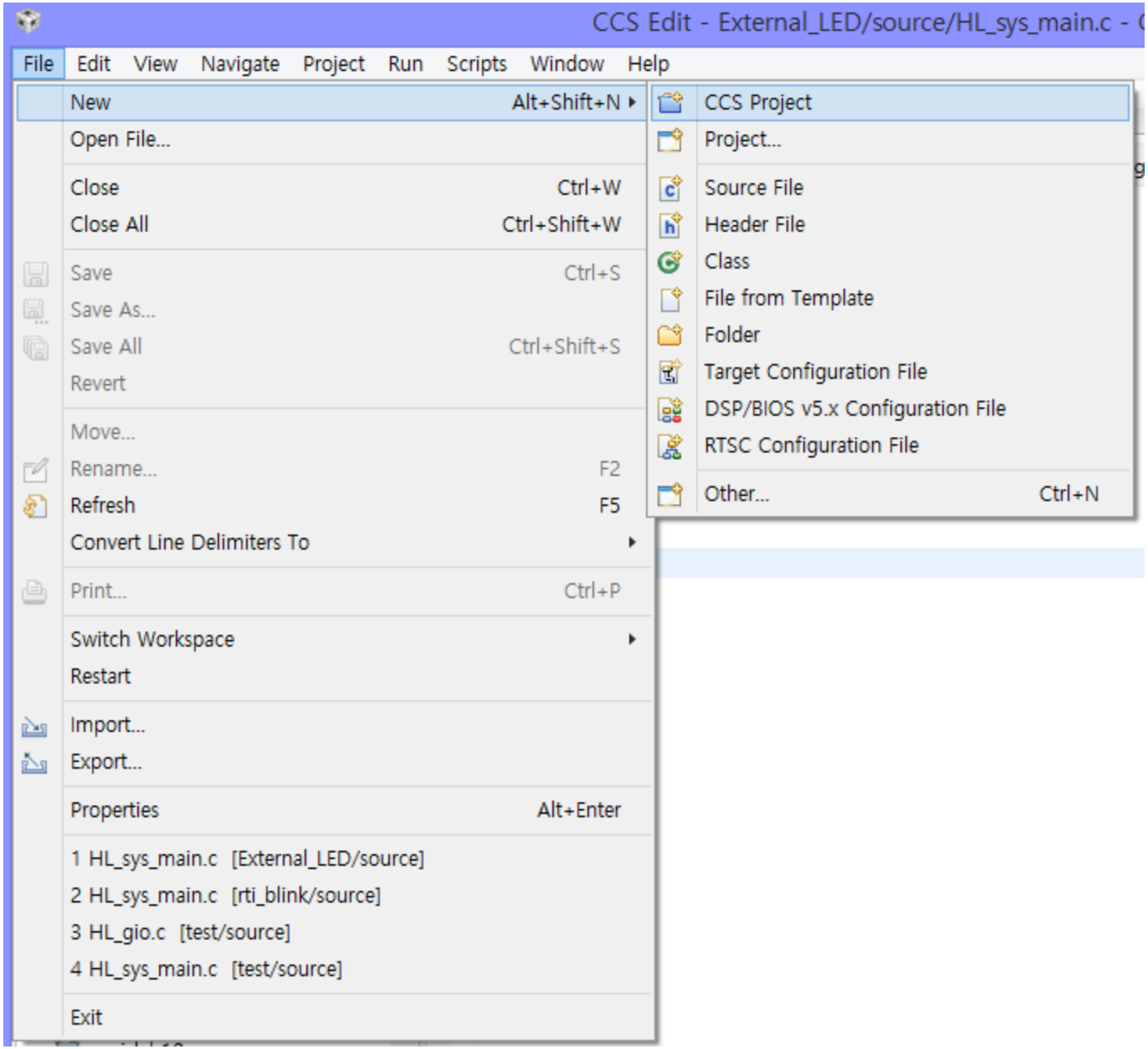
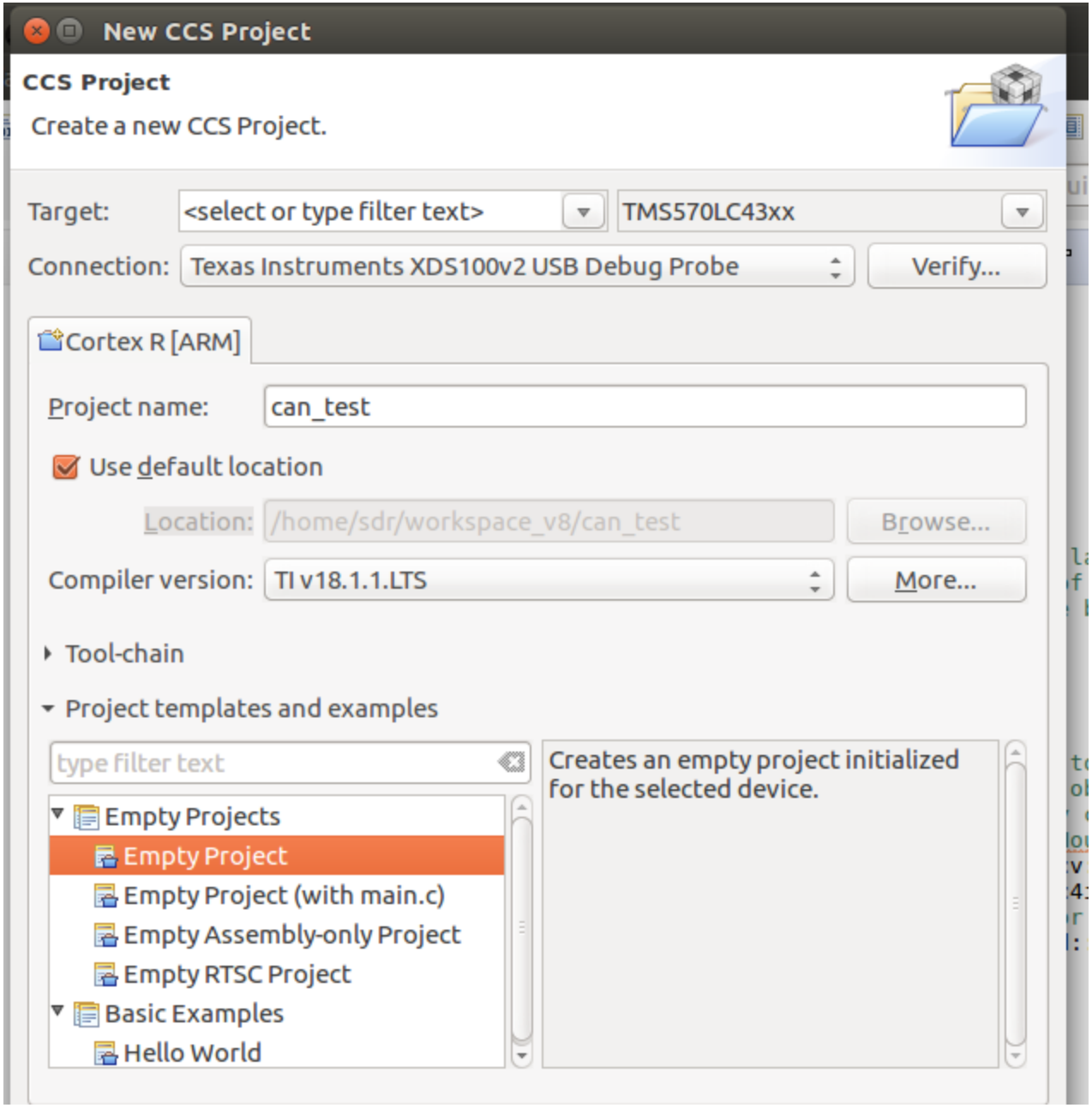
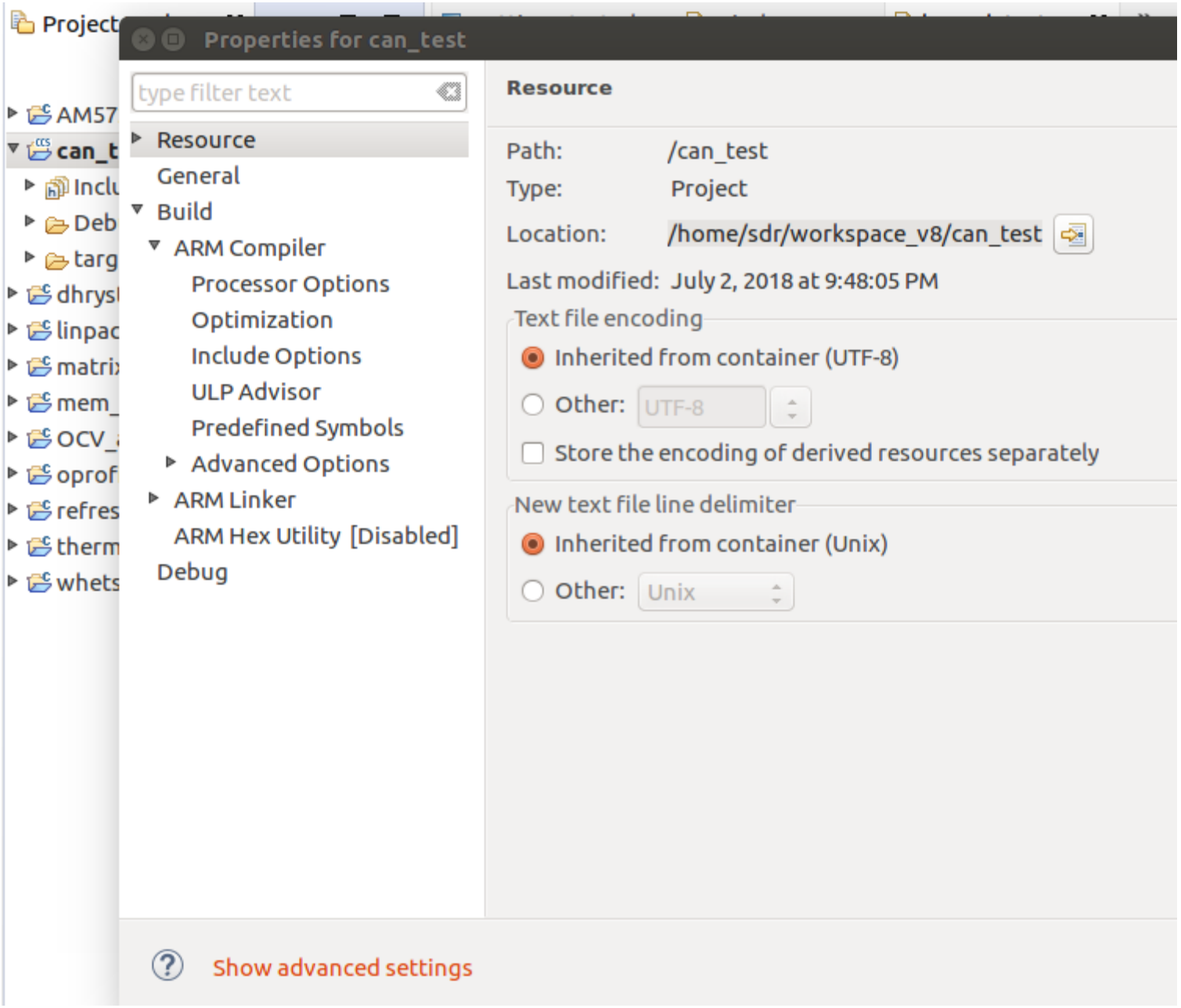
Xilinx Zynq FPGA, TI DSP, MCU 기반의 회로 설계 및 임베디드 전문가 과정

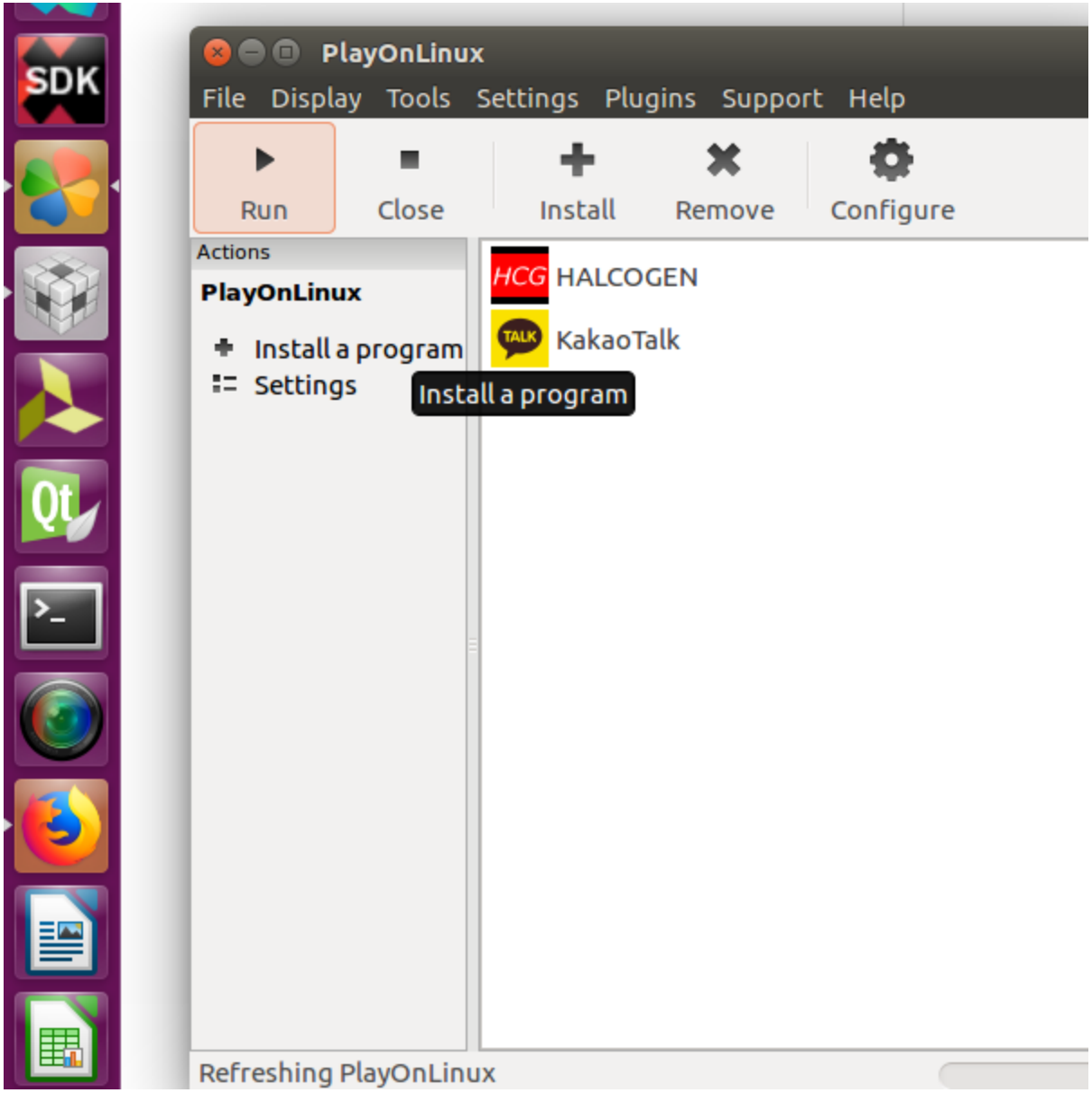
강사 – Innova Lee(이상훈)
gcccompil3r@gmail.com

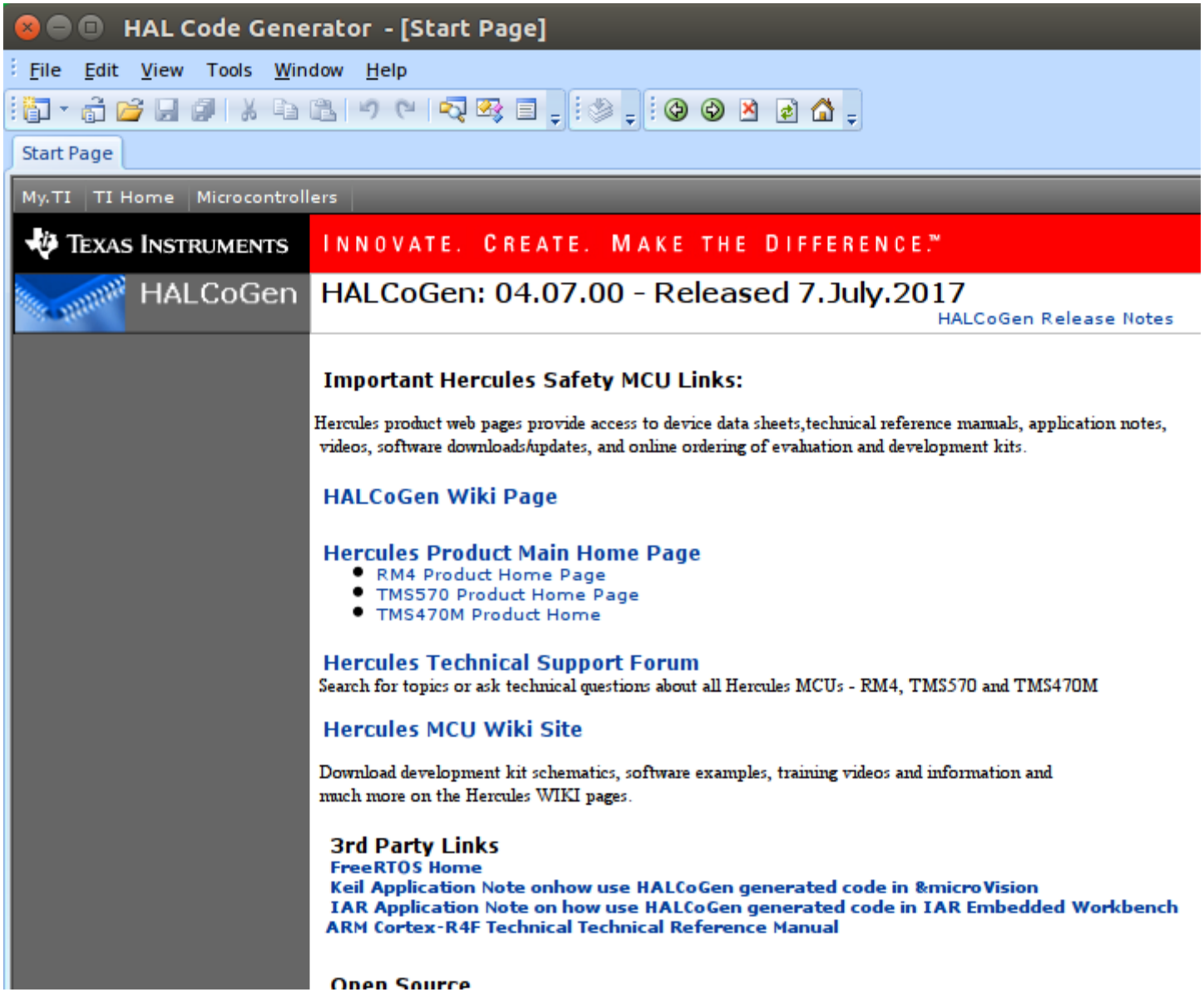
CAN Communication with TMS570 and PC


CCS Edit - External_LED/source/HL_sys_main.c -
File
Edit
View
Navigate
Project
Run
Scripts
Window
Help
New Alt+Shift+N
Open File...
Close Ctrl+W
Close All Ctrl+Shift+W
Save Ctrl+S
Save As...
Save All Ctrl+Shift+S
Revert
Move...
Rename... F2
Refresh F5
Convert Line Delimiters To
Print... Ctrl+P
Switch Workspace
Restart
Import...
Export...
Properties Alt+Enter
1 HL_sys_main.c [External_LED/source]
2 HL_sys_main.c [rti_blink/source]
3 HL_gio.c [test/source]
4 HL_sys_main.c [test/source]
Exit
CCS Project
Project...
Source File
Header File
Class
File from Template
Folder
Target Configuration File
DSP/BIOS v5.x Configuration File
RTSC Configuration File
Other... Ctrl+N


New CCS Project
CCS Project
Create a new CCS Project.
Target:
<select or type filter text>
TMS570LC43xx
Connection:
Texas Instruments XDS100v2 USB Debug Probe
Verify...
Cortex R [ARM]
Project name:
can_test
Use default location
Location:
/home/sdr/workspace_v8/can_test
Browse...
Compiler version:
TI v18.1.1.LTS
More...
Tool-chain
Project templates and examples
type filter text
Empty Projects
Empty Project
Empty Project (with main.c)
Empty Assembly-only Project
Empty RTSC Project
Basic Examples
Hello World
Creates an empty project initialized for the selected device.


Project
AM57
can_t
Inclu
Deb
targ
dhrys
linpac
matri
mem_
OCV_
oprof
refres
therm
whets
Properties for can_test
type filter text
Resource
General
Build
ARM Compiler
Processor Options
Optimization
Include Options
ULP Advisor
Predefined Symbols
Advanced Options
ARM Linker
ARM Hex Utility [Disabled]
Debug
Resource
Path: /can_test
Type: Project
Location: /home/sdr/workspace_v8/can_test
Last modified: July 2, 2018 at 9:48:05 PM
Text file encoding
Inherited from container (UTF-8)
Other: UTF-8
Store the encoding of derived resources separately
New text file line delimiter
Inherited from container (Unix)
Other: Unix
Show advanced settings


PlayOnLinux
File
Display
Tools
Settings
Plugins
Support
Help
Run
Close
Install
Remove
Configure
Actions
PlayOnLinux
Install a program
Settings
HALCOGEN
KakaoTalk
Install a program
Refreshing PlayOnLinux


HAL Code Generator - [Start Page]
File Edit View Tools Window Help
Start Page
My.TI TI Home Microcontrollers
Texas Instruments
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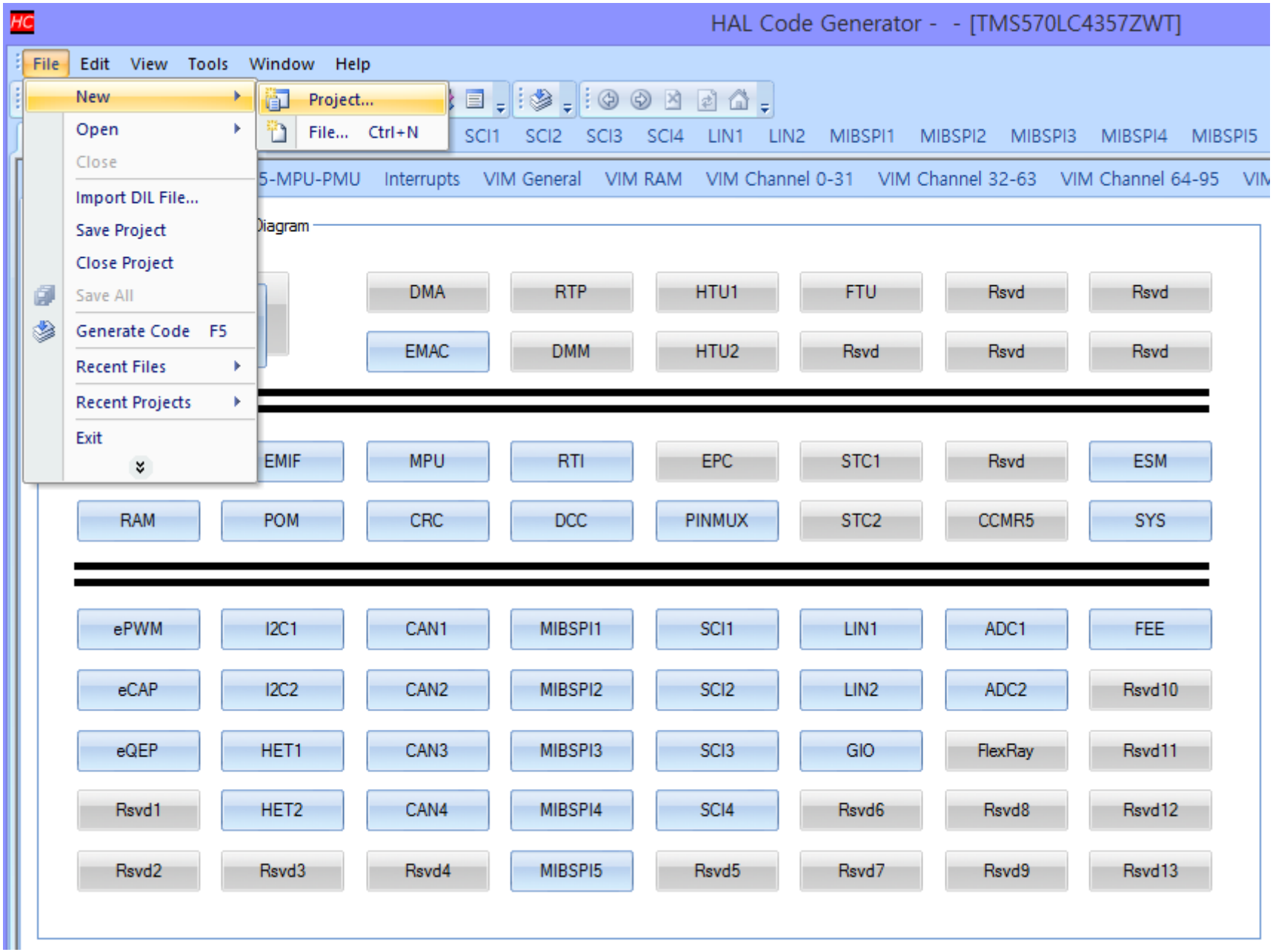
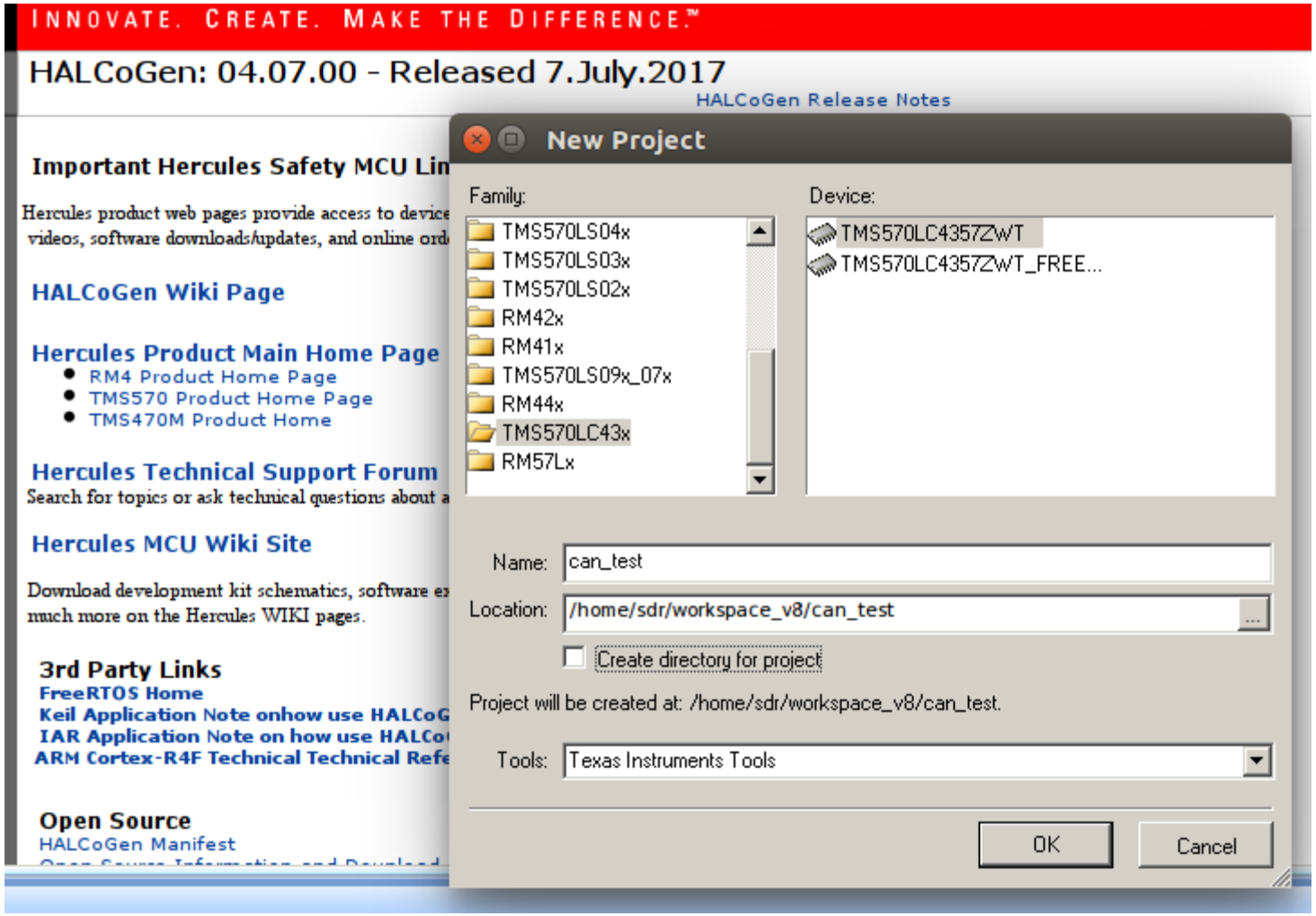
HALCoGen
HALCoGen: 04.07.00 - Released 7.July.2017
HALCoGen Release Notes
Important Hercules Safety MCU Links:
Hercules product web pages provide access to device data sheets,technical reference manuals, application notes, videos, software downloads/updates, and online ordering of evaluation and development kits.
HALCoGen Wiki Page
Hercules Product Main Home Page
RM4 Product Home Page
TMS570 Product Home Page
TMS470M Product Home
Hercules Technical Support Forum
Search for topics or ask technical questions about all Hercules MCUs - RM4, TMS570 and TMS470M
Hercules MCU Wiki Site
Download development kit schematics, software examples, training videos and information and much more on the Hercules WIKI pages.
3rd Party Links
FreeRTOS Home
Keil Application Note onhow use HALCoGen generated code in &microVision
IAR Application Note on how use HALCoGen generated code in IAR Embedded Workbench
ARM Cortex-R4F Technical Technical Reference Manual
Open Source


HAL Code Generator - - [TMS570LC4357ZWT]
File
Edit
View
Tools
Window
Help
New
Open
Close
Import DIL File...
Save Project
Close Project
Save All
Generate Code F5
Recent Files
Recent Projects
Exit
Project...
File... Ctrl+N
SCI1 SCI2 SCI3 SCI4 LIN1 LIN2 MIBSPI1 MIBSPI2 MIBSPI3 MIBSPI4 MIBSPI5
5-MPU-PMU Interrupts VIM General VIM RAM VIM Channel 0-31 VIM Channel 32-63 VIM Channel 64-95
Diagram
DMA RTP HTU1 FTU Rsvd Rsvd
EMAC DMM HTU2 Rsvd Rsvd Rsvd
EMIF MPU RTI EPC STC1 Rsvd ESM
RAM POM CRC DCC PINMUX STC2 CCMR5 SYS
ePWM I2C1 CAN1 MIBSPI1 SCI1 LIN1 ADC1 FEE
eCAP I2C2 CAN2 MIBSPI2 SCI2 LIN2 ADC2 Rsvd10
eQEP HET1 CAN3 MIBSPI3 SCI3 GIO FlexRay Rsvd11
Rsvd1 HET2 CAN4 MIBSPI4 SCI4 Rsvd6 Rsvd8 Rsvd12
Rsvd2 Rsvd3 Rsvd4 MIBSPI5 Rsvd5 Rsvd7 Rsvd9 Rsvd13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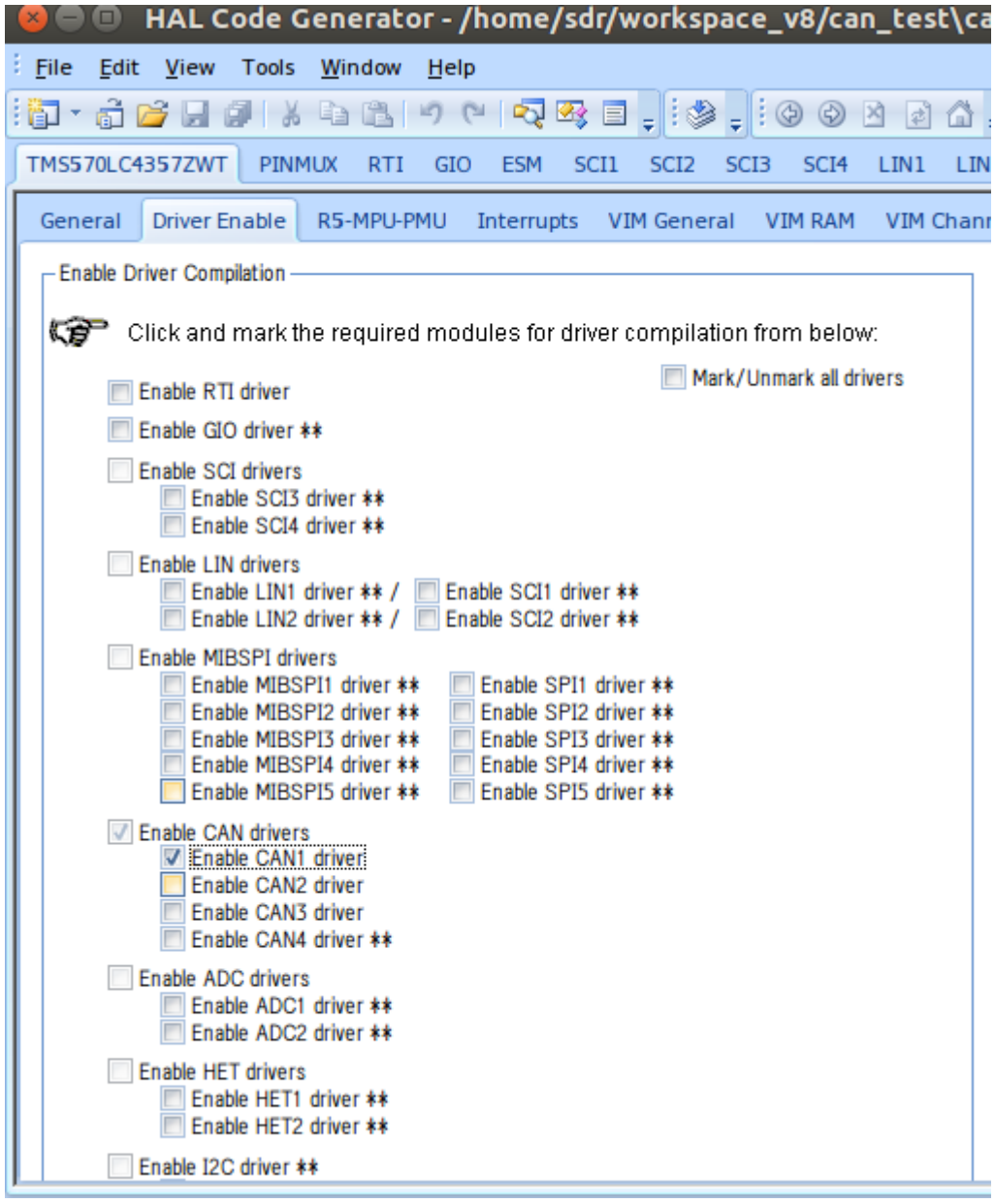
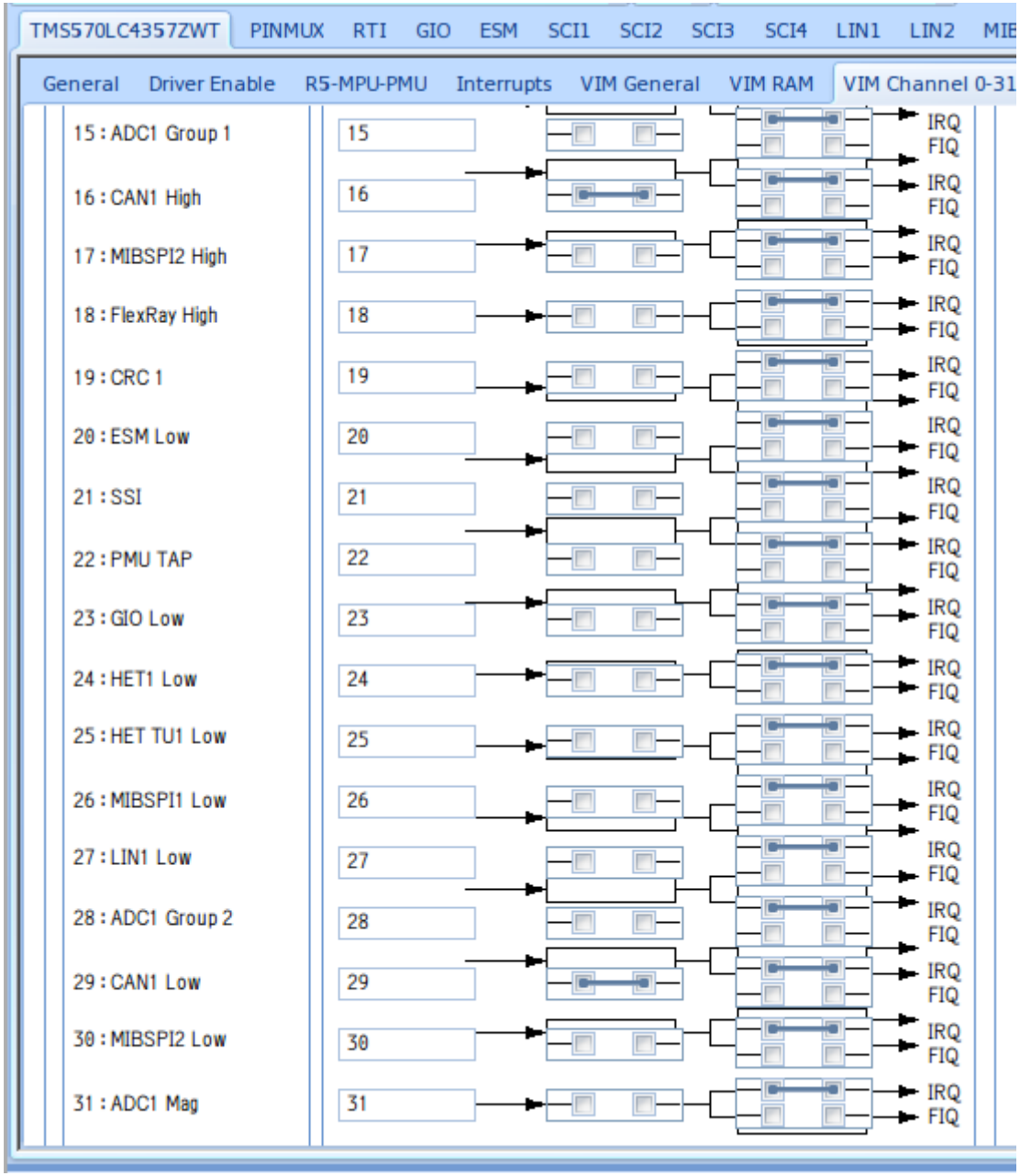
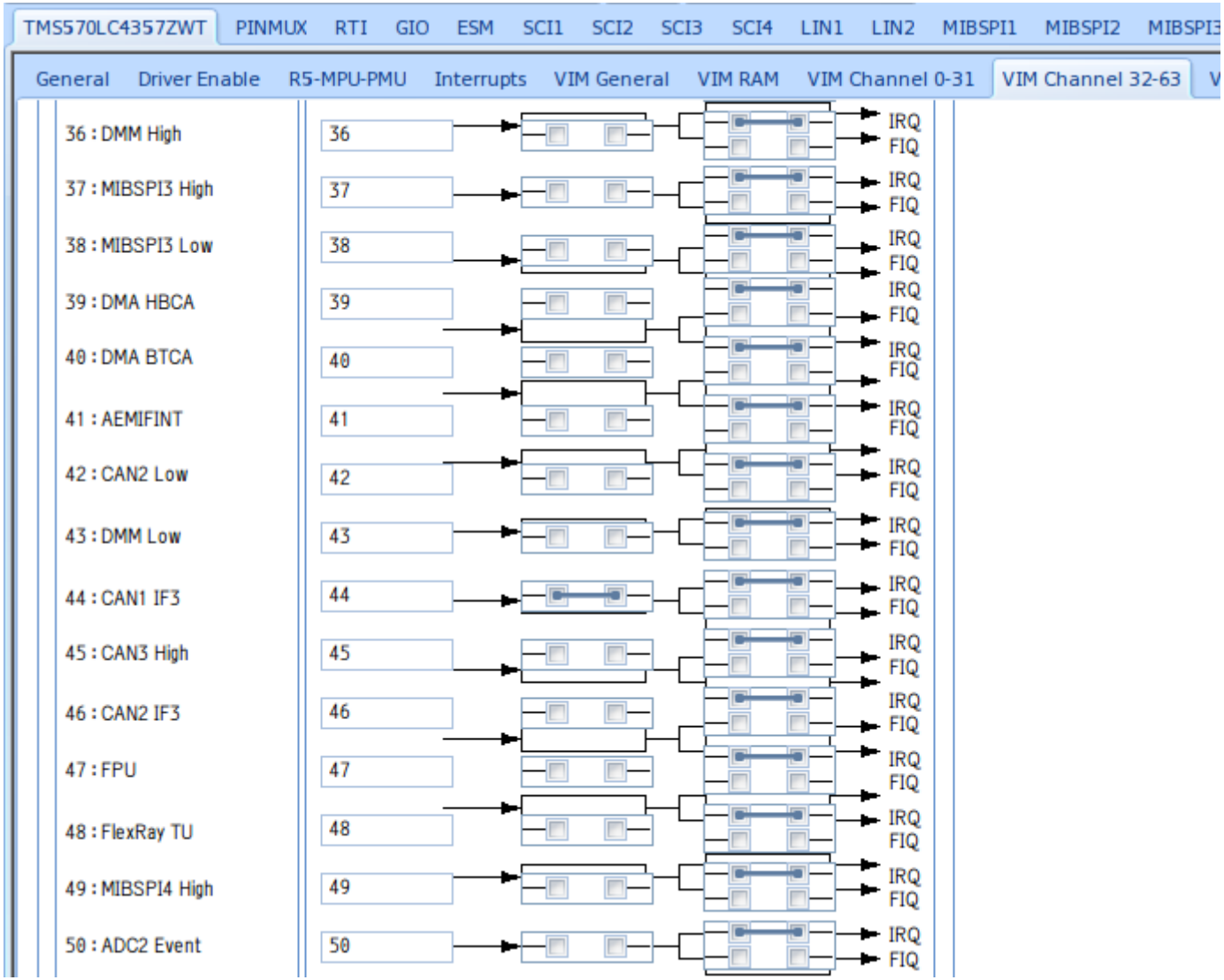
HALCoGen: 04.07.00 - Released 7.July.2017
HALCoGen Release Notes
Important Hercules Safety MCU Lin
Hercules product web pages provide access to device
videos, software downloads/updates, and online ord
HALCoGen Wiki Page
Hercules Product Main Home Page
RM4 Product Home Page
TMS570 Product Home Page
TMS470M Product Home
Hercules Technical Support Forum
Search for topics or ask technical questions about a
Hercules MCU Wiki Site
Download development kit schematics, software ex
much more on the Hercules WIKI pages.
3rd Party Links
FreeRTOS Home
Keil Application Note onhow use HALCoG
IAR Application Note on how use HALCo
ARM Cortex-R4F Technical Technical Refe
Open Source
HALCoGen Manifest
New Project
Family:
TMS570LS04x
TMS570LS03x
TMS570LS02x
RM42x
RM41x
TMS570LS09x_07x
RM44x
TMS570LC43x
RM57Lx
Device:
TMS570LC4357ZWT
TMS570LC4357ZWT_FREE...
Name: can_test
Location: /home/sdr/workspace_v8/can_test
Create directory for project
Project will be created at: /home/sdr/workspace_v8/can_test.
Tools: Texas Instruments Tools
OK
Cancel


HAL Code Generator - /home/sdr/workspace_v8/can_test\ca
File Edit View Tools Window Help
TMS570LC4357ZWT PINMUX RTI GIO ESM SCI1 SCI2 SCI3 SCI4 LIN1 LIN
General Driver Enable R5-MPU-PMU Interrupts VIM General VIM RAM VIM Chan
Enable Driver Compilation
Click and mark the required modules for driver compilation from below:
Mark/Unmark all drivers
Enable RTI driver
Enable GIO driver **
Enable SCI drivers
Enable SCI3 driver **
Enable SCI4 driver **
Enable LIN drivers
Enable LIN1 driver ** / Enable SCI1 driver **
Enable LIN2 driver ** / Enable SCI2 driver **
Enable MIBSPI drivers
Enable MIBSPI1 driver ** Enable SPI1 driver **
Enable MIBSPI2 driver ** Enable SPI2 driver **
Enable MIBSPI3 driver ** Enable SPI3 driver **
Enable MIBSPI4 driver ** Enable SPI4 driver **
Enable MIBSPI5 driver ** Enable SPI5 driver **
Enable CAN drivers
Enable CAN1 driver
Enable CAN2 driver
Enable CAN3 driver
Enable CAN4 driver **
Enable ADC drivers
Enable ADC1 driver **
Enable ADC2 driver **
Enable HET drivers
Enable HET1 driver **
Enable HET2 driver **
Enable I2C driver **


TMS570LC4357ZWT
PINMUX
RTI
GIO
ESM
SCI1
SCI2
SCI3
SCI4
LIN1
LIN2
MIB
General
Driver Enable
R5-MPU-PMU
Interrupts
VIM General
VIM RAM
VIM Channel 0-31
15 : ADC1 Group 1
16 : CAN1 High
17 : MIBSPI2 High
18 : FlexRay High
19 : CRC 1
20 : ESM Low
21 : SSI
22 : PMU TAP
23 : GIO Low
24 : HET1 Low
25 : HET TU1 Low
26 : MIBSPI1 Low
27 : LIN1 Low
28 : ADC1 Group 2
29 : CAN1 Low
30 : MIBSPI2 Low
31 : ADC1 Mag
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
IRQ
FIQ


TMS570LC4357ZWT
PINMUX
RTI
GIO
ESM
SCI1
SCI2
SCI3
SCI4
LIN1
LIN2
MIBSPI1
MIBSPI2
MIBSPI3
General
Driver Enable
R5-MPU-PMU
Interrupts
VIM General
VIM RAM
VIM Channel 0-31
VIM Channel 32-63
36 : DMM High
37 : MIBSPI3 High
38 : MIBSPI3 Low
39 : DMA HBCA
40 : DMA BTCA
41 : AEMIFINT
42 : CAN2 Low
43 : DMM Low
44 : CAN1 IF3
45 : CAN3 High
46 : CAN2 IF3
47 : FPU
48 : FlexRay TU
49 : MIBSPI4 High
50 : ADC2 Event
IRQ
FIQ

27.3 CAN Bit Timing

The DCAN supports bit rates between less than 1 kBit/s and 1000 kBit/s.

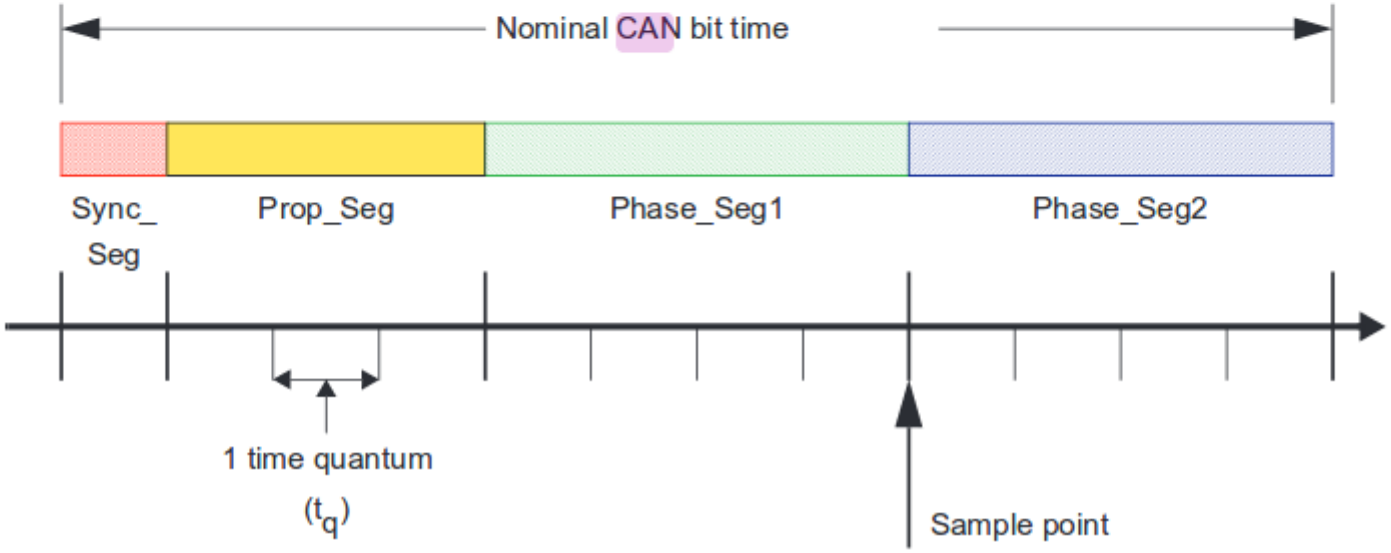
Each member of the CAN network has its own clock generator, typically derived from a crystal oscillator. The Bit timing parameters can be configured individually for each CAN node, creating a common Bit rate even though the CAN nodes' oscillator periods (f_{osc}) may be different.

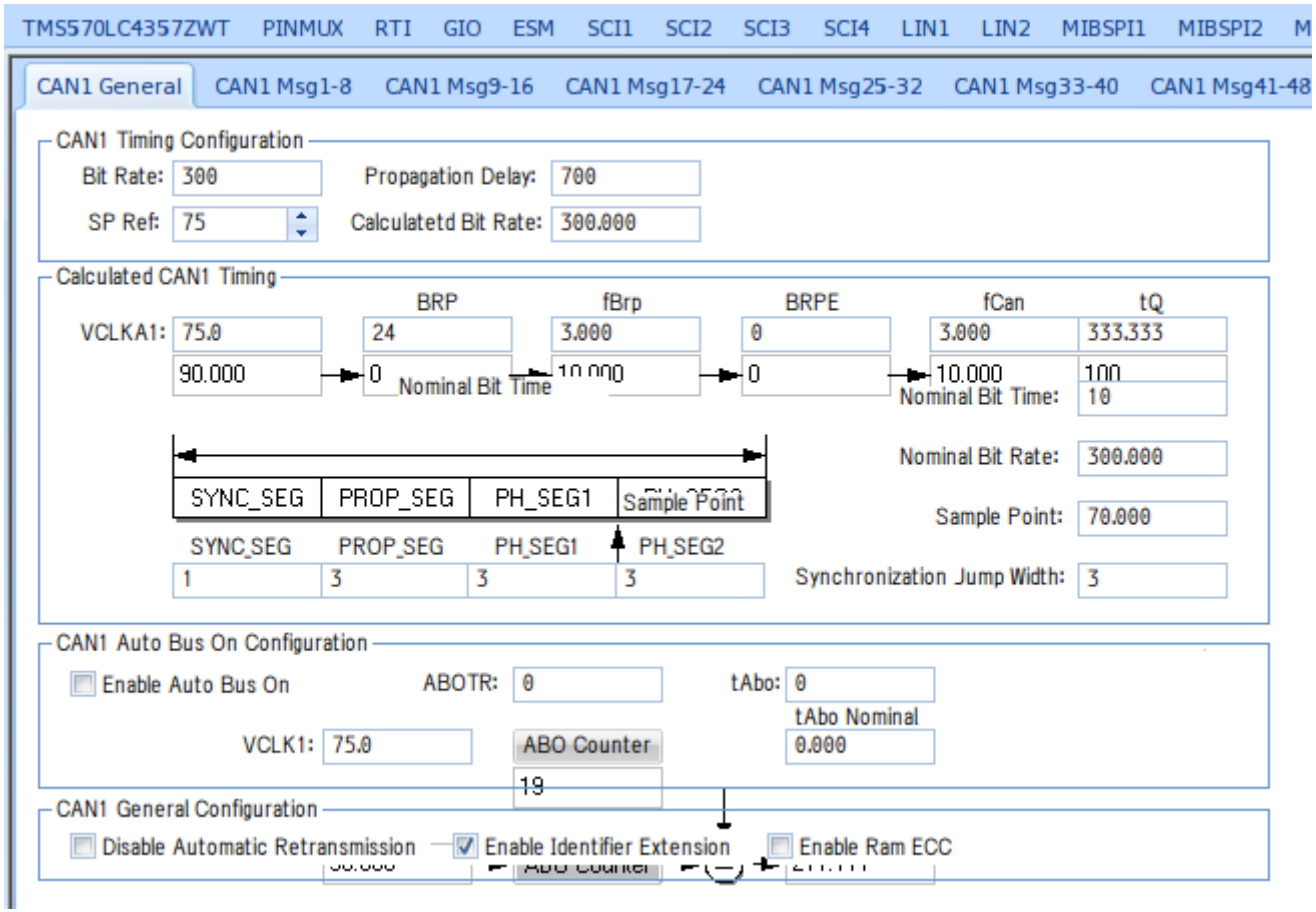
27.3.1 Bit Time and Bit Rate

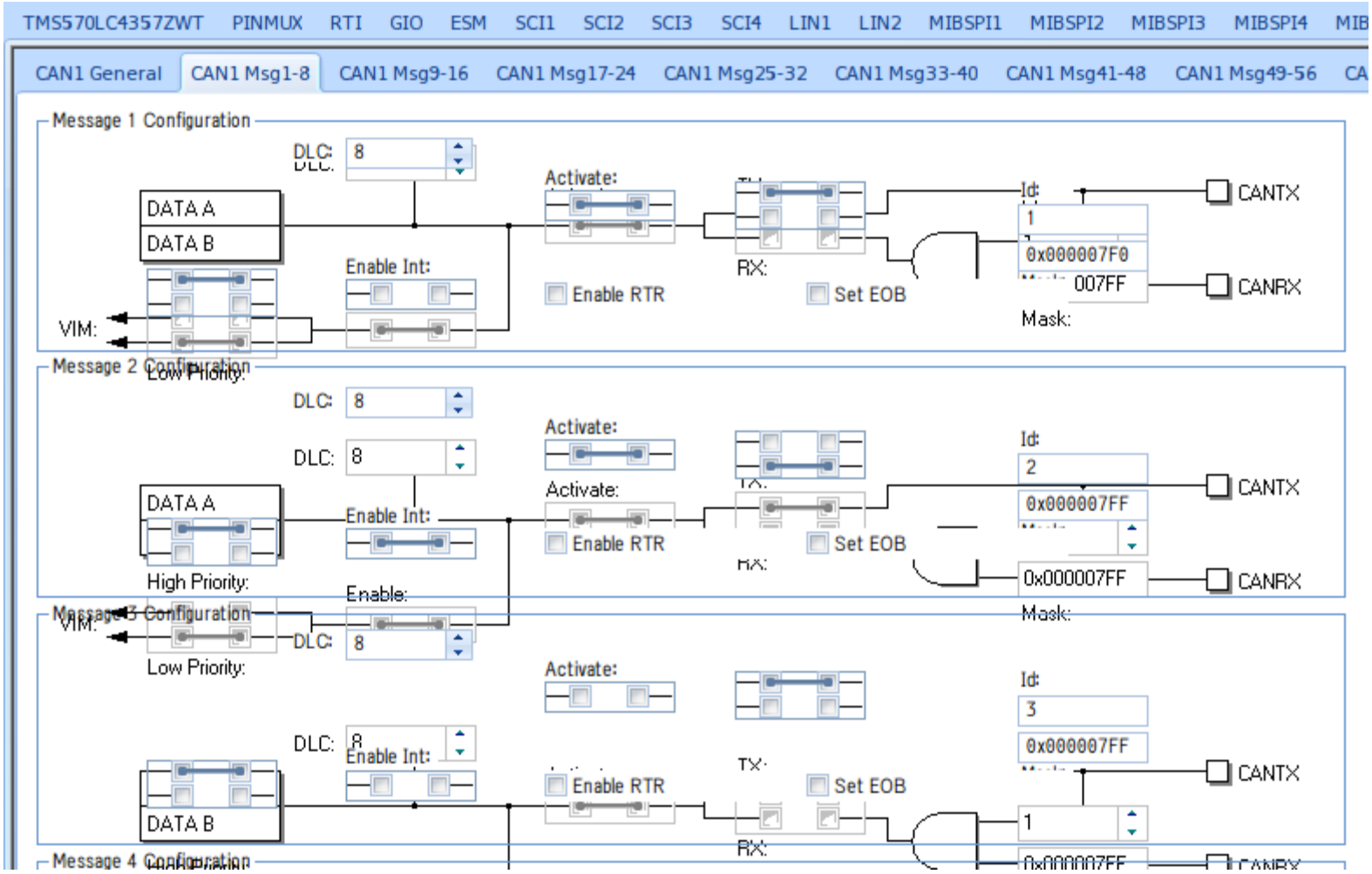
According to the CAN specification, the Bit time is divided into four segments (see Figure 27-2):

- Synchronization Segment (Sync_Seg)
- Propagation Time Segment (Prop_Seg)
- Phase Buffer Segment 1 (Phase_Seg1)
- Phase Buffer Segment 2 (Phase_Seg2)

Figure 27-2. Bit Timing




TMS570LC4357ZWT
PINMUX
RTI
GIO
ESM
SCI1
SCI2
SCI3
SCI4
LIN1
LIN2
MIBSPI1
MIBSPI2
M
CAN1 General
CAN1 Msg1-8
CAN1 Msg9-16
CAN1 Msg17-24
CAN1 Msg25-32
CAN1 Msg33-40
CAN1 Msg41-48
CAN1 Timing Configuration
Bit Rate: 300
Propagation Delay: 700
SP Ref: 75
Calculatetd Bit Rate: 300.000
Calculated CAN1 Timing
BRP
fBrp
BRPE
fCan
tQ
VCLKA1: 75.0
24
3.000
0
3.000
333.333
90.000
0
Nominal Bit Time
10.000
0
10.000
100
Nominal Bit Time: 10
SYNC_SEG
PROP_SEG
PH_SEG1
Sample Point
Nominal Bit Rate: 300.000
Sample Point: 70.000
SYNC_SEG
PROP_SEG
PH_SEG1
PH_SEG2
1
3
3
3
Synchronization Jump Width: 3
CAN1 Auto Bus On Configuration
Enable Auto Bus On
ABOTR: 0
tAbo: 0
tAbo Nominal
VCLK1: 75.0
ABO Counter
0.000
19
CAN1 General Configuration
Disable Automatic Retransmission
Enable Identifier Extension
Enable Ram ECC

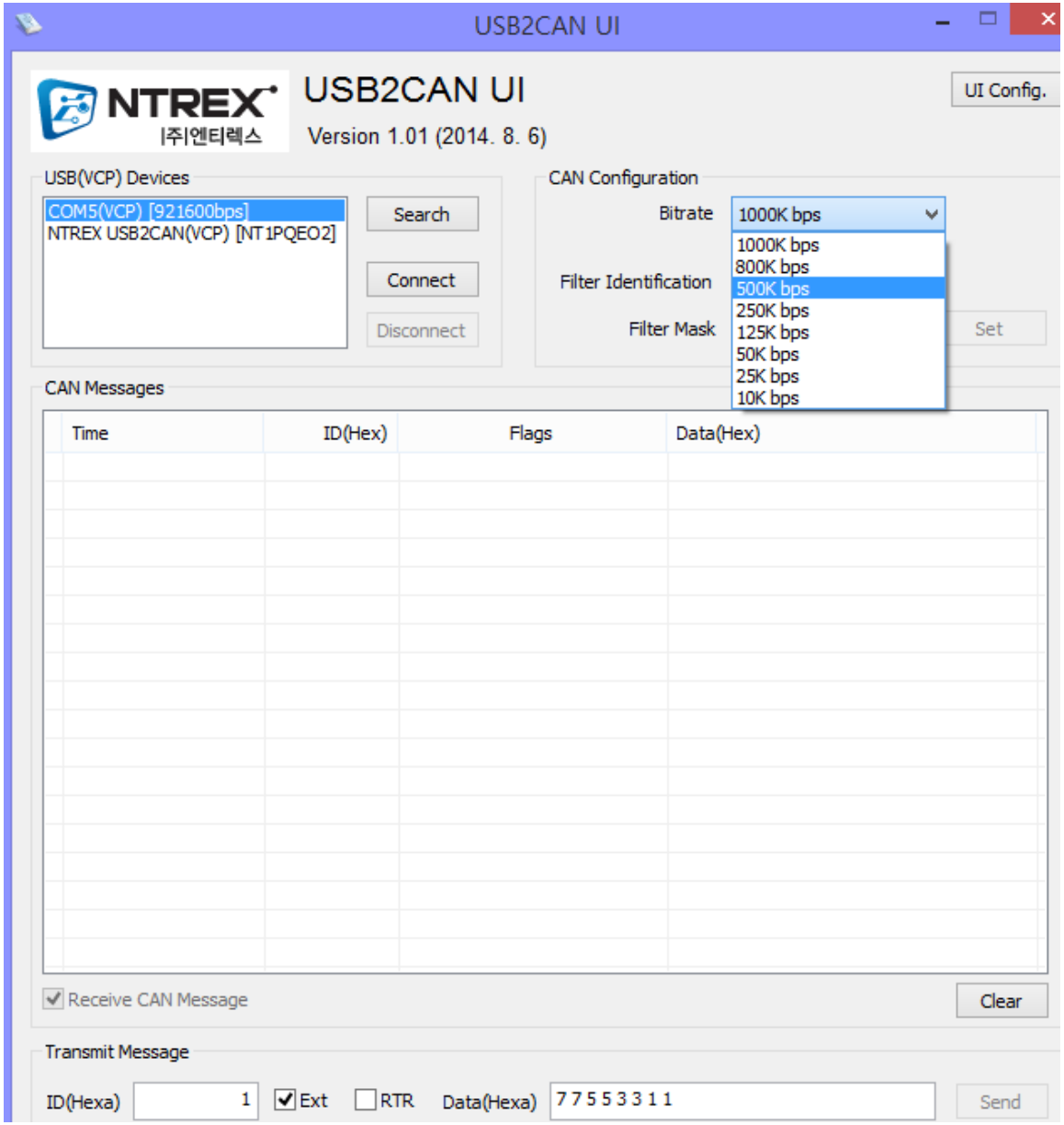

TMS570LC4357ZWT
PINMUX
RTI
GIO
ESM
SCI1
SCI2
SCI3
SCI4
LIN1
LIN2
MIBSPI1
MIBSPI2
MIBSPI3
MIBSPI4
CAN1 General
CAN1 Msg1-8
CAN1 Msg9-16
CAN1 Msg17-24
CAN1 Msg25-32
CAN1 Msg33-40
CAN1 Msg41-48
CAN1 Msg49-56
Message 1 Configuration
DLC:
8
DATA A
DATA B
Activate:
Enable Int:
Enable RTR
RX:
Set EOB
Id:
1
0x000007F0
007FF
Mask:
CANTX
CANRX
VIM:
Low Priority:
Message 2 Configuration
DLC:
8
DLC:
8
Activate:
Activate:
Id:
2
DATA A
Enable Int:
Enable RTR
Set EOB
0x000007FF
0x000007FF
Mask:
CANTX
CANRX
High Priority:
Enable:
VIM:
Message 3 Configuration
DLC:
8
Low Priority:
Activate:
Id:
3
DLC:
8
0x000007FF
Enable Int:
Enable RTR
Set EOB
1
CANTX
DATA B
Message 4 Configuration

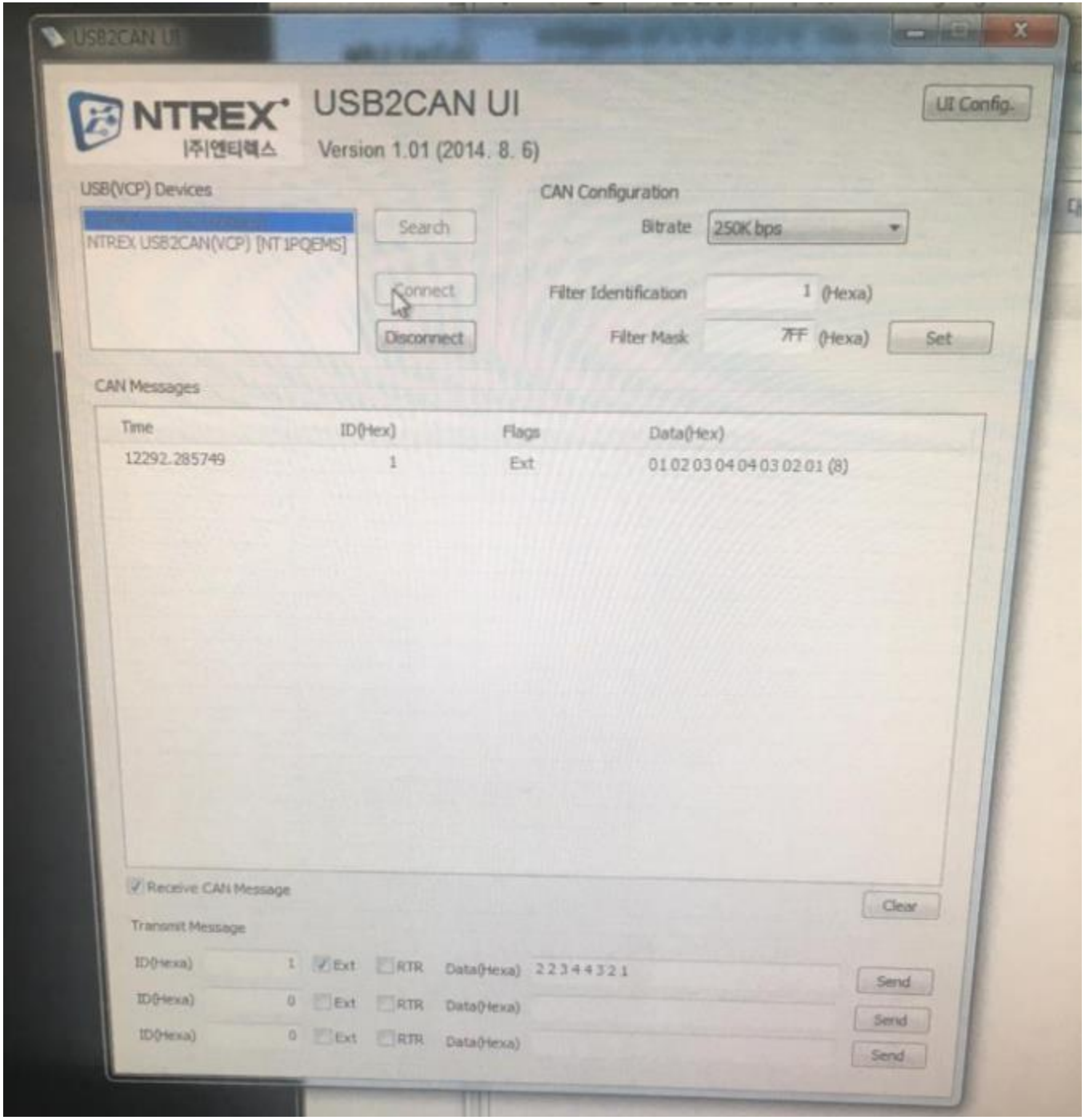
Getting Started | window.cpp | main.cpp | window.h | main.cpp | mai

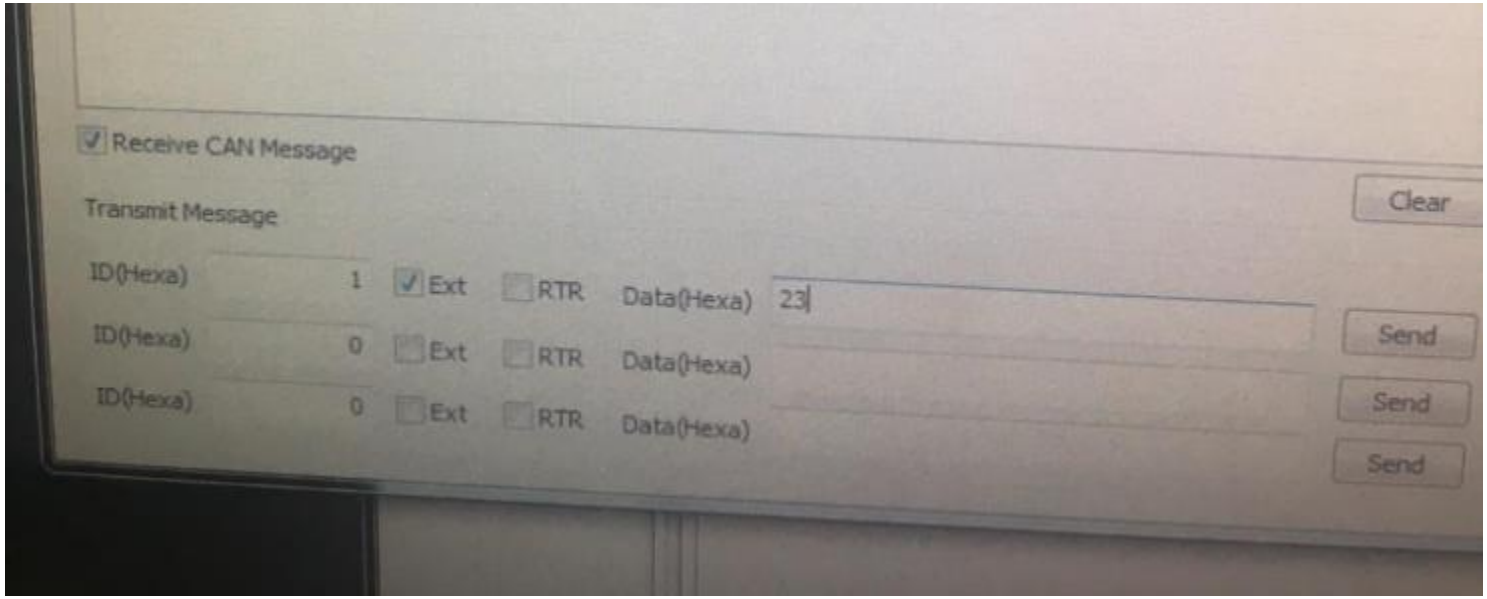
```
1 #include "HL_sys_common.h"
2 #include "HL_system.h"
3 #include "HL_can.h"
4 #include "HL_esm.h"
5 #include "HL_sys_core.h"
6
7 #include "stdio.h"
8
9 #define D_COUNT     8
10 #define D_SIZE      8
11
12 uint32 cnt = 0;
13 uint32 error = 0;
14 uint32 tx_done = 0;
15
16 uint8_t tx_data[D_COUNT] = {1, 2, 3, 4, 4, 3, 2, 1};
17 uint8_t rx_data[D_COUNT] = {0};
18
19 uint32_t checkPackets(uint8_t *src_packet, uint8_t *dst_packet, uint32_t psize);
20
21 void delay(int time)
22 {
23     int i;
24
25     for(i = 0; i < time; i++)
26         ;
27 }
28
```

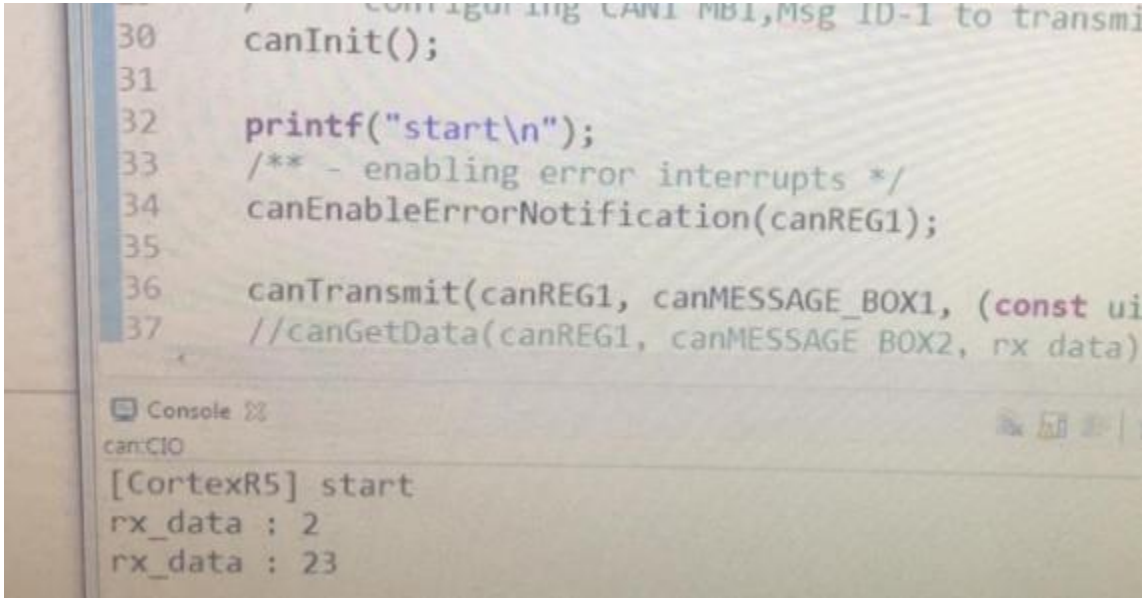
```
29 int main(void)
30 {
31     _enable_IRQ_interrupt_();
32     canInit();
33
34     printf("start\n");
35     canEnableErrorNotification(canREG1);
36
37     while(1)
38     {
39         delay(10000000);
40         canTransmit(canREG1, canMESSAGE_BOX1, (const uint8 *)&tx_data[0]);
41     }
42
43     return 0;
44 }
45
46 void canMessageNotification(canBASE_t *node, uint32_t messageBox)
47 {
48     if(node == canREG1)
49     {
50         while(!canIsRxMessageArrived(canREG1, canMESSAGE_BOX2))
51             ;
52         canGetData(canREG1, canMESSAGE_BOX2, (uint8 *)&rx_data[0]);
53         printf("rx_data : %x\n", *rx_data);
54     }
55 }
56
```

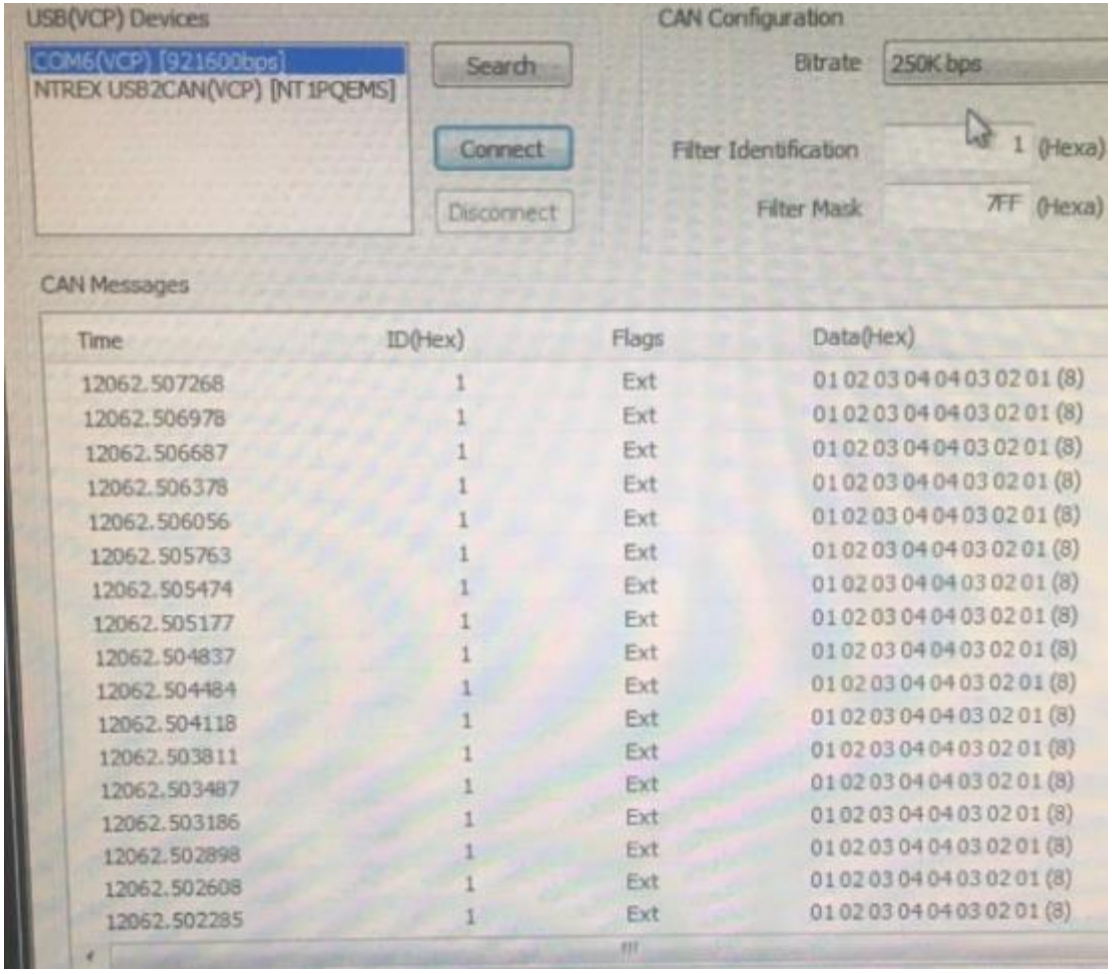
프로그램은 아래 링크에서 다운 받도록 한다.
http://www.devicemart.co.kr/1323537




USB2CAN UI
NTREX
주)엔티렉스
USB2CAN UI
Version 1.01 (2014. 8. 6)
UI Config.
USB(VCP) Devices
NTREX USB2CAN(VCP) [NT1PQEMS]
Search
Connect
Disconnect
CAN Configuration
Bitrate
250K bps
Filter Identification
1
(Hexa)
Filter Mask
7FF
(Hexa)
Set
CAN Messages
Time
ID(Hex)
Flags
Data(Hex)
12292.285749
1
Ext
01 02 03 04 04 03 02 01 (8)
Receive CAN Message
Clear
Transmit Message
ID(Hexa)
1
Ext
RTR
Data(Hexa)
2 2 3 4 4 3 2 1
Send
ID(Hexa)
0
Ext
RTR
Data(Hexa)
Send
ID(Hexa)
0
Ext
RTR
Data(Hexa)
Send


Receive CAN Message
Transmit Message
Clear
ID(Hexa) 1 Ext RTR Data(Hexa) 23
ID(Hexa) 0 Ext RTR Data(Hexa)
ID(Hexa) 0 Ext RTR Data(Hexa)
Send
Send
Send


canInit();
printf("start\n");
/** - enabling error interrupts */
canEnableErrorNotification(canREG1);
canTransmit(canREG1, canMESSAGE_BOX1, (const ui
//canGetData(canREG1, canMESSAGE_BOX2, rx_data)
Console
can:CIO
[CortexR5] start
rx_data : 2
rx_data : 23


USB(VCP) Devices
COM6(VCP) [921600bps]
NTREX USB2CAN(VCP) [NT1PQEMS]
Search
Connect
Disconnect
CAN Configuration
Bitrate
250K bps
Filter Identification
1 (Hexa)
Filter Mask
7FF (Hexa)
CAN Messages
Time
ID(Hex)
Flags
Data(Hex)
12062.507268 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.506978 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.506687 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.506378 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.506056 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.505763 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.505474 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.505177 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.504837 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.504484 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.504118 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.503811 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.503487 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.503186 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.502898 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.502608 1 Ext 01 02 03 04 04 03 02 01 (8)
12062.502285 1 Ext 01 02 03 04 04 03 02 01 (8)