DAB-EMBEDDED
electronic design house

Freescale Layerscape QorIQ LS1 Windows Embedded Compact 2013 BSP – User manual

Version 5.12.6

History of changes

HISTORY OF CHANGES		
VERSION	**DATE**	**COMMENTS**
1.0.0	October 6, 2014 17:10	**Initial document version**
2.0.0	October 20, 2014 9:31	**Basic functionality description added**
2.1.3	December 2, 2014 12:43	**Demo image description added**
2.1.4	January 7, 2015 17:24	**GPIO header description**
3.34.3	March 24, 2015 14:12	**New document version**
3.34.3	March 31, 2015 15:28	**SDK description**
4.22.4	March 31, 2015 15:28	**RCW changes and TWR-SER2 settings added**
5.12.6	June 16, 2016 8:07	**HDMI settings added**

Contents

1. Introduction

1.1. Introduction

DAB-Embedded BVBA (hereafter "DAB-Embedded") has ported Windows Embedded Compact 2013 BSP (hereafter "WEC2013") for Freescale QorIQ LS1 family based TWR-LS1021A board. This document describes how to prepare hardware and external storage drives for booting.

1.2. Scope

The primary scope of this document is to provide the user information about running the WEC2013 on the target platform including from different boot devices. This document does not describe configuring and compiling steps for the WEC2013 BSP. For this information please ask "Developer's Manual" additionally.

1.3. License restriction

The images should be used only in **demo purpose** and only **in 30 days** after starting evaluation.

2. Glossary

Abbreviation	Description	Comment
BSP	Board support package	Number of drivers, bootloaders, kernel modules necessary for startring WEC2013 on hardware.
SMP	Symmetric multiprocessing	Ability of CPU that provides fast performance by making multiple CPUs available to complete individual processes simultaneously (multiprocessing).
CPU	Central processing unit	A central processing unit is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.
SD/SDHC Card	Secure Digital / Secure Digital High-Capacity card	Nonvolatile memory card used extensively in portable devices
VFP	Vector Float Point (Unit)	VFP (Vector Floating Point) technology

		is an FPU (Floating-Point Unit) coprocessor extension to the ARM architecture. It provides low-cost single-precision and double-precision floating-point computation fully compliant with the ANSI/IEEE Std 754-1985 Standard for Binary Floating-Point Arithmetic.
LPUART	Low power Universal Asynchronous Receiver/Transmitter	
CEDDK	CE Driver Development Kit	
GPIO	General Purpose Input / Output	
I2C	Inter-Integrated Circuit(referred sometimes as TWI)	
KITL	Kernel Independent Transport Layer	
LED	Light Emitting Diode	
OAL	OS Abstraction Layer	
OEM	Original Equipment Manufacturer	
RTC	Real Time Clock	
SPI	Serial Peripheral Interface	
I2C	Inter-Integrated Circuit interface	
CPLD	Complex programmable logic device	
FLDR	First boot loader	This bootloader copies itself from Flash to internal RAM (OCRAM) and runs. FLDR initializes DDR3, Flash and SMMU.

3. Demo image description

Current (5.12.6) demo image has next features:

- Cache initialization;
- VFP initialization;
- SMP support (both cores in Cortex-A7 are used);
- Debug output (LPUART1);
- Hardware watchdog support;
- LCD (480x272) driver and HDMI output support;
- Ethernet driver;
- I2C driver;
- CRTouch driver;
- GPIO driver;
- Memory proxy driver;
- Software development kit;
- SD/MMC driver;
- USB 3.0 driver;

Additionally:

- EBOOT with:
  - I- & D- Cache support;
  - Ethernet support;

  - SD/SDHC support;
  - CPLD support;
  - I2C support;
  - NOR Flash support.
- FLDR (first boot loader for DDR3 and SMMU initialization).

FSL_QORIQ_LS1_ARM_WEC2013_V3.zip archive has:

1. "Images" folder:
   1.1. ls1_rcw_nor.raw – RCW block for NOR Flash;
   1.2. ls1_rcw_qspi.raw – RCW block for QSPI Flash;
   1.3. fldr_nor.raw – FLDR image for NOR Flash;
   1.4. fldr_sd.raw – FLDR image for SD Card;
   1.5. eboot.raw – EBOOT bootloader image;
   1.6. NK.bin – Windows Embedded image;
   1.7. LS1_SD_Imager.exe – utility for writing FLDR and EBOOT to SD card;

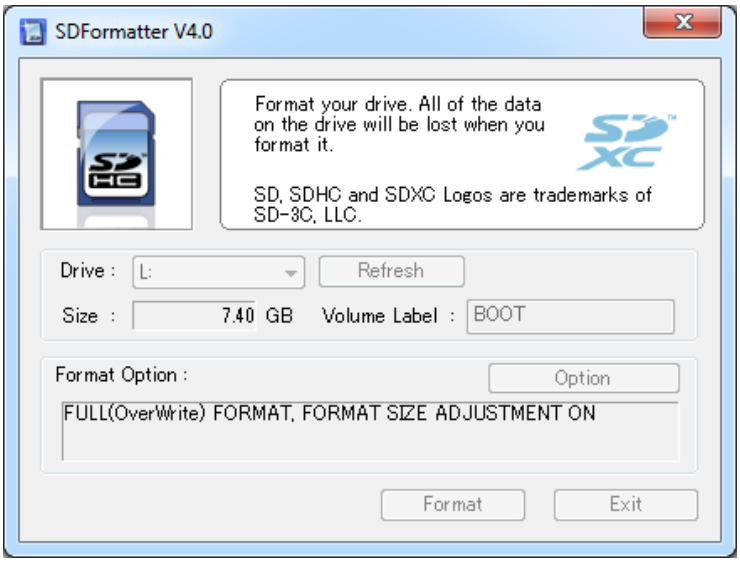
2. "Doc" folder:
   2.1. DAB14_WEC2013_FSL_LS1_BSP.pdf – WinCE BSP user manual.

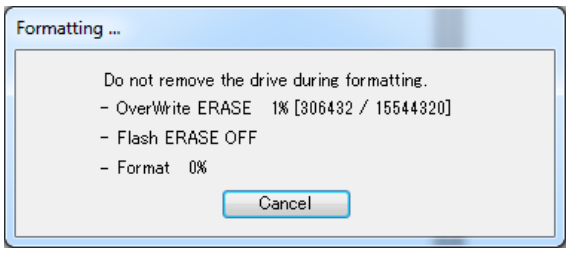
4. Preparing SD card for booting and writing images to the NOR Flash

NOTE: Please use SD/SDHC cards with minimum 1Gbyte size!

1. Download SD Formatter for Windows from www.sdcard.org:
   a. Go to www.sdcard.org -> Menu "Downloads" -> "SD Formatter for Windows Download";
   b. Agree with EULA by pressing "Accept" in bottom of the page;
   c. Download ZIP archive, unzip on your hard drive;
   d. Install tool by executing "Setup.exe" and follow installation process.

2. Extract FSL_QORIQ_LS1_ARM_WEC2013_V3.zip to hard drive.
3. Run SD Formatter from Start menu in Windows.





4. Press "Option" and enable format size adjustment and full format (Overwrite).
5. Then press "OK".
6. Press "Format" and agree with warning.
7. When format will finish, close SD Formatter tool, press Win+R (), then write "cmd" and press "OK".
8. In new shell window write:

   cd <drive where LS1_SD_Imager.exe is located>:
   cd <path to LS1_SD_Imager.exe >
   LS1_SD_Imager.exe <SD card reader letter>: fldr_sd.raw eboot.raw

   For example, LS1_SD_Imager.exe in g:\FSL_QORIQ_LS1_ARM_WEC2013_V3\Images,
   L - is SD card reader letter.

   cd g:
   cd FSL_QORIQ_LS1_ARM_WEC2013_V3\Images
   LS1_SD_Imager.exe L: fldr_sd.raw eboot.raw

9. After process will successfully finished:

```
LS1 QorIQ SD imager from DAB-Embedded (2015).
Your external drives:
K:\
L:\ [Selected]
Writing FLDR file to Sector 8...
Writing EBOOT file to Sector 120...
SD preparation finished!
```

10. Copy NK.bin, eboot.raw, fldr_nor.raw, ls1_rcw_nor.raw files to SD card disk.
11. Rename file ls1_rcw_nor.raw to ls1_rcw.raw on SD card.
12. Remove the card from the card reader safely.
13. Insert SD card into J18 (SD/MMC) slot on TWR-LS1021A.
14. Setup switches on TWR-LS1021A:

SW2.1 – OFF
SW2.2 – OFF
SW2.3 – ON
SW2.4 – OFF
SW2.5 – ON
SW2.6 – ON
SW2.7 – ON
SW2.8 – OFF

SW3.1 – OFF
SW3.2 – ON
SW3.3 – ON
SW3.4 – OFF
SW3.5 – OFF
SW3.6 – OFF
SW3.7 – OFF
SW3.8 – ON

15. Setup jumpers on TWR-LS1021A:

J19 – Close 1-2 position (LPUART is used)
J20 – Close 1-2 position (LPUART is used)

16. Setup jumpers on TWR-LCD-RGB board:

J2 – Close 1-2 position
J3 – Close 1-2 position
J5 – Close 1-2 position
J8 – Close 1-2 position
J9 – Close 2-3 position
J10 – Close 1-2 position

17. (Optional) Setup jumpers on TWR-SER2 board:

J1 – Open
J2 – Open
J7 – Open
J8 – Close
J9 – Close
J13 – Close 1-2 position
J16 – Open
J21 – Close
J24 – Open

J18 USB OTG should be used as USB Host port. Need additional "*USB Host Cable mini B male to USB A female OTG*".

18. Connect miniUSB cable to J3 and COM-port install drivers.
19. Open your favorite COM port terminal program and connect to "mbed Serial Port". If you have no terminal program – please use Tera Term.
    Setup COM port settings: 115200 bps, 1 stop bit, 8 bit data, **no flow control**.
20. Connect power supply to TWR-LS1021A board.

21. When EBOOT starts, immediately press <Space> and you will get next message:

```
CPLD rev 2

Using SERDES1 Protocol: 0x20
FLDR v1.0 by DAB-Embedded (2015)
Found SD/MMC card.
Starting EBOOT....

Microsoft Windows CE Bootloader Common Library Version 1.4 Built Mar 25 2015
11:46:00
EBOOT v.3.34 for Freescale LS102x Tower system (TWR-LS1021A) by DAB-Embedded, 2014
CPU:   Freescale LayerScape LS1021E, security enabled, Version: 1.0, (0x87081110)
SetClockRate - Requested Rate: 150000 Hz, Setting clock rate to 144097 Hz
SD High Density card
SetClockRate - Requested Rate: 25000000 Hz, Setting clock rate to 23714285 Hz
SD: Switched to 4 bit mode
INFO: Initialized SD Card
Found NOR Flash.
Detect NOR Flash : Micron PC28F00AM29EW
System ready!
Preparing for download...

-----------------------------------
ARM clock     : 1000 MHz
BUS clock     : 300 MHz
DDR3 clock    : 800 MHz
UART clock    : 150 MHz
SDHC clock    : 300 MHz
I2C clock     : 150 MHz
-----------------------------------
WARN: Boot config wasn't found, using defaults
Hit space to enter configuration menu 1 ...

--------------------------------------------------------------------------------
 Main Menu
--------------------------------------------------------------------------------
  [1] Show Current Settings
  [2] Select Boot Device
  [3] Select Debug Device
  [4] Network Settings
  [6] Set Device ID
  [7] Save Settings
  [8] Bootloader shell
  [0] Exit and Continue

  Selection:
```

22. Press <8> and you will get access to the EBOOT Shell menu:

```
--------------------------------------------------------------------------------
 Bootloader shell
--------------------------------------------------------------------------------
 [1] Read physical register (DWORD)
 [2] Write physical register (DWORD)
 [3] Read physical register (WORD)
 [4] Write physical register (WORD)
 [5] Read physical register (BYTE)
 [6] Write physical register (BYTE)
 [7] Read physical registers block (DWORD)
 [8] Cold boot
 [9] SerDes mux show
 [a] SerDes mux set
 [b] I2C read
 [c] I2C write
 [d] NOR boot prepare
 [0] Exit and Continue
```

23. Press <d> for preparing NOR Flash with correct RCW, FLDR and EBOOT.
24. After process will be done, select NOR Flash as boot source by switch on TWR-LS1021A:

    SW2.1 – ON
    SW2.2 – OFF
    SW2.3 – OFF
    SW2.4 – OFF

25. Now press reset button (SW1) on TWR-LS1021A board.

5. Using HDMI output

NOTE: According errata – using HDMI is possible only in NOR Flash boot mode (I2C restriction).

1. Disconnect TWR-LCD-RGB and TWR-SER2 boards;
2. No need extra settings for HDMI, just use correct binaries.

6. Booting demo image

For normal booting from NOR Flash and SD card, you need to do step 4 once, later your TWR-LS1021A will boots automatically.

NOTE: NK.bin loads from SD card only.

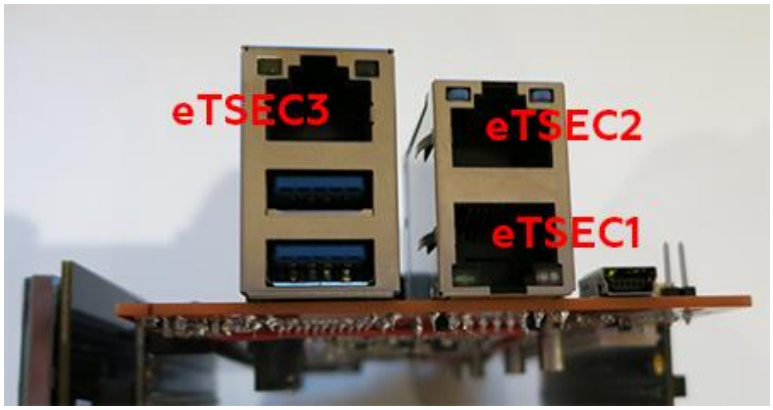
7. How to use GPIO from user application

Need to use sdk_gpio.h header to access to the GPIO functionality from user space area. This header file gives access not only to gpio functionality, but also to the interrupt control and physical memory translation.

For building demo_app.cpp, LS1021 WEC2013 SDK should be used. In Visual Studio 2012 select File->New->Project, in Templates select Visual C++ ->Windows Embedded Compact -> TWR-LS1021A SDK -> Win32 Windows Application .

8. Network connection between host PC and TWR-LS1021A

Ethernet connection is used for debugging applications. By default, eTSEC2 is used as main WEC2013 network card connection.



eTSEC2 use dynamic IP settings (DHCP).
MAC address of eTSEC2 is always 00:ED:20:01:02:04.

For debugging applications (from host PC with Visual Studio 2012) need to install SDK first (check chapter 8).

Also check link: http://msdn.microsoft.com/en-us/library/dn269526.aspx

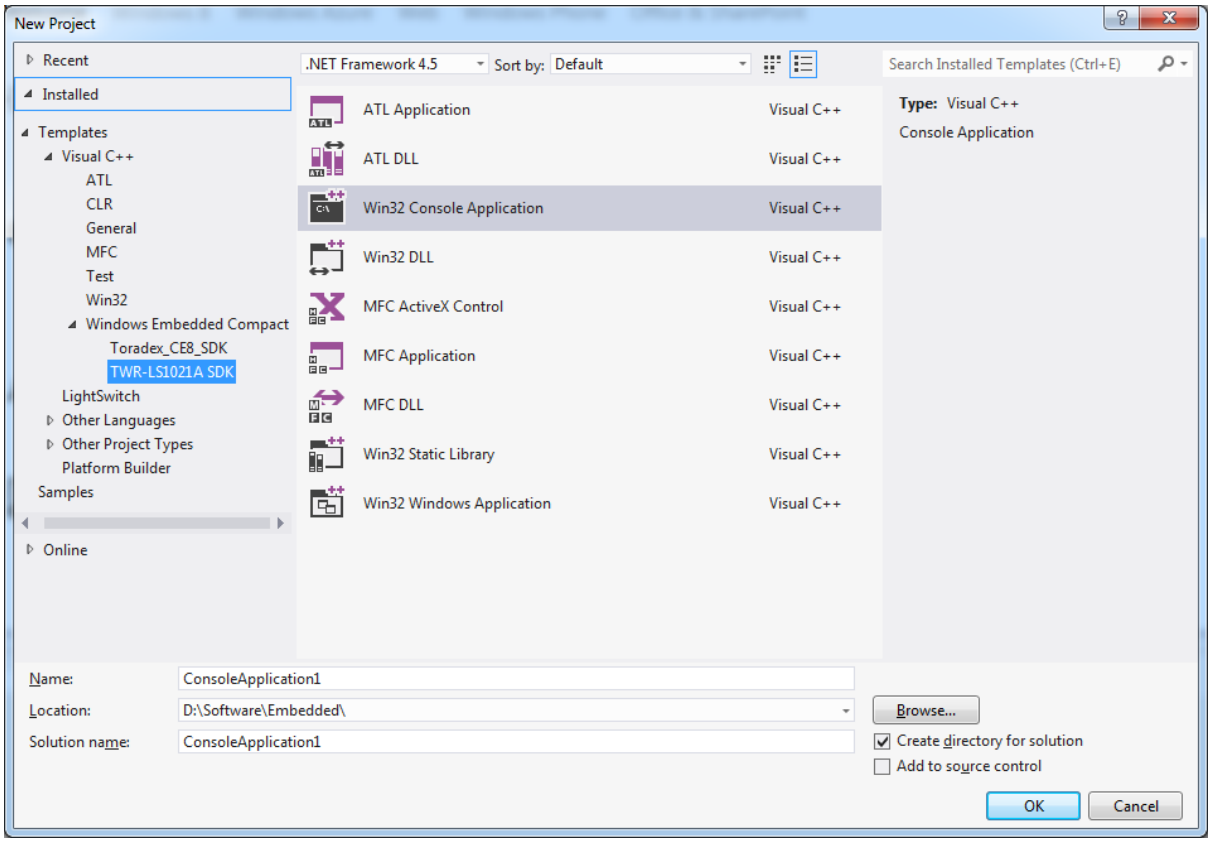
("To attach a native application to the application debugger").

NOTE: device-side Core Connectivity binary files already included in Windows Embedded Compact 2013, and ConmanClient3.exe is starting when WEC2013 image booting.

9. How to create and debug your first HelloWold application on LS1021A

NOTE: For working with ARM-based SDK you need Visual Studio 2012/2013.

Please run SDK-WEC2013-TWR-LS1021A.msi for SDK installation on PC. Finish SDK installation and start your Visual Studio.

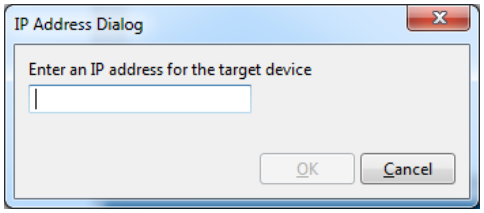


Go to File->New->Project (Ctrl+Shift+N) and select Windows Embedded Compact -> TWR-LS1021A-SDK in window. In list please select Win32 Console application and write name of your application. Select also “Create directory for solution checkbox”.

New project will be created.

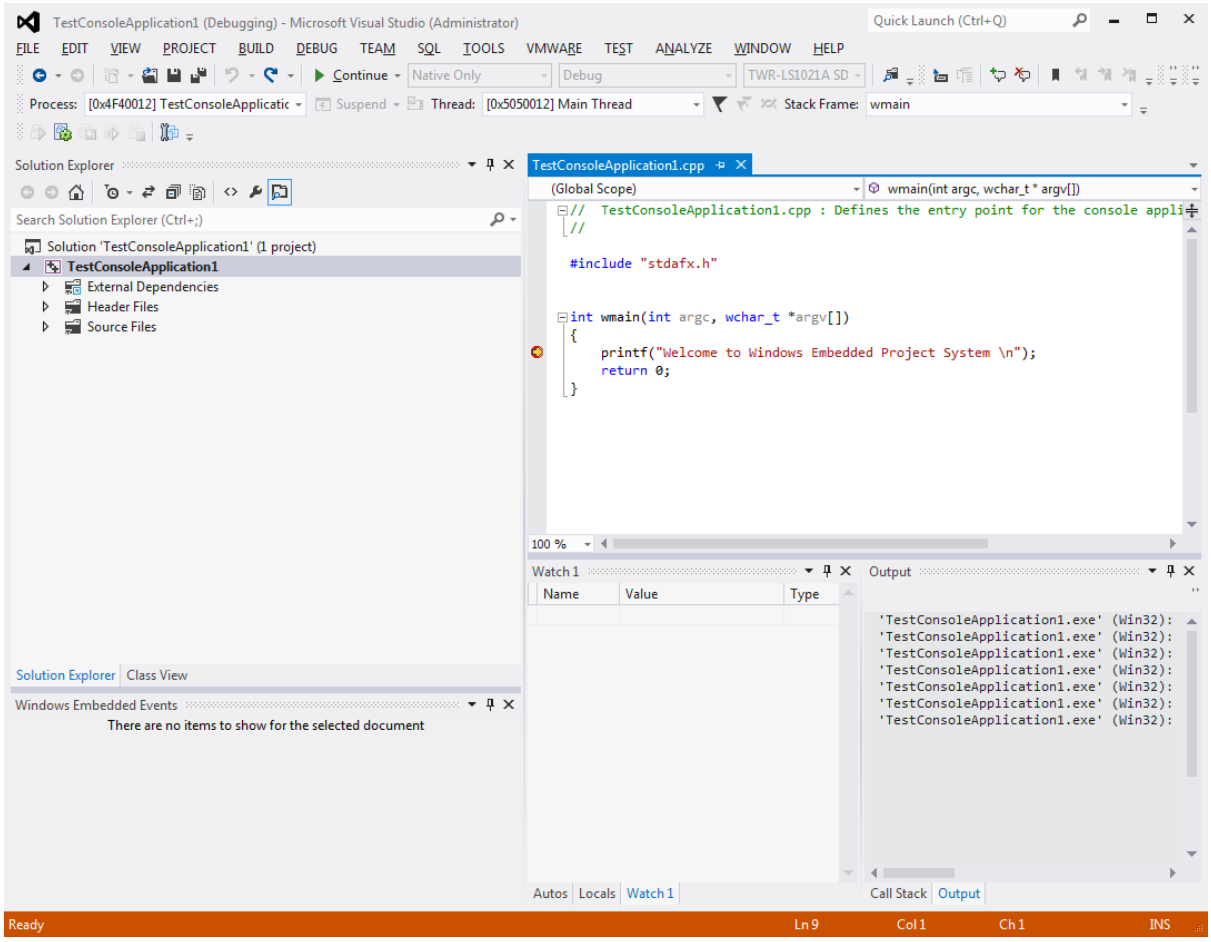
Press F7 for build solution and then put cursor on line in CPP source where “printf("Welcome to …” is located (normally line 9). Press F9 for set break point on the line.

Connect network cable to eTSEC2 port, setup your PC according IP settings described in chapter 7 and power on board. Wait until Windows will boots.
Press F5 in Visual Studio for run application on TWR-LS1021A. You will see IP request dialog.



Enter your IP.

Now you able to run and debug your application.


TestConsoleApplication1 (Debugging) - Microsoft Visual Studio (Administrator)
Quick Launch (Ctrl+Q)
FILE EDIT VIEW PROJECT BUILD DEBUG TEAM SQL TOOLS VMWARE TEST ANALYZE WINDOW HELP
Continue
Native Only
Debug
TWR-LS1021A SD
Process: [0x4F40012] TestConsoleApplicatic
Suspend
Thread: [0x5050012] Main Thread
Stack Frame: wmain
Solution Explorer
Search Solution Explorer (Ctrl+;)
Solution 'TestConsoleApplication1' (1 project)
TestConsoleApplication1
External Dependencies
Header Files
Source Files
Solution Explorer
Class View
Windows Embedded Events
There are no items to show for the selected document
TestConsoleApplication1.cpp
(Global Scope)
wmain(int argc, wchar_t * argv[])
// TestConsoleApplication1.cpp : Defines the entry point for the console appli
//
#include "stdafx.h"
int wmain(int argc, wchar_t *argv[])
{
printf("Welcome to Windows Embedded Project System \n");
return 0;
}
100 %
Watch 1
Name
Value
Type
Autos
Locals
Watch 1
Output
'TestConsoleApplication1.exe' (Win32):
Call Stack
Output
Ready
Ln 9
Col 1
Ch 1
INS