Dialog SDK 5.0.x/6.0.x Tutorial

Debugging

2017 March

…personal
…portable
…connected

BLE device advertising process

Let’s build a demo together …

- **Before we start, we recommend you to …**
  - Install the latest Smartsnippets studio from Dialog customer support website
  - Download the SDK as well
  - Link:
    - https://support.dialog-semiconductor.com/connectivity

- **Consideration …**
  - All the changes are applicable in both the SDK 5.0.x (DA14580/1/2/3) and SDK 6.0.x (DA14585/6) if it is not mentioned specifically for a particular application

- **What are you going to learn from this tutorial …**
  - Debugging using serial port
  - Possible ways of analysing hard-fault

Contents

Debugging using serial port

Possible way of analyzing hard-fault

Serial debug Contents

Barebone example

- **This example demonstrates:**
  - How to activate and use serial debug in a DA1458x project step by step

- **Software you need:**
  - Dialog Smartsnippets studio
  - Dialog SDK
  - Project location:
    - ..\projects\target_apps\ble_examples\ble_app_profile

Serial debug

Configuration

TODO 1 - Define the serial UART print flag, initially it is undefined.

```
/* @file da1458x_config_basic.h */
/* copy and paste */
```

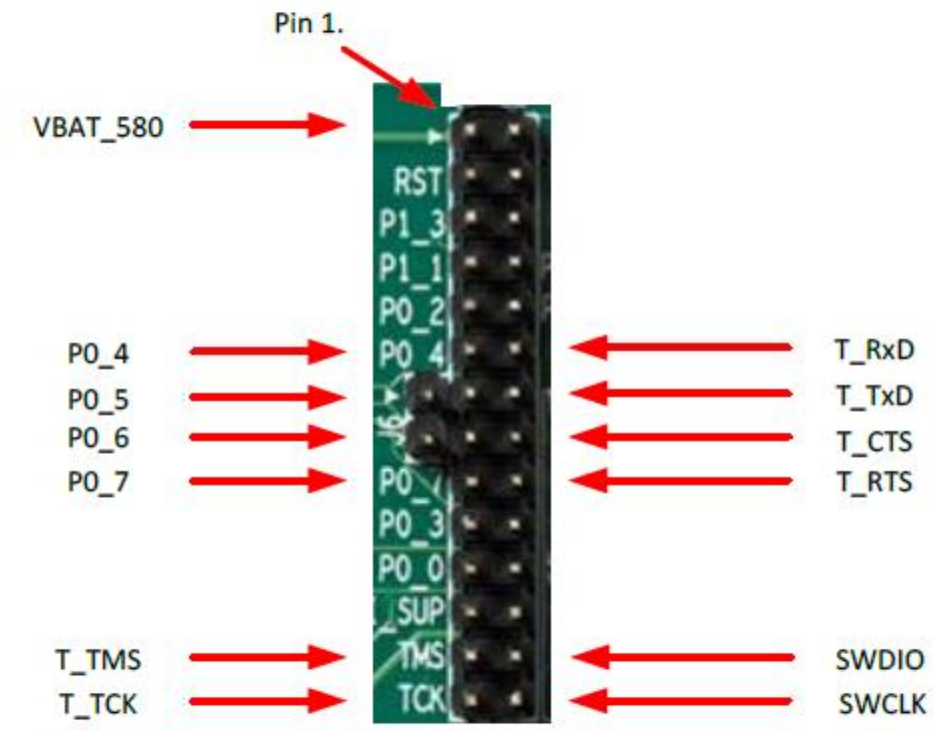
```
#define CFG_PRINTF
```

TODO 2 - Check the port configuration

```
/* @file user_periph_setup.h */
```

```
/****************************************************************************************/
/* UART2 pin configuration (debug print console)                                      */
/****************************************************************************************/
#ifdef CFG_PRINTF_UART2
…
   #elif HW_CONFIG_PRO_DK
      #define UART2_TX_GPIO_PORT  GPIO_PORT_0
      #define UART2_TX_GPIO_PIN   GPIO_PIN_4
      #define UART2_RX_GPIO_PORT  GPIO_PORT_0
      #define UART2_RX_GPIO_PIN   GPIO_PIN_5
…
   #endif
#endif
```

J5 - UART Configuration



Serial debug

Configuration

TODO 3 - Find user_barbone.c under user_app project folder.

```
/* @file user_barebone.c */
/* copy and paste */
```

```
#include "arch_console.h"
```

TODO 4 - Check the port configuration

```
/* @file user_barebone.c */
```

```
void user_app_adv_start(void)
{
    struct gapm_start_advertise_cmd* cmd;
    // Schedule the next advertising data update
    app_adv_data_update_timer_used = app_easy_timer(APP_ADV_DATA_UPDATE_TO, adv_data_update_timer_cb);
   // PRINT
    arch_printf("\r\n ADVERTISING TEST STARTED *\r\n");
    cmd = app_easy_gap_undirected_advertise_get_active();
    // add manufacturer specific data dynamically
    mnf_data_update();
    app_add_ad_struct(cmd, &mnf_data, sizeof(struct mnf_specific_data_ad_structure));
    app_easy_gap_undirected_advertise_start();
}
```

Serial debug

Try this

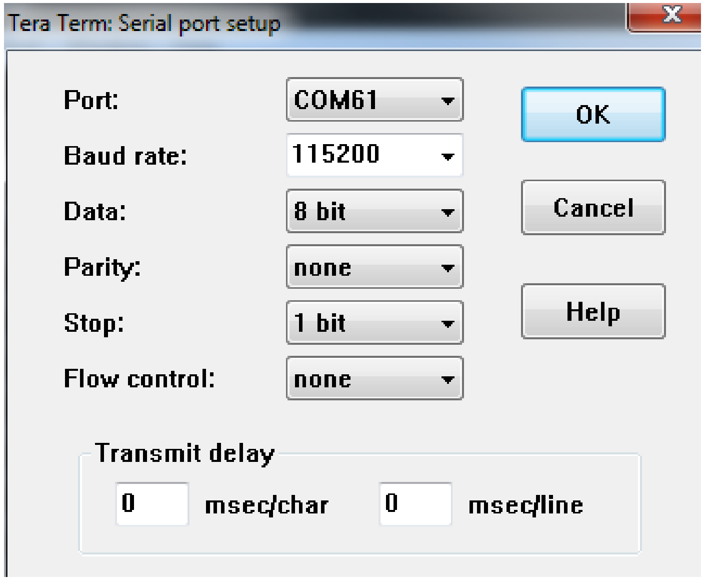
TODO 5 - Try to find out how to send a complete advertising serial message.

We have used Teraterm as a terminal software and you can see the configuration in the next slide page.

```
/* @file user_barebone.c */
/* copy and paste */
#include "arch_console.h"
```

Serial debug

Output



Tera Term: Serial port setup

Port: COM61

Baud rate: 115200

Data: 8 bit

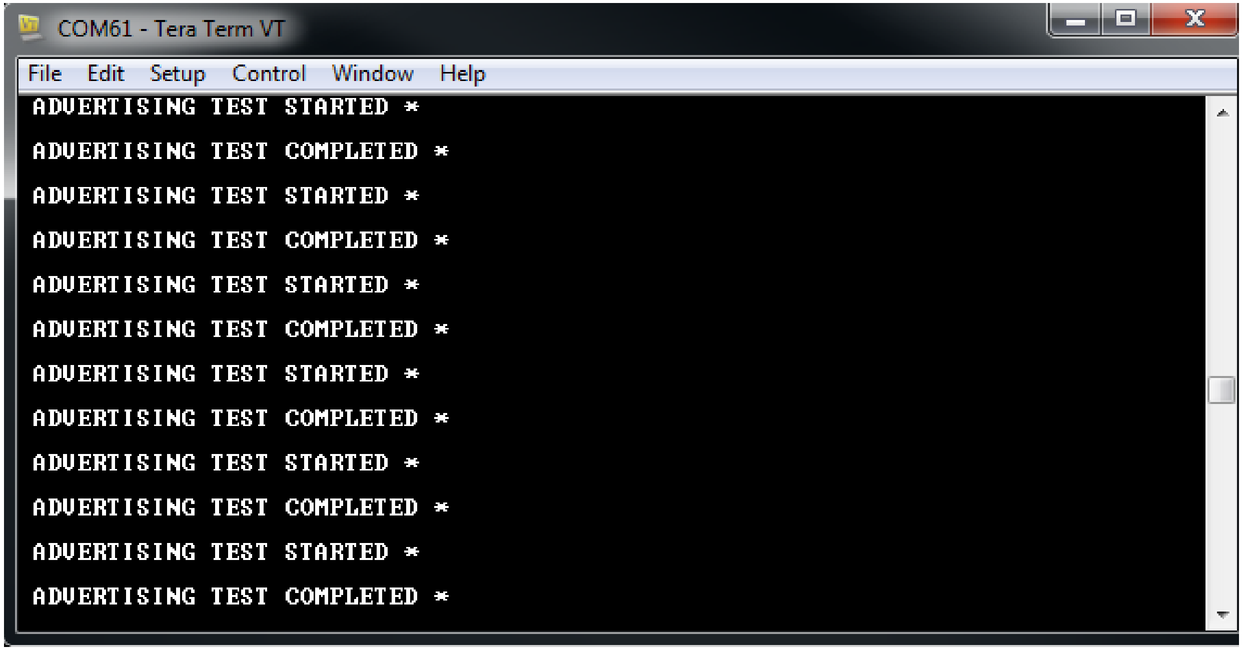
Parity: none

Stop: 1 bit

Flow control: none

Transmit delay

0 msec/char 0 msec/line



```
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
ADVERTISING TEST STARTED *
ADVERTISING TEST COMPLETED *
```

Contents

Possible way of analyzing hard-fault

Hard-fault analysis Contents

Peripheral custom profile example

- **This example demonstrates:**
  - How to track hard-fault in DA1458x project step by step

- **Software you need:**
  - Dialog Smartsnippets studio
  - Dialog SDK
  - Project location:
    - ..\projects\target_apps\ble_examples\ble_app_peripheral

Hard-fault debug

Configuration

TODO 1 - Insert a jumper in J9 of DA14580 DEV-KIT Pro.

TODO 2 - Open ..\target_apps\ble_examples\ble_app_peripheral\Keil_5\ble_app_peripheral.uvprojx.

TODO 3 - Search for LED write indication handler - **user_custs1_led_wr_ind_handler**

TODO 4 - Replace with the following code in - **user_custs1_led_wr_ind_handler**

```
void user_custs1_led_wr_ind_handler(ke_msg_id_t const msgid,
                                    struct custs1_val_write_ind const *param,
                                    ke_task_id_t const dest_id,
                                    ke_task_id_t const src_id)
{
    uint8_t val = 0;
    memcpy(&val, &param->value[0], param->length);

    if (val == CUSTS1_LED_ON)
        GPIO_SetActive(GPIO_LED_PORT, GPIO_LED_PIN);
    else if (val == CUSTS1_LED_OFF)
        GPIO_SetInactive(GPIO_LED_PORT, GPIO_LED_PIN);

    // test
    *(uint32_t *)0x90 = 0x90;
}
```

Hard-fault debug

Configuration

TODO 5 - You can switch off the sleep mode by assigning app_default_sleep_mode = ARCH_SLEEP_OFF; in user_config.h file and change default BD address and device name (these are optional).

TODO 6 - Compile and download the code in the device (device starts advertising).

TODO 7 - Open iOS Light-Blue - you will find your device is advertising.

TODO 8 - Connect to your device using Light-Blue.

TODO 9 - Find - LED State characteristics and press on it.

TODO 10 - Find - write new value - and press on it.

TODO 11 - Write - 1 and press – Done.

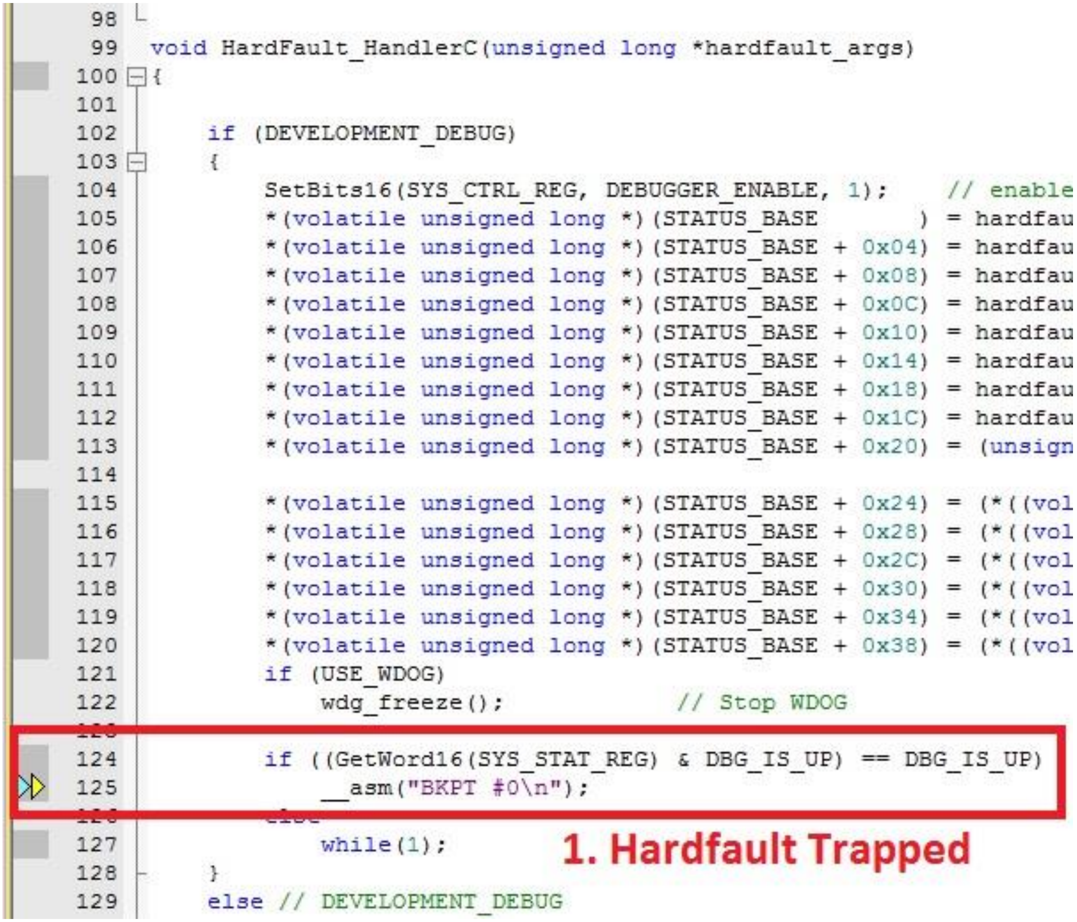
TODO 12 - You will see the Light-Blue shows disconnection alert message.

TODO 13 - Go to Keil IDE you will see a hard-fault is trapped.

Hard-fault debug

Configuration

TODO 13 – Go to Keil IDE you will see a hard-fault is trapped.



```
void HardFault_HandlerC(unsigned long *hardfault_args)
{

    if (DEVELOPMENT_DEBUG)
    {
        SetBits16(SYS_CTRL_REG, DEBUGGER_ENABLE, 1);    // enable
        *(volatile unsigned long *)(STATUS_BASE       ) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x04) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x08) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x0C) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x10) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x14) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x18) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x1C) = hardfau
        *(volatile unsigned long *)(STATUS_BASE + 0x20) = (unsign

        *(volatile unsigned long *)(STATUS_BASE + 0x24) = (*((vol
        *(volatile unsigned long *)(STATUS_BASE + 0x28) = (*((vol
        *(volatile unsigned long *)(STATUS_BASE + 0x2C) = (*((vol
        *(volatile unsigned long *)(STATUS_BASE + 0x30) = (*((vol
        *(volatile unsigned long *)(STATUS_BASE + 0x34) = (*((vol
        *(volatile unsigned long *)(STATUS_BASE + 0x38) = (*((vol
        if (USE_WDOG)
            wdg_freeze();                   // Stop WDOG

        if ((GetWord16(SYS_STAT_REG) & DBG_IS_UP) == DBG_IS_UP)
            __asm("BKPT #0\n");
        else
            while(1);
    }
    else // DEVELOPMENT_DEBUG
```

1. Hardfault Trapped

Hard-fault debug

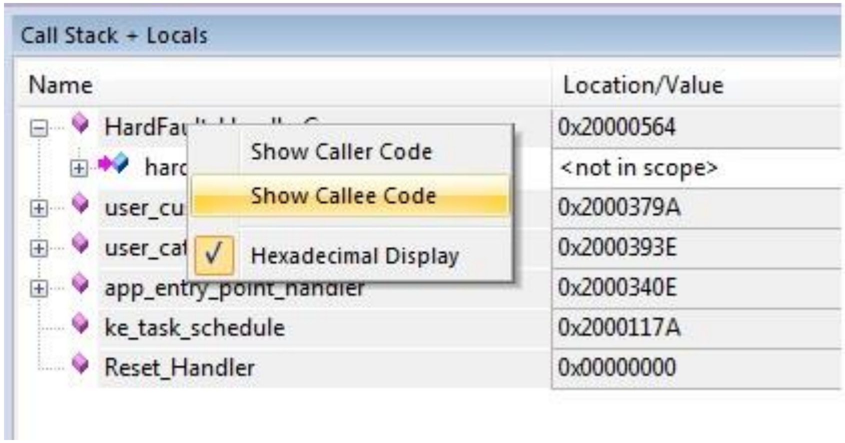
Configuration 1

TODO 14 - Now there are 2 options to debug hard-fault.

Option 1 is the easiest one:

TODO 15 - Open KEIL IDE call stack from - [View->Call stack window]

TODO 16 - Press right button mouse on [HardFault_HandlerC] and press [Show Callee Code] option

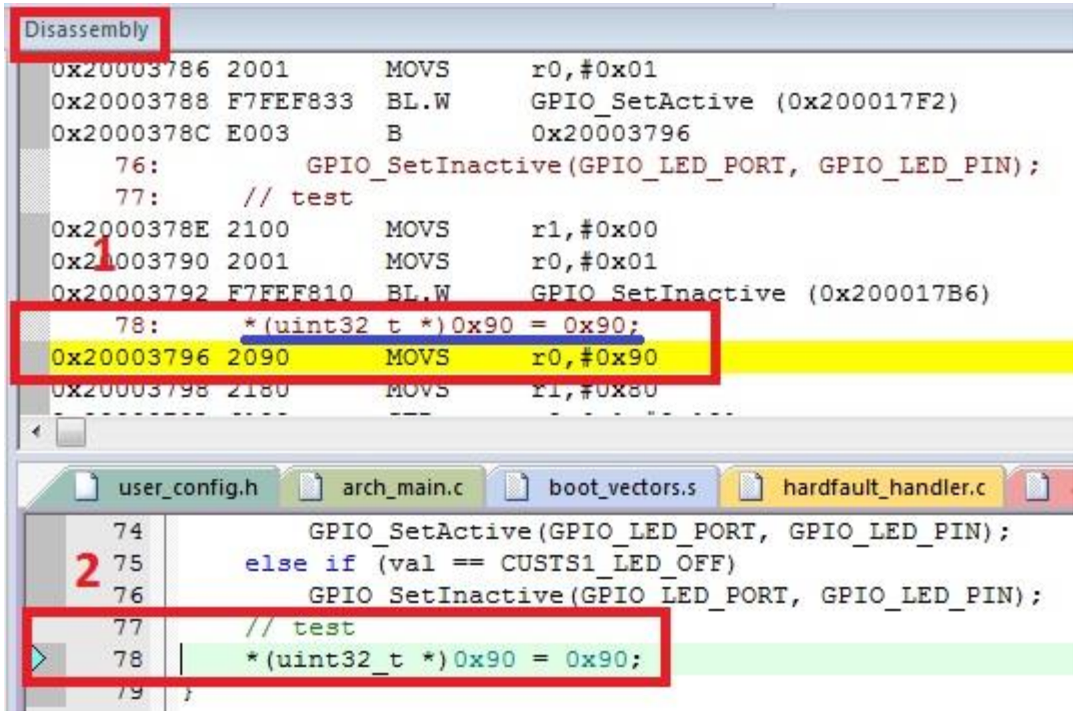


Name	Location/Value
HardFau	0x20000564
harc	<not in scope>
user_cu	0x2000379A
user_cat	0x2000393E
app_entry_point_handler	0x2000340E
ke_task_schedule	0x2000117A
Reset_Handler	0x00000000

Hard-fault debug

Configuration

TODO 17 - You will see in disassembly window that where exactly the hardfault has occurred. You can see the hard-fault in code window too.



```
0x20003786 2001      MOVS     r0,#0x01
0x20003788 F7FEF833  BL.W     GPIO_SetActive (0x200017F2)
0x2000378C E003      B        0x20003796
    76:         GPIO_SetInactive(GPIO_LED_PORT, GPIO_LED_PIN);
    77:     // test
0x2000378E 2100      MOVS     r1,#0x00
0x20003790 2001      MOVS     r0,#0x01
0x20003792 F7FEF810  BL.W     GPIO_SetInactive (0x200017B6)
    78:     *(uint32_t *)0x90 = 0x90;
0x20003796 2090      MOVS     r0,#0x90
0x20003798 2180      MOVS     r1,#0x80
```

```
        GPIO_SetActive(GPIO_LED_PORT, GPIO_LED_PIN);
    else if (val == CUSTS1_LED_OFF)
        GPIO_SetInactive(GPIO_LED_PORT, GPIO_LED_PIN);
    // test
    *(uint32_t *)0x90 = 0x90;
}
```

Hard-fault debug

Configuration 2

Option 2 when there is no call stack generated:

TODO 15 - Open KEIL IDE call stack from - [View->Register window]

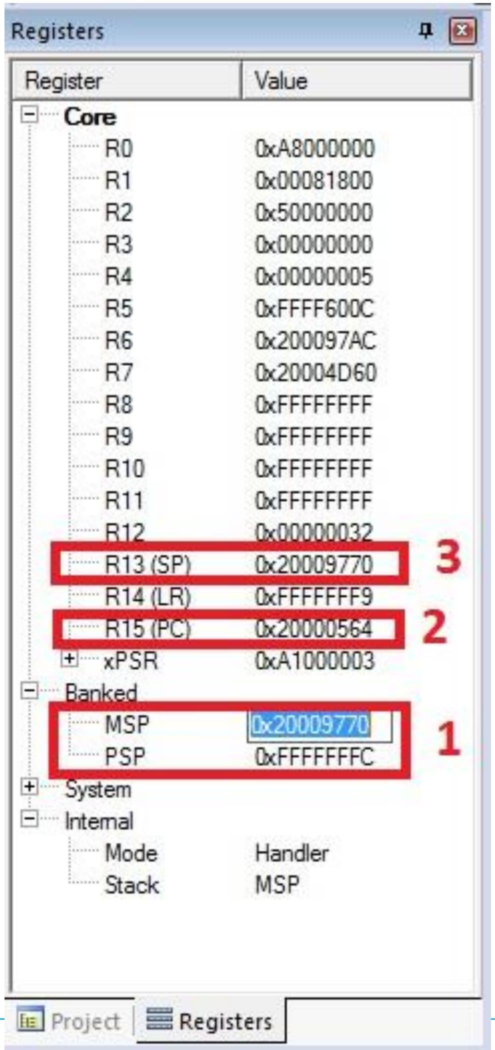
TODO 16 - Open KEIL IDE call stack from - [View->Memory window->Memory 1]

TODO 17 - In Registers window find out

Main stack pointer (MSP) for this study the address is **0x20009770**

Stack pointer (SP) for this study the address is **0x20009770**

Program counter (PC) for this study the address is **0x20000564**



Registers

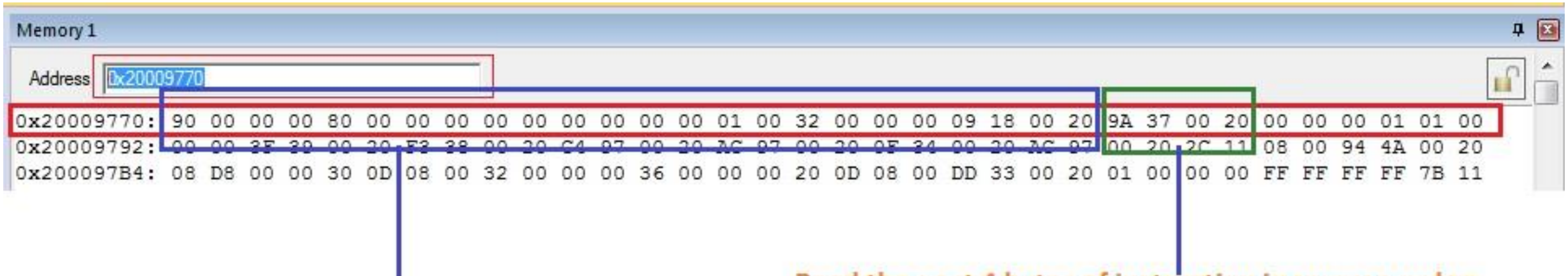
Register	Value
Core	
R0	0xA8000000
R1	0x00081800
R2	0x50000000
R3	0x00000000
R4	0x00000005
R5	0xFFFF600C
R6	0x200097AC
R7	0x20004D60
R8	0xFFFFFFFF
R9	0xFFFFFFFF
R10	0xFFFFFFFF
R11	0xFFFFFFFF
R12	0x00000032
R13 (SP)	0x20009770
R14 (LR)	0xFFFFFFF9
R15 (PC)	0x20000564
xPSR	0xA1000003
Banked	
MSP	0x20009770
PSP	0xFFFFFFFC
System	
Internal	
Mode	Handler
Stack	MSP

Hard-fault debug

Configuration 2

TODO 18 - Copy Main stack pointer (MSP) in this study the address is **0x20009770**
Paste in **Address of Memory 1 window.** Then create the memory address as instructed below:

In this study it is **0x2000379A**



```
Address 0x20009770
0x20009770: 90 00 00 00 80 00 00 00 00 00 00 00 00 00 01 00 32 00 00 00 09 18 00 20 9A 37 00 20 00 00 00 01 01 00
0x20009792: 00 00 3F 30 00 20 F3 38 00 20 C4 07 00 20 AC 07 00 20 0F 34 00 20 AC 07 00 20 2C 11 08 00 94 4A 00 20
0x200097B4: 08 D8 00 00 30 0D 08 00 32 00 00 00 36 00 00 00 20 0D 08 00 DD 33 00 20 01 00 00 00 FF FF FF FF 7B 11
```

Skip the 1st 24 byte of instruction

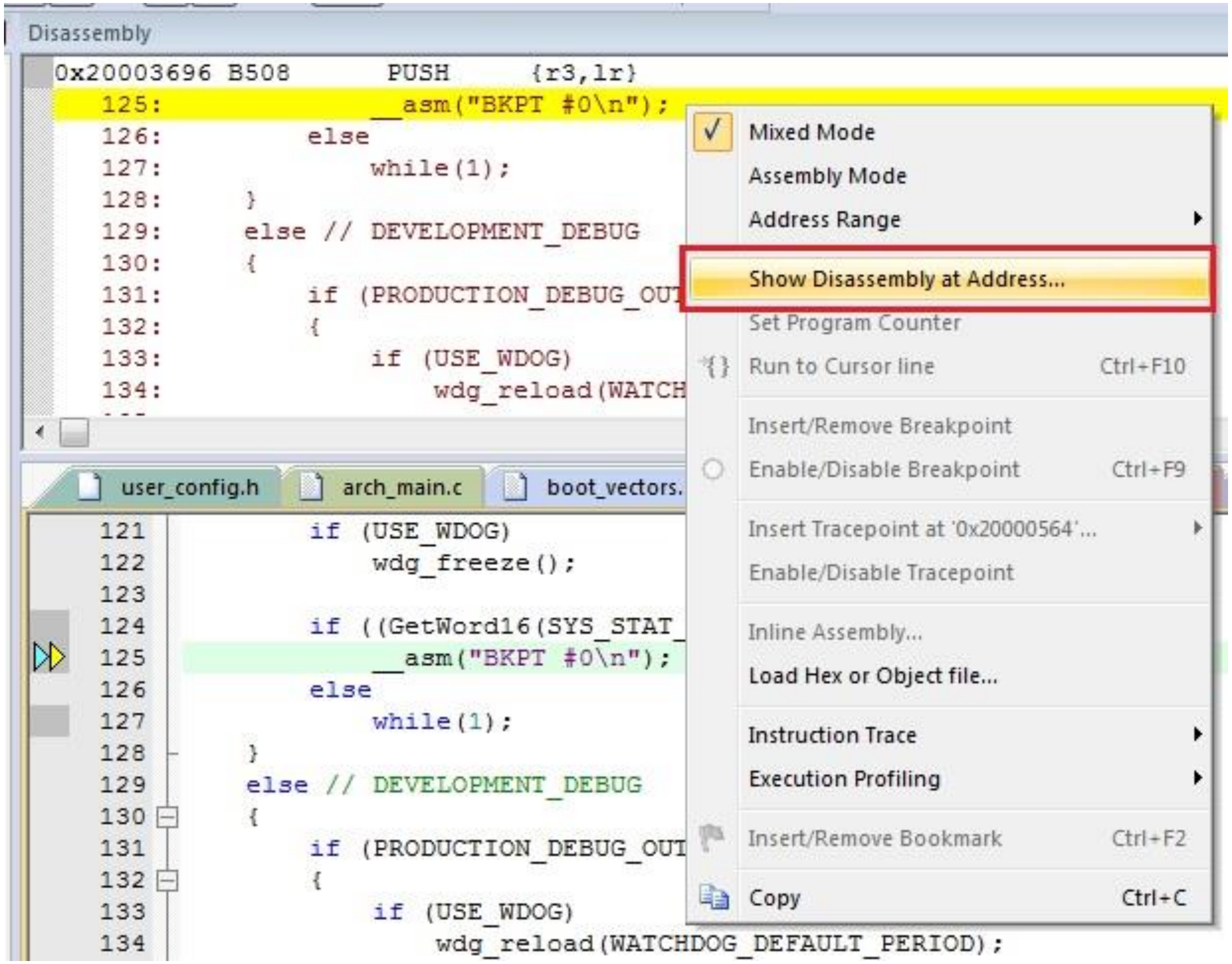
Read the next 4 bytes of instruction in reverse order:
20 00 37 9A = 0x2000379A

Please read ARM Cortex M0 and KEIL IDE manuals for more information.

Hard-fault debug

Configuration 2

TODO 19 - Right click on - [Disassembly window] and Select [Show Disassembly at Address...]



```
0x20003696 B508      PUSH     {r3,lr}
   125:                  __asm("BKPT #0\n");
   126:          else
   127:              while(1);
   128:      }
   129:      else // DEVELOPMENT_DEBUG
   130:      {
   131:          if (PRODUCTION_DEBUG_OUT
   132:          {
   133:              if (USE_WDOG)
   134:                  wdg_reload(WATCH
```

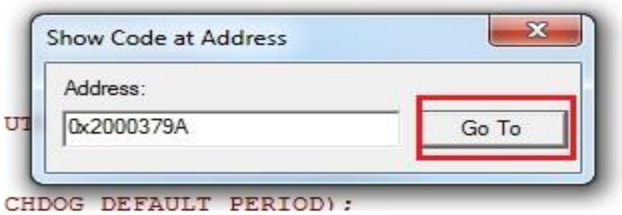
```
121              if (USE_WDOG)
122                  wdg_freeze();
123
124              if ((GetWord16(SYS_STAT_
125                  __asm("BKPT #0\n");
126              else
127                  while(1);
128          }
129          else // DEVELOPMENT_DEBUG
130          {
131              if (PRODUCTION_DEBUG_OUT
132              {
133                  if (USE_WDOG)
134                      wdg_reload(WATCHDOG_DEFAULT_PERIOD);
```

Disassembly
user_config.h
arch_main.c
boot_vectors.
✓ Mixed Mode
Assembly Mode
Address Range
Show Disassembly at Address...
Set Program Counter
Run to Cursor line Ctrl+F10
Insert/Remove Breakpoint
Enable/Disable Breakpoint Ctrl+F9
Insert Tracepoint at '0x20000564'...
Enable/Disable Tracepoint
Inline Assembly...
Load Hex or Object file...
Instruction Trace
Execution Profiling
Insert/Remove Bookmark Ctrl+F2
Copy Ctrl+C

Hard-fault debug

Configuration 2

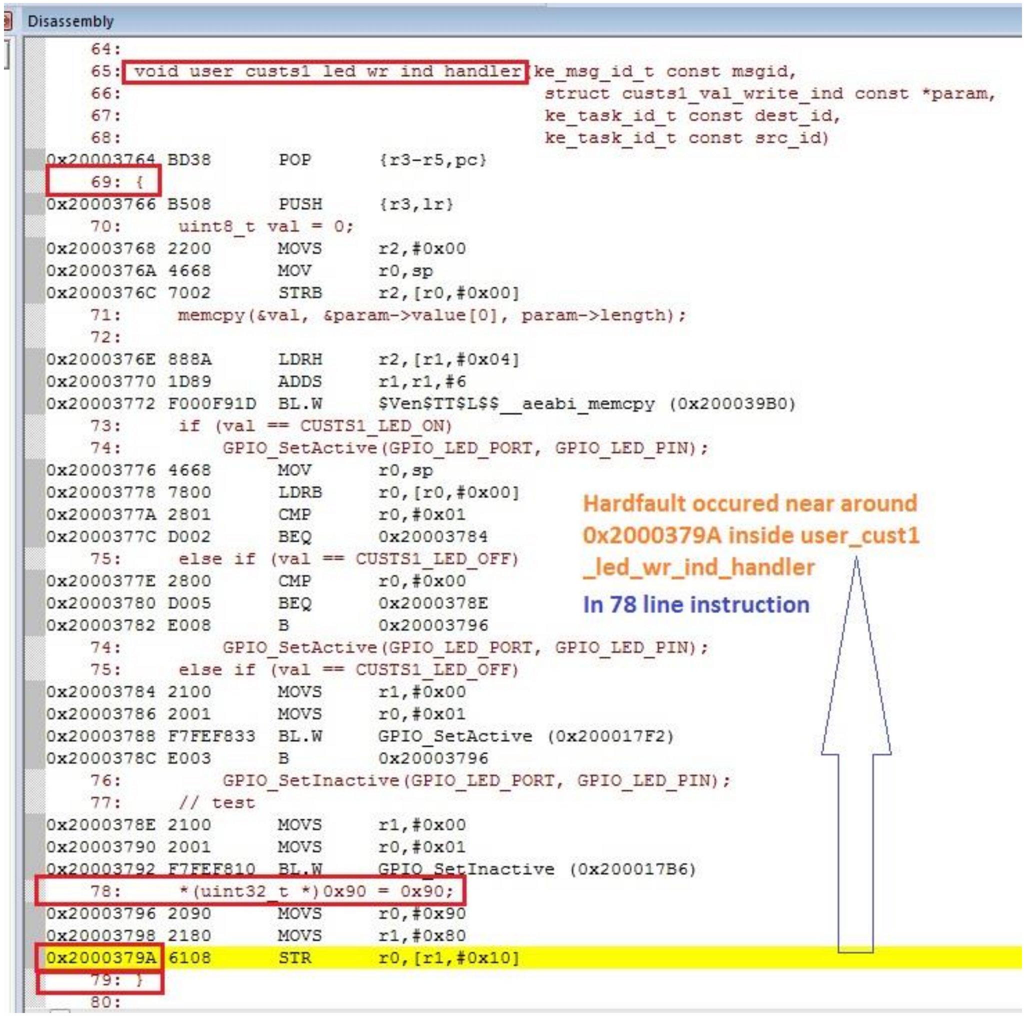
TODO 20 – Paste the address **0x2000379A** in [Show code at address window] and press [Go To] button.



Hard-fault debug

Configuration 2

TODO 21 - Check the disassembly window.



Disassembly

```
    64:
    65: void user custs1 led wr ind handler(ke_msg_id_t const msgid,
    66:                                      struct custs1_val_write_ind const *param,
    67:                                      ke_task_id_t const dest_id,
    68:                                      ke_task_id_t const src_id)
0x20003764 BD38      POP      {r3-r5,pc}
    69: {
0x20003766 B508      PUSH     {r3,lr}
    70:     uint8_t val = 0;
0x20003768 2200      MOVS     r2,#0x00
0x2000376A 4668      MOV      r0,sp
0x2000376C 7002      STRB     r2,[r0,#0x00]
    71:     memcpy(&val, &param->value[0], param->length);
    72:
0x2000376E 888A      LDRH     r2,[r1,#0x04]
0x20003770 1D89      ADDS     r1,r1,#6
0x20003772 F000F91D  BL.W     $Ven$TT$L$$__aeabi_memcpy (0x200039B0)
    73:     if (val == CUSTS1_LED_ON)
    74:         GPIO_SetActive(GPIO_LED_PORT, GPIO_LED_PIN);
0x20003776 4668      MOV      r0,sp
0x20003778 7800      LDRB     r0,[r0,#0x00]
0x2000377A 2801      CMP      r0,#0x01
0x2000377C D002      BEQ      0x20003784
    75:     else if (val == CUSTS1_LED_OFF)
0x2000377E 2800      CMP      r0,#0x00
0x20003780 D005      BEQ      0x2000378E
0x20003782 E008      B        0x20003796
    74:         GPIO_SetActive(GPIO_LED_PORT, GPIO_LED_PIN);
    75:     else if (val == CUSTS1_LED_OFF)
0x20003784 2100      MOVS     r1,#0x00
0x20003786 2001      MOVS     r0,#0x01
0x20003788 F7FEF833  BL.W     GPIO_SetActive (0x200017F2)
0x2000378C E003      B        0x20003796
    76:         GPIO_SetInactive(GPIO_LED_PORT, GPIO_LED_PIN);
    77:     // test
0x2000378E 2100      MOVS     r1,#0x00
0x20003790 2001      MOVS     r0,#0x01
0x20003792 F7FEF810  BL.W     GPIO_SetInactive (0x200017B6)
    78:     *(uint32_t *)0x90 = 0x90;
0x20003796 2090      MOVS     r0,#0x90
0x20003798 2180      MOVS     r1,#0x80
0x2000379A 6108      STR      r0,[r1,#0x10]
    79: }
    80:
```

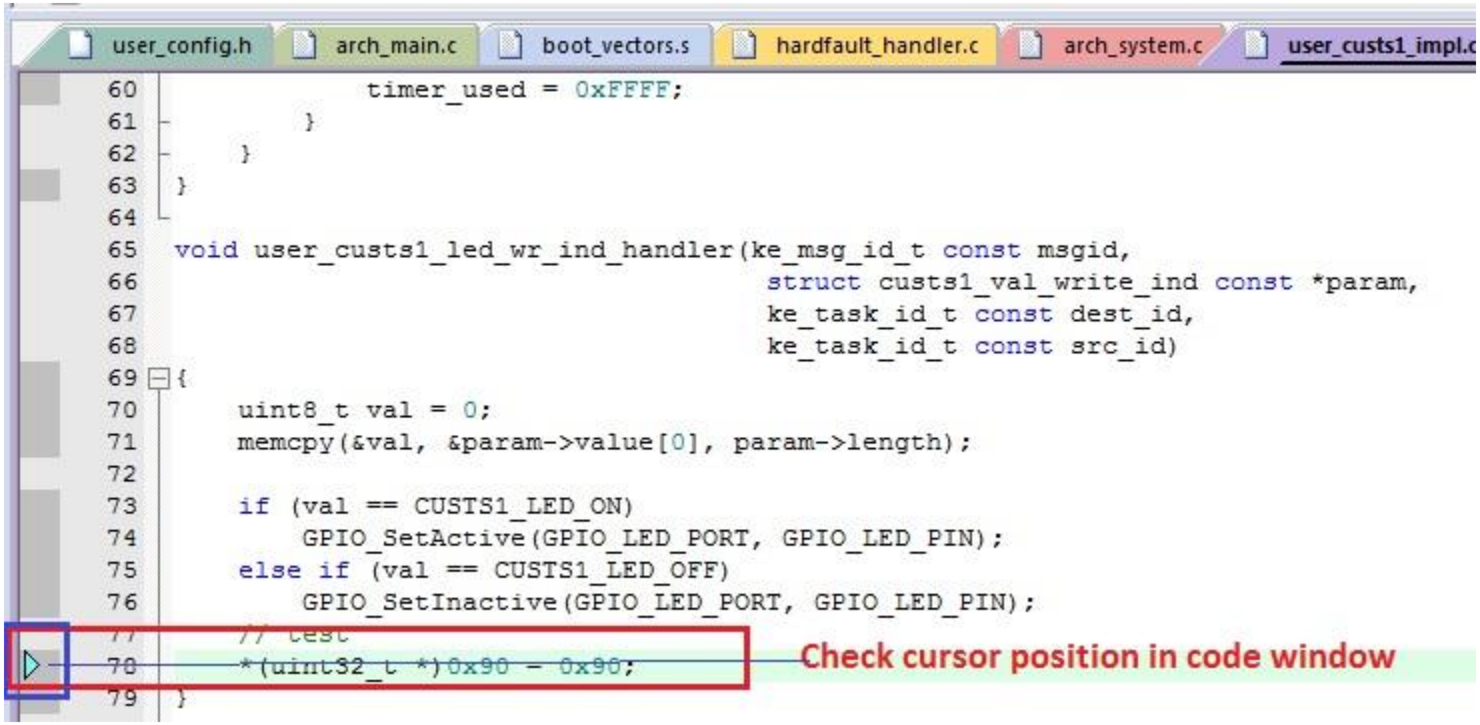
Hardfault occured near around 0x2000379A inside user_cust1 _led_wr_ind_handler

In 78 line instruction

Hard-fault debug

Configuration 2

TODO 22 - Check the cursor position in [code window]



```
                timer_used = 0xFFFF;
            }
        }
}

void user_custs1_led_wr_ind_handler(ke_msg_id_t const msgid,
                                     struct custs1_val_write_ind const *param,
                                     ke_task_id_t const dest_id,
                                     ke_task_id_t const src_id)
{
    uint8_t val = 0;
    memcpy(&val, &param->value[0], param->length);

    if (val == CUSTS1_LED_ON)
        GPIO_SetActive(GPIO_LED_PORT, GPIO_LED_PIN);
    else if (val == CUSTS1_LED_OFF)
        GPIO_SetInactive(GPIO_LED_PORT, GPIO_LED_PIN);
    // test
    *(uint32_t *)0x90 = 0x90;
}
```

Check cursor position in code window

TODO 23 - PRACTISE, PRACTISE, PRACTISE

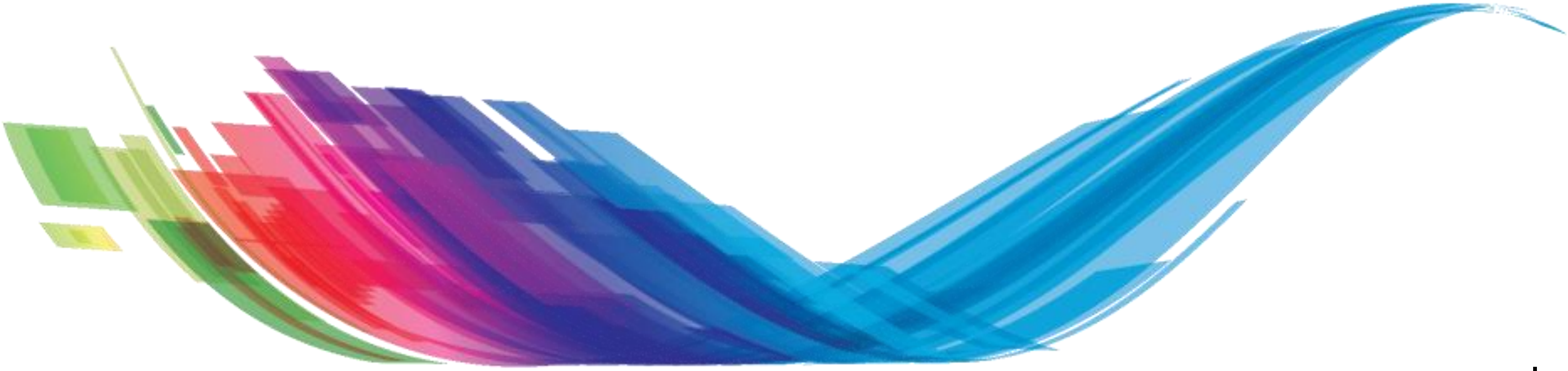
What’s next

For more …

- **What’s next …**
  - Please follow the other Dialog tutorials based on –
    - **SDK 5.0.x** for **DA14580/1/2/3** development OR
    - **SDK 6.0.x** for **DA14585/6** development
  - See **Reference** section of this training slide
  - Learn about Dialog BLE chip **differences** at a glance from –

    https://support.dialog-semiconductor.com/connectivity/products

The Power To Be…



…personal
…portable
…connected