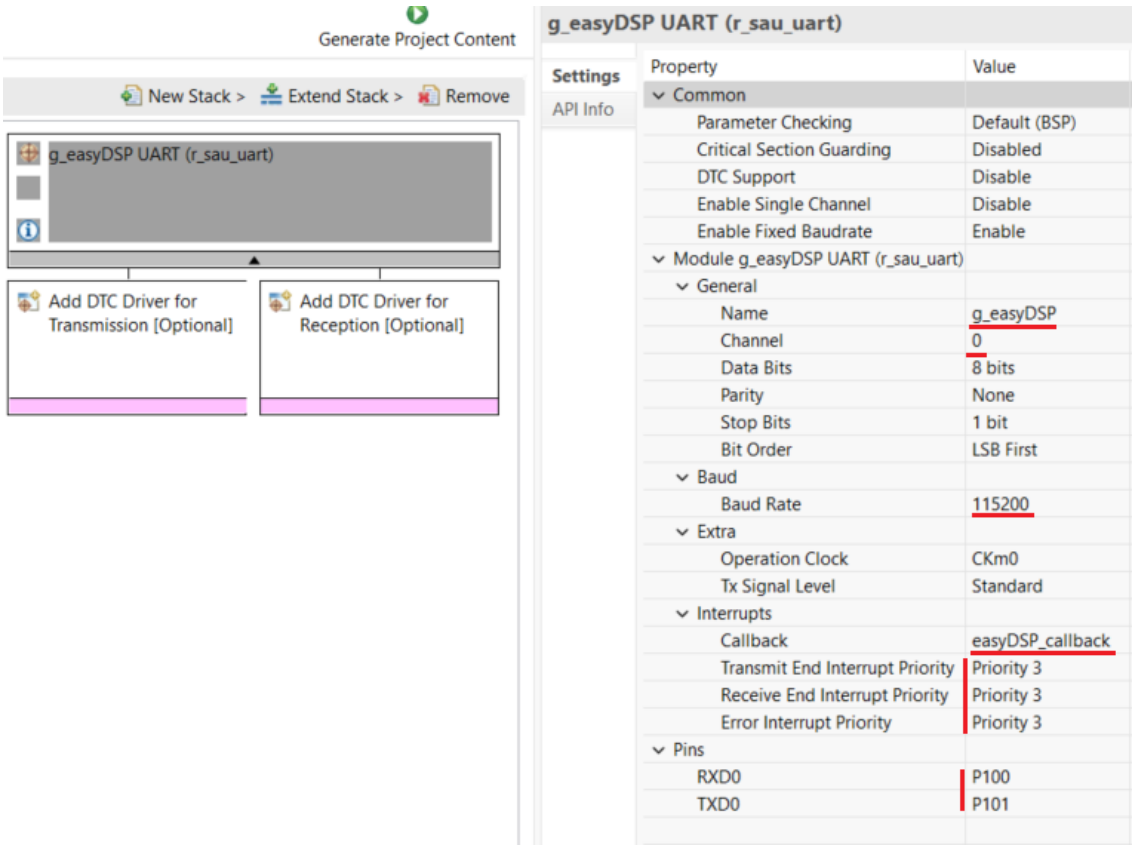


FSP setting

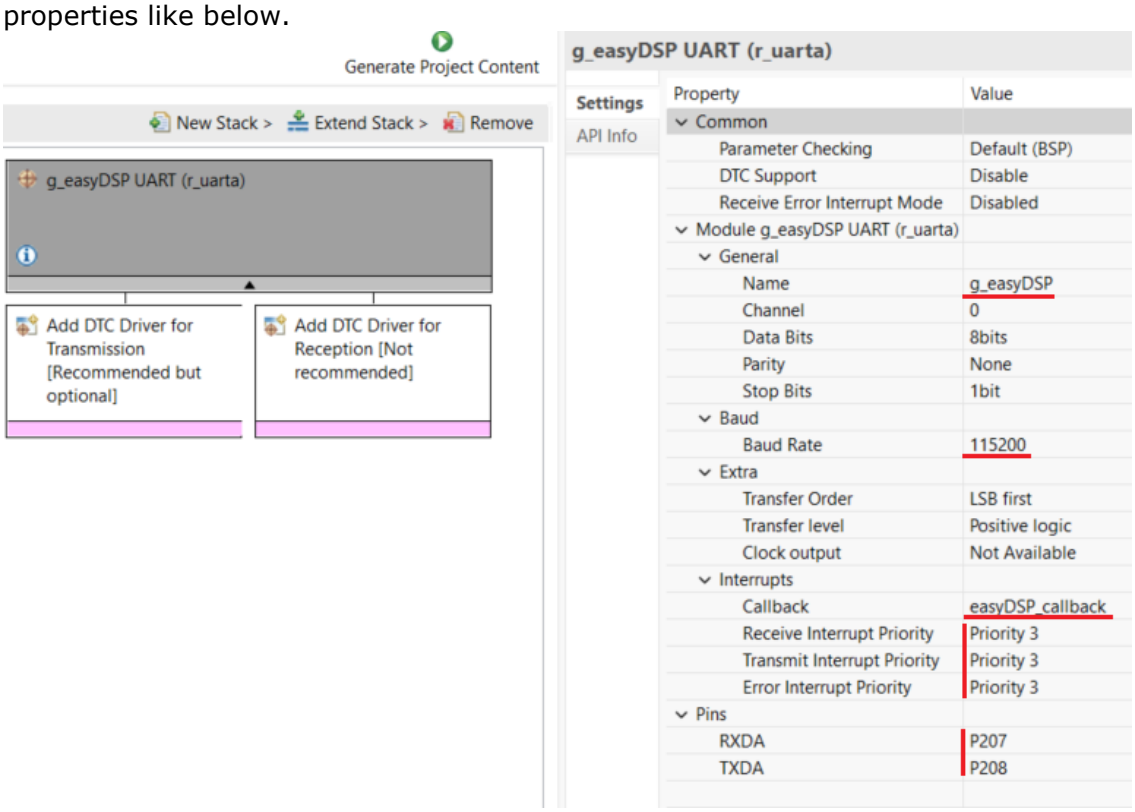
First, activate FSP by clicking 'configuration.xml' file.
Then go to the Stacks tab and generate UART stack with either r_sau_uart or r_uarta module.



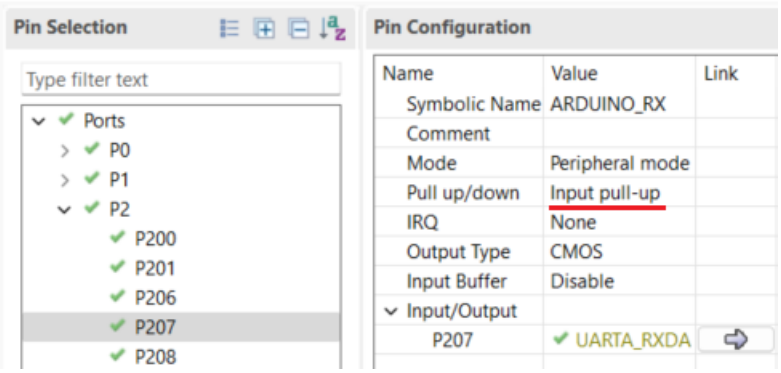
If r_sau_uart module is used for easyDSP communication, please set its properties :
The name of the module is g_easyDSP. Set the channel acc. to your board. The baud rate should be same to the one in the easyDSP project setting. The name of callback is easyDSP_callback. The priority of interrupts are the lowest (higher number). Finally set the pin number.



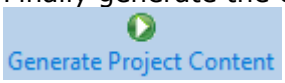
If r_uarta module is used for easyDSP communication, similarly to r_sau_uart module, please set its properties like below.



Then go to the Pins tab, and set the pull-up to both RXD and TXD pin.



Also check if the clock to the used communication channel is enabled in the Clocks tab.
Finally generate the code.



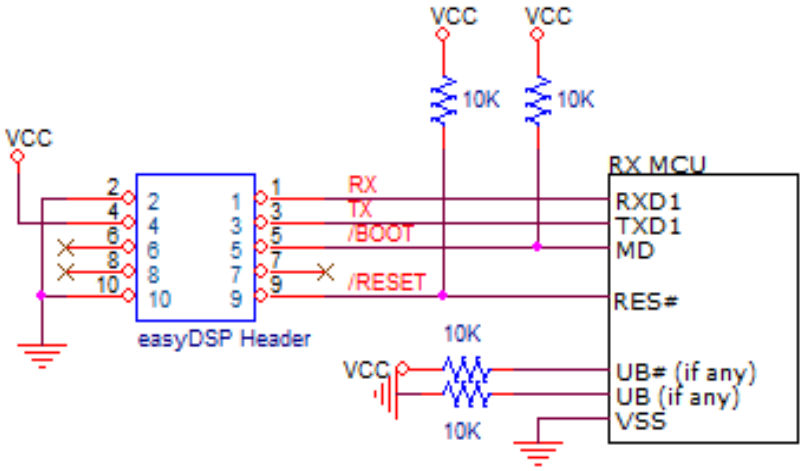
Calling easyDSP_init() and IDE setting

Same to the other RA series. So please check here.

7.11 RX

7.11.1 RX hardware

To do monitoring and flash programming together, SCI1 should be connected to easyDSP.
So connect RXD1 and TXD1 pins of MCU to the easyDSP RX and TX pins.
Also connect easyDSP header #4 pin to MCU VCC.



Please check the corresponding pins by MCU type in the table below. The number of pin should be checked from MCU datasheet.

In case MCU has UB or UB# pin, it should be pulled down or pulled up respectively.

MCU		RXD1	TXD1	UB or UB#
RX100	RX110	P15	P16	N.A.
	RX111	P15	P16	P14/UB#
	RX113	P15	P16	P14/UB#
	RX130	P30	P26	N.A.
	RX13T	PB7	PB6	N.A.
	RX140	P30	P26	N.A.
RX200	RX230 RX231	P30	P26	PC7/UB
	RX23E-A	P30	P26	N.A.
	RX23T	PD5	PD3	N.A.
	RX23W	P30	P26	PC7/UB
	RX24T	PD5	PD3	N.A.
	RX24U	PD5	PD3	N.A.
	RX26T	PD5	PD3	N.A.
RX600	RX64M	PF0 (177/176-pin products) P26 (145/144/100-pin products)	PF2 (177/176-pin products) P30 (145/144/100-pin products)	PC7/UB
	RX651 RX65N	PF0 (177- and 176-pin products) P26 (145-, 144-, 100-, and 64-pin products)	PF2 (177- and 176-pin products) P30 (145-, 144-, 100-, and 64-pin products)	PC7/UB
	RX660	P26	P30	PC7/UB
	RX66N	PF0 (224- and 176-pin products) P26 (145-, 144-, and 100-pin products)	PF2 (224- and 176-pin products) P30 (145-, 144-, and 100-pin products)	PC7/UB
	RX66T	PD3	PD5	P00/UB
	RX671	P26	P30	PC7/UB
RX700	RX71M	PF0 (177/176-pin products) P26 (145/144/100-pin products)	PF2 (177/176-pin products) P30 (145/144/100-pin products)	PC7/UB
	RX72M RX72N	PF0 (224- and 176-pin products) P26 (144-, and 100-pin products)	PF2 (224- and 176-pin products) P30 (144-, and 100-pin products)	PC7/UB
	RX72T	PD3	PD5	P00/UB

note) N.A. = not available

Other considerations :
- When reset, easyDSP /RESET pin goes low for 500msec around.
- In case there is a reset IC between easyDSP /RESET and MCU RES#, it should transfer easyDSP /RESET signal to MCU RES# within 0.5sec.
- RX and TX pins of easyDSP header are pulled up with 100kOhm resistor in the pod.
- In case you can't use SCI1, you can use another SCI channel but only monitoring is doable (flash programming not doable). In this case no need to connect /BOOT and /RESET pins.

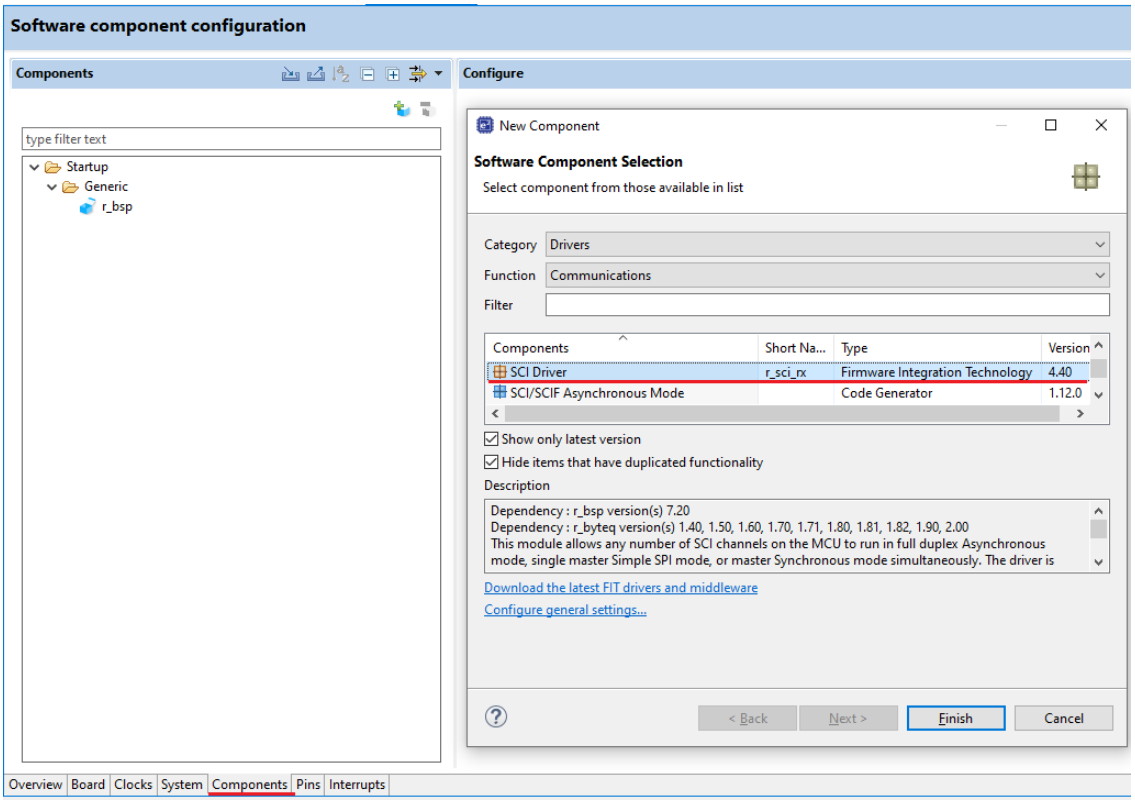
7.11.2 RX sofrware

---

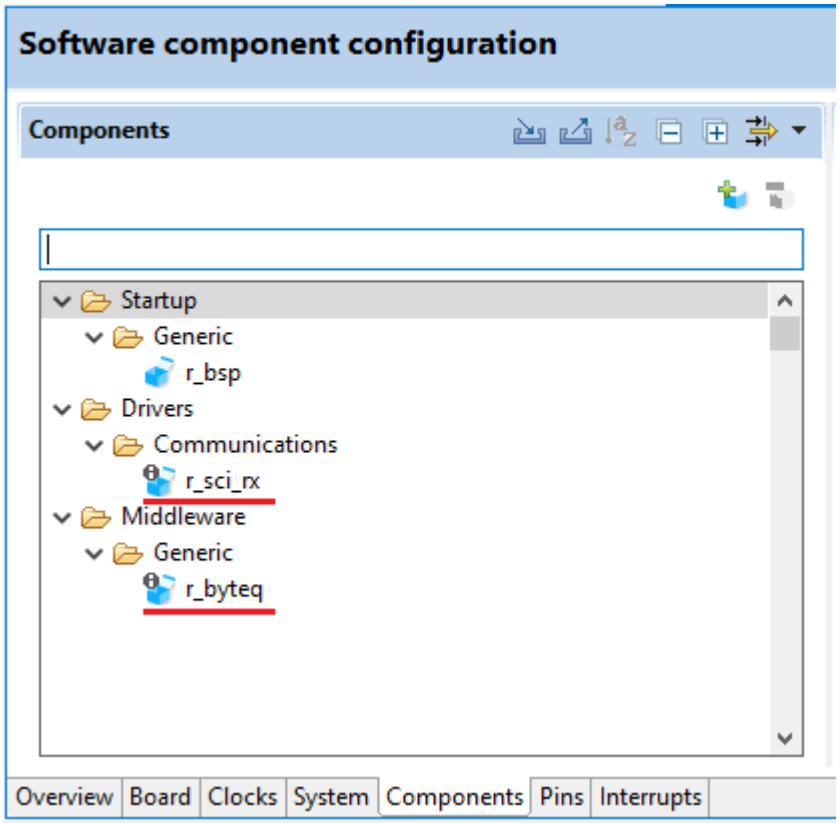
easyDSP uses the generated code from RX Smart Configurator. You can find the detailed process below based on RX Smart Configurator v1.40.

STEP 1 : Smart Configurator setting

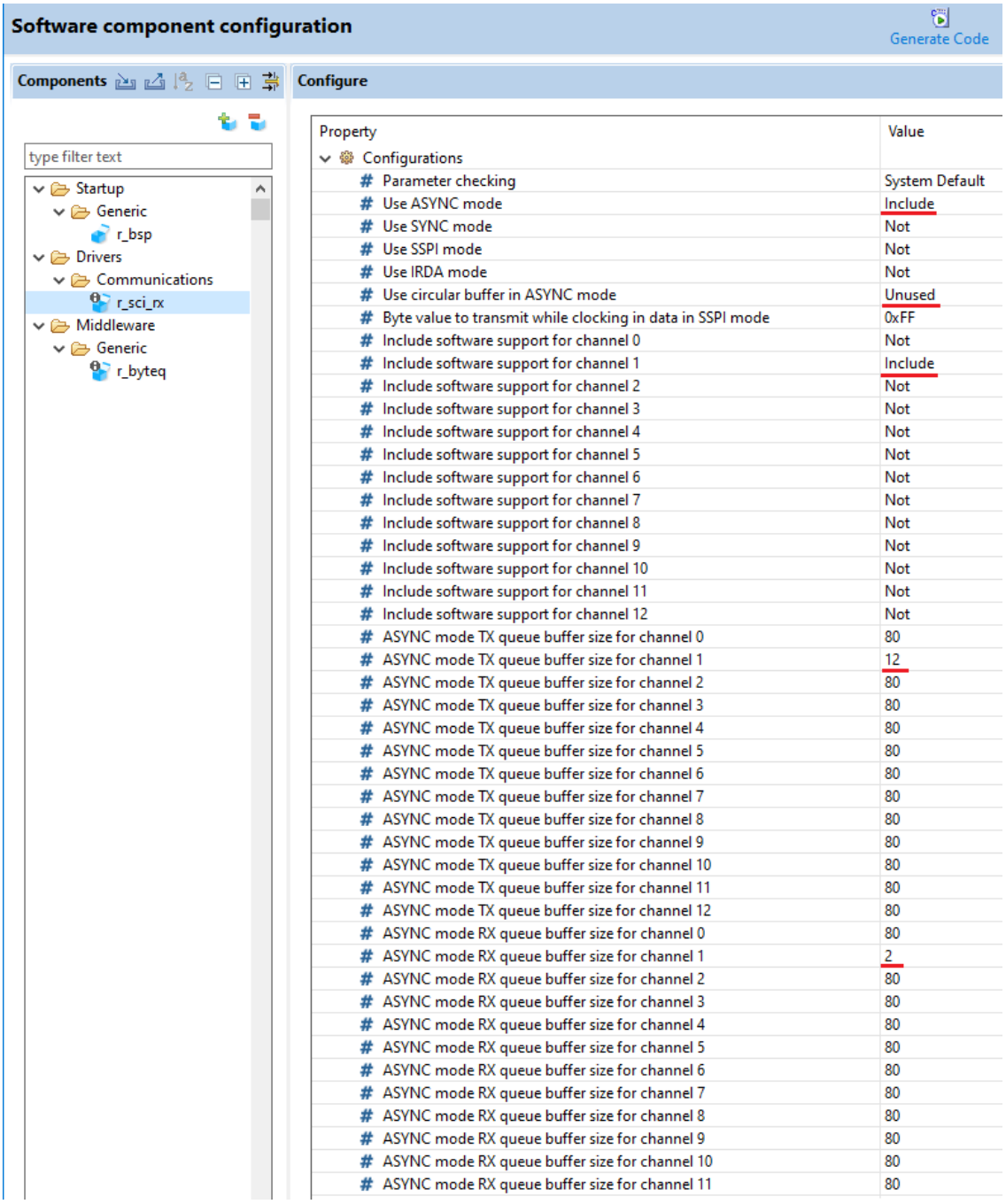
Please add 'SCI Driver' component by cliking 'Add component' button in the 'Components' tab.



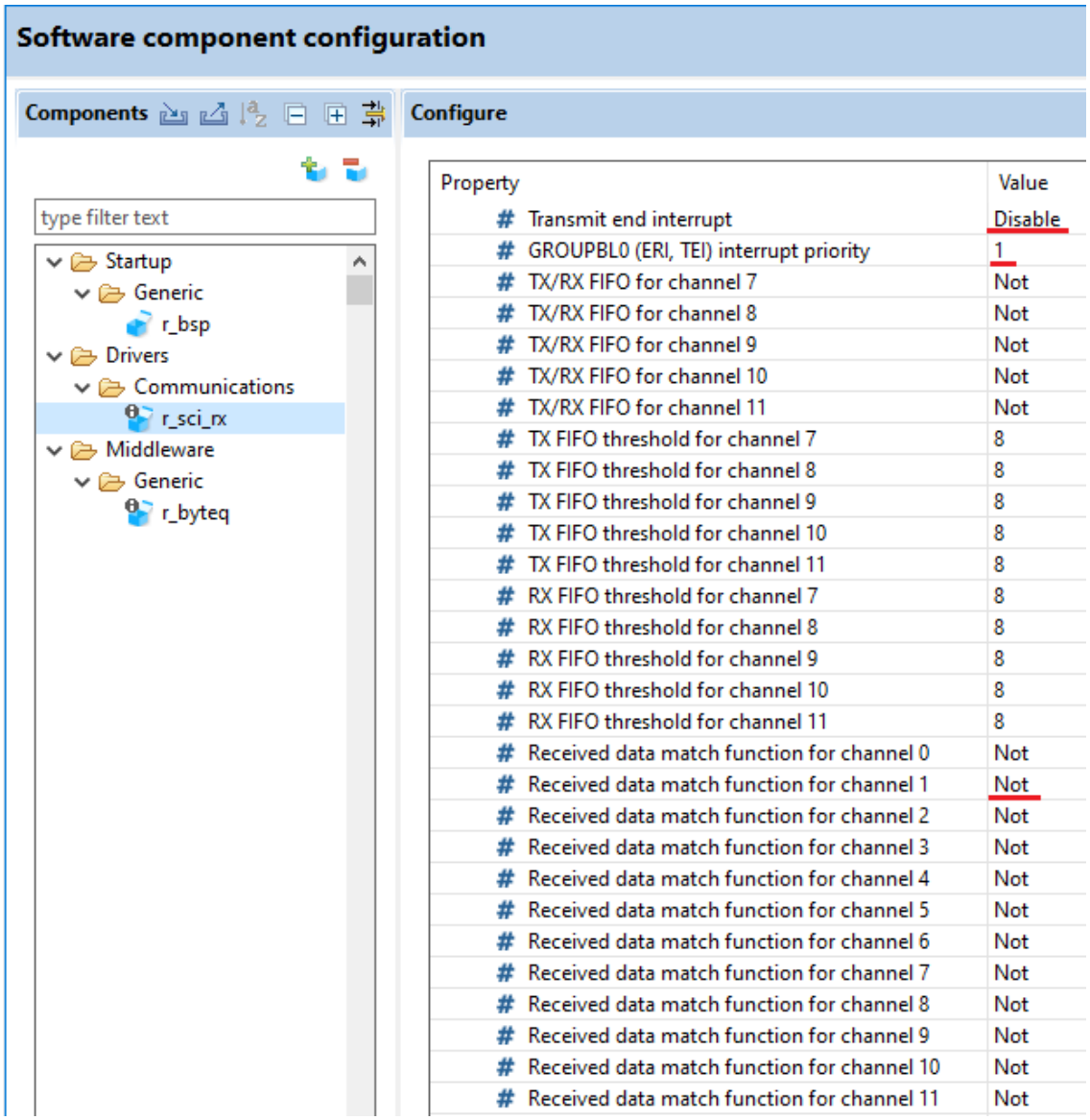
Then r_sci_rx and r_byteq components are created.

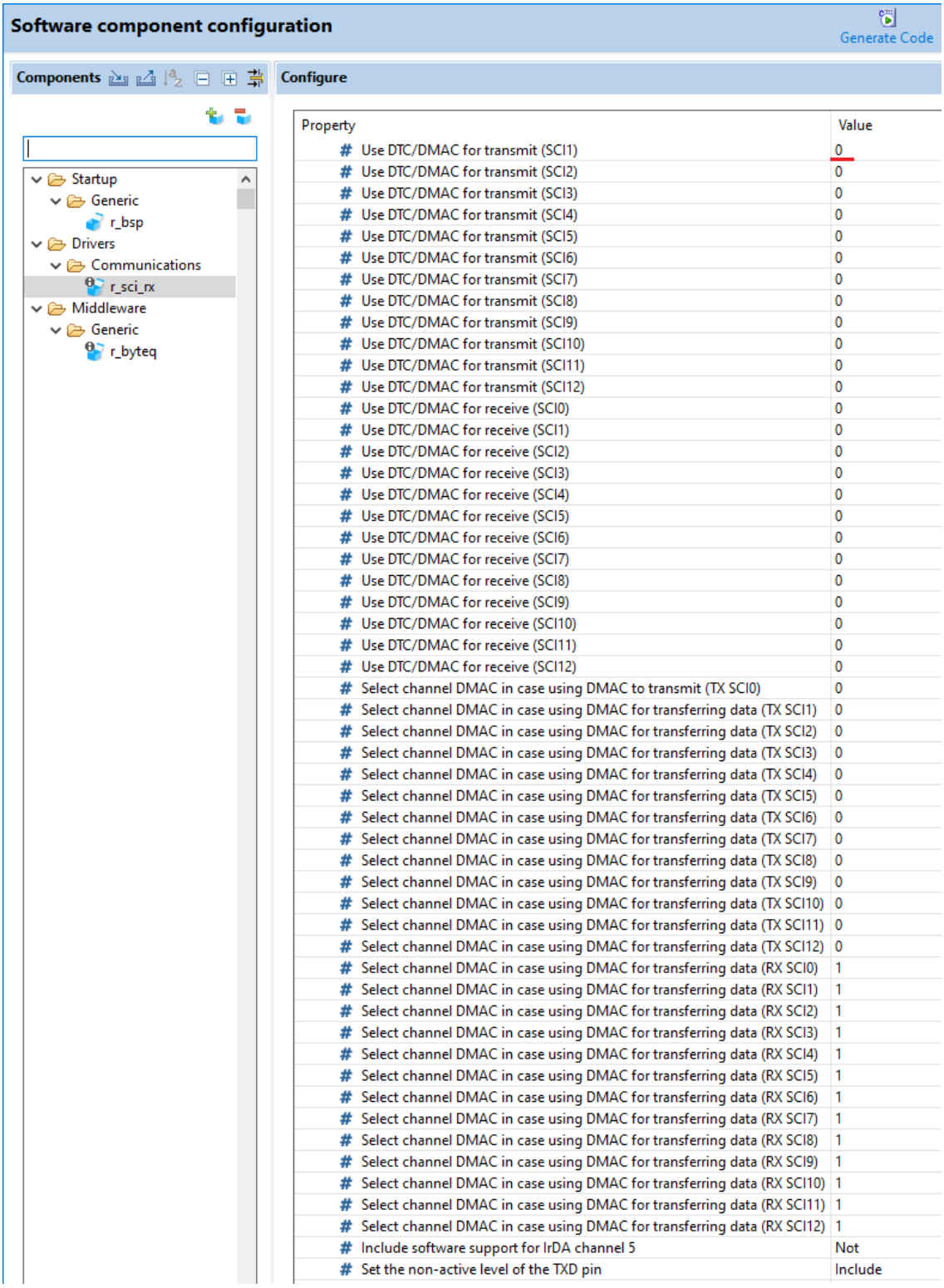


Since easyDSP uses SCI channel 1, 'r_sci_rx' components should be set accordingly. Please refer to the red line below.
The circular buffer is not required for easyDSP. TX and RX queue buffer size should be 12 and 2 respectively at its minimum.

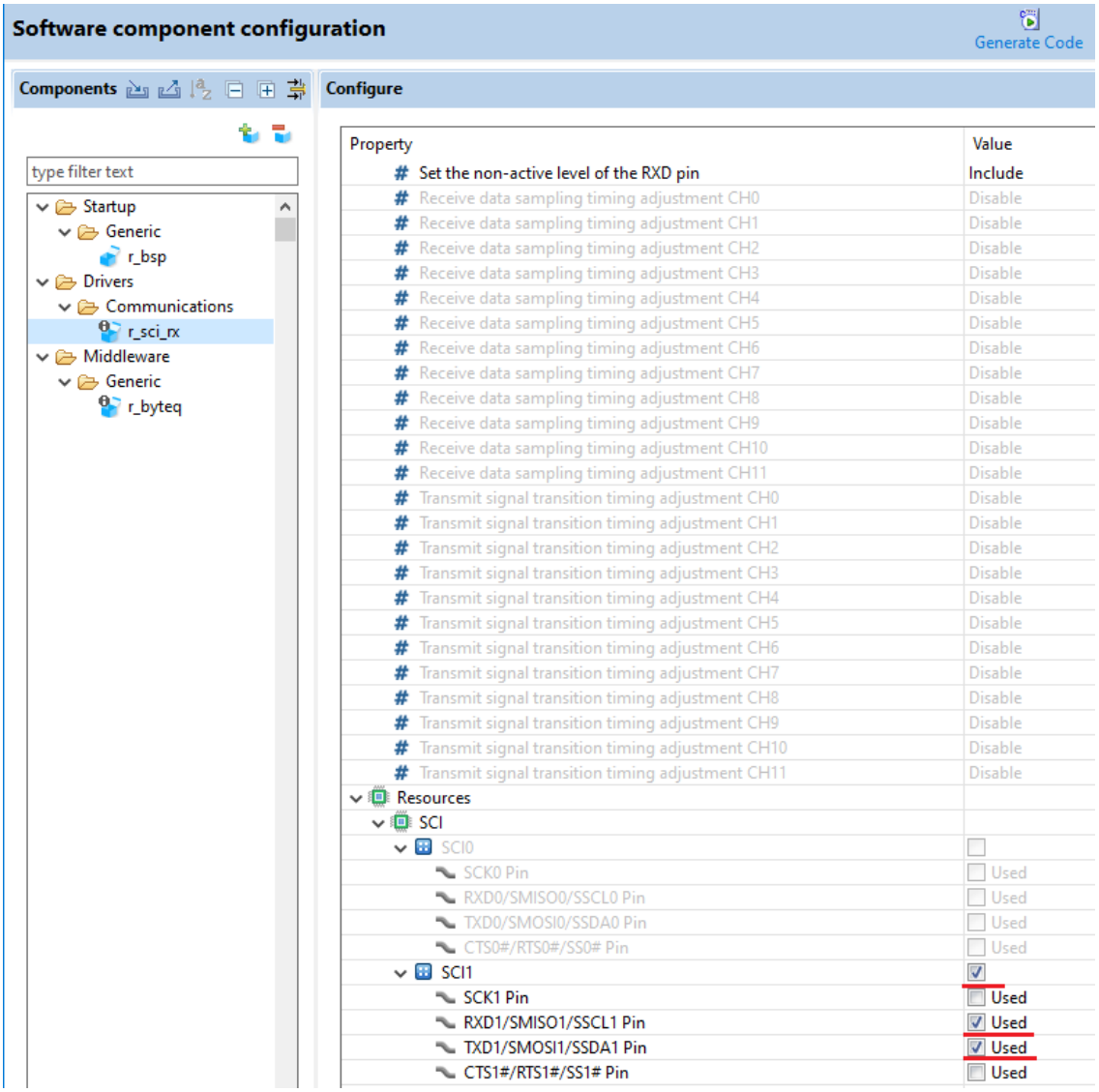


TEI interrupt is not used.
The interrupt priority level of ERI and TEI should be the lowest, 1.

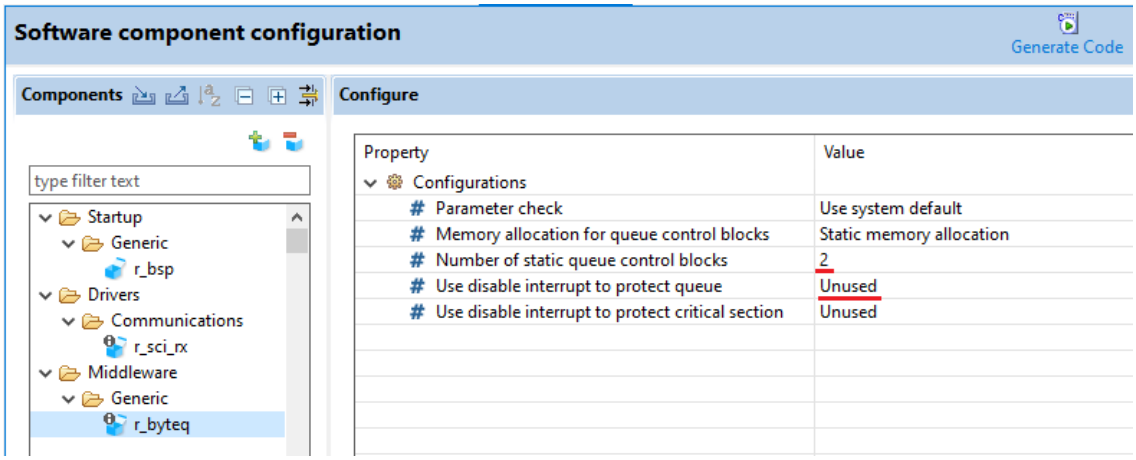

Software component configuration
Components
Configure
type filter text
Startup
Generic
r_bsp
Drivers
Communications
r_sci_rx
Middleware
Generic
r_byteq
Property
Value
Transmit end interrupt
Disable
GROUPBL0 (ERI, TEI) interrupt priority
1
TX/RX FIFO for channel 7
Not
TX/RX FIFO for channel 8
Not
TX/RX FIFO for channel 9
Not
TX/RX FIFO for channel 10
Not
TX/RX FIFO for channel 11
Not
TX FIFO threshold for channel 7
8
TX FIFO threshold for channel 8
8
TX FIFO threshold for channel 9
8
TX FIFO threshold for channel 10
8
TX FIFO threshold for channel 11
8
RX FIFO threshold for channel 7
8
RX FIFO threshold for channel 8
8
RX FIFO threshold for channel 9
8
RX FIFO threshold for channel 10
8
RX FIFO threshold for channel 11
8
Received data match function for channel 0
Not
Received data match function for channel 1
Not
Received data match function for channel 2
Not
Received data match function for channel 3
Not
Received data match function for channel 4
Not
Received data match function for channel 5
Not
Received data match function for channel 6
Not
Received data match function for channel 7
Not
Received data match function for channel 8
Not
Received data match function for channel 9
Not
Received data match function for channel 10
Not
Received data match function for channel 11
Not



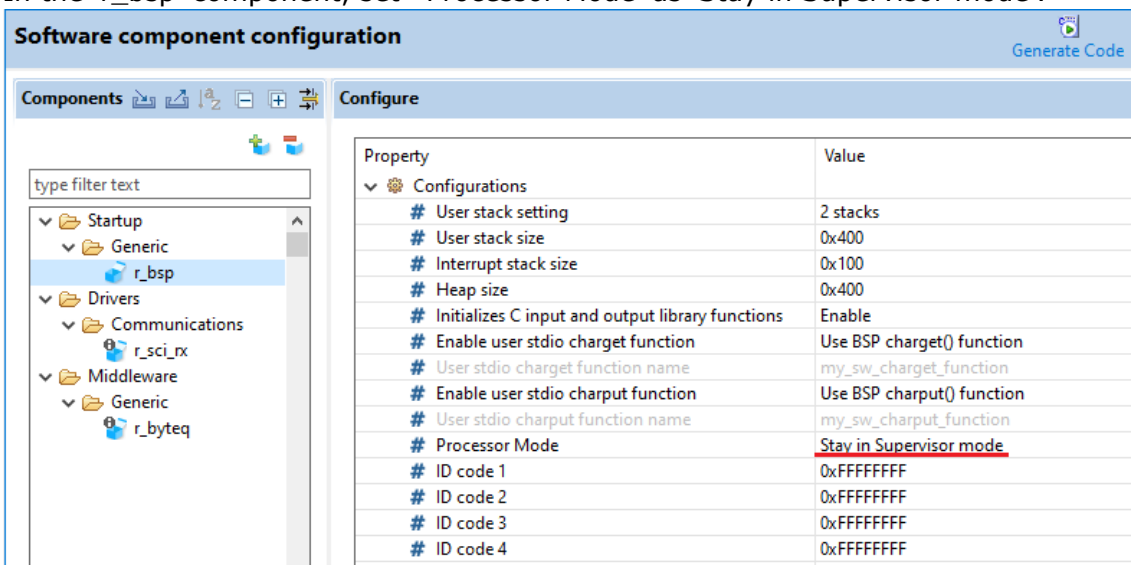
RXD1 and TXD1 pins of SCI1 should be enabled. The other pins of SCI1 are not used.



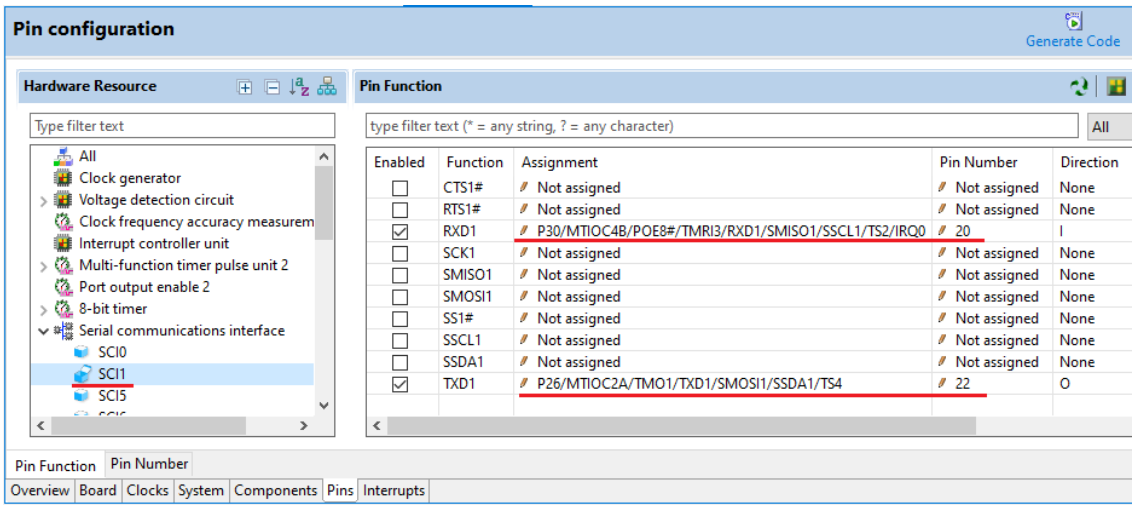
Now in the 'r_byteq' components. At least, two queue control blocks are required for easyDSP.
In case you don't use circular buffer in the 'r_sci_rx' component, set the 'Use disable interrupt to protect queue' as 'Unused'.
In case you use circular buffer, then set as 'Used'.



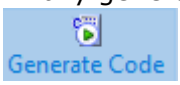
In the 'r_bsp' component, set 'Processor Mode' as 'Stay in Supervisor mode'.



RXD1 and TXD1 pins are allocated in the 'Pins' tab. Please set 'Assignment' column so that it matchs with [the hardware setting]. Please check the MCU datasheet to allocate 'Pin Number' column.



Finally generate code.



STEP 2 : Calling easyDSP_init()

Two files are provided for easyDSP communication (easyRX.h and easyRX.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\RX).
First choose the baudrate of SCI communication to easyDSP. Also note it should be same to what you set in the easyDSP project setting.

```
//////////////////////////////////////////////////////////////
// set the baud rate for UART communication with easyDSP
// it should be same to the baudrate of easyDSP project
//////////////////////////////////////////////////////////////
#define EZ_BUAD_RATE        230400
```

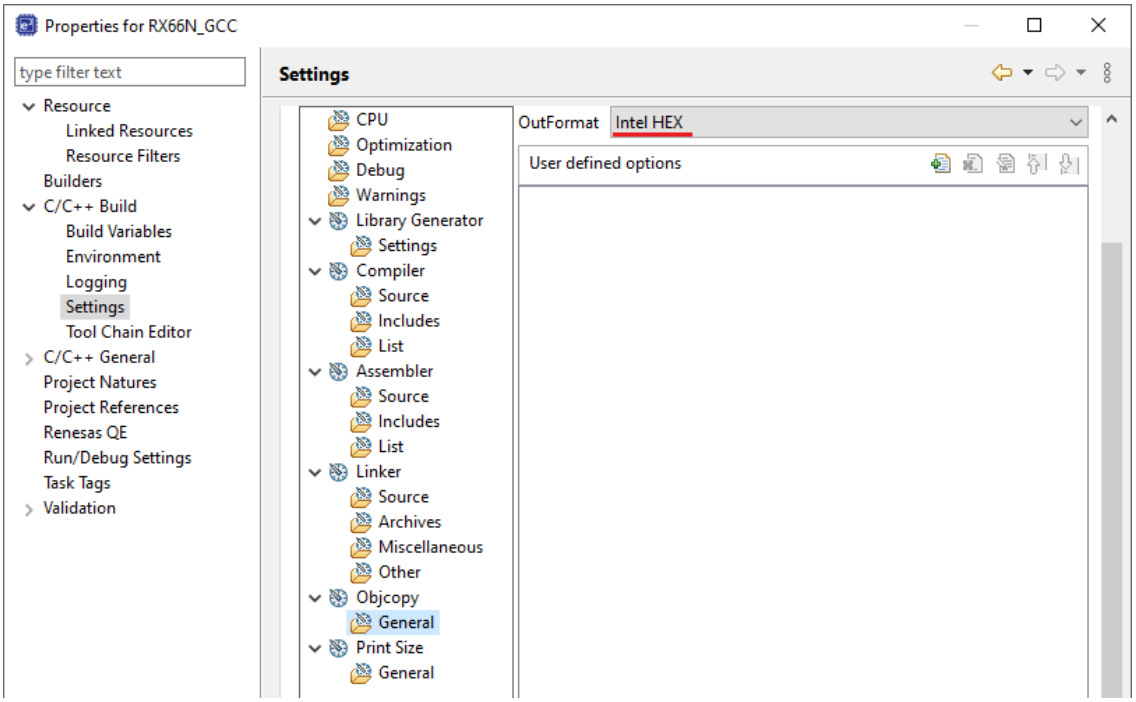
Then please call the easyDSP_init() function in the main.c.
The priority level of SCI interrupt easyDSP uses is the lowest one (IPL[3:0] = 1). The priority level of the other user interrupt should be set higher than this.

```
#include "easyRX.h"

int main(void)
{
    // initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

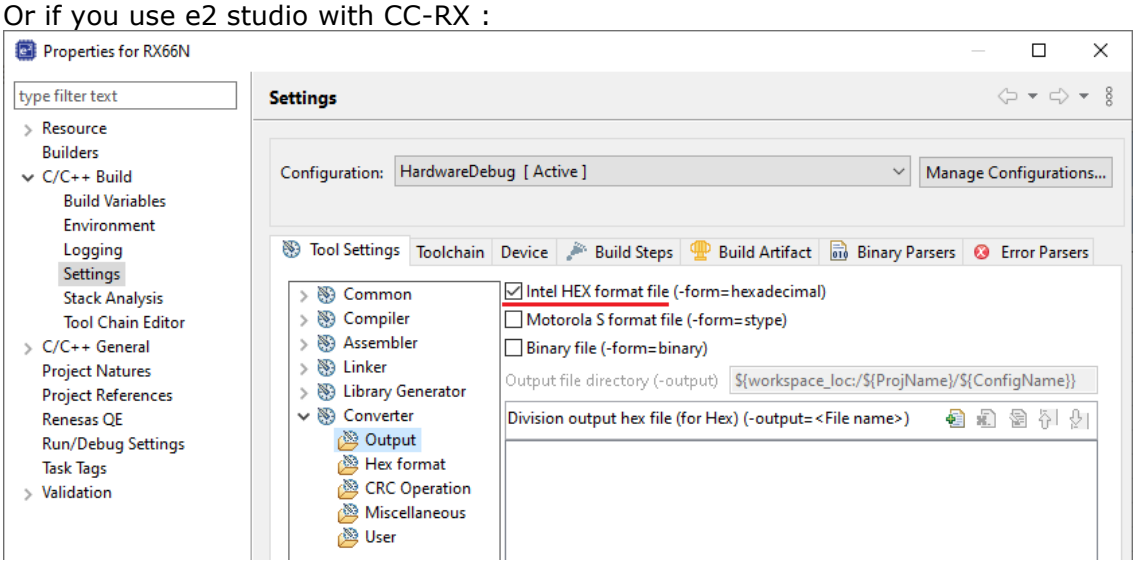
STEP 3 : IDE setting

1. The output file easyDSP uses should have DWARF debugging information. Therefore when using CC-RX compiler, the output file with DWARF debugging information should be created in every compiling time. This is actually done as a default in e2 studio.
2. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Please set your IDE accordingly to create hex file in every compilation.

For example, if you use e2 studio IDE with GCC :

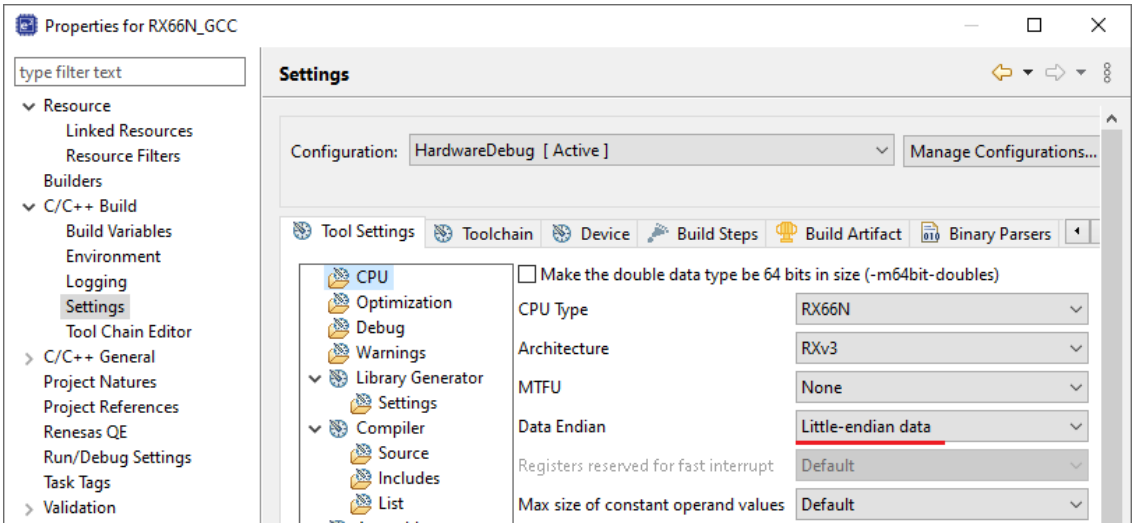


Or if you use e2 studio with CC-RX :

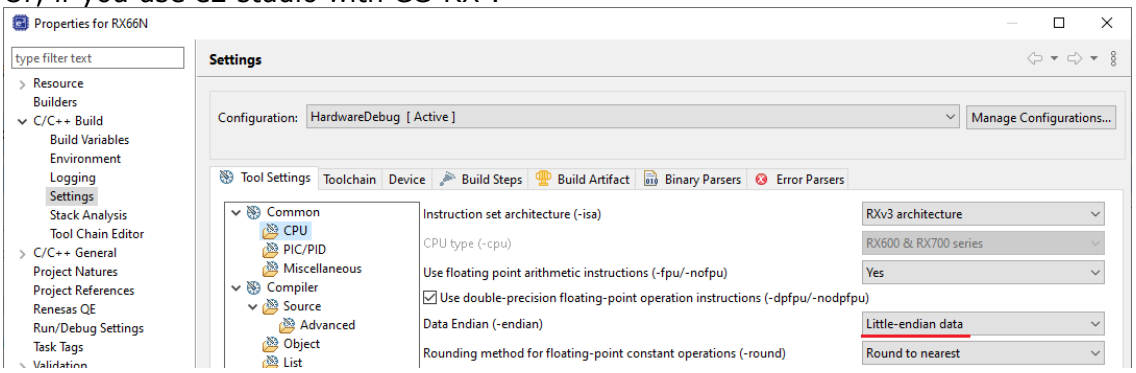


3. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
4. The declared but unused variables could be excluded from the debug information depending on compiler's optimization level and linker option. In this case, you can't monitor this variable with easyDSP. If necessary, you can set the linker option so that the unused variables are not excluded.
5. easyDSP supports the little endian mode only.

For example, if you use e2 studio with GCC :



Or, if you use e2 studio with CC-RX :

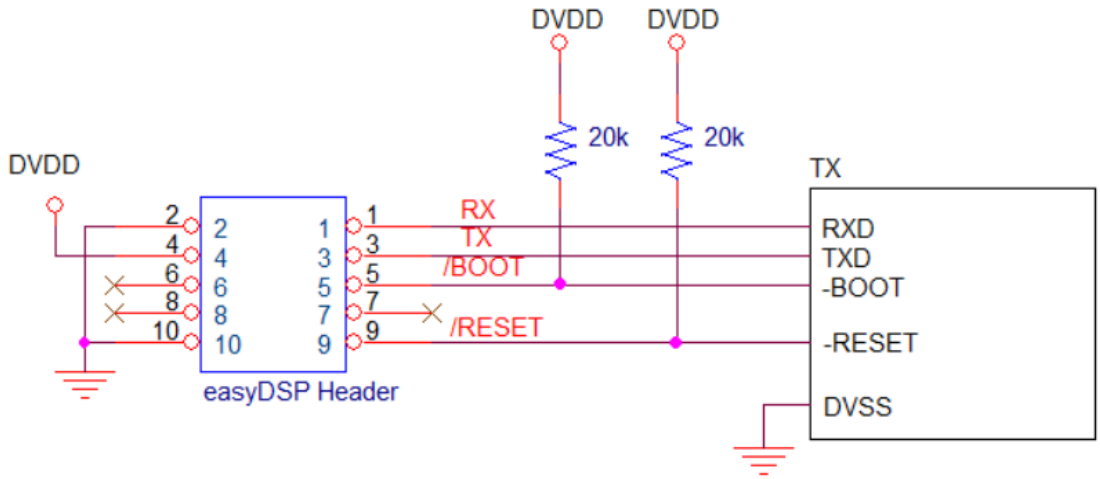


7.12 TX

TX setting

STEP 1 : Hardware

easyDSP uses MCU's single boot mode to access the flash memory. So the SIO/UART channel that is used in the single boot mode should be used for easyDSP.
Otherwise, easyDSP can support only monitoring, not flash writing.
Please kindly check the datasheet of target MCU to identify which SIO/UART channel and which port pins are used in the single boot mode and connect them to easyDSP pod.



For example, below datasheet capture for TMPM370FY indicates :
/BOOT of easyDSP pod should be connected to PF0 of MCU.
TX of easyDSP pod should be connected to PE0 of MCU.
RX of easyDSP pod should be connected to PE1 of MCU.

19.2.6 Interface specification

In Single Boot mode, an SIO channel is used for communications with a programming controller. The same configuration is applied to a communication format on a programming controller to execute the on-board programming. Both UART (asynchronous) and I/O Interface (synchronous) modes are supported. The communication formats are shown below.

- UART communication

  Communication channel : SIO channel 0

  Serial transfer mode : UART (asynchronous) mode, half -duplex, LSB first

  Data length : 8 bits

  Parity bit : None

  STOP bit : 1 bit

  Baud rate : Arbitrary baud rate

- I/O Interface mode

  Communication channel : SIO channel 0

  Serial transfer mode : I/O interface mode, full -duplex, LSB first

  Synchronization clock (SCLK0) : Input mode

  Handshaking signal : PE4 configured as an output mode

  Baud rate : Arbitrary baud rate

Table 19-3 Required Pin Connections

Pin		Interface	
		UART	I/O Interface Mode
Power supply pins	DVDD5	o	o
	DVDD5E	o	o
	DVSS	o	o
	AVDD5A	o	o
	AVSSA	o	o
	AVDD5B	o	o
	AVSSB	o	o
	VOUT3	o	o
	VOUT15	o	o
	RVDD5	o	o
Mode-setting pin	$\overline{\text{BOOT}}$ (PF0)	o	o
Reset pin	$\overline{\text{RESET}}$	o	o
Communication pin	TXD0 (PE0)	o	o
	RXD0 (PE1)	o	o
	SCLK0 (PE2)	×	o (Input mode)
	PE4	×	o (Output mode)

Other considerations :
- DVDD could be either DVDD3 or DVDD5 depending MCU type.
- In case there is a reset IC between easyDSP /RESET and MCU -RESET, it should transfer easyDSP /RESET signal to MCU -RESET within 0.5sec.
- In case pull-up resistor is attached, resistor value should be higher than several k Ohm.

STEP 2 : Modification of easyTX.h file

Two files are provided for easyDSP communication (easyTX.h and easyTX.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\TX_TXZ).
Since Peripheral Driver library from the MCU supplier are used in the files, this library should be included in your project.

First, include *_gpio.h and *_uart.h according to MCU.
Also based on the hardware connection above, set the channel number and its port.
Below example is made based on TMPM370. You should modify it according to target MCU.
Finally set the baudrate of easyDSP communication. The baud rate should be same to that of easyDSP project.

```
////////////////////////////////////////////////////////////////////////////////
////////////////////////////////////////////////////////////////////////////////
// step 1 : change header files(*_gpio.h and *_uart.h) according to MCU
//          and set the SIO/UART channel number and its port pins.
////////////////////////////////////////////////////////////////////////////////

// for TMPM370 : SIO/UART channel 0 /w PE0 and PE1 port
#include "tmpm370_gpio.h"
#include "tmpm370_uart.h"
#define EZ_UARTx_CH         0
#define EZ_SIO_PORT         GPIO_PE
#define EZ_TXD_BIT_NUM      GPIO_BIT_0
#define EZ_RXD_BIT_NUM      GPIO_BIT_1


////////////////////////////////////////////////////////////////////////////////
// step 2 : set the baud rate for SIO/UART communication with easyDSP
//          it should be same to the baudrate of easyDSP project
////////////////////////////////////////////////////////////////////////////////
#define EZ_BUAD_RATE        230400
```

STEP 3 : Calling easyDSP_init()

Pleae include easyTX.h in the top of main.c and call easyDSP_init() in the main() after the initialization of others.

```
#include "easyTx.h"

int main(void)
{




    easyDSP_init();

    while (1) {

    }
}
```

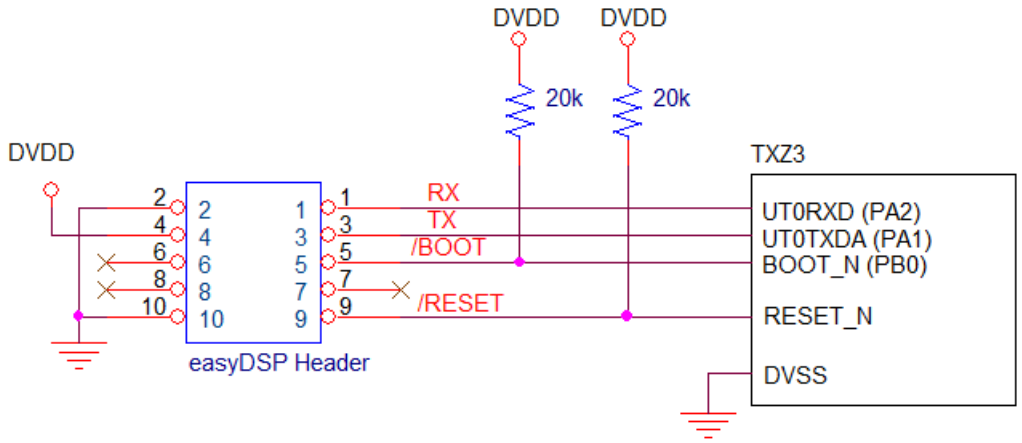
STEP 4 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file (ex *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time.
2. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded.
4. To compile inline functions in the easyTx.c, please enables c99 mode in the compiler options if required.

7.13 TXZ3

STEP 1 : Hardware

easyDSP uses MCU's single boot mode to access the flash memory. So the UART0 channel (PA1/PA2) that is used in the single boot mode should be used for easyDSP.
Otherwise, easyDSP can support only monitoring, not flash writing. Also the source file easyTXZ3.c should be modified accordingly by you.



Other considerations :
- DVDD could be either DVDD3 or DVDD5.
- In case there is a reset IC between easyDSP /RESET and MCU -RESET, it should transfer easyDSP /RESET signal to MCU -RESET within 0.5sec.
- In case pull-up resistor is attached, resistor value should be higher than several k Ohm.

STEP 2 : Modification of easyTXZ3.h file

Two files are provided for easyDSP communication (easyTXZ3.h and easyTXZ3.c). Please include them in your project. You can find them in the easyDSP installation folder (\source\TX_TXZ).
Since Peripheral Driver library from the MCU supplier are used in the files, this library should be included in your project.

First, include the CMSIS header file according to target MCU.
Finally set the baudrate of easyDSP communication. The baud rate should be same to that of easyDSP project.

```
////////////////////////////////////////////////////////////////////////////////
// step 1 : include CMSIS Peripheral Access Layer Header File
//          include header file name accordingly to target MCU
////////////////////////////////////////////////////////////////////////////////
#include <TMPM3H6.h>    // For example, TMPM3H6.h for TMPM3H6 MCU.
//#include <TMPM3HQ.h>  // For example, TMPM3HQ.h for TMPM3HQ MCU.

////////////////////////////////////////////////////////////////////////////////
// step 2 : set the baud rate for UART communication with easyDSP
//          it should be same to the baudrate of easyDSP project
////////////////////////////////////////////////////////////////////////////////
#define EZ_BUAD_RATE        115200
```

STEP 3 : Calling easyDSP_init()

Pleae include easyTXZ3.h in the main.c and call easyDSP_init() in the main() after the initialization of others.

```
#include "easyTXZ3.h"

int main(void)
{
    .
    .
    .
    .
    .

    easyDSP_init();

    while (1){


    }
}
```

STEP 4 : IDE setting

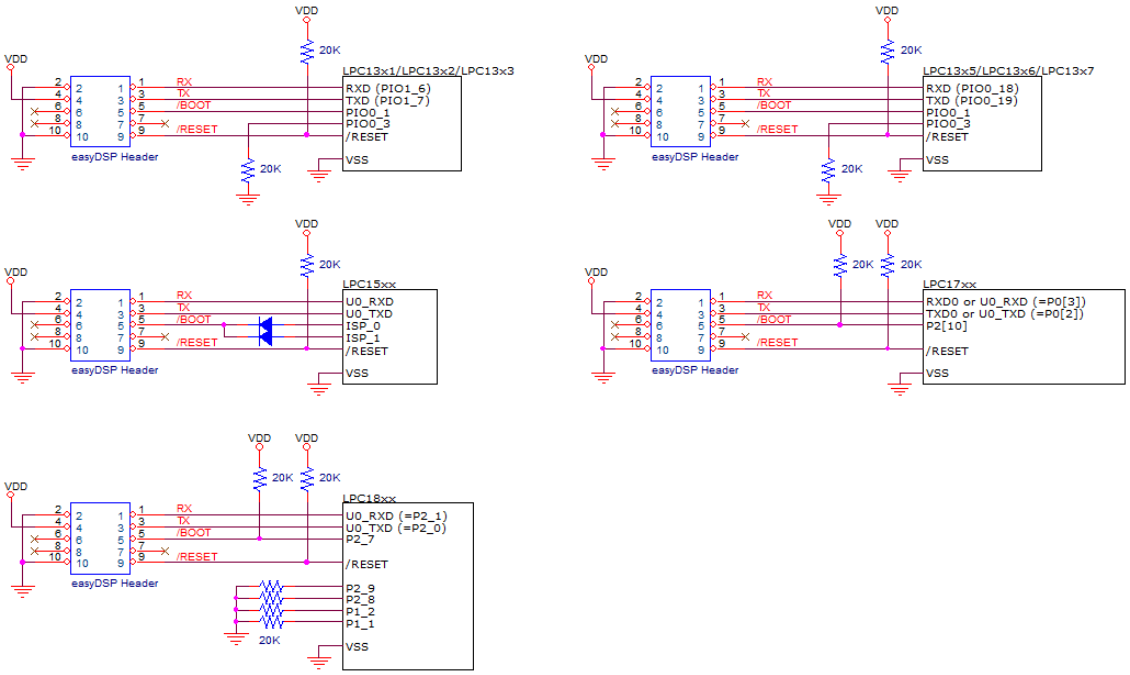
1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file (ex *.elf) with same file name. The hex file extension could be either 'hex' or 'ihex'. easyDSP first check if the hex file with extension 'hex' exists and use it for flash programming. If the hex file with extension 'hex' doesn't exist, easyDSP uses the hex file with extension 'ihex'. Pleae set your IDE accordingly to create hex file in every compiling time.
2. For easyDSP to access the variable, the debug information should be included in the output file (ex, *.elf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded.
4. To compile inline functions in the easyTXZ3.c, plase enables c99 mode in the compiler options if required.

7.14 LPC

LPC1x00 setting

STEP 1 : Hardware

easyDSP uses MCU's USART0 channel to communicate with MCU and program flash. So check the below hardware connection by MCU type.



For LPC1500, pin by different MCU package is shown below.

ISP pin	LQFP48	LQFP64	LQFP100
ISP_0	PIO0_4	PIO1_9	PIO2_5
ISP_1	PIO0_16	PIO1_11	PIO2_4
U0_TXD	PIO0_15	PIO0_18	PIO2_6
U0_RXD	PIO0_14	PIO0_13	PIO2_7

For LPC1800, make sure that OTP memory is not programmed or the BOOT_SRC bits are all zero so that the boot mode is determined by the states of the boot pins P2_9, P2_8, P1_2, and P1_1.

Other considerations : TX and RX pin of easyDSP header is pulled up with 100k Ohm resistor inside of easyDSP pod.

STEP 2 : Use of LPCOpen library

easyDSP implements USART communication with MCU by using NPCOpen library. Therefore this library should be included in the user program.

STEP 3 : easyDSP source and header file

Two files are provided for easyDSP communication (easyLPC1x00_va.b.h and easyLPC1x00_va.b.c). Depending on its version, a and b are changeable. You can find them in the easyDSP installation folder (\source\LPC).
Please include them in your project according to target MCU.
In the header file, please set a target MCU or MCU package or baudrate of easyDSP communication. The baud rate should be same to that of easyDSP project.
It differs by target MCU series. Please refer to below for LPC1500.

```
////////////////////////////////////////////////////////////////////////////////////////////
// Package Selection : Please choose MCU package and define it as 1. set as 0 for others.
////////////////////////////////////////////////////////////////////////////////////////////
#define EZDSP_LQFP48            0
#define EZDSP_LQFP64            1
#define EZDSP_LQFP100           0

////////////////////////////////////////////////////////////////////////////////////////////
// step 2 : set the baud rate for USART communication with easyDSP
//          it should be same to the baudrate of easyDSP project
////////////////////////////////////////////////////////////////////////////////////////////
#define EZDSP_BAUDRATE          115200L
```

STEP 4 : Calling easyDSP_init() function

Please include easyLPC1x00_va.b.h in the main.c. And in the main(), call easyDSP_init() after the initialization of MCU.
In the easyDSP_init() function, all necessary setting for easyDSP monitoring are done.

```
#include "easyLPC1x00.h"

int main(void)
{
    // initial setting
    .
    .
    .
    .
    .
    .

    // call easyDSP_init() to enable easyDSP monitoring
    easyDSP_init();

    // loop forever
    while(1)
    {
        .
        .
        .
    }
}
```

STEP 5 : IDE setting

1. Hex file (Intel format) is used for flash programming. So it should be created in every compiling time in the same folder to output file (for example, *.axf) with same file name. Pleae set your IDE accordingly to create hex file in every compilation.
   For example, if you use MCUXpresso IDE, register arm-none-eabi-objcopy -O ihex "${BuildArtifactFileName}" "${BuildArtifactFileBaseName}.hex" in the Post-build steps.
2. For easyDSP monitoring, the debug information should be included in the output file (for example, *.axf). And the option of assembler, compiler and linker should be set accordingly.
3. The unused variables could be excluded from the debug information depending on compiler's optimization level and linker setting. If necessary, you can set the linker option so that the unused variables are not excluded.

7.15 Cautions

*** Reset pin of MCU**

Don't connect or disconnect easyDSP pod during MCU operation. It could cause any unintentional reset to MCU. In case you have to connect, please connect easyDSP to PC first, then to MCU. In case you have to disconnect, please disconnect easyDSP from MCU first, then from PC.
For your reference, reset signal is driven to low by easyDSP during 500msec. Therefore you can add enough filters to the reset pin of MCU.

*** What is proper baud rate ?**

Normally higher baud rate means faster communication. But MCU should be able to handle this much high baud rate data communication. For example, it takes around 86usec (1/115200bps*10bit) for easyDSP to send one byte to MCU at 115200bps baud rate. MCU should process this one byte data within next 86usec for proper communication. If higher prioritized routine takes most of time and very small time is left for ISR routine for SCI, then easyDSP fails its communication and display the value of variables as '?'.

* Various IDE

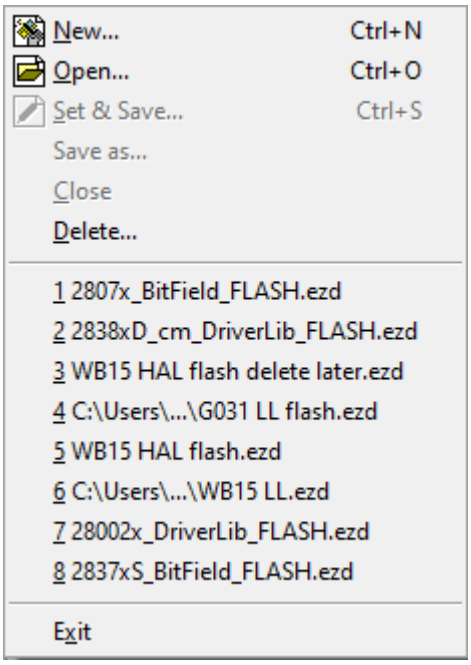
For Arm MCU, easyDSP is designed for a wide range of software integrated development environments (IDEs) but is not fully tested for all IDEs. If not working properly, report it to easyDSP@gamil.com .

* Variable is not displayed

Depending of options of compiler and linker, the variable could be not displayed in the easyDSP if this variable is not used meaningfully in the user program.
This variable is not displayed in the map file too. Or displayed but with its address 0.
To display it in the easyDSP, please change the compiler/linker option accordingly.

8. Menus

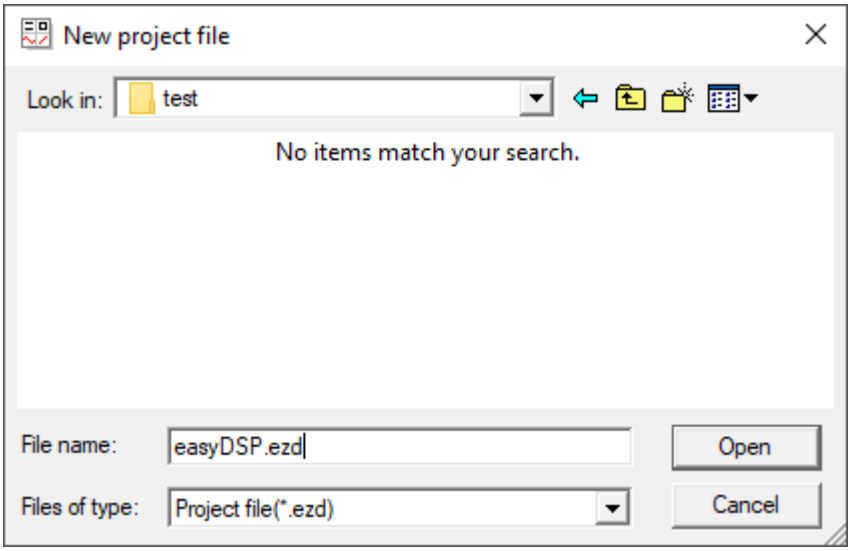
8.1 Project



easyDSP deals with your working files with the project concept. The menus belongs to 'Project' menus are

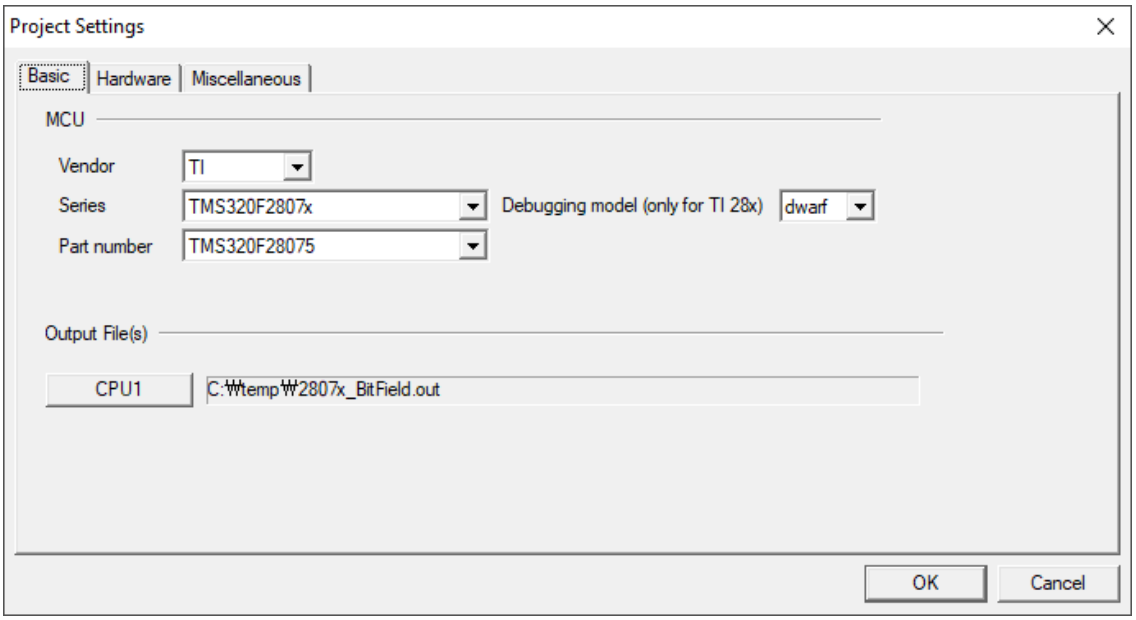
'New' menu:

Clicking 'New' menu shows the dialog box where you can select the name of project file. The extension of project file should be "ezd".



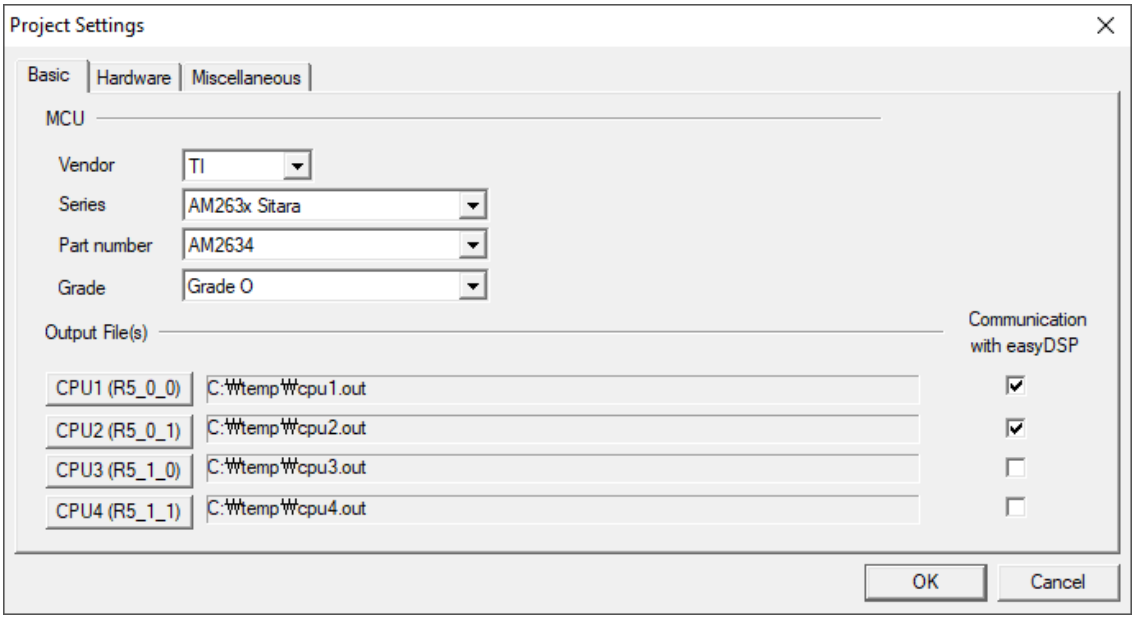
And then you can set the properties of your project in the property sheet. The property sheet consists of three pages such as 'Basic', 'Hardware' and 'Miscellaneous'.

'Basic' page sets the target MCU and output file (*.out, *.elf, *.axf and *.x).
First set the target MCU. In case of some STM32 MCU, single or dual bank is specified in the MCU name only when bank mode should be specified. That is, there is no bank mode in the STM32 MCU name either when bank mode is fixed (single or dual) in the MCU or when there is no need for understanding bank mode for easyDSP operation.
For some TI C28x MCUs for which debugging model (either COFF or DWARF) should be specified, the combo box for this is shown. The debugging model should be same to that of compiler option.
Please note that further improvement or bug fix for coff debugging model is stopped from easyDSP version 9.
Then the output file should be specified. The output file should exist before creating new easyDSP project.
Also except TI C28x with COFF debugging model, the output file should be DWARF debugging information.
Once the project is created, 'Basic' page is not edited any longer.

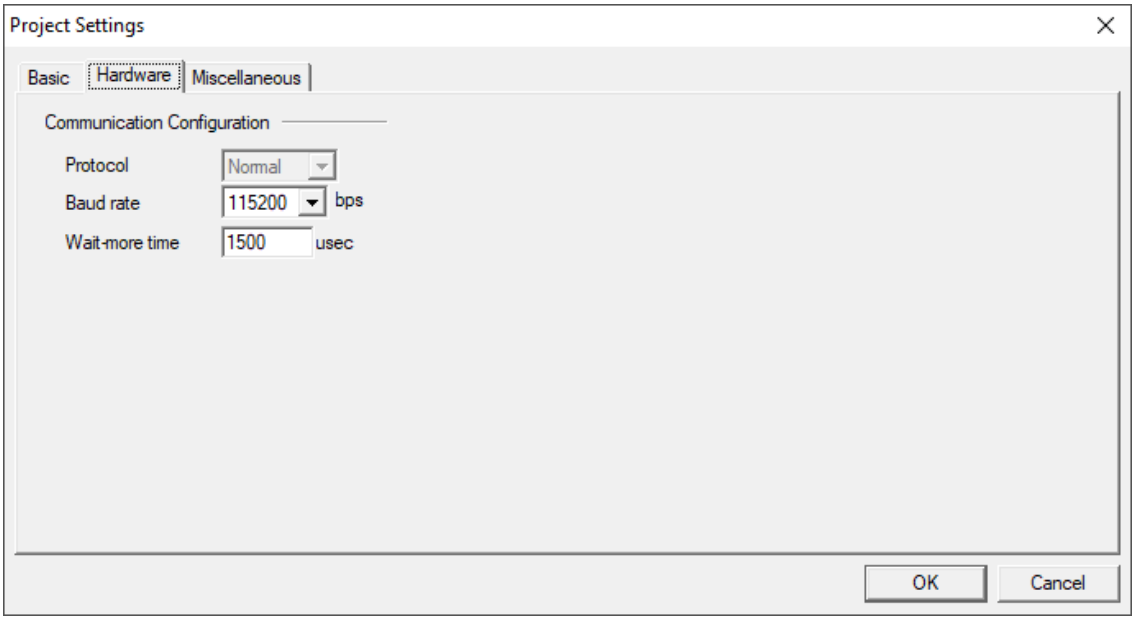


NEW In case of multi core MCU, please specify the output files for all the used cores of MCU in the user program. easyDSP uses these files for RAM booting and flash programming. Also specifiy the core

easyDSP is communicating with in the 'Communication with easyDSP' check boxes.
In below figure, easyDSP is communicating with CPU1 and CPU2 while CPU1, CPU2, CPU3 and CPU4 is running in the MCU.

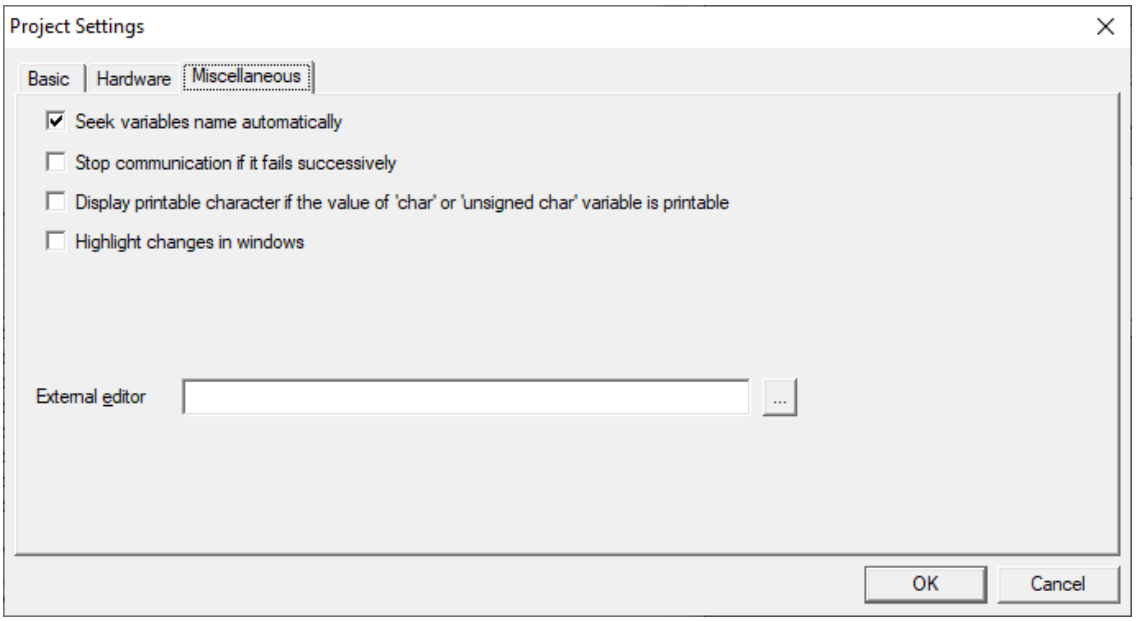


'Hardware' page sets the hardware configuration for easyDSP communication.
'Protocol' : This is disabled menu.
'Baud rate' : This value means baud rate at PC side which should be same to SCI/UARt baudrate of MCU.
'Wait-more time' : During communication with MCU, easyDSP wait for the response from MCU for certain period. This value extends the waiting time. Please set this value 1000 usec as a first step. If the communication fails due to slow response from MCU, please try to increase this value a little step by step (maximum value is 30000usec) until the communication becomes ok.



'Miscellaneous' page sets the remains.
'Seek ...' function is very useful when you type the variable name in the window (For ex, command window). It recommends candidates for variable name automatically.
'Stop...' function stops communication of easyDSP if the communication fails successively.
'Display printable ...' display not value but character in case either char or unsigned char variable has a value between 0x20 and 0x7F.

'Highlight ...' shows the changed value of variables in yellow background color.
External editor : set the editor program to be called in the Tools>Editor menu.



'Open' menu:

opens the existing project.

'Set & Save' menu :

sets the properties of active project and then save.

'Close' menu:

closes current project.

'Delete' menu :

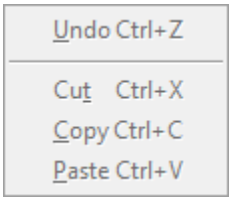
deletes all files easyDSP created.
easyDSP makes some files either in the project folder or in the folder the output file is located. They are

MCU	in the easyDSP project folder	in the folder where output file is located
Common	project name.ezd : saves properties of project project name.vars : saves information of variables project name.cfg : saves information of the others	
C28x	easyDSP_FlashApiWrapper.out easyDSP_FlashApiWrapper.ou~ easyDSP_FlashApiWrapper.ez.bin : files for flash operation	output file name.ez.bin : RAM booting and flash programming file (Gen2) output file name.ez.hex : flash programming file (Gen3)
PSOC		output file name.ez.cyacd : flash programming file

STM32 TM4C MSPM0 RA / RX PSOC XMC TX(Z) LPC S32		output file name.ez.hex : RAM booting (if doable) and flash programming file
AM2x		output file name.ez.appimage : RAM booting and flash programming file

8.2 Edit

Edit menu

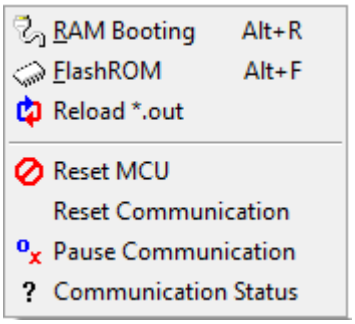


No need to explain ;-)

8.3 MCU

8.3.1 Common

MCU menu



'RAM Booting' menu
'Flash ROM' menu

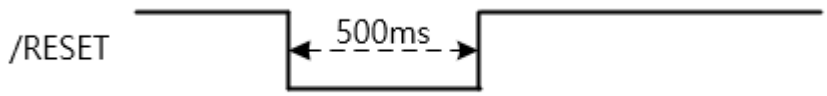
Please check the below.
C28x
STM32
S32
AM263x
TM4C
MSPM0
PSoC4
XMC1
XMC4
RA
RX
TX, TXZ3
LPC

'Reload *.out' menu

reloads output file (*.out, *.elf or *.axf). It comes in handy when you use debugger and easyDSP together or when you uses easyDSP only for communication (not using /RESET and BOOT pin).
For the MCU easyDSP doesn't support flash programming such as XMC1, please use this menu to update symbol information whenever the user program is updated (programmed).

'Reset MCU' menu

The /RESET pin of easyDSP pod goes down to low for 500ms to make reset MCU.
The /BOOT and BOOT pin of easyDSP pod are inactive : no signal output from them.
For the MCU easyDSP doesn't support flash programming such as XMC1, this menu is not disabled.



'Reset Communication' menu

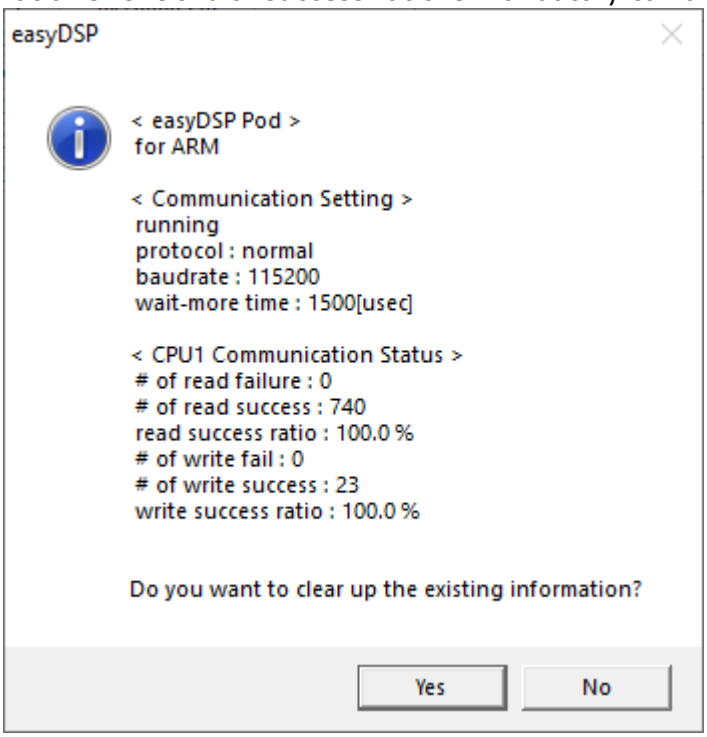
It initializes the states of ISR for easyDSP.

'Pause(Resume) Communication' menu

It pauses the communication of easyDSP. This menu toggles into 'Resume Communication' menu.

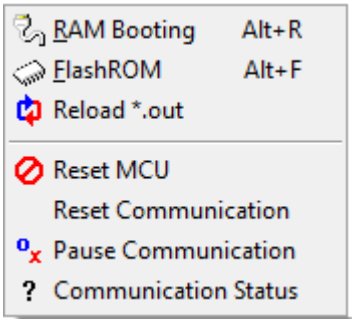
'Communication Status' menu

It displays the target MCU of easyDSP pod and communication state such as read/write fail/success ratio. Over 90% of success ratio is mandatory to have fluent communication.



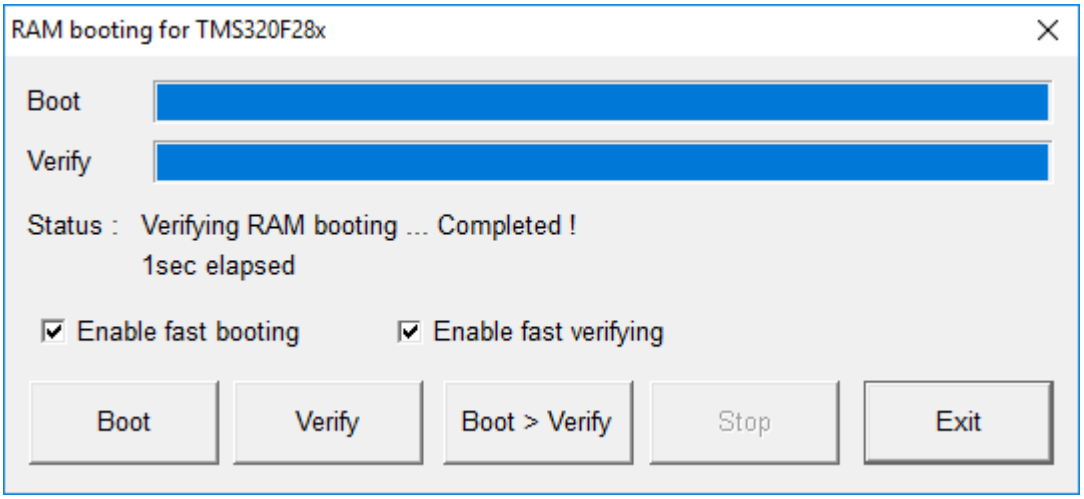
8.3.2 C28x

MCU menu (TI C28x)



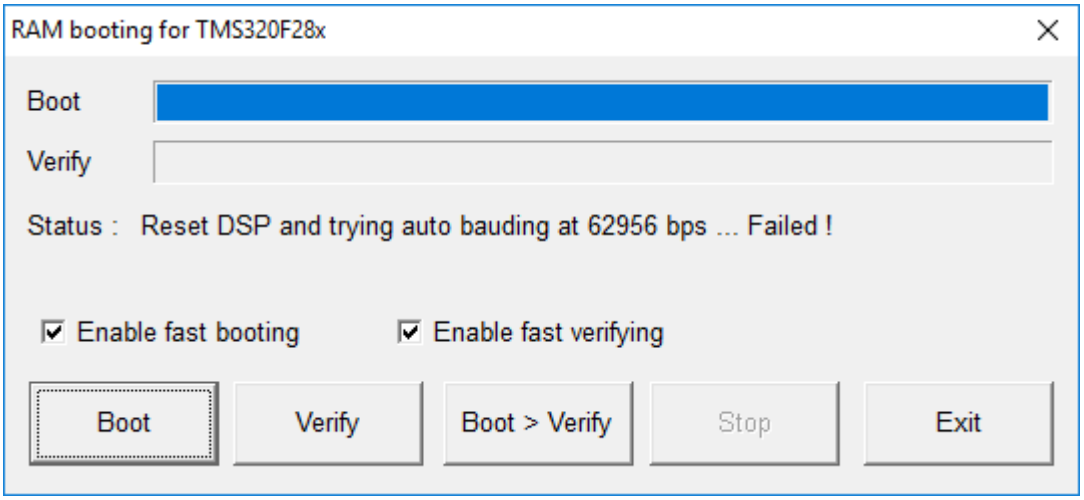
'RAM Booting' menu

is for booting to RAM area only (NO flashrom area). During RAM booting, communications in all windows are temporarily paused.

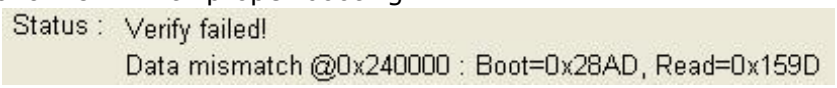


'Boot' button starts booting operation. First it is checked if user program is appropriate for RAM booting. If it fails, booting operation stops.
In case the user program is re-compiled in the meantime, easyDSP detects it and asks you whether you will use new program.
Faster action will be tried if you check 'Enable fast ....' check box.
If 'Enable fast verifying' is not working properly due to limited resource availability, please disable this option.

Below error message during RAM booting indicates DSP didn't get into booting mode due to most likely wrong hardware connection.

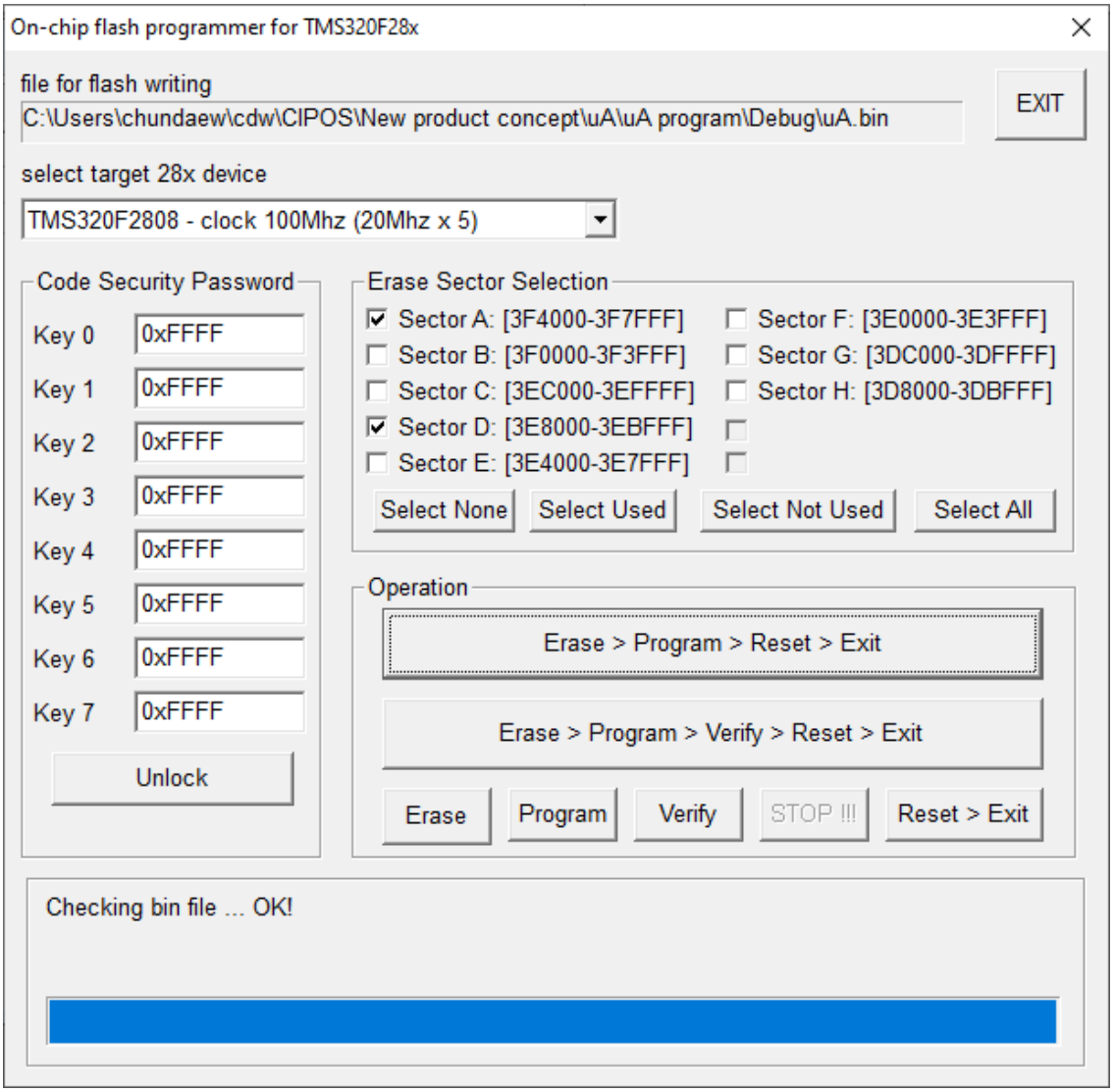


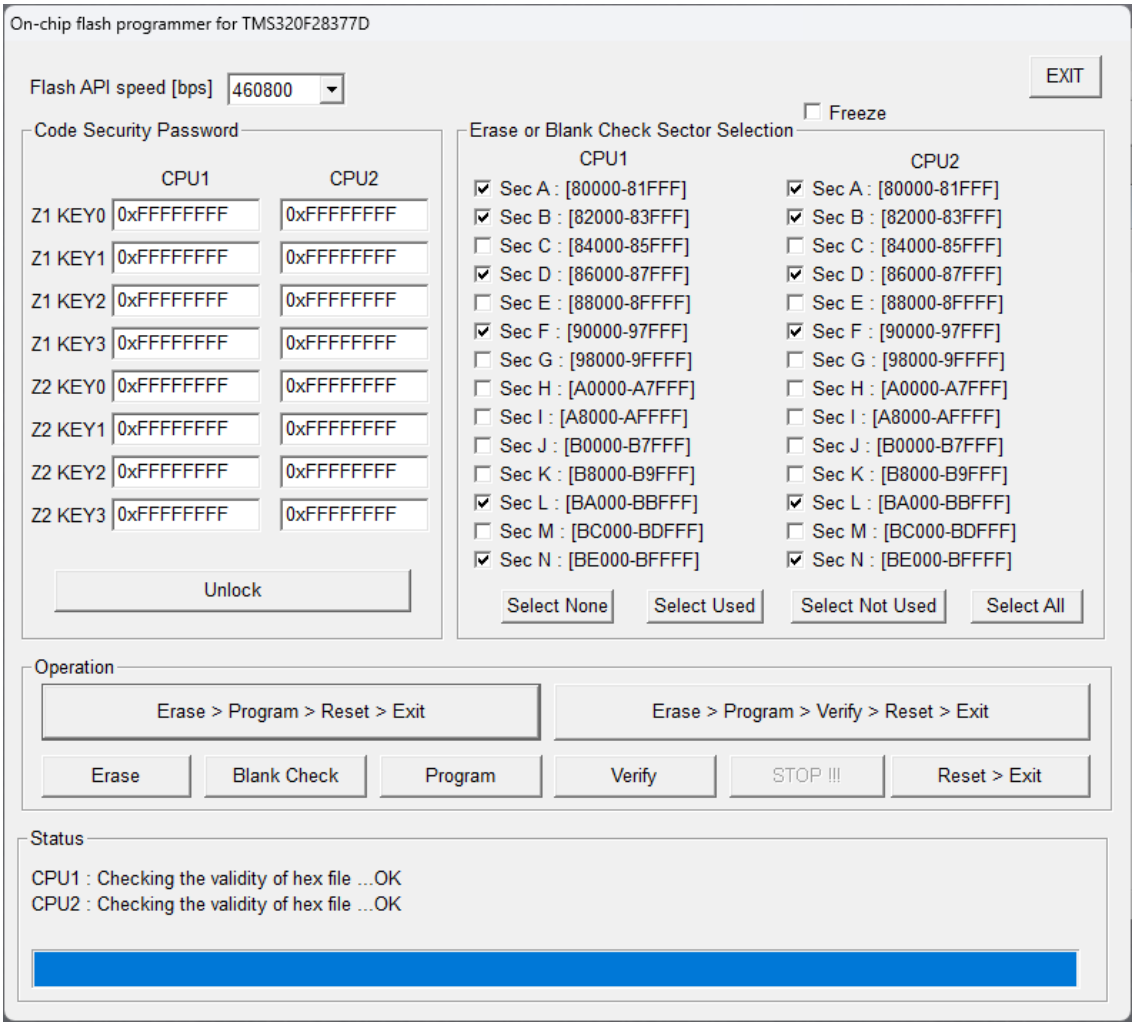
'Verify' button check if the RAM booting was done correctly. If failed during verifying, below message comes out. It means that the data at address 0x240000 is now 0x159D which is supposed to be 0x0x28AD with proper booting.

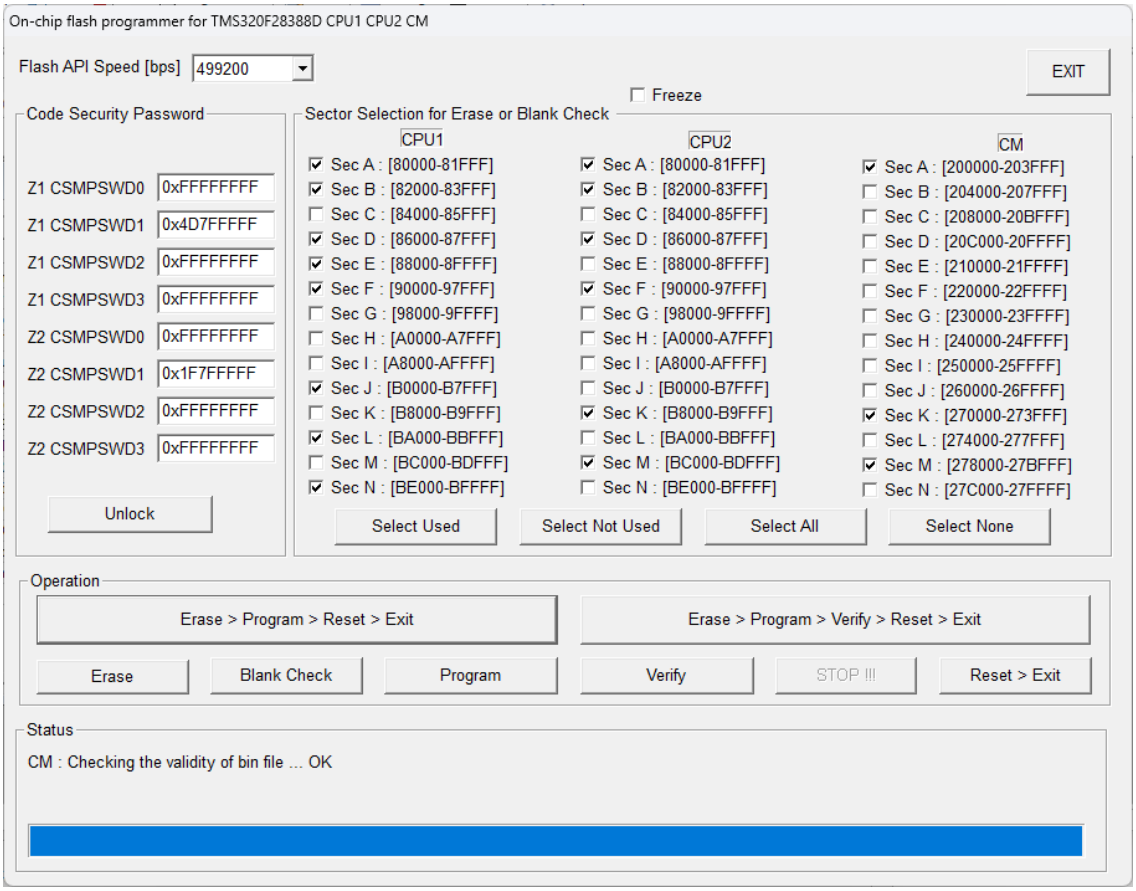


'Boot > Verify' button is doing 'Boot' and 'Verify' button consecutively.
'Stop' button stops any ongoing activity either booting or verifying.

'Flash ROM' menu for Gen2 MCU, F2837xD and F2838x


On-chip flash programmer for TMS320F28x
file for flash writing
C:\Users\chundaew\cdw\CIPOS\New product concept\uA\uA program\Debug\uA.bin
EXIT
select target 28x device
TMS320F2808 - clock 100Mhz (20Mhz x 5)
Code Security Password
Key 0
0xFFFF
Key 1
0xFFFF
Key 2
0xFFFF
Key 3
0xFFFF
Key 4
0xFFFF
Key 5
0xFFFF
Key 6
0xFFFF
Key 7
0xFFFF
Unlock
Erase Sector Selection
Sector A: [3F4000-3F7FFF]
Sector B: [3F0000-3F3FFF]
Sector C: [3EC000-3EFFFF]
Sector D: [3E8000-3EBFFF]
Sector E: [3E4000-3E7FFF]
Sector F: [3E0000-3E3FFF]
Sector G: [3DC000-3DFFFF]
Sector H: [3D8000-3DBFFF]
Select None
Select Used
Select Not Used
Select All
Operation
Erase > Program > Reset > Exit
Erase > Program > Verify > Reset > Exit
Erase
Program
Verify
STOP !!!
Reset > Exit
Checking bin file ... OK!


On-chip flash programmer for TMS320F28377D
Flash API speed [bps]
460800
EXIT
Freeze
Code Security Password
CPU1
CPU2
Z1 KEY0
Z1 KEY1
Z1 KEY2
Z1 KEY3
Z2 KEY0
Z2 KEY1
Z2 KEY2
Z2 KEY3
0xFFFFFFFF
Unlock
Erase or Blank Check Sector Selection
Sec A : [80000-81FFF]
Sec B : [82000-83FFF]
Sec C : [84000-85FFF]
Sec D : [86000-87FFF]
Sec E : [88000-8FFFF]
Sec F : [90000-97FFF]
Sec G : [98000-9FFFF]
Sec H : [A0000-A7FFF]
Sec I : [A8000-AFFFF]
Sec J : [B0000-B7FFF]
Sec K : [B8000-B9FFF]
Sec L : [BA000-BBFFF]
Sec M : [BC000-BDFFF]
Sec N : [BE000-BFFFF]
Select None
Select Used
Select Not Used
Select All
Operation
Erase > Program > Reset > Exit
Erase > Program > Verify > Reset > Exit
Erase
Blank Check
Program
Verify
STOP !!!
Reset > Exit
Status
CPU1 : Checking the validity of hex file ...OK
CPU2 : Checking the validity of hex file ...OK



It programs onchip flash of MCU. Note that the communication in other windows are temporarily paused.

Please follow below sequence.
step 1 : First select target device according to your MCU and clock configuration. This menu is available for some MCU only.
step 2 : Select the sectors for erasing or blank checking. Either use the buttons or click the checkboxes of sectors.

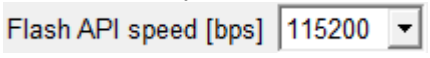
All sectors used in the user program are selected with 'Select Used' button. The other way around with 'Select Not Used' button.

For some MCUs, Freeze checkbox is provided to enable or disable sector selection.
step 3 : When the buttons (‘Erase’, ‘Blank Check’,‘Program’, ‘Verify’ or ‘Unlock’) are pressed first time, easyDSP boots MCU with the agency program (not user program) to handle flashrom manipulation.

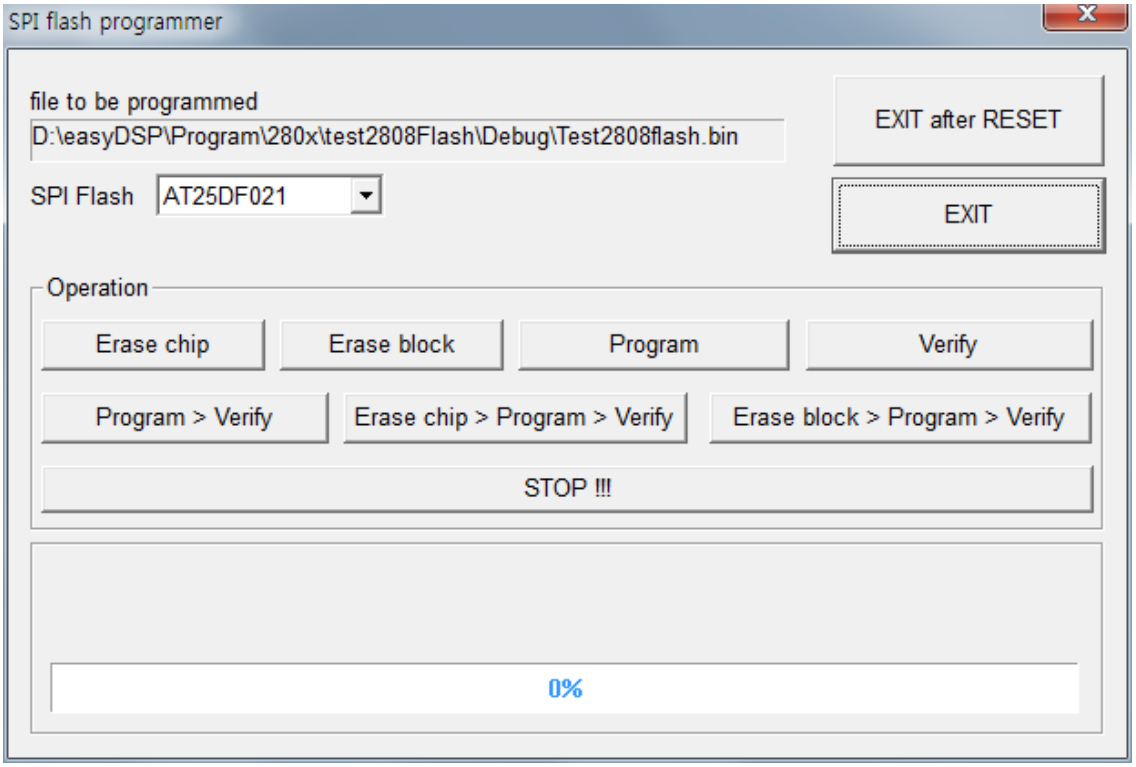
If the output file (*.out) is updated meantime, easyDSP ask the user to use update output file or not.

One click for all operations possible (ex. 'Erase > Program > Reset > Exit' button)
step 4 : Now MCU is booted and communicates with easyDSP for proper flashrom access.
step 5 : when exiting this dialog box, easyDSP forces MCU to be reset. Then MCU boots with flashrom and user program starts.
note) above dialog box looks different depending on the MCU type
note) For 2837xD and 2838xS(D), this will program the supplied data portion in flash along with automatically generated ECC(Error Correction Code).
note) In case below menu is activated, bps of flashAPI wrapper can be selected to reduce flash operation time. Note that certain bps could not work.

This bps value has nothing to do with the bps value used in variable monitoring. So, don't need to match with the bps value in the easyDSP header file and in the project setting. NEW



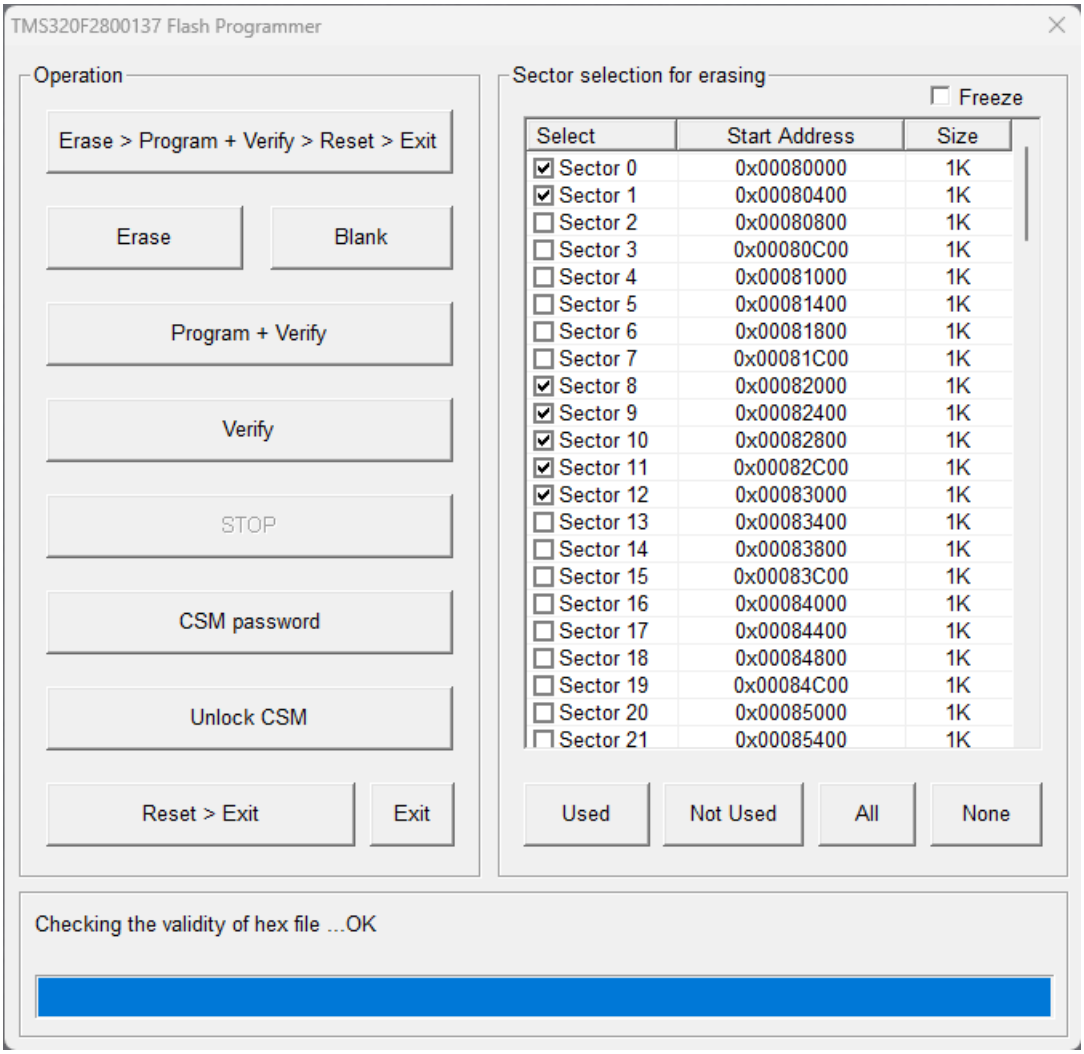
'Flash ROM' menu for C2834x series



Since 2834x doesn't have internal flash, easyDSP supports external flashs with SPI interface. They are AT25DF021(2M bit), AT25DF041(4M bit), AT26DF081(8M bit), AT25DF321(32M bit), M25P20(2M bit), M25P40(4M bit), M25P80(8M bit), M25P16(16M bit), M25P32(32M bit) manufactured by ATMEL or Numonyx. Other flashs which support same commands and features to above could be operated.
There are two kinds 'Erase' function : 'Erase chip' erases all chip memory. 'Erase block' erases only the memory region which will be programmed with user program. Because 'Erase block' uses '4K byte block erasing' feature of ATMEL flash, the memory region to be erased will be normally larger than the actual code size, at the most, 4K bytes.
Please note that easyDSP does 'global unprotect' action to the flash during its operation.
Also note that easyDSP sets LOSPCP = 2 and SPIBRR = 0 to control SPI-A boot mode speed.

'Flash ROM' menu for others

This is for Gen.3 single core MCU and Gen.3 multi core MCU like F28Px.
It programs onchip flash of MCU with user program. Note that the monitoring of easyDSP is temporarily paused during flash operation.

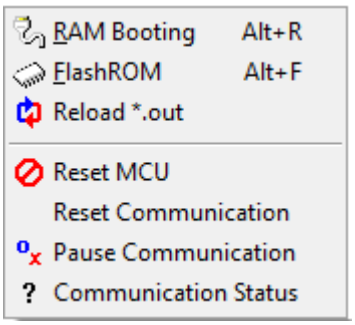


Please follow below sequence.

step 1 : If necessary, set the CSM key values and unlock CSM by using 'CSM password' and 'Unlock CSM' buttons
step 2 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.
All sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.
step 3 : When the buttons (Erase, Blank, Program+Verify, Verify) are clicked first time, MCU enters to single boot mode after reset.
step 4 : Execute necessary flash actions.
note) It programs the supplied data portion in flash along with automatically generated ECC(Error Correction Code).
step 5 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

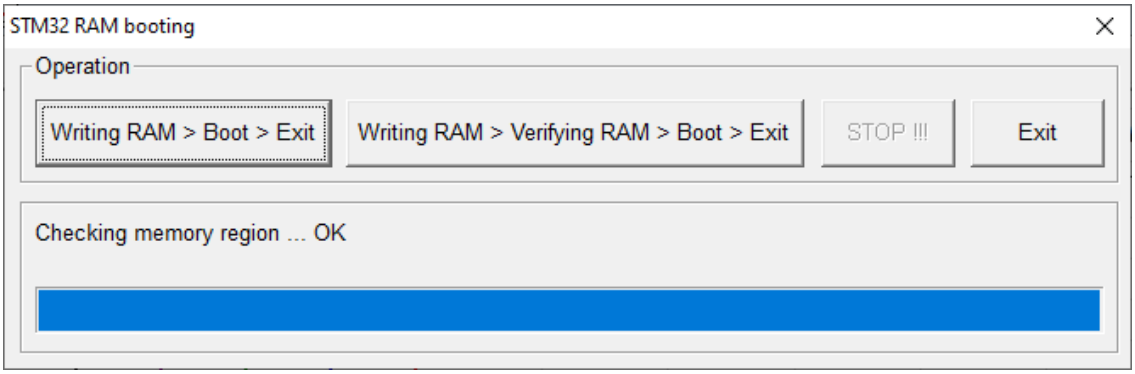
8.3.3 STM32

MCU menu (ST STM32)

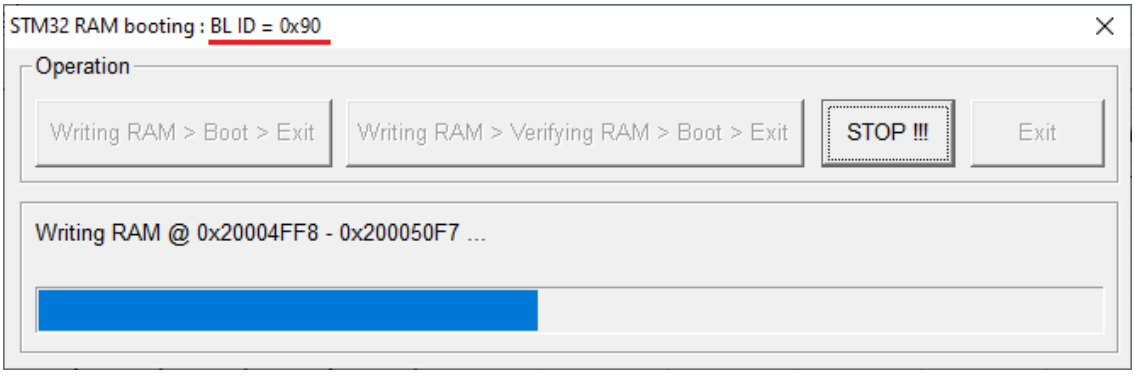


'RAM Booting' menu

is for booting to RAM area only (NO flashrom area). During RAM booting, communications in all windows are temporarily paused.



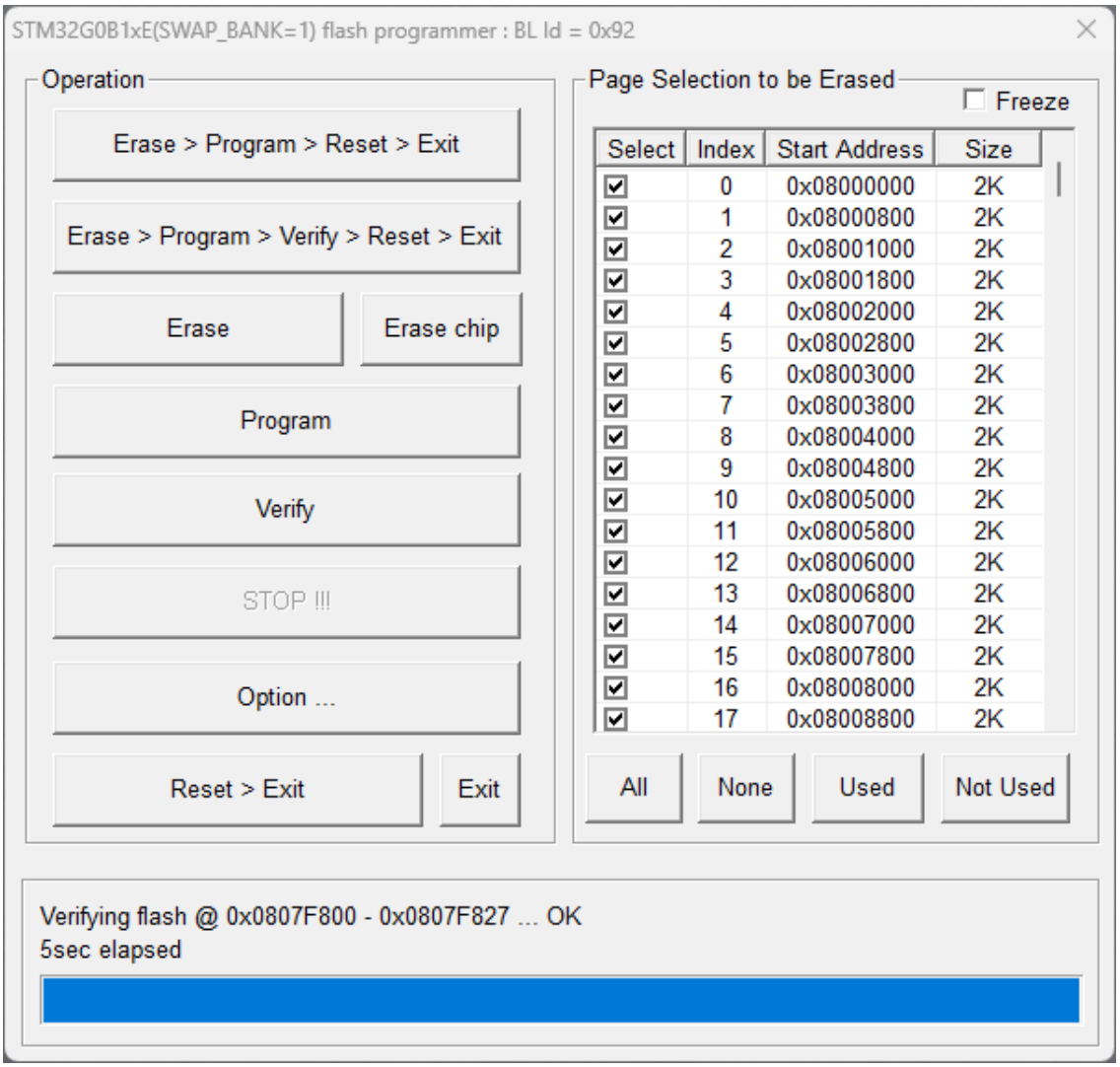
'Boot' button starts booting operation. First it is checked if user program is appropriate for RAM booting. If it fails, booting operation stops.
In case the user program is re-compiled in the meantime, easyDSP detects it and asks you whether you will use new program.
Before action, easyDSP check MCU's bootloader version and display it on the title bar of window.



'Stop' button stops any ongoing activity.
Note that RAM booting is not supported for dual core MCU.

'Flash ROM' menu

It programs onchip flash of MCU with user program. Access to OTP memory, Data memory and option byte is not supported.
Its functionality could be limited with activated Trust Zone or Secure MPU.
Note that the communication in other windows are temporarily paused.



Please follow below sequence.

step 1 : Select the flash pages to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkboxes of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.

step 2 : If 'Option...' button is enabled, click it and select the proper option.

For example, you choose (not change) SWAP_BANK bit status for STM32G0B1.

Since the option is saved, you can choose option only when change.

step 3 : When the buttons ('Program', 'Verify', 'Erase' or 'Erase chip') are clicked first time, MCU enters to bootload mode after reset.

step 4 : Execute necessary flash actions.

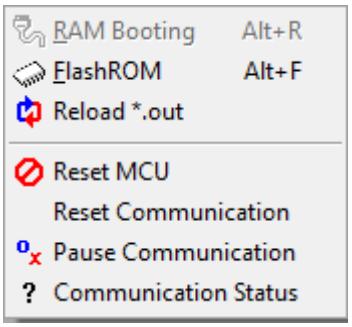
'Erase chip' erases all the flash in the MCU regardless of selected check box.

step 5 : When exiting this dialog box, use 'Reset > Exit' button. It makes MCU reset and boot with flash. And user program starts.

If you exit this dialog box without MCU reset, MCU still stay in the bootload mode.

8.3.4 S32

MCU menu (NXP S32)



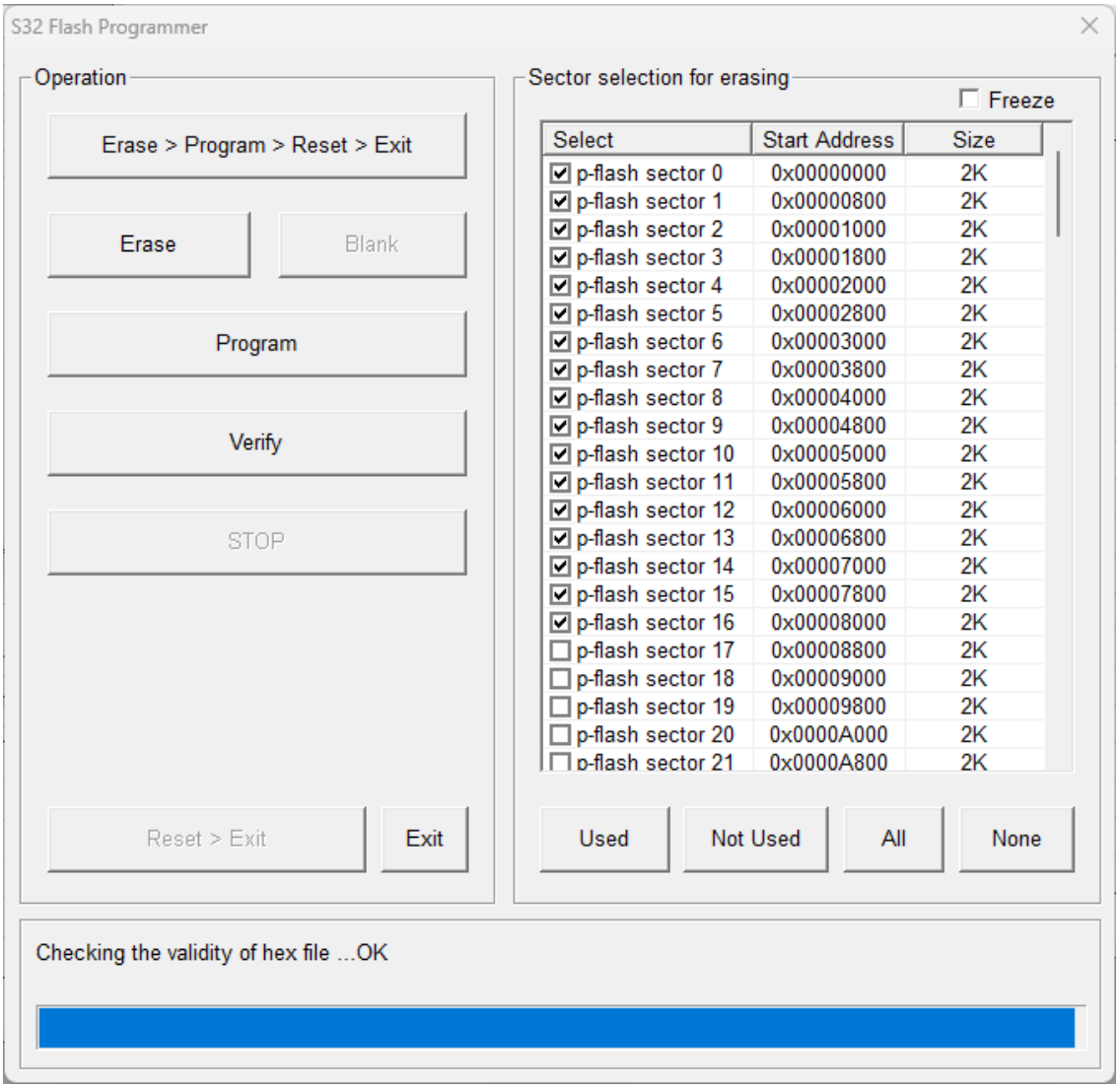
RAM Booting menu

This menu is not supported.

Flash ROM menu

NOTE : this menu is working only when EZ_BOOTLOADER_USE is defined as 1 in the easyS32**.h file. For detailes, refer to this page.

It programs onchip flash of MCU with user program. During this operation, the monitoring of easyDSP is temporarily paused.
Note that you have to disable any flash related protection feature in the MCU while using this menu.



step 1 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.

step 2 :When the buttons (Erase, Program, Verify) are clicked first time, MCU enters to bootloade (easyDSP_boot() function) after reset.

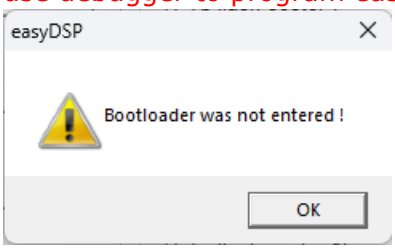
step 3 : Execute necessary flash actions. 'Blank' button is disabled.

step 4 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

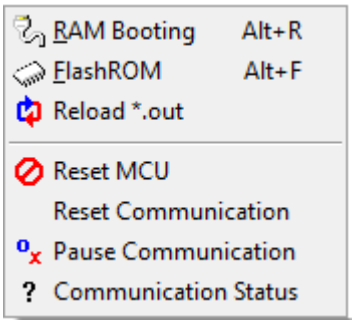
Note :

To program flash, the bootloader should be provided since there is no ROM bootloader in this MCU. The bootloader easyDSP provides is the function (name : easyDSP_boot) and it resides in the user program. Therefore it can program flash only when it is already programmed in the flash. In case flash is empty or flash doesn't have easyDSP bootloader, you can't enter into the bootloader and will see the message below. In this case, you have to use the debugger to program flash. And in same principle, you have to

use debugger to program easyDSP bootloader into flash at the beginning.

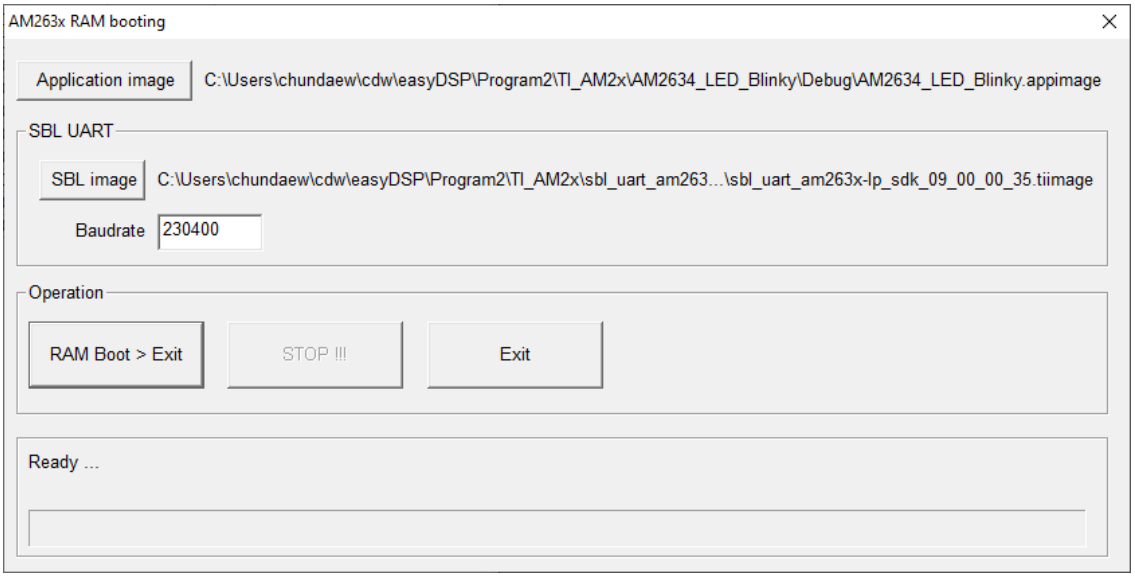


8.3.5 AM263x



'RAM Booting' menu

It is for MCU booting to RAM area only (NO flashrom area) by using TI SBL UART mechanism.
During RAM booting, easyDSP monitoring in all windows is temporarily paused.



easyDSP doesn't provide SBL UART image file. It provides the method for RAM booting using the given SBL UART image file from either TI or your own.
Please follow below steps.

step 1 : Please select the application image file to be downloaded to RAM. By default, the app image file which easyDSP is using is selected. But you can change it by clicking 'Application image' button.
step 2 : Please choose SBL UART image file via 'SBL image' button and then input the baudrate of SBL UART.

If you use the prebuilt SBL by TI (the files located in C:\ti\mcu_plus_sdk_am263x_09_00_00_35\tools\boot\sbl_prebuilt folder for example), set the baudrate to 115200.

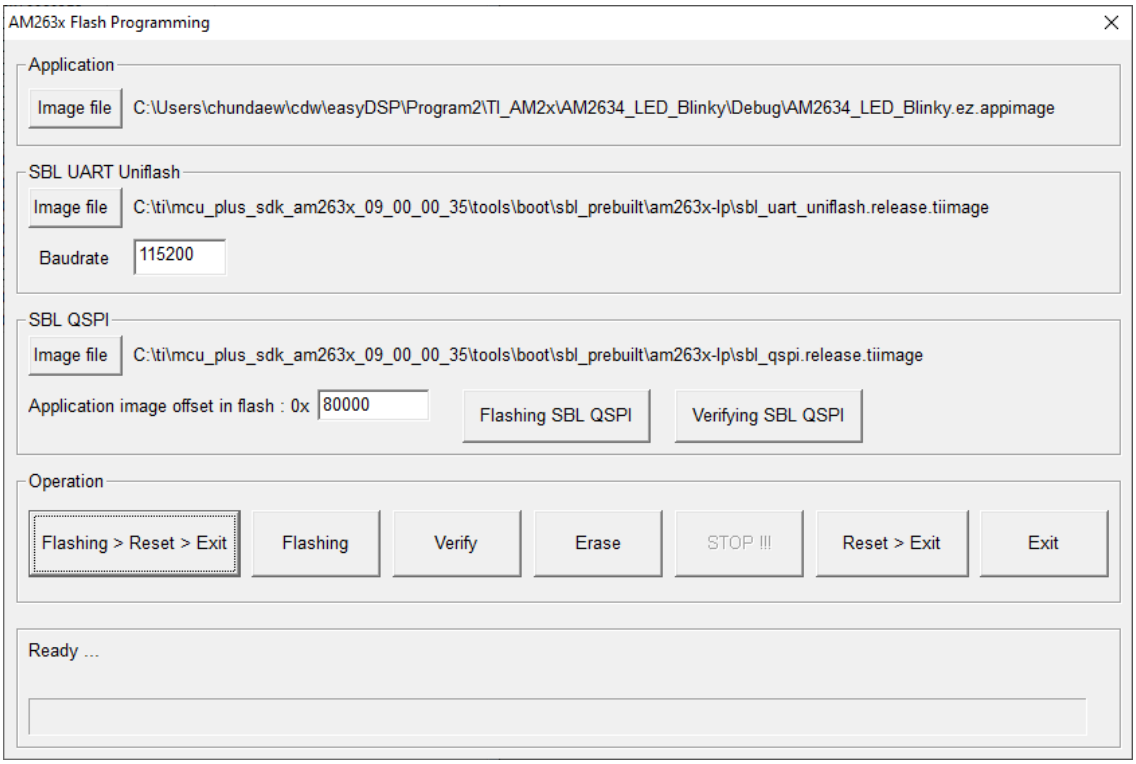
If you use your own SBL UART, set the baudrate according to your own SBL UART.

step 3 : 'RAM Boot > Exit' button starts booting operation. In case the user program is re-compiled in the meantime, easyDSP detects it and asks you whether you will use new program.

'Stop' button stops any ongoing activity.

'Flash ROM' menu

It programs user program to SPI flash. easyDSP monitoring in all windows is temporarily paused and below dialog box appears.



easyDSP doesn't provide SBL image files themself. It provides the method for downloading SBL and flashing the application using the given SBL image files from either TI (prebuilt SBL) or your own. Please follow below steps.

step 1 : Please select the application image file to be downloaded to SPI flash. By default, the app image file which easyDSP is using is selected. But you can change it by clicking 'image file' button.

Please note that easyDSP generates app image file (file extension = ez.appimage) from *.rprc files created by IDE.

step 2 : Please choose SBL UART Uniflash image file via 'image file' button and then input the baudrate of the SBL.

If you use the prebuilt SBL by TI (the files located in C:\ti\mcu_plus_sdk_am263x_09_00_00_35\tools\boot\sbl_prebuilt folder for example), set the baudrate to 115200.

If you use your own SBL, set the baudrate according to your own SBL.

step 3 : Please choose SBL QSPI image file via 'image file' button. And set the offset where the app image will be written to SPI flash.

For prebuilt SBL by TI, the offset is 0x80000. For your own SBL, set the offset accordingly.

step 4 : Flashing SBL QSPI by clicking 'Flashing SBL QSPI' button. Once done, not required anymore until you change the SBL QSPI.

Once all set until step 4, you don't need to repeat the steps.

step 5 : Execute necessary flash actions by clicking buttons in the 'Operation' area.

When the buttons ('Flashing', 'Verify' or 'Erase') are clicked first time, MCU enters to boot mode

after reset and SBL UART Uniflash is downloaded and runs.

Flashing is the successive action of Erase > Program > Verify. So, Erasing or Verifying before/after flashing is optional.

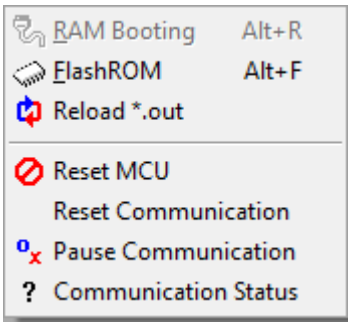
Note that flashing and verifying action is done in 192kB block unit.

step 6 : When exiting this dialog box, use 'Reset > Exit' button. It makes MCU reset and boot with QSPI (4S) - Quad Read Mode. And user program starts.

If you exit this dialog box without MCU reset, MCU still stay in SBL and the easyDSP monitoring will fail.

8.3.6 TM4C

MCU menu (TI TM4C)

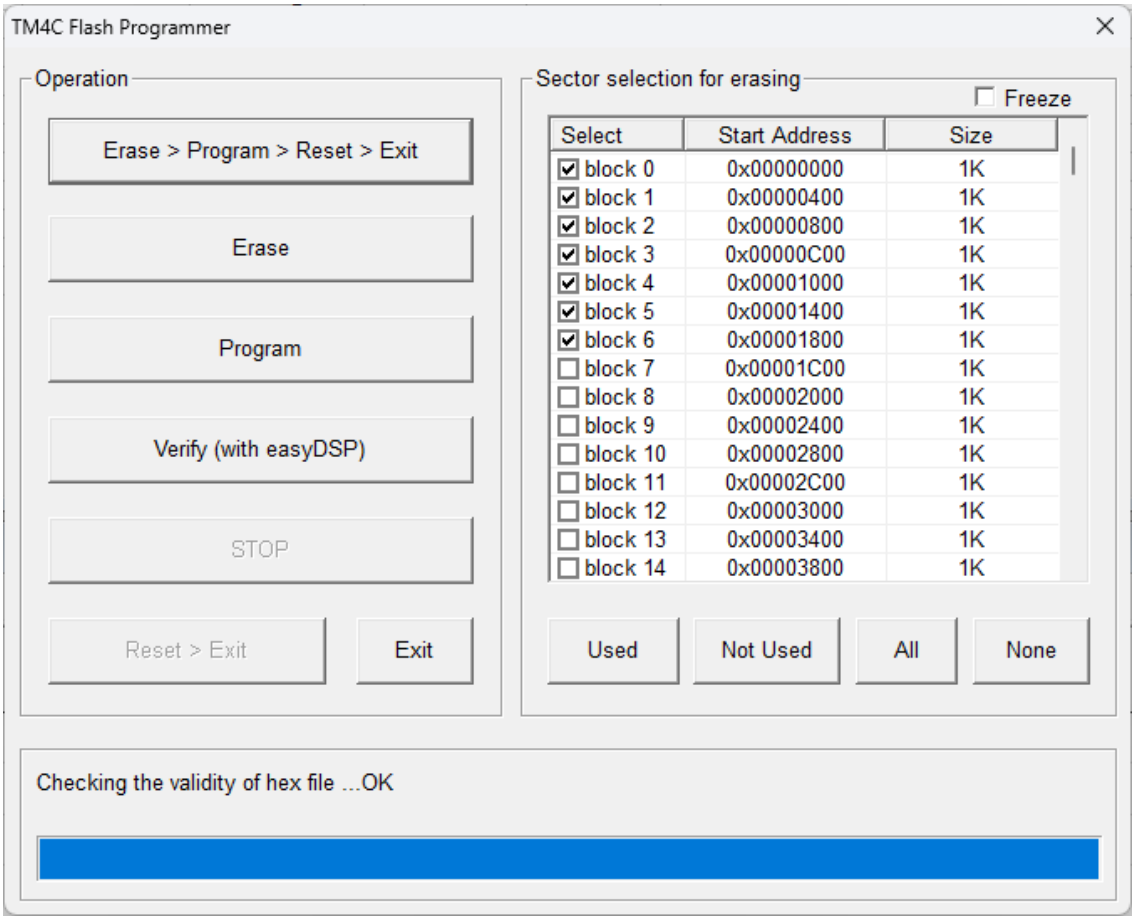


RAM Booting menu

This menu is not supported.

Flash ROM menu

It programs onchip flash of MCU with user program. Note that the monitoring of easyDSP is paused with this menu.



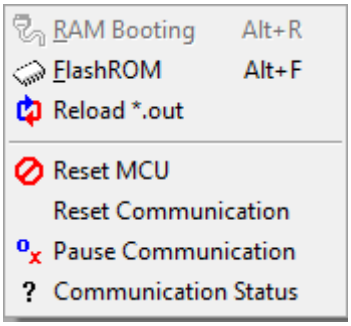
Please follow below sequence :
step 1 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.
step 2 : When the buttons (Erase, Program) are clicked first time, MCU enters to ROM boot loader after reset.
step 3 : Execute necessary flash actions.
step 4 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

Note : Since MCU ROM boot loader doesn't support verify function, easyDSP provides 'Verify (with easyDSP)' button instead. This is verification of flash contents by using easyDSP monitoring, not by ROM boot loader. This button is disabled once MCU enters ROM boot loader.

8.3.7 MSPM0



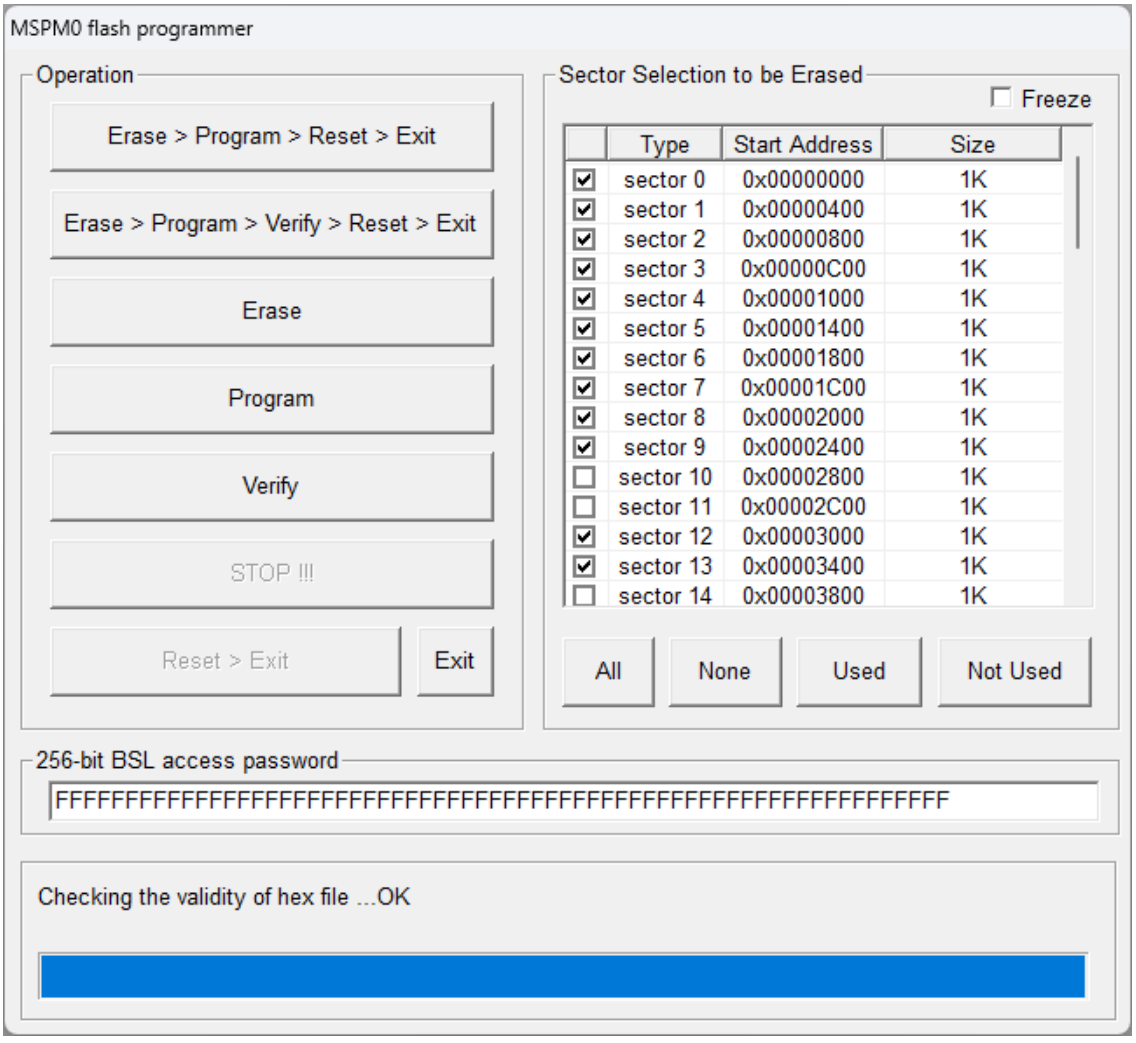
RAM Booting menu

This menu is not supported.

Flash ROM menu

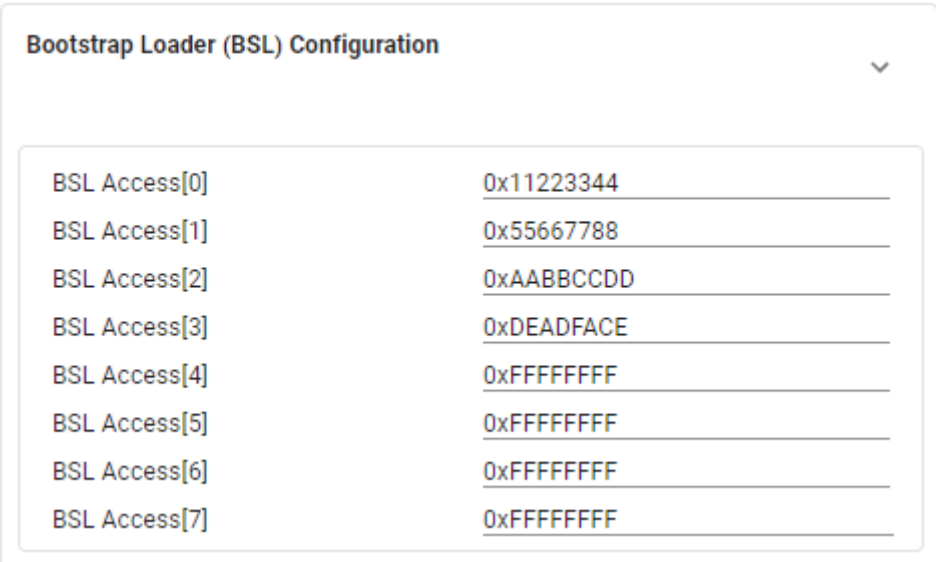
It programs MAIN flash memory region of MCU with user program.
Please disable any flash related protection feature in the MCU while using this menu.
Since easyDSP can't support NONMAIN flash memory region (such as BCR and BSL configuration area), please use the debugger or any other tool to program NONMAIN flash.

When this menu is activated, the monitoring of easyDSP is temporarily paused.

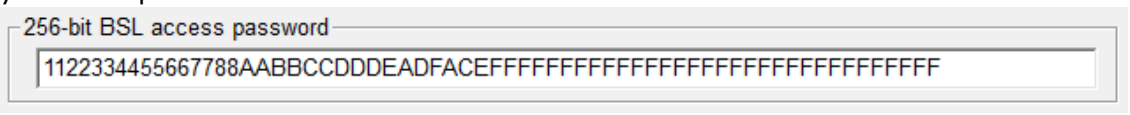


Please follow below sequence.

step 1 : Set the 32 bytes password to enter bootstrap mode. It is all 0xFF at TI production state.
If you set them in SysConfig like below,



you can input like below.



step 2 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.

step 3 : When the buttons (Erase, Program, Verify) are clicked first time, MCU enters to bootstrap mode after reset.

step 4 : Execute necessary flash actions.

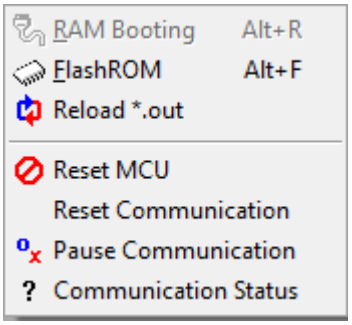
'Verify' button acts differently depending on the 'BSL Read Out Enable' value in the SysConfig > BSL Configuration tab.

If read out is disabled (like TI factory default), it checks 1024 bytes CRC without reading the flash memory.

If read out is enabled, it reads the flash memory.

step 5 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

8.3.8 PSoC4

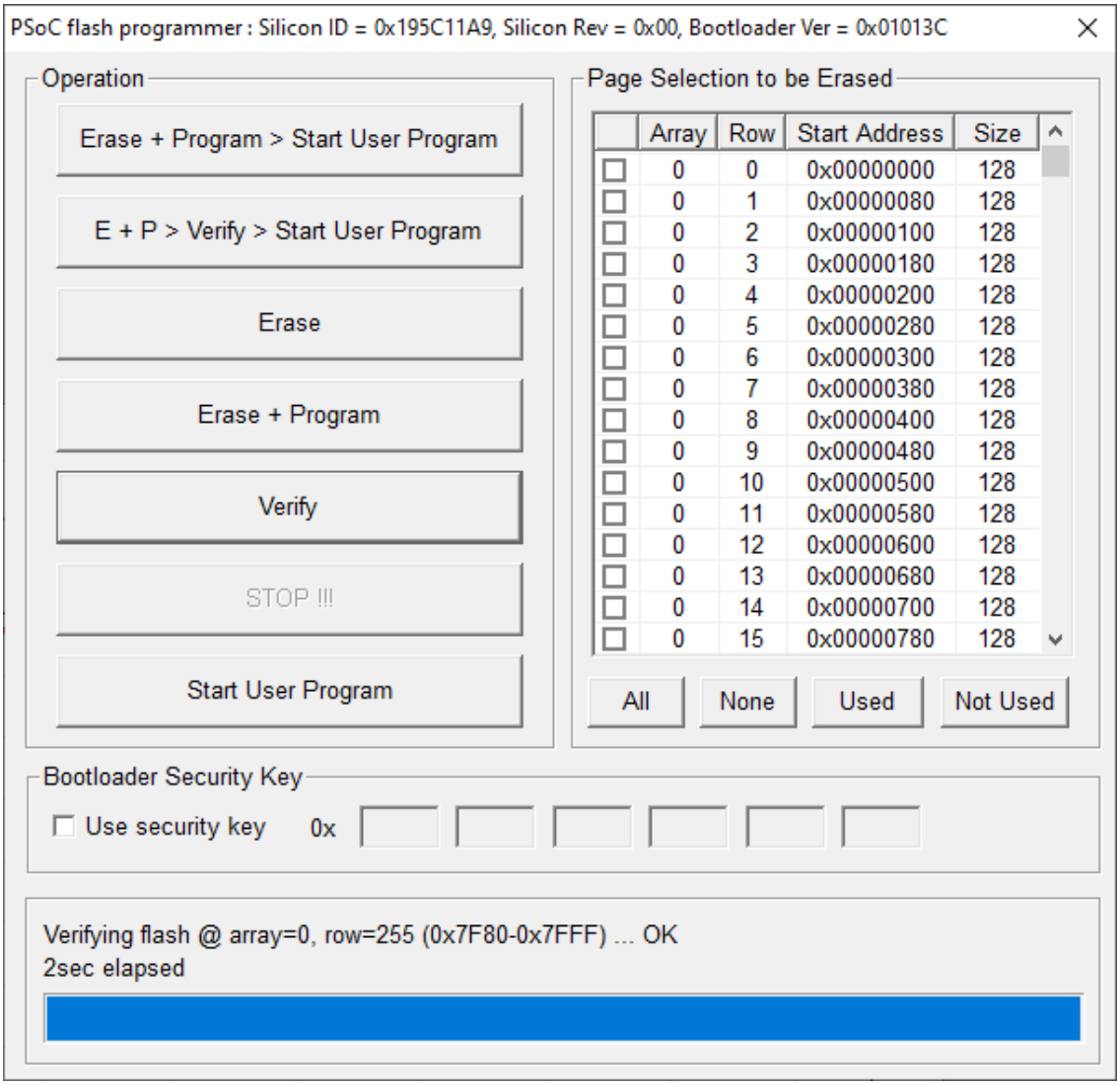


RAM Booting menu

This menu is not supported.

Flash ROM menu

It programs onchip flash of MCU with user program only for single-application bootloader configuration. Note that the monitoring of easyDSP is temporarily paused.

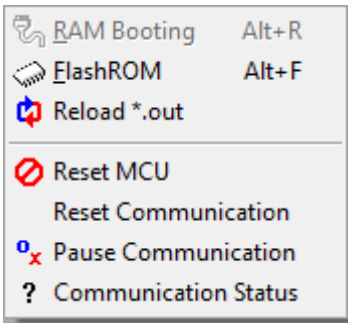


Please follow below sequence.

step 1 : Select the flash array and row to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.
All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.
step 2 : If bootloader security key is used, please input the key value after clicking 'Use security key' button.
step 3 : When the buttons (Erase, Erase+Program, Verify) are clicked first time, MCU enters to bootloader mode after reset.
Also silicon ID, selicon revision, bootloader version is displayed in the title bar.
step 4 : Execute necessary flash actions.
step 5 : Click 'Start User Program' button when exiting this dialog box. It makes MCU reset and user program starts.
note : erasing the flash where bootloader program is located is not enabled.

8.3.9 XMC1

MCU menu (Infineon XMC1)



RAM Booting menu

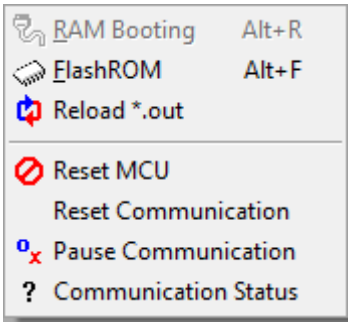
This menu is disabled.

Flash ROM menu

This menu is disabled.

8.3.10 XMC4

MCU menu (Infineon XMC4)

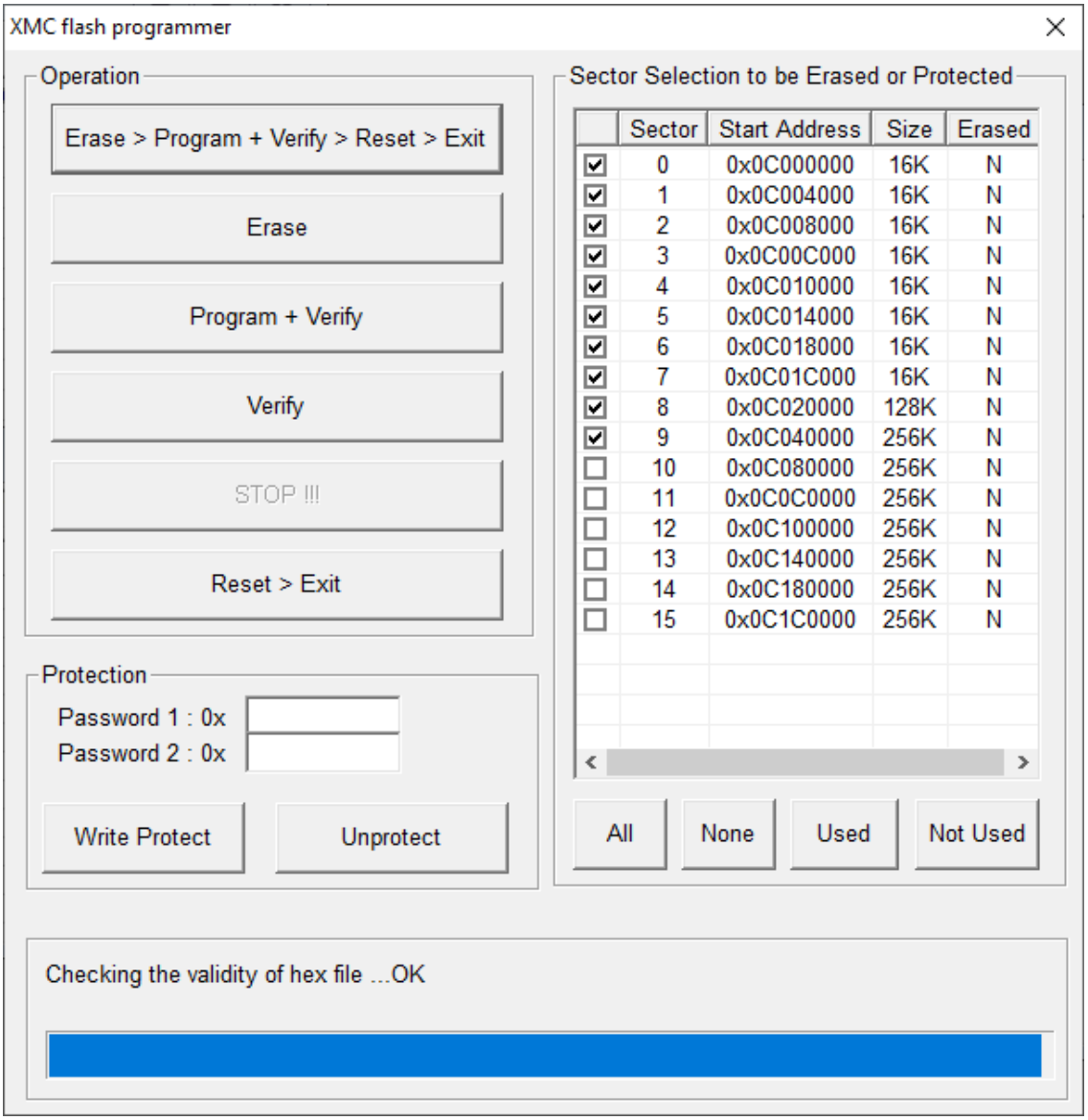


RAM Booting menu

This menu is not supported.

Flash ROM menu

It programs onchip flash of MCU with user program. Note that the monitoring of easyDSP is temporarily paused.

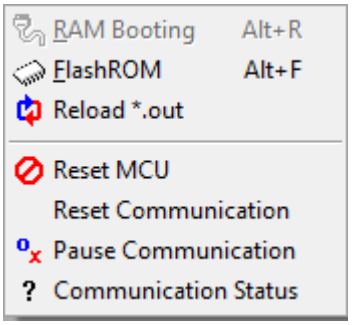


Please follow below sequence.

step 1 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.
All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.
step 2 : If necessary, use write-protection.
step 3 : When the buttons (Erase, Program+Verify, Verify) are clicked first time, MCU enters to bootloader mode after reset.
step 4 : Execute necessary flash actions.
step 5 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.
NOTE) programming to not erased sector may causes malfunction.

8.3.11 RA

MCU menu (Renesas RA)

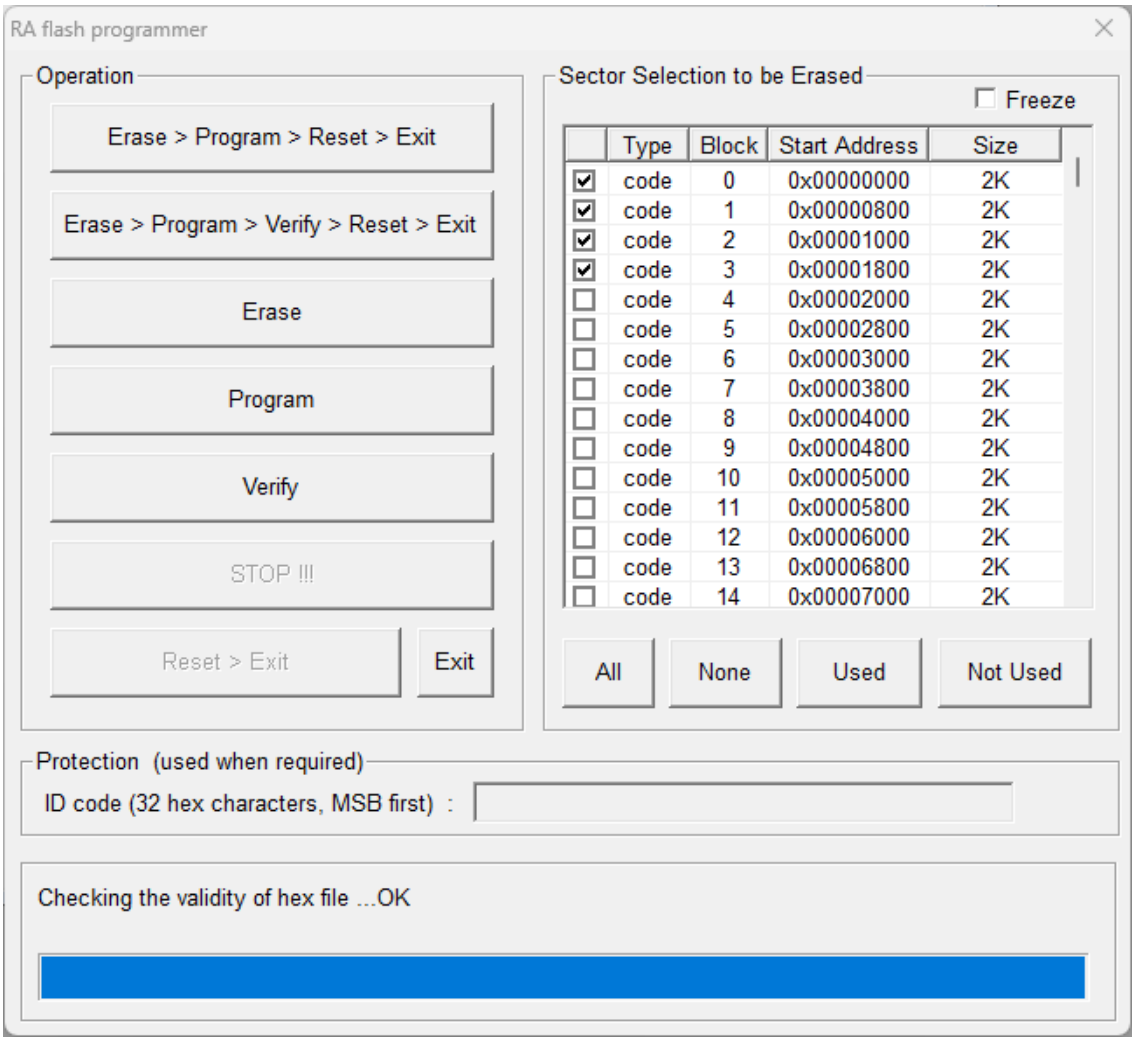


RAM Booting menu

This menu is not supported.

Flash ROM menu

It programs onchip flash of MCU with user program. Note that flash programming is not supported for RA0 series.
Note that the programming would be not available in case security or protection is set to the memory.
When clicked, the monitoring of easyDSP is temporarily paused and dialog will be present as below.



Please follow below sequence.

step 1 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the

checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.

Note that erasing of option flash is not performed since it is not necessary.

step 2 : When the buttons (Erase, Program+Verify, Verify) are clicked first time, MCU enters to bootmode after reset.

For MCU without DLM(Device Lifecycle Management), ID code will be used to unlock MCU if required.

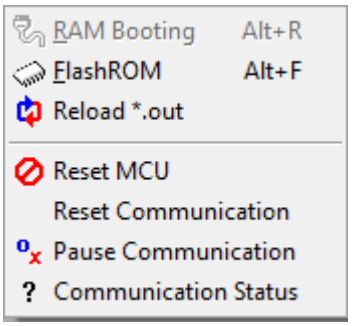
For MCU with DLM, DLM state transition is not supported.

step 3 : Execute necessary flash actions.

step 4 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

8.3.12 RX

MCU menu (Renesas RX)

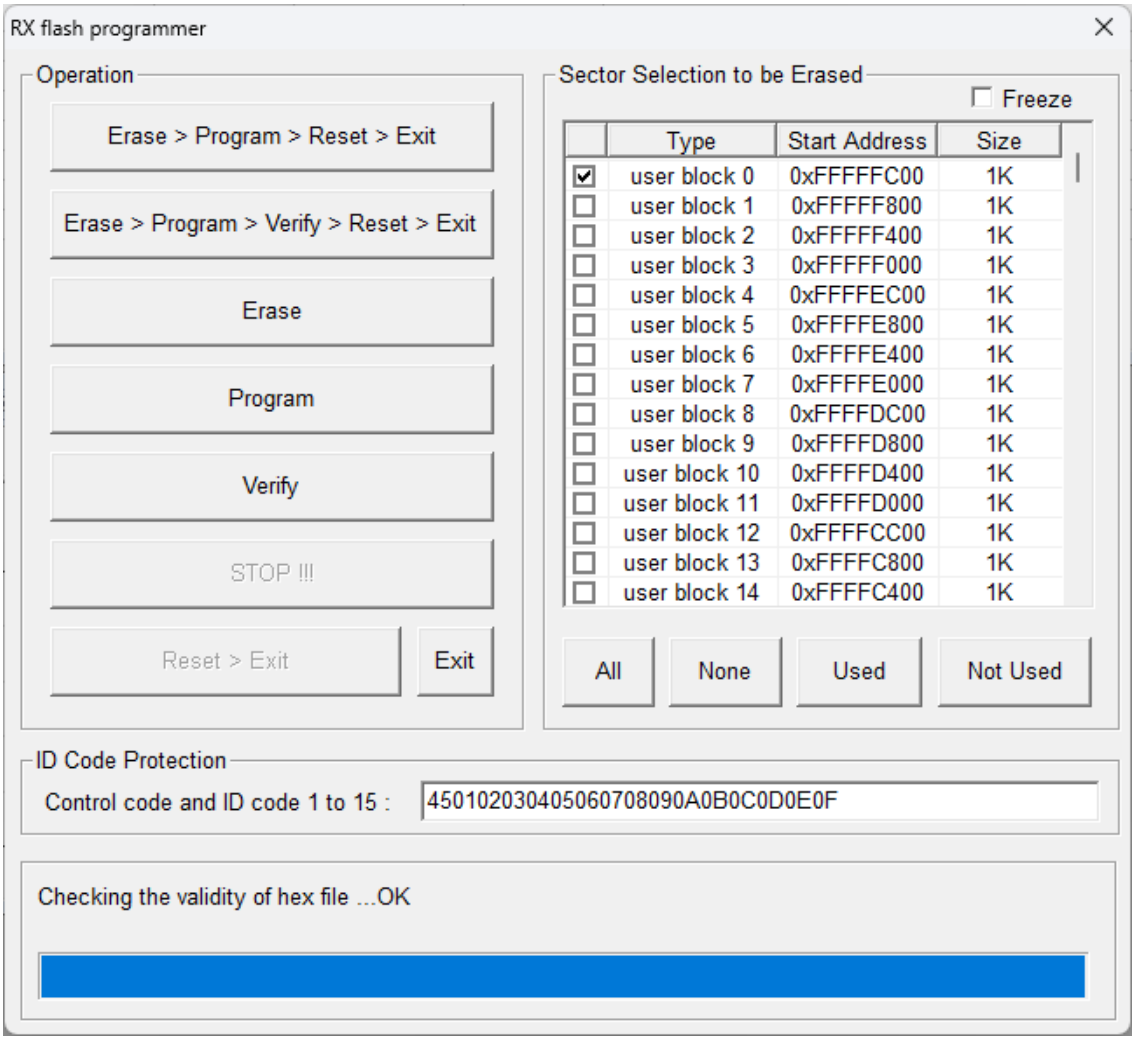


RAM Booting menu

This menu is not supported.

Flash ROM menu

It programs onchip flash of MCU with user program except the protected area by area protection or trusted memory.
Therefore please disable any flash related protection feature in the MCU while using this menu.
When this menu is activated, the monitoring of easyDSP is temporarily paused.



Please follow below sequence.

step 1 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.

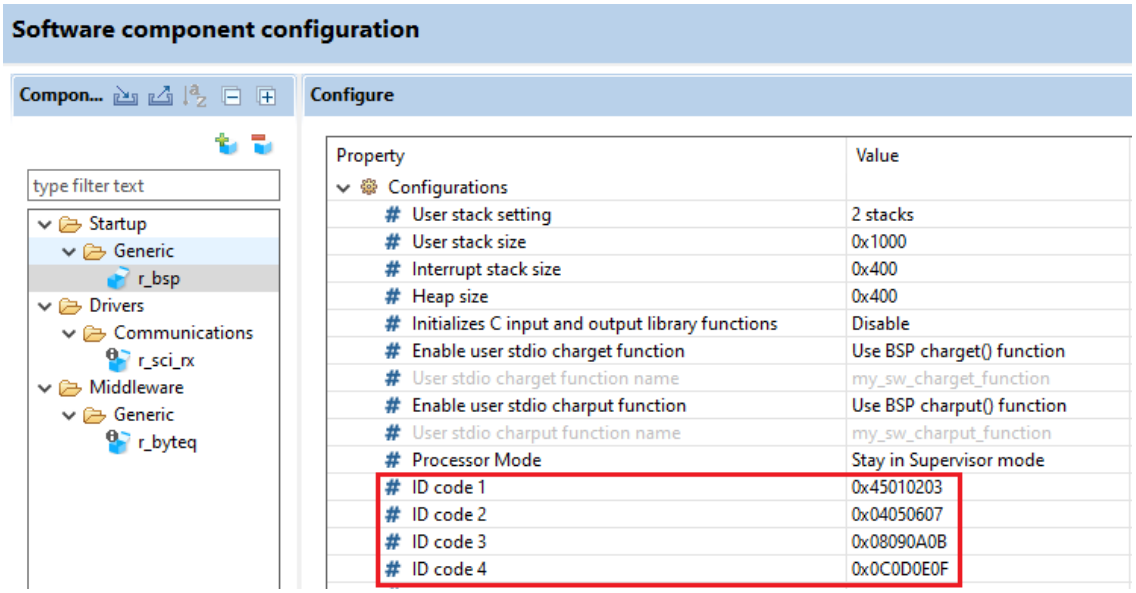
step 2 : When the buttons (Erase, Program+Verify, Verify) are clicked first time, MCU enters to bootmode after reset.

step 3 : Execute necessary flash actions.

step 4 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

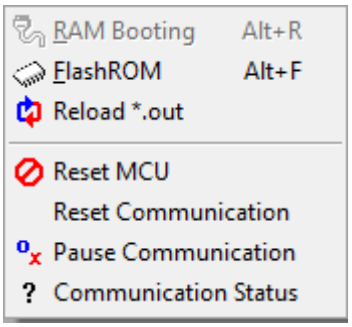
If boot mode ID code protection is enabled in the MCU, MCU enters to boot mode only when ID code you input matches.

If you set the ID code like below in the Smart Configurator, please set the ID code in the flash dialog as above.



Note :
1. All the flash contents are erased before entering to boot mode if the control ID is neither 0x45 nor 0x52 for RX100 and RX200 MCU series.
2. For RX64M, RX660, RX66T, RX71M and RX72T series, programming of option setting memory is not supported.

8.3.13 TX, TXZ3

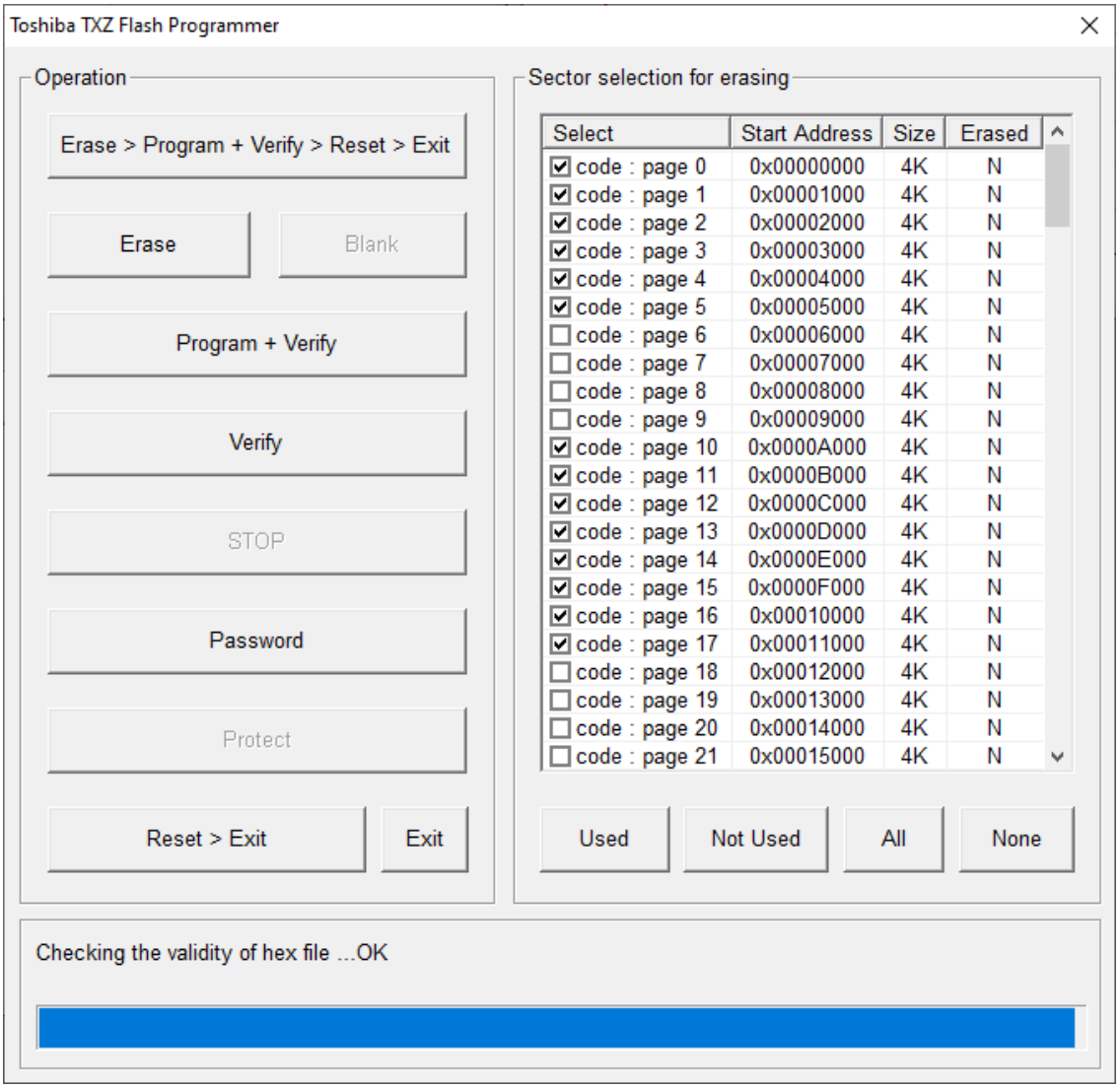


RAM Booting menu

This menu is not supported.

Flash ROM menu

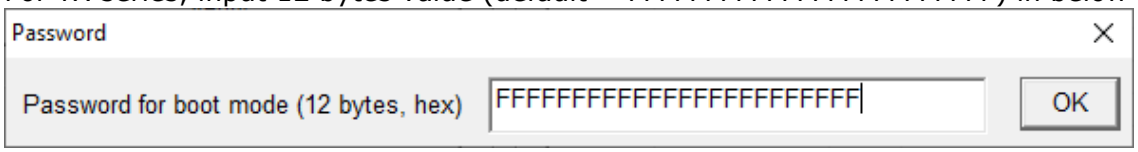
It programs onchip flash of MCU with user program. Note that the monitoring of easyDSP is temporarily paused.



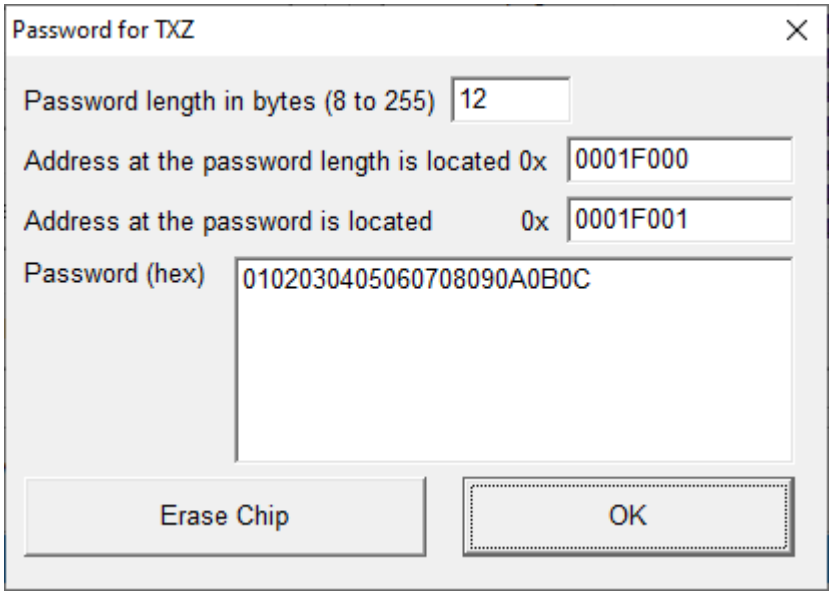
Please follow below sequence.

step 1 : By clicking 'Password' button, set the password which is required to enter single boot mode.

For TX series, input 12 bytes value (default = FFFFFFFFFFFFFFFFFFFFFFFF) in below dialog box.



For TXZ3 series, input related values in below dialog box.



step 2 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

step 3 : When the buttons (Erase, Program+Verify, Verify) are clicked first time, MCU enters to single boot mode after reset.

step 4 : Execute necessary flash actions.

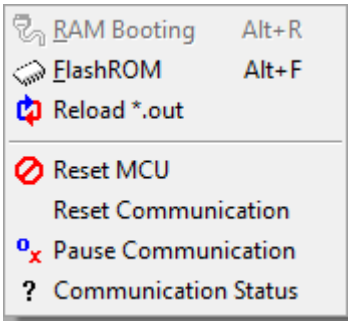
step 5 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

Note) programming to not erased sector may causes malfunction.

Note) Blank and Protect buttons are disabled.

8.3.14 LPC

MCU menu (NXP LPC1x00)



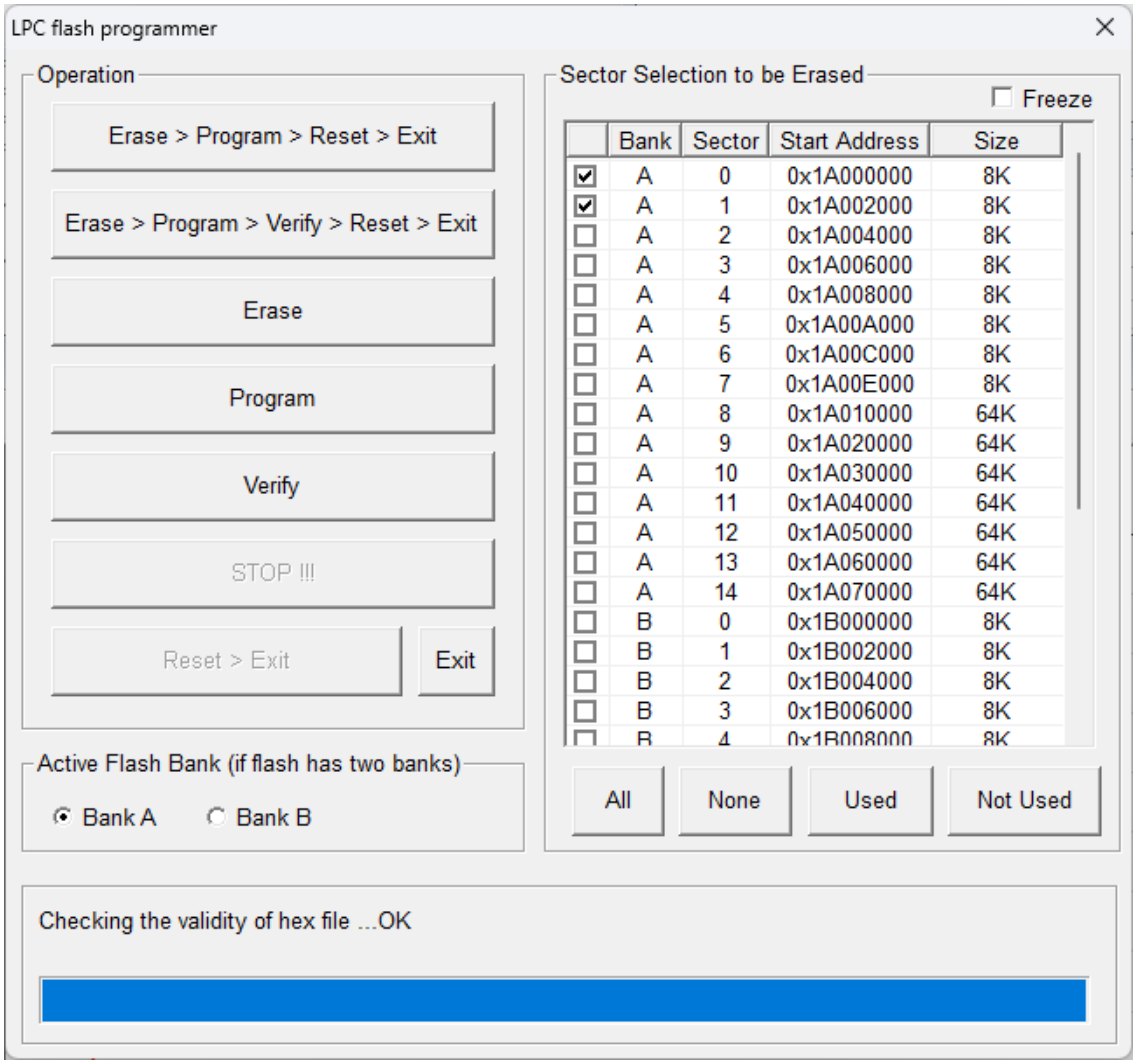
RAM Booting menu

This menu is disabled.

Flash ROM menu

It programs onchip flash of MCU with user program. During this operation, the monitoring of easyDSP is temporarily paused.

Note that you have to disable any flash related protection feature in the MCU while using this menu.

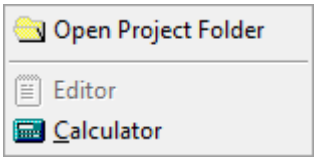


Please follow below sequence.
step 1 : In case MCU has two flash banks (for example, part of LPC1800 series), select the active flash bank where your program will run after reset.
step 2 : Select the flash sector to be erased. Use 'All', 'None', 'Used', 'Not Used' buttons. Or click the checkbox of sectors.

All the sectors used in the user program are selected with 'Used' button. The other way around with 'Not used' button.

Freeze checkbox disables the sector selection.
step 3 :When the buttons (Erase, Program+Verify, Verify) are clicked first time, MCU enters to bootmode after reset.
step 4 : Execute necessary flash actions.
step 5 : Click 'Reset>Exit' button when exiting this dialog box. It makes MCU reset and user program starts.

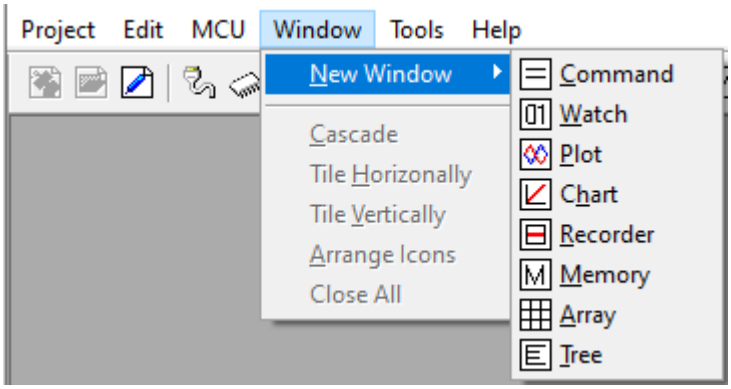
8.4 Tools



You can use various tools.

'Open Project Directory' : opens the folder of the active project.
'Editor': runs the editor which you set before in project settings.
'Calculator' : runs the calculator of Windows.

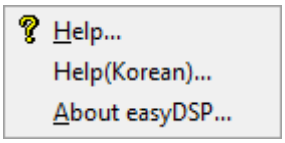
8.5 Window



Opening/closing/arranging windows.

8.6 Help

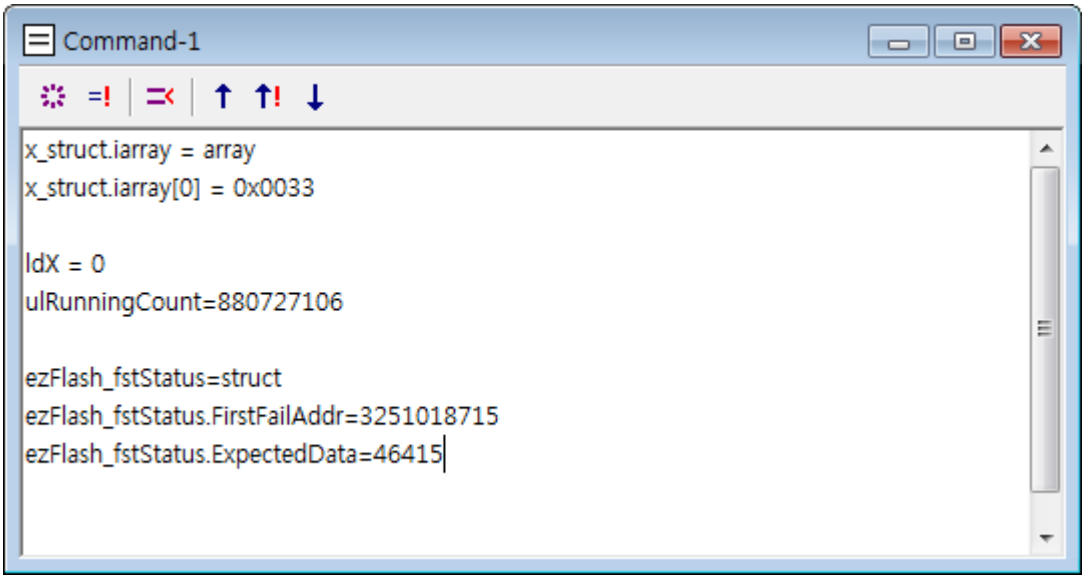
Help menu



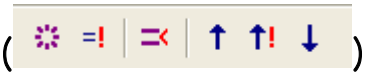
'Help...' : Opens this help file
'About easyDSP...' : basic information of easyDSP

9. Windows

9.1 Command



Command window is designed for writing or reading variables. The available commands are found by typing 'help' command. All commands are executed by enter-key input.

* Tool bar()

Update the block. If you select the block of commands by dragging mouse and then press this button, the commands which belong to the block are updated. If no block selected, the current line is updated. You can do it by clicking right button of mouse.

Run the block. If you select the block of commands by dragging mouse and then press this button, the commands which belong to the block are executed. If no block selected, the current line is executed.

Insert new line without running command. When you press enter key, the corresponding line is running as command. If you use this tool button, new line is inserted without running command. Same as 'Ctrl-Enter' key press.

Read command file. Copy the file to the command window. No execution. You can also type 'r filename' in the command window.

Load command file. command file is the set of commands. Frequently used commands can be saved into command file and then use this function. You can also type 'l filename' in the command window.

Save the block of lines to file. Save the selected block of commands as a file. Afterwards, you load this file by 'l' commands.

* Commands :

Caution:
1: The number of character in one command line should not exceed 300
2: all commands should be small-character

Decimal system	
dec var	decimal display (default)
hex var	hex-decimal display
bin var	binary display

Assign and Display	
var =	display the value of var
&var =	display the address of var
*var =	In case var is pointer to basic type, display the value of variable pointed by pointer var note) not supported for Arm MCU
(*var).x =	In case var is pointer to struct/union type, display the value of variable x pointed by pointer var note) not supported for Arm MCU
var = number	assign value to var 0x***(hex-decimal) form is supported If var is float type, following dimension form is supported 3e-3, 23K, 23m, 0.34p For dimension usage, refer to 'watch window'
var1 = &var2	assign the address of var2 into var1 var1 should be int type or unsigned int type
var = 'character'	In case var is either char or unsigned char type, printable character can be assgined such as 'A'. To display its value also with printable character, please check the option 'Display printable character ...' optino in the 'miscellaneous' tab in the project setting.
var = <exp>	assign the result of exp into var Example of expression: <e^pi-pi^e>, <1/ln(x)/x>, <exp(-1/pow(x/100,2))>
*var = number or <exp>	In case var is pointer to basic type variable, assign number or expression to the variable pointed by pointer var note) not supported for Arm MCU
(*var).x = number or <exp>	In case var is pointer to struct or union variable, assign number or expression to the variable x pointed by pointer var note) not supported for Arm MCU
var = number**Qn** ex. aa = 3.3Q15	Q-format assignment. n at Qn is from 1 to 15 in case var is 16bit integer. n at Qn is from 1 to 31 in case var is 32bit integer. number could be float.
var = number**Q** ex. aa = 3.3Q	If you set default Q number to var, then you can omit to describe it. For example, if var has default Q number 12, then var=3.14Q has the same effect as var=3.14Q12.

var = <exp>**Qn** var = <exp>**Q**	expression in <> is automatically calculated and then processed as in number

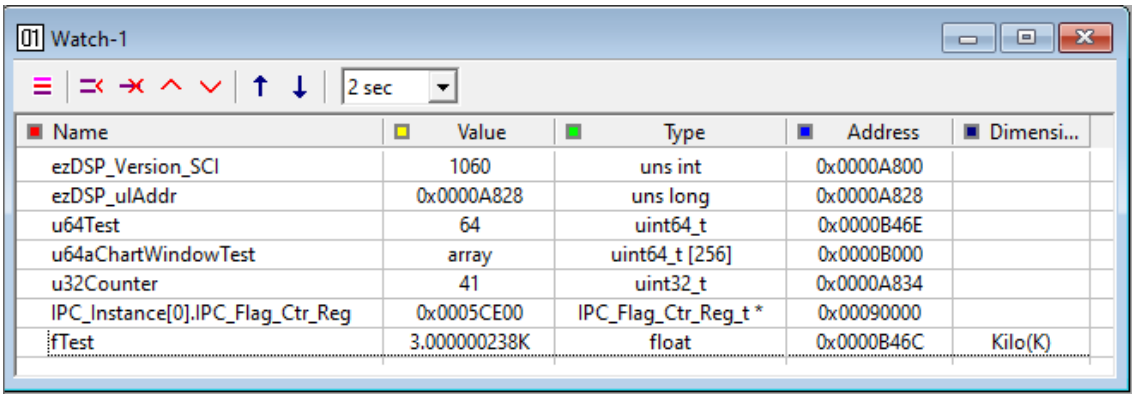
Others

clear	clear all command window context
//	one line comment
help	list all commands
l file	load command file (default extension = cmd). That is, execute the contexts of command file by line-to-line.
r file	read command file. Copy the file to the command window. No execution.
skip	During executing command file, the commands after 'skip' command are ignored.

* Dimension / Q assignment functionality

Dimension format (ex, 2.3m, 400p) is for writing/reading float type variables.
Q format (ex, 3.14Q15) is for writing/reading integer type variables and is available only for 2x MCU series.
You can set their default configuration for each variables only in 'Watch' window. For more details, please refer to the 'Watch' window section in this help.

9.2 Watch



You can read from or write to the variables in watch window. Note that only visible items are updated to reduce the communication burden of MCU.
The function of buttons are ..

(toggled) : displays all variables or only registered variables

: registers variable (same to 'Insert' key)

: delete variable (same to 'Delete' key)

: move up variable

: move down variable

 : loads the list of registered variables from the text file. The value of variables are not changed due to this action.

 : saves the list of registered variables to text file. It saves the value of variables too. You can load this file in Command window so that you change variables to the value in current watch window. This action helps handle the variables related to board settings or event recording.

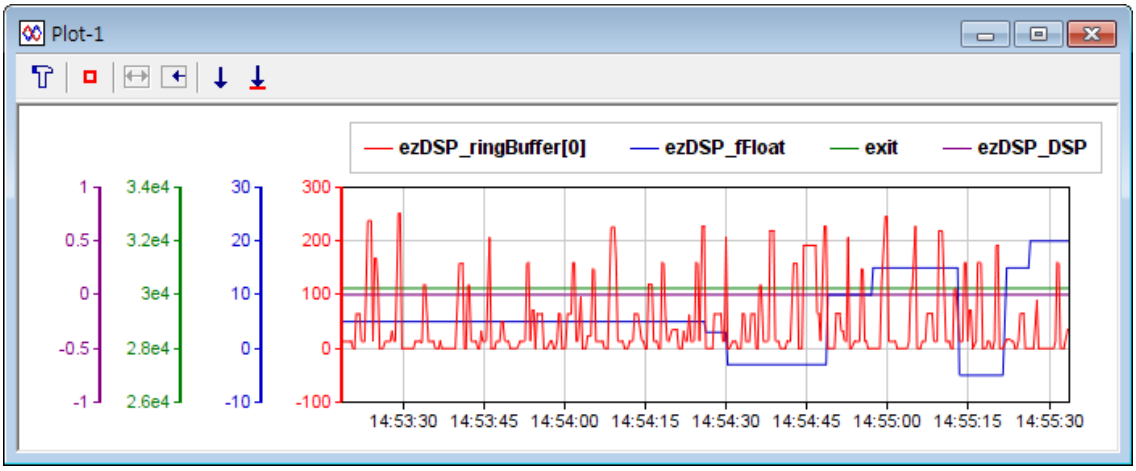
Some details for each column are.....

Column	Function
Name	It displays variable name. You can use 'value at address operator (*)' for TI C28x MCU. For example, *pointer variable when pointing to basic type (*pointer variable) when pointing to structure/union type
Value	It displays variable value. Mouse right click toggles the display mode (decimal => hex-decimal => binary => decimal....). Hex-decimal number begins with "0x". Binary number begins with "0b". But display mode of pointer variable is fixed to hex-decimal. If you specify dimension, the value is displayed as like 100u, 1K, 1p and so on. If you specify Q-format, the value is displayed such as 3.14Q15. You can change the variable by clicking left mouse button or pressing enter-key. Either number or <expression> is possible as an input format. Various format is supported when you input the value to the variable. Please check the help file of 'Command' window help file.
Type	It displays the type of variable.
Address	It displays the address of variable.
Dimension	Depending on the variable type, this column can display either dimension or Q format. Dimension If the variable is floating-point type, you can set the dimension of variable. You can change the dimension by clicking left mouse button. You can also use dimension when writing to the variable. For example, writing "30u" is same as "0.0003". dimension p = pico (10^{-12}) dimension n = nano (10^{-9}) dimension u = micro (10^{-6}) dimension m = mili (10^{-3}) dimension K = Kilo (10^{3}) dimension M = Mega (10^{6}) dimension G = Giga (10^{9}) Q format If the variable is integer type, you can set the Q format of variable. Q format is helpful especially to fixed point MCU. Q0 to Q15 can be applied to 16bit integer variable. Q0 to Q30 can be applied to 32bit integer variable. Once the variable is set by Q-format, it can be read/written as a float type variable. Plot and Chart window also displays Q-format integer variable as it is a floating-point type.

	- Reading integer variable if integer variable has Q0(default) format , then it is displayed as an integer value. if integer variable has Q15 format, then it is displayed as fraction number, for example, '3.14Q15' with suffix 'Q15'. **- Writing integer variable** if integer variable has Q0(default) format, below writing method is possible. var1 = 314 var1 = 3.14Q15 (3.14 is converted as Q15 format then written to var1) var1 = <cos(pi/3)>Q15 (Since cos(pi/3) is 0.5, it's same to 0.5Q15) if integer variable has Qn(n=1-31) format, below writing method is possible. var1 = 3.14Q (3.14 is converted Q format of var1 then written to var1) var1 = 3.14Q15 (3.14 is converted Q15 format then written to var1. It doesn't care for Q-format of var1) var1 = <cos(pi/3)>Q (Since cos(pi/3) is 0.5, it's same to 0.5Q) var1 = <cos(pi/3)>Q31 (Since cos(pi/3) is 0.5, it's same to 0.5Q31)

9.3 Plot

Plot window



This window plots the value of variables in real-time and saves its data for some time. If the dynamics of the variable is rather slower than the sampling interval, this window will act as an recorder.
The integer variable with Q-format is displayed as it is float type. For example, 32bit integer variable with Q31 format is displayed within 1 and -1.

Toolbar

: you can set the variable name, min/max/auto of Y-axis display and display mode. Maximum 8 variables can be displayed in one plot window.

The minimum sampling interval is 5msec. easyDSP reads the value of variable in every sampling interval, then displays it for 'total plot period' duration.

Please note that maximum count of data is limited to 4,294,967,295 per variable. In case PC memory is not enough, it will be less than that.

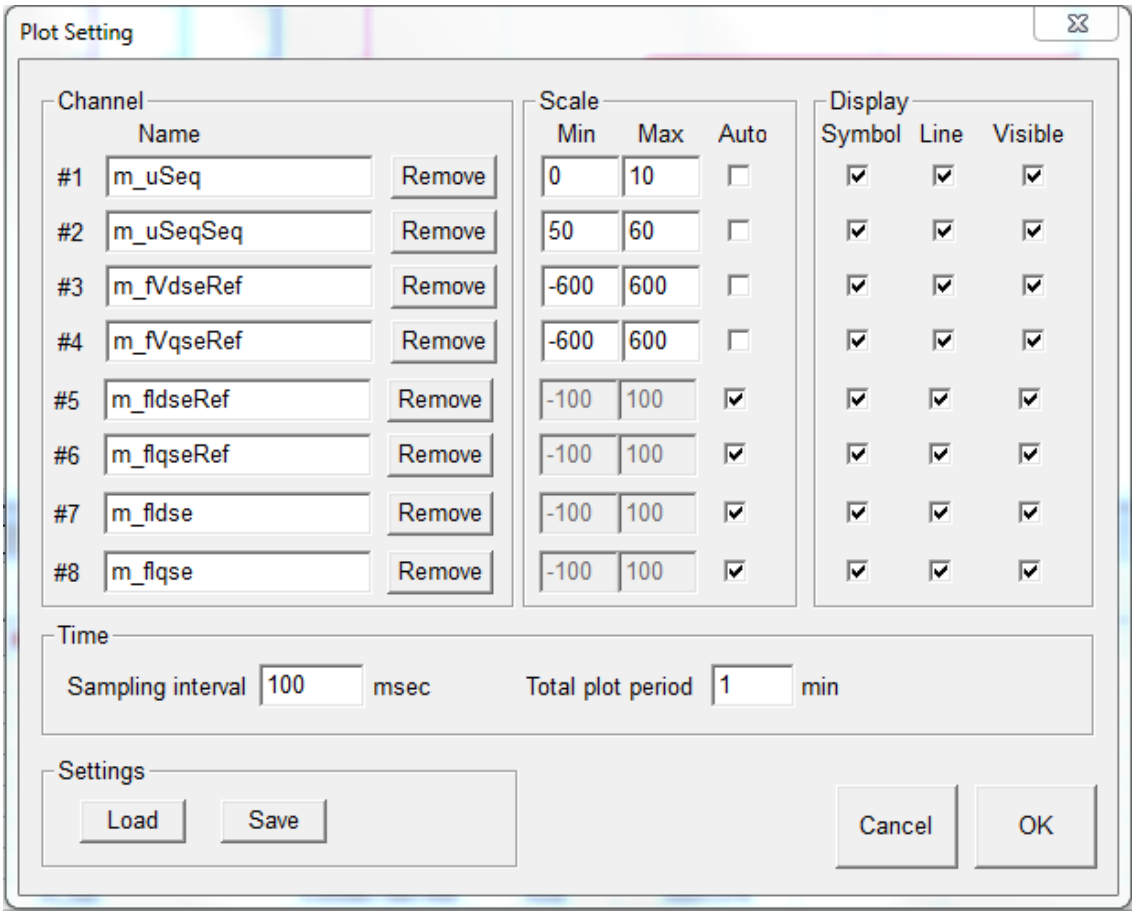
Please note that the sampling interval you set is not guaranteed. Most of cases, actual sampling interval is longer than your setting value especially when the data count is large.

Also timer resolution of Windows systme is roughly 10msec.

The setting can be saved to and loaded from the file by clicking 'Save'/'Load' button.

The colors and symbols are predefined as follows.

channel #1 : red - circle
channel #2 : blue - square
channel #3 : green - triangle
channel #4 : violet - diamond
channel #5 : black - right triangle
channel #6 : weak green - left triangle
channel #7 : grey - '+' shape
channel #8 : orange - 'x' shape



(toggled) : pauses graph / resumes graph.

: shows all graph data. Its shows all the data stored in memory allocated to support 'Total plot period'.

: shows recent data. It shows the latest data fitting to current plot window size.

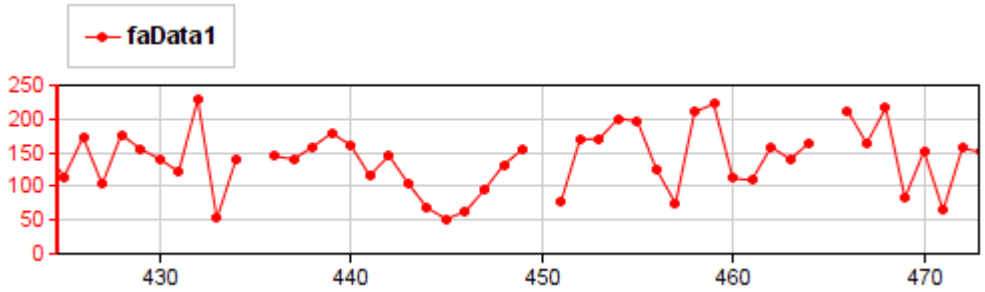
: saves the graph into graphic file (bmp, jpg, png formats) or save the graph data into text file (csv format as shown below).

m_uSeq				
date(year-month-day)	time(hour-min-sec)	time(mili_sec)	elapsed time(mili_sec)	value
2017-09-04	12:48:42	223	0	2
2017-09-04	12:48:42	359	136	2
2017-09-04	12:48:42	475	252	2
2017-09-04	12:48:42	597	374	2
2017-09-04	12:48:42	722	499	2
2017-09-04	12:48:42	848	625	2
2017-09-04	12:48:42	976	753	2
2017-09-04	12:48:43	98	875	2
2017-09-04	12:48:43	226	1003	2
2017-09-04	12:48:43	346	1123	2
2017-09-04	12:48:43	470	1247	2
2017-09-04	12:48:43	584	1361	2
2017-09-04	12:48:43	706	1483	2

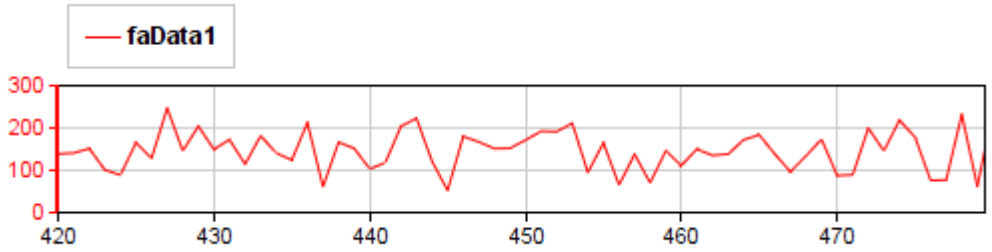

: saves the graph data to record file (file extension = rec). You can open the record file with record window.

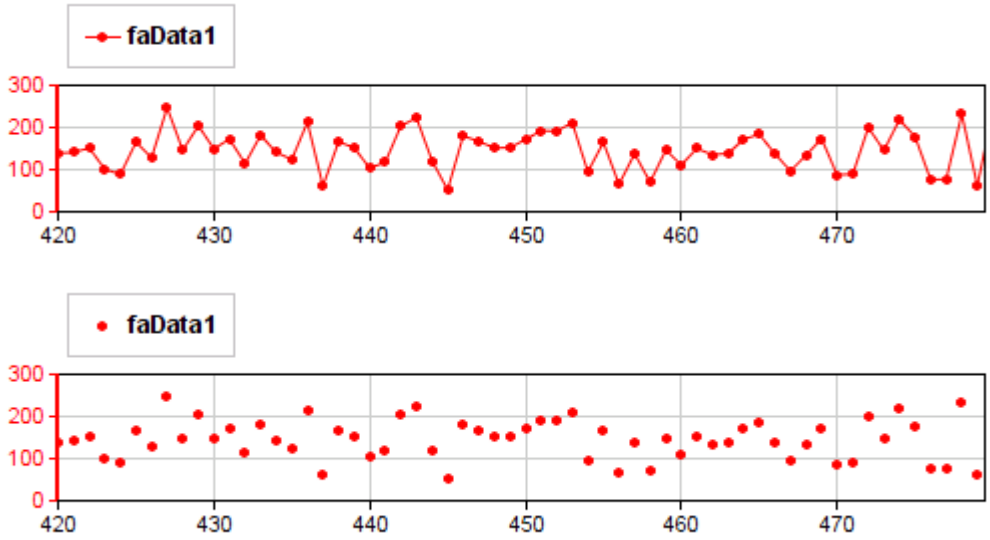
Useful features

- Tooltip function : The data value at the mouse cursor position will be displayed with small box
- If the communication failed with MCU, the corresponding data point is not displayed at all. As shown below, the line looks broken.
  Same when the user intentionally pauses the communication.

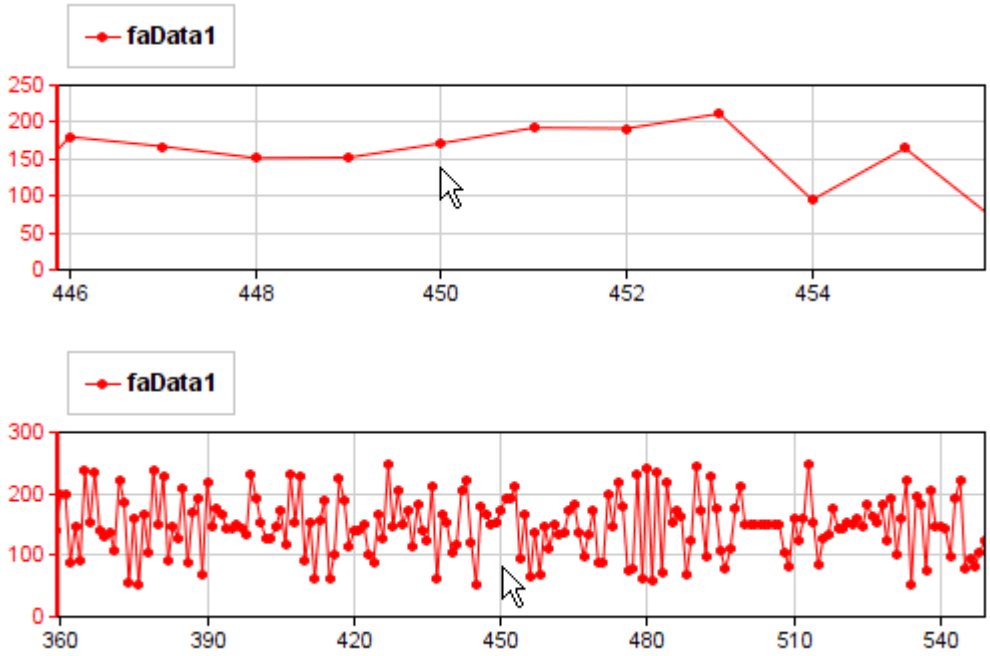


- Versatile line display mode by selecting symbol/line/visibility.

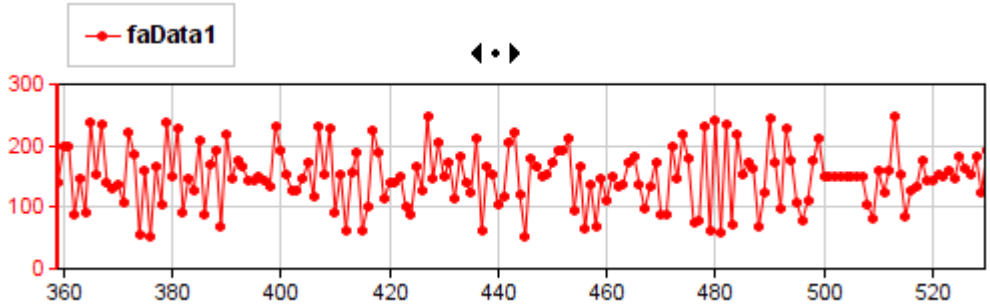




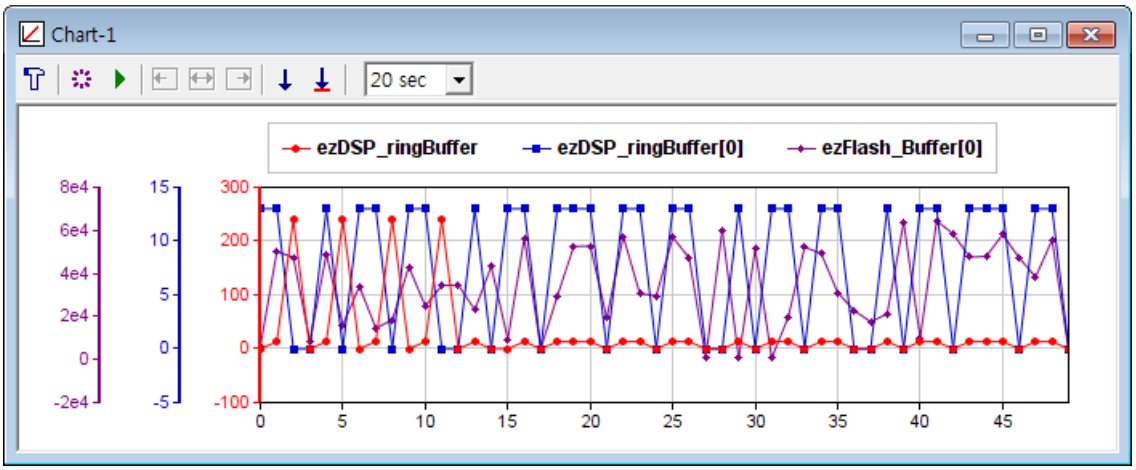
- X-axis zoom in/out possible with mouse wheeling.



- Screen dragging is possible in X-axis direction by dragging mouse. (mouse cursor has special shape in this mode)



9.4 Chart



It displays all data of 1-dim array type variable. So, you can use it as an software substitute for the oscilloscope, if your MCU program samples a certain variable into this array variable.
Writing to the array is not allowed in Chart window.
It displays the Q-format integer variable as its fractional number. (Ex, 32bit integer with Q31 format is displayed in the range of +1/-1).

Toolbar

: When clicked, the below dialog box shows up and you can register upto 8 variables and its display properties.

'Channel' : You can select the one-dimensional array variable.

'Scale' : Select the Y-axis range. 'Auto' will adjust its scale automatically based on the variable values in every display.

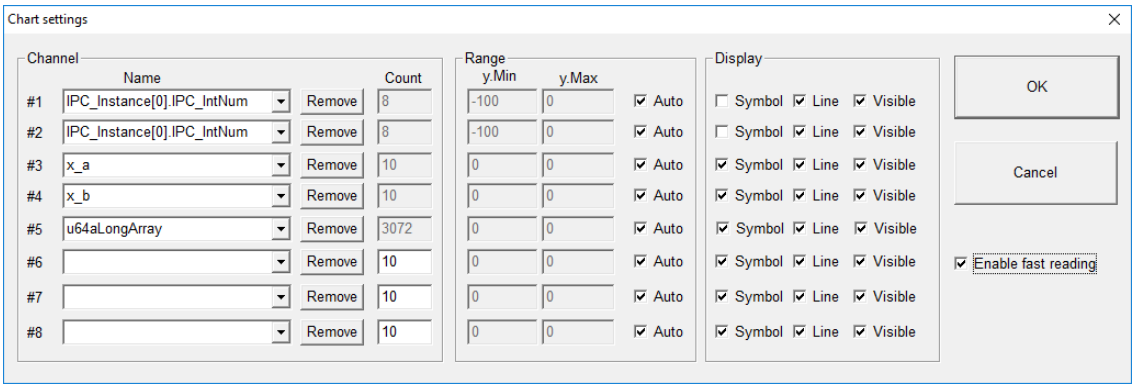
'Display' : Determines its display mode. The data acquisition keeps going whatever its display mode is.

'Enable fast reading' : makes chart update faster when the MCU resource for communication with easyDSP is enough.

If this option is not working properly, the window becomes empty.

The colors and symbols are predefined as follows.

channel #1 : red - circle
channel #2 : blue - square
channel #3 : green - triangle
channel #4 : violet - diamond
channel #5 : black - right triangle
channel #6 : weak green - left triangle
channel #7 : grey - '+' shape
channel #8 : orange - 'x' shape



: updates graph only for one time. If your data are too large, updating them in every sampling interval takes so much time. Please use this toolbar in that case.

(toggled) :pauses graph update / resumes graph update.

: shows left-most part of the graph

: shows all graph data.

: shows right-most part of the graph.

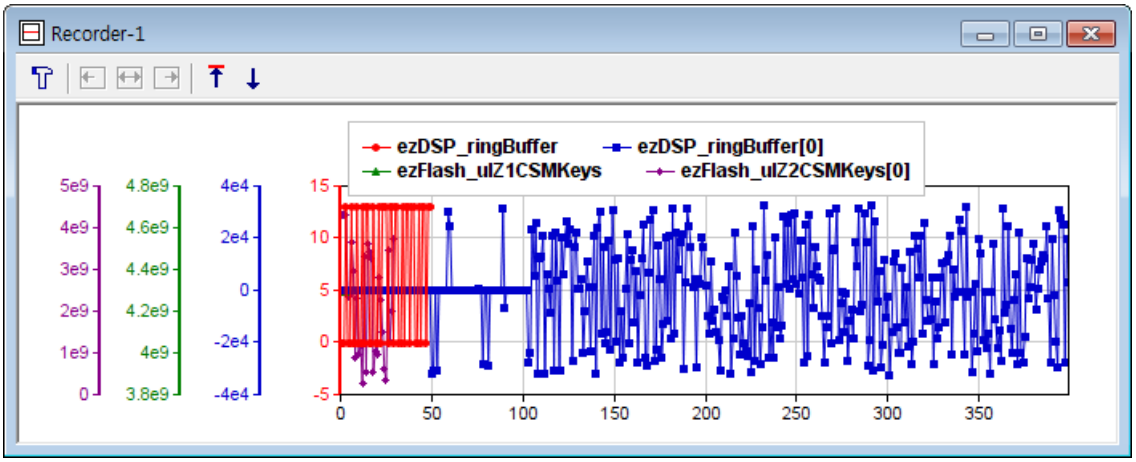
: saves the current graph into graphic file (bmp, jpg, png formats) or save the current graph data into text file (csv format).

: saves the graph data to record file (file extension = rec). You can open the record file with record window.< /FONT >

Useful features

- Please check the link how to use the graph

9.5 Record



It displays the data of record file (extension = rec) which was saved before in either Chart window or Plot window.

Thus, your first action is opening the record file by clicking button.
When opening it, all settings you made before was automatically restored i.e. record file, zoom in/out area and various display mode.

Toolbar

: When clicked, the below dialog box shows up with the information of record file name and its saving time. The other part is same to that of either Chart or Plot window.

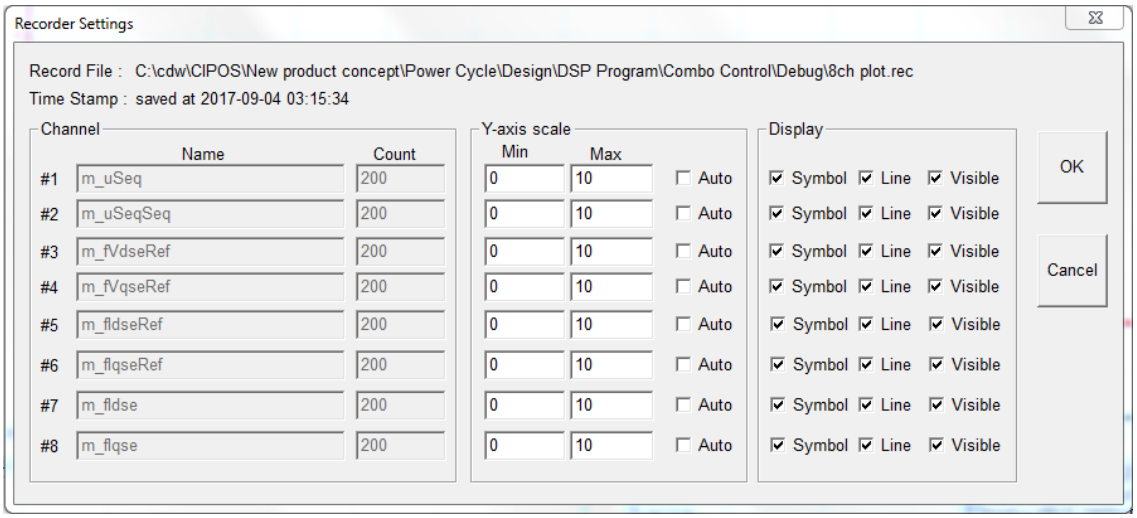
'Channel' : It just display the variable name and its data count as the record file has. No change is possible.

'Scale' : Select the Y-axis range. 'Auto' will adjust its scale automatically based on the variable values in every display.

'Display' : Determines its display mode.

The colors and symbols are predefined as follows.

channel #1 : red - circle
channel #2 : blue - square
channel #3 : green - triangle
channel #4 : violet - diamond
channel #5 : black - right triangle
channel #6 : weak green - left triangle
channel #7 : grey - '+' shape
channel #8 : orange - 'x' shape



: shows the left-most part of graph.

: shows all graph data.

: shows the right-most part of graph.

: load the record file. This is your first action to use this window.

: saves the current graph into graphic file (bmp, jpg, png formats) or save the current graph data into text file (csv format).

Useful features

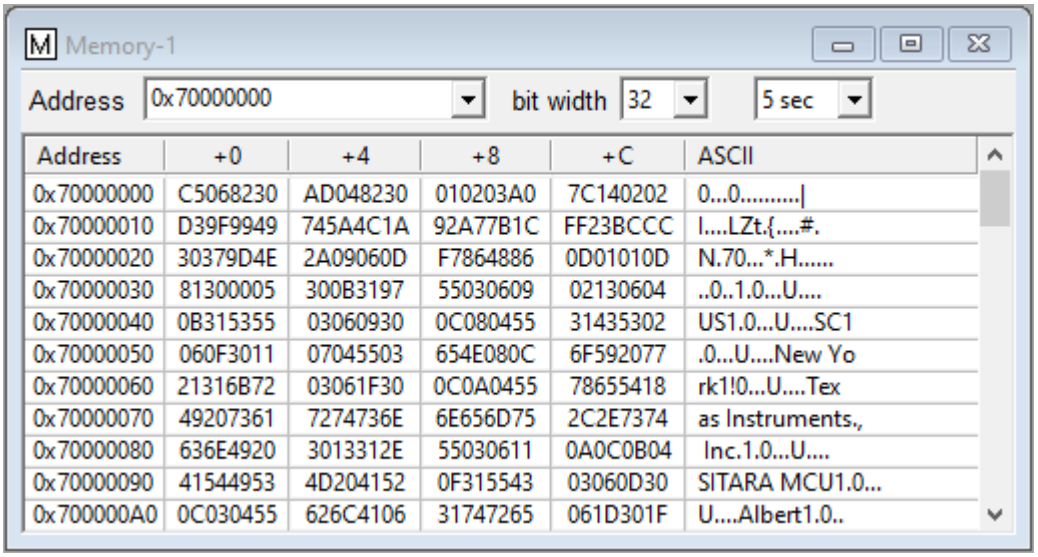
- Please check the link how to use the graph

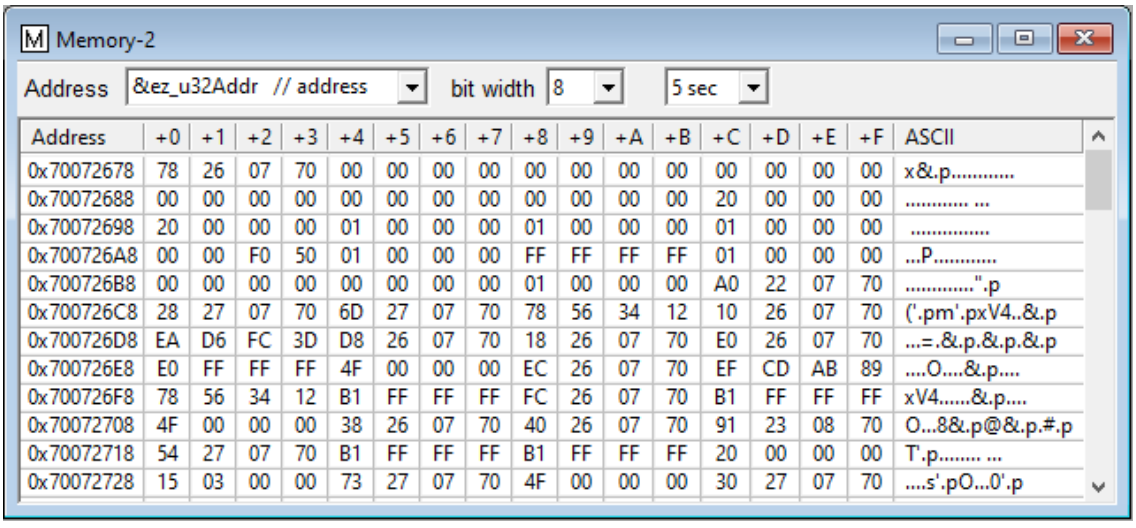
9.6 Memory

Common

You can monitor and change the memory under given address. But change of memory is available only for RAM memory.
Note that only visible items are updated to reduce the communication burden of MCU. So, please minimize the window size so that the communication burden of MCU could be also minimized.
easyDSP limits the address range according to MCU. In case the adress is limited by easyDSP, the data of address is displayed as '-' without reading.

NOTE :
1. For Arm core MCU, HardFault is caused by accessing an invalid address or security setting. Please be careful when setting the address.
2. For a certain STM32 MCU with secure MPU activated, MCU can be stuck after memory access.





This window displays a memory with hex format and variable bit width (8/16/32 bits).
To change its value, first select the row and click left button of mouse in the target location.
Versatile address input is available such as 0x1234 (hex), 1234 (hex without 0x prefix) and &variable.
Also comment (//) can be added to the address input such as '0x1234 // register'.
In the address combo box, the recent addresses are registered so that you can easily swap between.

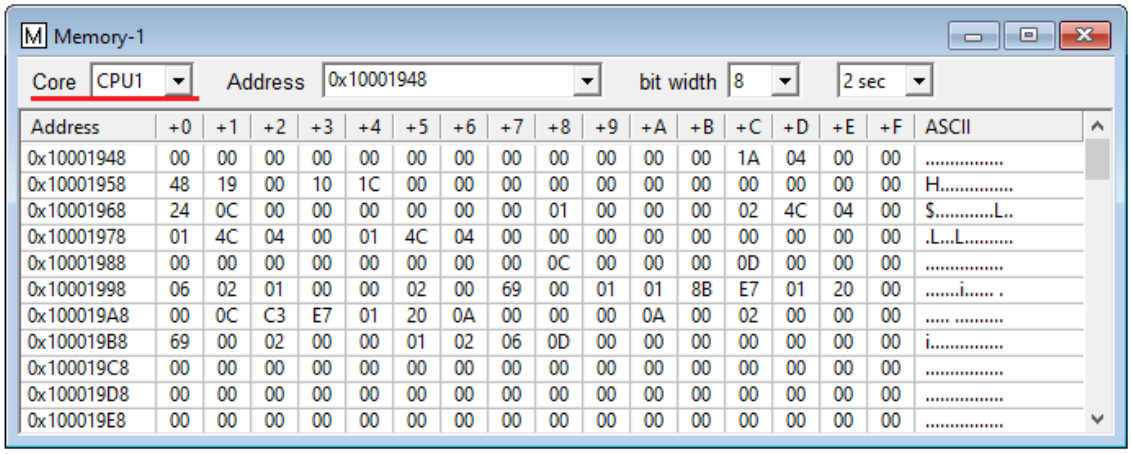
Total memory size to be displayed in a window is 1kB (0x400). But regular data update is limited to only visible area of window.

Note :

1. The start address is 4B aligned for TI C28x MCU.
   example) if input address is 0x--0 or 0x--1, then start address is 0x--0.
   example) if input address is 0x--2 or 0x--3, then start address is 0x--2.
2. The start address is 8B aligned for Arm core.
   example) if input address is 0x--0 to 0x--7, then start address is 0x--0.
   example) if input address is 0x--8 to 0x--F, then start address is 0x--8.
3. The first memory address shown in the window could be not the address you input in the adress combo box.
4. 1kB memory area is displayed from the start address.
5. In case &var format is used as an address input, if it is changed with code modification, the address of the window is automatically changed after MCU booting.

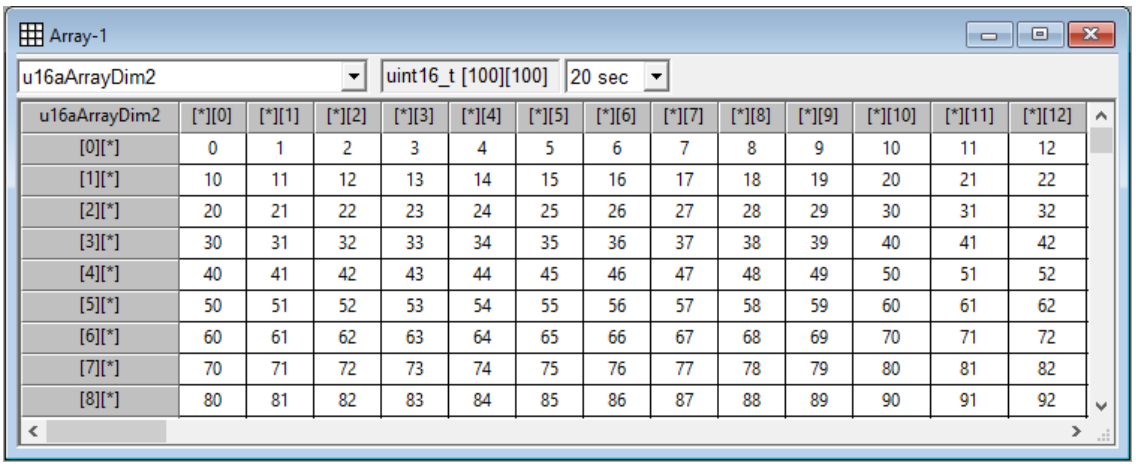
When easyDSP communicates with multi cores of ARM MCU

You can select which core accesses the memory.
This is useful in case each core has different memory contents.
If the start address is set by '&n:var' format, the core is fixed to CPUn.



Address	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F	ASCII
0x10001948	00	00	00	00	00	00	00	00	00	00	00	00	1A	04	00	00	.....
0x10001958	48	19	00	10	1C	00	00	00	00	00	00	00	00	00	00	00	H.....
0x10001968	24	0C	00	00	00	00	00	00	01	00	00	00	02	4C	04	00	$.....L..
0x10001978	01	4C	04	00	01	4C	04	00	00	00	00	00	00	00	00	00	.L...L.....
0x10001988	00	00	00	00	00	00	00	00	0C	00	00	00	0D	00	00	00	.....
0x10001998	06	02	01	00	00	02	00	69	00	01	01	8B	E7	01	20	00	.....i..... .
0x100019A8	00	0C	C3	E7	01	20	0A	00	00	00	0A	00	02	00	00	00	....
0x100019B8	69	00	02	00	00	01	02	06	0D	00	00	00	00	00	00	00	i.....
0x100019C8	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
0x100019D8	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
0x100019E8	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....

9.7 Array



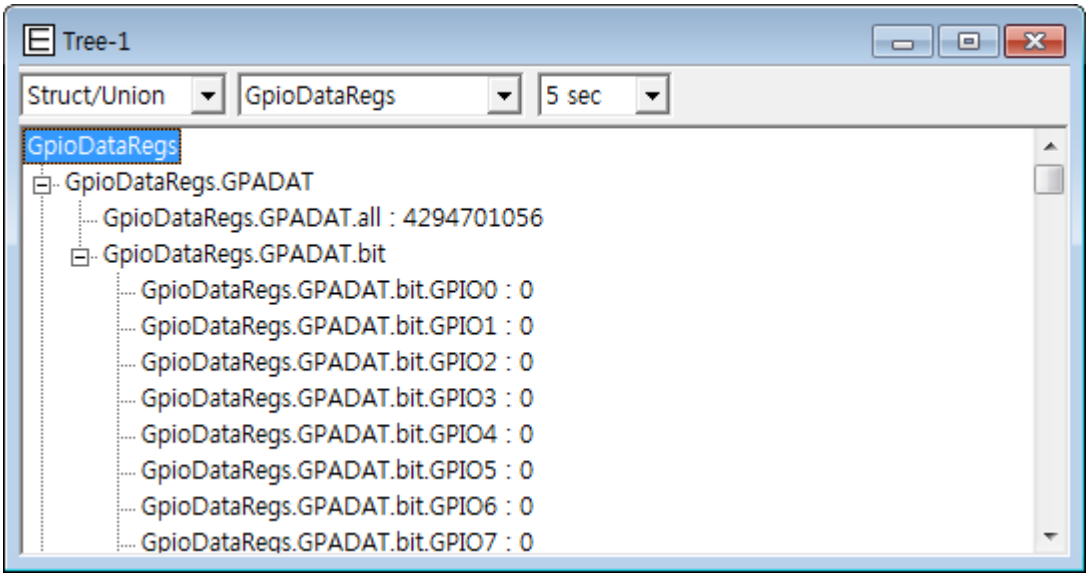
u16aArrayDim2	[*][0]	[*][1]	[*][2]	[*][3]	[*][4]	[*][5]	[*][6]	[*][7]	[*][8]	[*][9]	[*][10]	[*][11]	[*][12]
[0][*]	0	1	2	3	4	5	6	7	8	9	10	11	12
[1][*]	10	11	12	13	14	15	16	17	18	19	20	21	22
[2][*]	20	21	22	23	24	25	26	27	28	29	30	31	32
[3][*]	30	31	32	33	34	35	36	37	38	39	40	41	42
[4][*]	40	41	42	43	44	45	46	47	48	49	50	51	52
[5][*]	50	51	52	53	54	55	56	57	58	59	60	61	62
[6][*]	60	61	62	63	64	65	66	67	68	69	70	71	72
[7][*]	70	71	72	73	74	75	76	77	78	79	80	81	82
[8][*]	80	81	82	83	84	85	86	87	88	89	90	91	92

In Array window, the values of array variable which is one dimensional or two dimensional are displayed with grid view.
Note that only visible cells are updated to reduce the communication burden of MCU.

The member of array should be fundamental type. Please use Tree window if the member of array is structural variable type. You can change its value by mouse left button or enter key.
You can use 'copy-paste'. Especially with Microsoft Excel program. Please select block by clicking column or row of this array. You can select all by clicking the name of variable. Note that it could take addtional communication time since easyDSP first fills the empty cells (if any) before copying.

9.8 Tree

Tree window



In tree window, the values of array, structure type variable are displayed with tree view.
Note that only visible cells are updated to reduce the communication burden of MCU.
By clicking left mouse button or enter key input, you can change the value of variable.
By clicking right mouse button, you can change display mode (decimal => hex-decimal => binary = > decimal....).

10. Trouble Shooting

10.1 Common

Trouble : easyDSP communication fails at first try of easyDSP use

Shooting: there are several reasons for this. Please check below check points.
check point 1 : If ram booting or flash programming is not successful, please check the hardware setting particularly for connector pin mapping, contact failure of connector and cable. You can check if the hardware and software setting is proper by running MCU with debugger and monitoring the variables by easyDSP.

check point 2 : The easyDSP source file and header file should be included in your project.
check point 3 : #define variable should be set properly in the easyDSP header file.
check point 4 : In the main.c, easyDSP related functions should be called.
check point 5 : The baud rate of project setting should be same to that in the easyDSP header file.
check point 6 : In the user program, don't allocate SCI or UART for easyDSP to another GPIO pins.

check point 7 : In the user program, don't allocate GPIO for easyDSP to another function.
check point 8 : easyDSP ISR (Interrupt Service Routine) should have enough time resource to run properly. Please check below.

Trouble : communication fails due to the lack of time resource to easyDSP

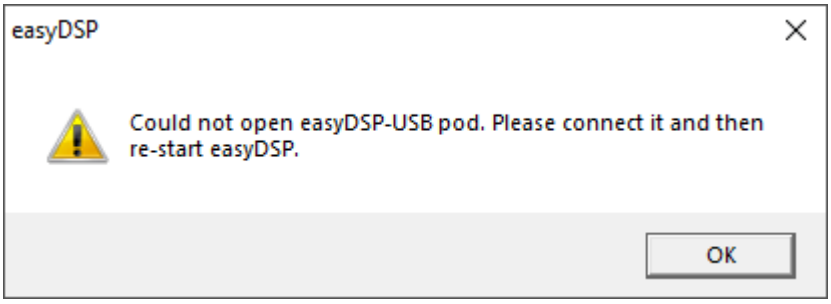
Shooting: You have to secure the required time resource to easyDSP communication. Please try below methods.
1. Increases 'wait-more-time' in the project menu
2. Slows down the baud-rate
3. Minimize the number of variables of monitoring (For example, use Command Window only)
4. If possible, increase the priority of easyDSP ISR (SCI or UART)

Trouble : At first, easyDSP works well but soon it fails. Why?

Shooting 1 : easyDSP uses the lowest prioritized ISR (Interrupt Service Routine) of MCU by default. If higher prioritized interrupt routine starts to take most of time resource, then ISR for easyDSP doesn't work properly. Please refer to above trouble and shooting.
Shooting 1 : in a power electronics system with high voltage and high current switching operation, easyDSP communication could failed due to either conducted or radiated noise. Please take a measure to reduce the noise accordingly.

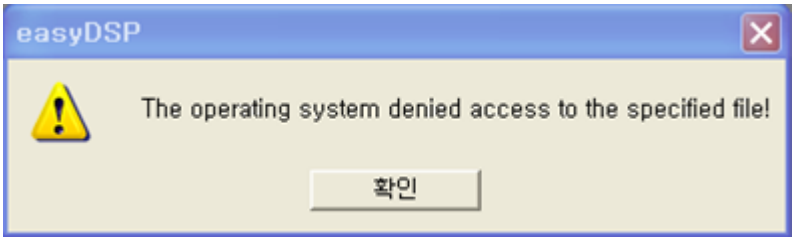
Trouble : easyDSP is not connected

Cause : mechanical connection is not stable
Shooting : please connect easyDSP directly to PC (not via USB extension port) or use different USB port or use new USB cable.



Trouble : Error message like below

Shooting : You will face below (or similar) error message with 32bit Windows. Please use 64bit Windows.



Trouble : can't access the website (www.easydsp.com)

Cause : due to limited traffic size allowable per day, its access is temporarily blocked.
Shooting : please access the web site tomorrow.

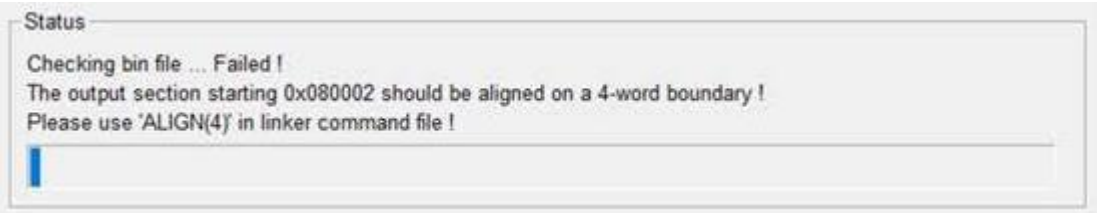
10.2 C28x

Trouble shooting (TI C28x)

Trouble : when SCI-A GPIO port recommended by easyDSP could not be usable

To use RAM booting and flash programming with easyDSP, easyDSP should be connected to the designated SCI-A and GPIO port.
In case only monitoring is used with easyDSP, easyDSP can be connected to any SCI and any GPIO port, but you have to modify the easyDSP source file accordingly.
To use RAM booting and flash programming with easyDSP, but with other GPIO port than designated, please refer to the help file 'How to use other SCI port than designated'.
It's about how to use designated SCI-A port during RAM booting or flash programming, and then use other SCI port than designated during monitoring.

Trouble : 'section not aligned' message in flashrom dialog



Shooting : easyDSP uses TI's flash API to access onchip flashrom. TI flash API of Gen.3 MCU (ex. F2807x, F28002x, F28004x, F2837x, F2738x) requires section alignment on the address (min. 4 words boundary or recommended 8 words boundary) depending on MCU. That is, the start address of the section should be either 0x*0, 0x*4, 0x*8 or 0x*C for C28x core and either 0x*0 or 0x*8 for Arm Cortex-M4 (ex, F2838x CM). In the picture above, the error is caused since the start address of the section is 0x*2.To avoid this problem, please align all sections linked to flash on a minimum 64-bit boundary in the linker command file for your code project. As shown below linker command file from TI, it is already applied as recommended value for default sections but you need to do it yourself for your own section.
If the program continues even after above measure, please check your map file (*.map) and identify which section makes error (the section starting from the address 0x080002 in the picture) and apply section specific measures.

<in case of TMS320F280049>

```
SECTIONS
{
   codestart        : > BEGIN,     PAGE = 0, ALIGN(4)
   .text            : >> FLASH_BANK0_SEC2 | FLASH_BANK0_SEC3 | FLASH_BANK0_SEC5,   PAGE = 0, ALIGN(4)
   .cinit           : > FLASH_BANK0_SEC1,     PAGE = 0, ALIGN(4)
   .switch          : > FLASH_BANK0_SEC1,     PAGE = 0, ALIGN(4)
   .reset           : > RESET,     PAGE = 0, TYPE = DSECT /* not used, */

   .stack           : > RAMM1,     PAGE = 1

#if defined(__TI_EABI__)
   .init_array      : > FLASH_BANK0_SEC1,       PAGE = 0,       ALIGN(4)
   .bss             : > RAMLS5,       PAGE = 1
   .bss:output      : > RAMLS3,       PAGE = 0
   .bss:cio         : > RAMLS0,       PAGE = 0
   .data            : > RAMLS5,       PAGE = 1
   .sysmem          : > RAMLS5,       PAGE = 1
   /* Initalized sections go in Flash */
   .const           : > FLASH_BANK0_SEC4,       PAGE = 0,       ALIGN(4)
#else
   .pinit           : > FLASH_BANK0_SEC1,       PAGE = 0,       ALIGN(4)
   .ebss            : > RAMLS5,       PAGE = 1
   .esysmem         : > RAMLS5,       PAGE = 1
   .cio             : > RAMLS0,       PAGE = 0
   .econst          : > FLASH_BANK0_SEC4,    PAGE = 0, ALIGN(4)
#endif

   ramgs0           : > RAMGS0,    PAGE = 1
   ramgs1           : > RAMGS1,    PAGE = 1
```

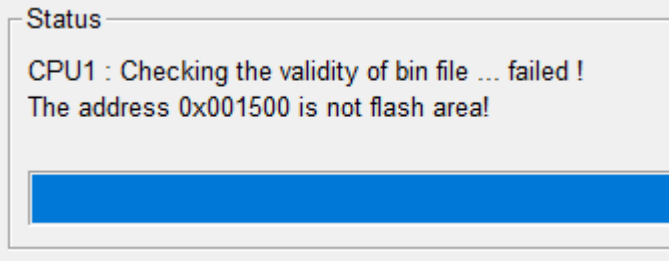
<in case of TMS320F28388 CPU1 and CPU2 >

```
SECTIONS
{
   codestart           : > BEGIN, ALIGN(8)
   .text               : >> FLASH1 | FLASH2 | FLASH3 | FLASH4, ALIGN(8)
   .cinit              : > FLASH4, ALIGN(8)
   .switch             : > FLASH1, ALIGN(8)
   .reset              : > RESET, TYPE = DSECT /* not used, */
   .stack              : > RAMM1

#if defined(__TI_EABI__)
   .init_array      : > FLASH1, ALIGN(8)
   .bss             : > RAMLS5
   .bss:output      : > RAMLS3
   .bss:cio         : > RAMLS5
   .data            : > RAMLS5
   .sysmem          : > RAMLS5
   /* Initalized sections go in Flash */
   .const           : > FLASH5, ALIGN(8)
#else
   .pinit           : > FLASH1, ALIGN(8)
   .ebss            : > RAMLS5
   .esysmem         : > RAMLS5
   .cio             : > RAMLS5
   /* Initalized sections go in Flash */
   .econst          : >> FLASH4 | FLASH5, ALIGN(8)
#endif
```

<in case of TMS320F28388 CM>

```
SECTIONS
{
   .resetisr        : > CMBANK0_RESETISR, ALIGN(16)
   .vftable         : > CMBANK0_SECTOR0, ALIGN(16)   /* Application placed vector table in Flash*/
   .vtable          : > S0RAM             /* Application placed vector table in RAM*/
   .text            : >> CMBANK0_SECTOR0 | CMBANK0_SECTOR1, ALIGN(16)
   .cinit           : > CMBANK0_SECTOR0, ALIGN(16)
   .pinit           : >> CMBANK0_SECTOR0 | CMBANK0_SECTOR1, ALIGN(16)
   .switch          : >> CMBANK0_SECTOR0 | CMBANK0_SECTOR1, ALIGN(16)
   .sysmem          : > S2RAM

   .stack           : > C1RAM
   .ebss            : > C1RAM
   .econst          : >> CMBANK0_SECTOR0 | CMBANK0_SECTOR1, ALIGN(16)
   .esysmem         : > C1RAM
   .data            : > S3RAM
   .bss             : > S3RAM
   .const           : >> CMBANK0_SECTOR0 | CMBANK0_SECTOR1, ALIGN(16)
```

Trouble : 'The address xxx is not flash area !' error message when entering to flash dialog



Cause : Flash programming is not feasible since the initialized section is located at RAM. Particularly in the case that initial value of user variable in CLA program is set.
Shooting : Please refer to below manual capture. In case the initial value is needed, write the variable with the value in the main() or other C28x code.

10.2.3 C Language Restrictions

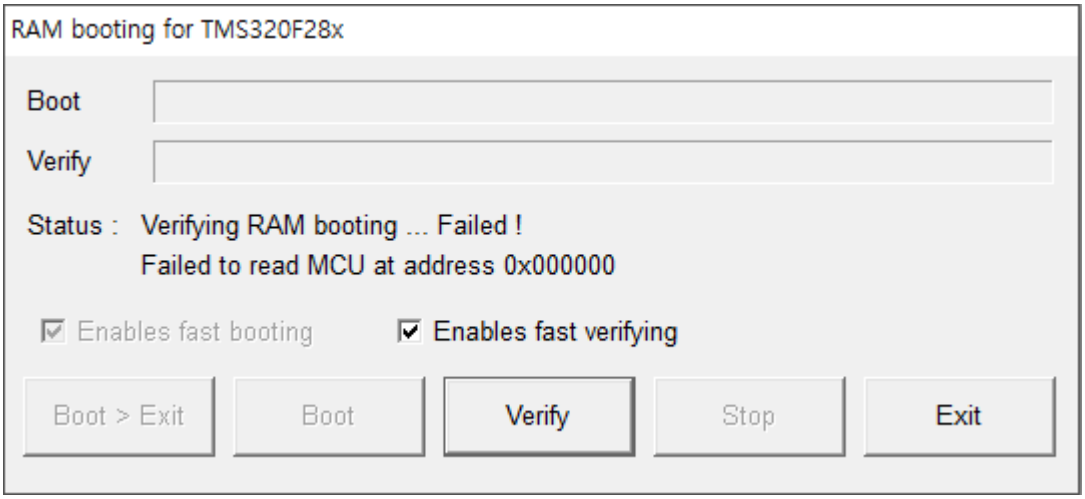
There are several additional restrictions to the C language for CLA.

- Defining and initializing global/static data is not supported.

  Since the CLA code is executed in an interrupt driven environment, there is no C system boot sequence. As a result, global/static data initialization must be done during program execution, either by the C28x driver code or within a CLA function.

  Variables defined as const can be initialized globally. The compiler creates initialized data sections named .const_cla to hold these variables.
- CLA code cannot call C28x functions. The linker provides a diagnostic message if code compiled for C28 calls code compiled for CLA or if code compiled for CLA calls code compiled for C28.
- Recursive function calls are not supported.
- The use of function pointers is not supported.

Trouble : Booting is successful but verifying is not from the address 0 due to MCU reading failure



Verifying is done by the easyDSP communication with MCU. So, any reason to block the communication could cause this problem.

cause-1 : The source files easyDSP provides for its communication is not included in the project
Shooting-1 : please include them in the project and modify main.c file accordingly. Please refer to the help file.

cause-2 : user program sets the GPIO easyDSP is using improperly.
Shooting-2 : please remove the GPIO seeting from your program.

cause-3 : enough time resource is not allocated to easyDSP communication
Shooting-3 : For example, if ePWM interrupt has high frequency, please reduce it.

Trouble : compile error of easyDSP source file /w controlSUITE

cause : controlSUITE has the different register naming from C2000Ware
Shooting : please use the latest TI source file (C2000Ware)

Trouble : MCU is working improperly when using a large number of variables or big size array

cause : bug of TI source file
Shooting : please use the latest TI source file (C2000Ware)

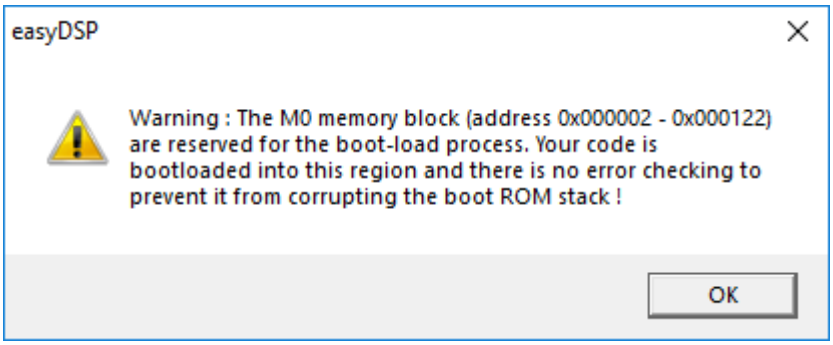
Trouble : F2838x is not working with easyDSP

Shooting : In case your board has 20Mhz clock and your source file is based on C2000Ware_3_02_00_00 (or upward), please predefine USE_20MHZ_XTAL so that TI source files can be compiled based on 20MHz. Please check below excerpt from TI's C2000Ware_3_02_00_00 release note.

- F2838x driverlib and examples updated to use 25MHz XTAL clock as default input clock

  Note: By default, Device_init function in driverlib and InitSysctrl function in bitfield examples assumes that the XTAL frequency is 25MHz. If a 20MHz XTAL is used, please add a predefined symbol "USE_20MHZ_XTAL" in your CCS project. If a different XTAL is used, you need to update the PLL multipliers and dividers accordingly. Note that the latest F2838x controlCARDs (Rev.B and later) have been updated to use 25MHz XTAL by default. If you have an older 20MHz XTAL controlCARD (E1, E2, or Rev.A), refer to the controlCARD documentation on steps to reconfigure the controlCARD from 20MHz to 25MHz.

Trouble: Warning message as below before RAM booting is started



Shooting : change your cmd file so that your code is not overlapped with the reserved RAM memory for bootrom.

For example, 28377D has the reserved RAM memory for bootrom operation as shown in the table below (Excerpt from Technical Reference Manual (Literature Number: SPRUHM8I, Revised September 2019)).

Table 4-19. Reserved RAM and Flash Memory Map for CPU1

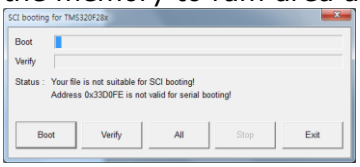
Memory	Description	Start Address	End Address	Length
RAM	Boot ROM	0x0000 0002	0x0000 0122	0x0121
	TI-RTOS(1)	0x0000 0780	0x0000 07FF	0x0080
Flash	TI-RTOS(1)(2)	0x0008 2000	0x0008 2823	0x0824

(1) If the user is not planning on using TI-RTOS in ROM, then these memory locations are free to be used by the application.
(2) For using the TI-RTOS in flash sector A, TI recommends that this sector be made unsecure, or at minimum, the sector should be verified that there is no secure zone claiming this sector.

In case your code is overlapped with this area, easyDSP detects it and shows warning message.

Trouble: RAM booting failed with message box below

Shooting : RAM booting is failed since program memory is allocated to flash area, not ram area. The address shown in the box (ex, 0x33D0FE) belongs to flash. Please change your link file to allocate all the memory to ram area and try again.



Trouble: Auto bauding failed

Shooting :
Mainly due to wrong hardware connection between easyDSP and your MCU board.
Step 1 : please check if your connection is correct. Hope you find misconnection in this step. Or, move to step 2.
Step 2 : please check the waveforms of easyDSP pins during booting. Also refer to the below sequence of easyDSP pin status.

In case /RESET of easyDSP is NOT directly connected to reset pin of DSP, please check reset pin status of DSP pin together.

Step 2-1 : please check if /BOOT is low when /RESET is changed from low to high.

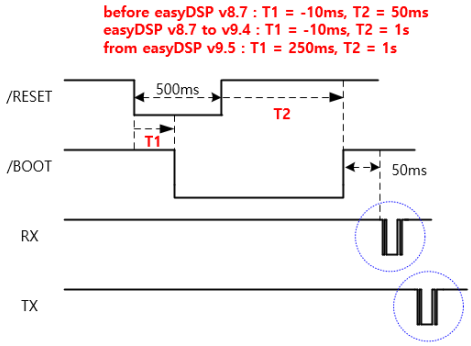
In case power monitoring IC (TPSxxxx) is used to generate /XRS signal and /RESET is an input to the IC,

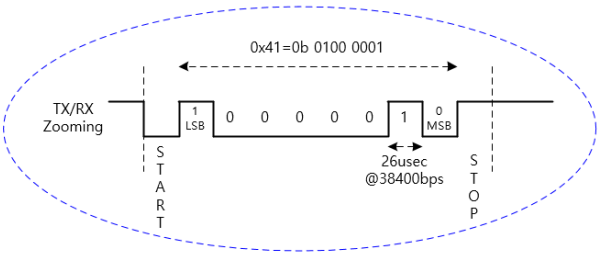
some cases it happens that /XRS becomes high after /BOOT is high, which will make booting failure.

Step 2-2 : please check RX and TX. After /BOOT pins are released high, 0x41 is sent from PC to MCU via RX.

Bauding bps could be different by MCU type and booting speed option.

Then MCU send 0x41 at the detected bps (ex. 38400bps here). Please check the waveforms and see what is missing in your board.





Trouble : compilation failed with below error message

```
undefined first referenced
 symbol       in file
--------- ----------------
LL$$OR    C:\\tidcs\\c28\\DSP2833x\\Project\\Debug\\easy2833x_sci_v7.3.obj
ULL$$CMP  C:\\tidcs\\c28\\DSP2833x\\Project\\Debug\\easy2833x_sci_v7.3.obj
```

error: unresolved symbols remain
error: errors encountered during linking; "./Debug/inverter.out" not built

>> Compilation failure

Shooting : The TMS320C28x does not directly support some C/C++ integer operations. Evaluating these operations is done with calls to run-time-support routines. These routines are hard-coded in assembly language. They are members of the object and source run-time-support libraries.

"ULL$$CMP" = unsigned long long comparison

"LL$$OR" = long long oring

Therefore, please include run-time library at compiling.

Trouble : Type of all variables are displayed as 'int'

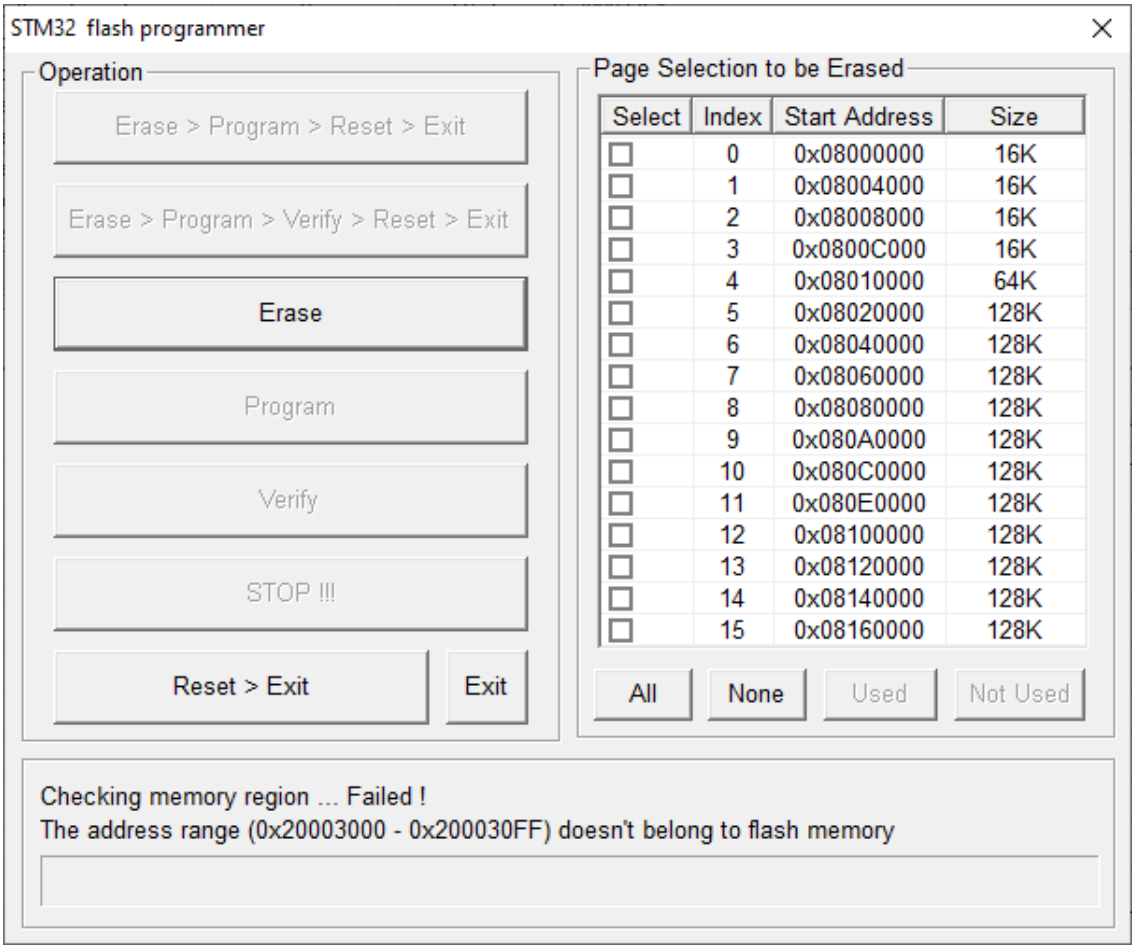
Shooting: Please use the latest easyDSP version and set the proper debugging model (either coff or dwarf) in the project setting.

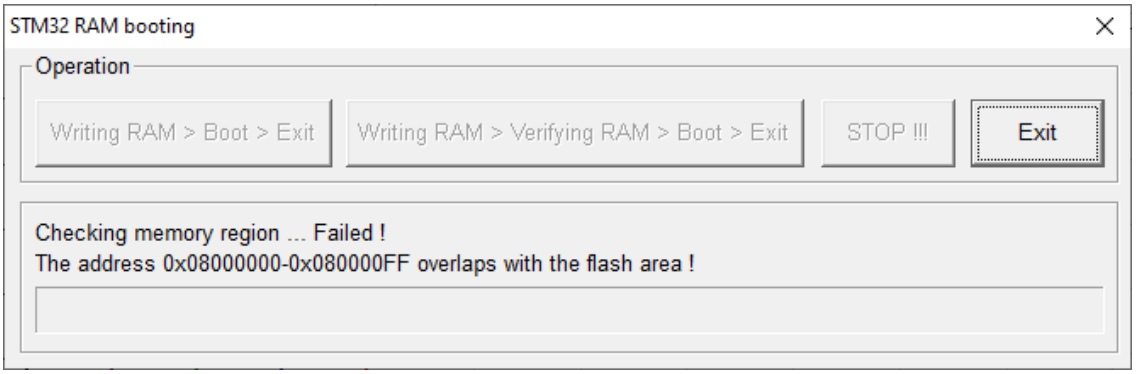
10.3 STM32

Trouble shooting (ST STM32)

Trouble: below error message from FlashROM or RAM booting dialog

Shooting : place your code to flash area for flash dialog operation. And place your code to RAM area for RAM booting dialog operation.





Trouble: Failed to enter bootloader mode

Shooting :
Mainly due to wrong hardware connection between easyDSP and your MCU board.
Step 1 : please check if your connection is correct. Hope you find misconnection in this step. Or, move to step 2.
Step 2 : please check the waveforms of easyDSP pins during booting. Also refer to the below sequence of easyDSP pin status.

In case /RESET of easyDSP is NOT directly connected to reset pin of MCU, please check reset pin status of DSP pin directly.

Step 2-1 : please check if BOOT pin is high when /RESET pin is changed from low to high.

In case power monitoring IC (TPSxxxx) is used to generate NRST signal and /RESET is an input to the IC,

it could happen that NRST becomes high after BOOT is low, which will make booting failure.

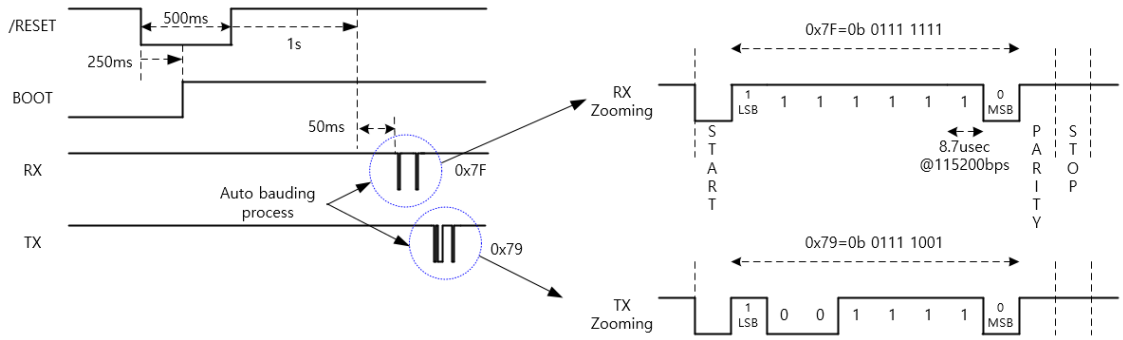
Step 2-2 : please check RX and TX. After BOOT pin is low, 0x7F (even parity) is sent from PC

to MCU via RX.

Bauding bps could be either 115200bps or 57600bps or other value depending of MCU type.

Then MCU send 0x79 (even parity) to PC at the detected bps. With this handshake, bps of each side (easyDSP and MCU) are aligned.

In case you can't observe 0x79 at all, please modify the option byte accordingly.



11. Tips

11.1 DA converter

If your MCU board has DA converter, you can monitor the variables on the oscilloscope by outputing them via DA converter. It is very helpful in debugging your program. In this tip, it is explained how you can change the content of DA converter (that is, variable to display) easily in real time.

Step 1 : Modify da.h file

easyDSP supports c source file and its header file (da.c and da.h) for dac control. File da.h is like below.

```
// File name : da.c
// function : DA output control

// variable explanation(#=1,2,3,4)
// da# : address of variable
// da#_type = 0 ; the variable is float
// = 1 ; the variable is integer
// da#_mid : mid value
// da#_rng : da scale

// use this routine in EasyDSP as below
// da1=&var_float
// da1_type=0
// da1_mid=0.
// da1_rng=20
// da2 = &var_int
// da2_type = 1
// da2_mid= 0.
// da2_rng = 20
```

```
#ifndef _DA_EasyDSP
#define _DA_EasyDSP

// you should specify the da address of your own
#define DA1_ADDR (*(int *)0X03C000e)
#define DA2_ADDR (*(int *)0X03C000d)
#define DA3_ADDR (*(int *)0X03C000b)
#define DA4_ADDR (*(int *)0X03C0007)
#define

extern unsigned int da1, da2, da3, da4, da1_type, da2_type, da3_type, da4_type;
extern float da1_rng, da1_val, da1_mid;
extern float da2_rng, da2_val, da2_mid;
extern float da3_rng, da3_val, da3_mid;
extern float da4_rng, da4_val, da4_mid;

// Notice : If you need faster DA output, please replace 'divide' part
// in the macro with 'multiply' accordingly.

// 12 bit DA
#define DA12(num) \
da##num##_val = (da##num##_type == 0 ? *(float *)da##num : (float)(*(int *)da##num)) ; \
DA##num##_ADDR = (int)((da##num##_val-da##num##_mid )* 0x7ff/da##num##_rng) +
0x800 ;

// 8 bit DA
#define DA8(num) \
da##num##_val = (da##num##_type == 0 ? *(float *)da##num : (float)(*(int *)da##num)) ; \
DA##num##_ADDR = (int)((da##num##_val-da##num##_mid )*0x7f/da##num##_rng) + 0x80 ;

#endif
```

At first, the address of da converter on your board should be defined correctly in the DA#_ADDR define lines(#=1,2,3,4). And then, you should also modify the macro function for dac output considering the feature of your dac's own. In above example code, 8 bit and 12bit dac with positive/negative output dac are shown.
Note : divide operation in the macro may need long time to be executed. For faster da output, replace it by the multiply operation.

Necessary variables are defined in the da.c file and their meanings are
da# = The address of variable which is output to DA channel #
da#_type = The type of variable. 1 = Integer, 0 = float
da#_rng = range of display
da#_mid = mid value of display

Step 2 : Modify your program

Make your MCU program contain the da.c and da.h you modified. And insert following macros where you want dac output is made .Normally, the insertion place is in the timer interrupt routine for repetitive output.

```
#include "da.h"
```

```
.....

DA12(1);
DA12(2);
DA12(3);
DA12(4);
.....
```

Step 3 : Use easyDSP

Finally, you can control the da converter in the command window or other windows as follows.

```
da1=&var_float
da1_type=0
da1_mid=0
da1_rng=20

da2 = &var_int
da2_type = 1
da2_mid= 0
da2_rng = 20
```

11.2 Others

---

only for MCU flash programming with easyDSP NEW

In case you like MCU flash programming only without using various easyDSP communication features, then please make a easyDSP project with the target output file (for example, *.out file), and go to flashROM menu and program flash.

Insert new line in command window

Basically, enter-key input in command window means the running of current line command. To insert new line without running command, two methods are supported. One is just clicking the tool bar of new line  . The other is 'Ctrl + Enter' key input.

Confirm your assignment command in command window

You can change variable value by assignment commands(=). And then confirm change by clicking the right button of mouse. This action is equal to the tool bar of 'update'  .

Save some information on the flashrom

Because easyDSP supports sector erase of flashrom, you can use some sectors of flashrom for booting data and the other sectors for saving your system information.

11.3 FAQ

What's difference between easyDSP and Jtag/SWD debugger ?

They have different purpose. Debugger is useful when you develop hardware and software in the beginning especially with breakpoint, step-in operation. But in some applications like motor drives, you can't use this features when the system is running. So during system operation, you need to monitor the variables in your code for system debugging. The variable monitoring with debugger has some limits such as limited number of variables, monitoring speed. Even worse is under very noisy environment (high current, high voltage switching) the debugger is sometimes disconnected. And for mass production, the debugger accessibility is limited to protect IP.
On the other hand, easyDSP has very stable connection all the time since it communicates with MCU with communication channel like SCI or UART.

When to use easyDSP, when to use debugger ?

Debugger is useful when you develop MCU board or its basic firmware. On the other hands, easyDSP is useful when you develop/debugg a high-level system algorithm. By combining debugger and easyDSP, the best debugging environment could be implemented.

How reliable is reading variable?

100% reliability is not guaranteed. easyDSP could read wrong value of variable.

How reliable is writing variable?

2 byte checksum is checked before writing to variable. So the probability of having incorrect writing is extremely remote. But not 100% guaranteed.

How reliable is writing flash rom?

Flashrom is written by clicking 'Program' button. But nothing is checked and verified during writing process. Therefore you should check it by yourself by clicking 'Verify' button afterwards.

Which value will be displayed if the reading operation fails ?

either '?' (ex, in watch window) or no display in plot and chart window.

Does easyDSP do compiling and linking C program?

No. They are done by compiler and linker provided by chip maker.

How many variables can I monitor using easyDSP?

As much as the resource of your PC, speed and memory are permitted.

12. Driver

12.1 Driver Installation

NOTE) 64bit Windows is mandatory !!

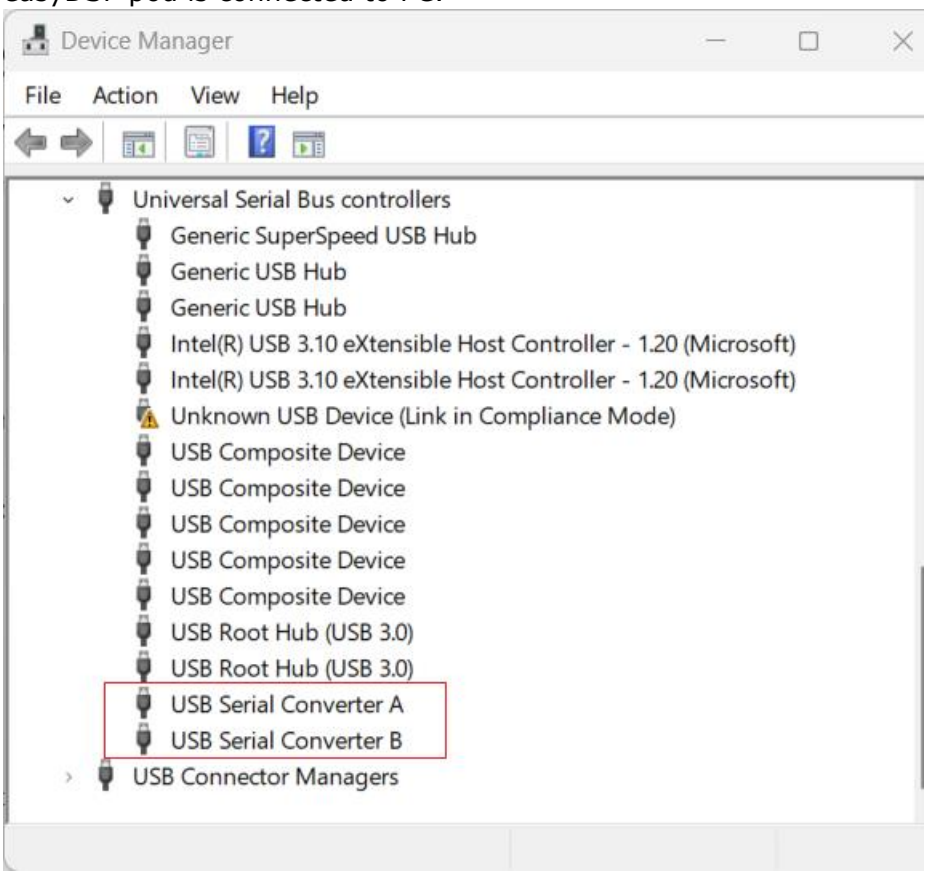
easyDSP uses FT2232 chip from FTDI as an USB controller IC. Therefore driver of easyDSP is same to D2XX Direct Driver of FT2232.
You can get all drivers in http://www.ftdichip.com/Drivers/D2XX.htm, all installation guidance in http://www.ftdichip.com/Documents/InstallGuides.htm.

Windows OS	How to install driver

Windows 11 Windows 10 Windows 8.1 Windows 8 Windows 7	Just run the "CDM212364_Setup.exe" in "Driver" folder of easyDSP program **BEFORE** connecting easyDSP pod into your PC. To install the latest driver file always, please visit http://www.ftdichip.com/Drivers/D2XX.htm . Please refer to the below links for detailed installation process. Windows 10/11 Installation Guide Windows 8 Installation Guide Windows 7 Installation Guide
Windows Vista Windows XP	Not included in the installation files but you can download it Drivers : http://www.ftdichip.com/Drivers/CDM/CDM20824_Setup.exe Installation process : Windows Vista Installation Guide Windows XP Installation Guide

Since easyDSP uses FT2232 USB controller chip from FTDI, you can refer to the latest driver file (D2XX direct driver) and its installation guideline from FTDI.
http://www.ftdichip.com/Drivers/D2XX.htm
http://www.ftdichip.com/Documents/InstallGuides.htm

After the driver is well installed, you will find USB Serial Converter A/B in the device manager once the easyDSP pod is connected to PC.



12.2 Driver Uninstallation

In case general Windows way of driver removal is not successful, CDM Uninstaller can be used. CDM Uninstaller is a free application that can selectively remove Windows device drivers from the user's system as specified by the device Vendor ID and Product ID. This application comes as a command driven application or as a GUI executable.
The readme for the GUI version can be viewed here. Please refer to the readme for running the

application.
Both applications come as a zipped executable that needs to be extracted prior to running.

[Download CDM Uninstaller (command line version + GUI version)]

Major process is to add Vendor/Product ID and click 'Remove Devices'.