1. **Project title**:Threading using RTX on XMC 4500 Realax LITE

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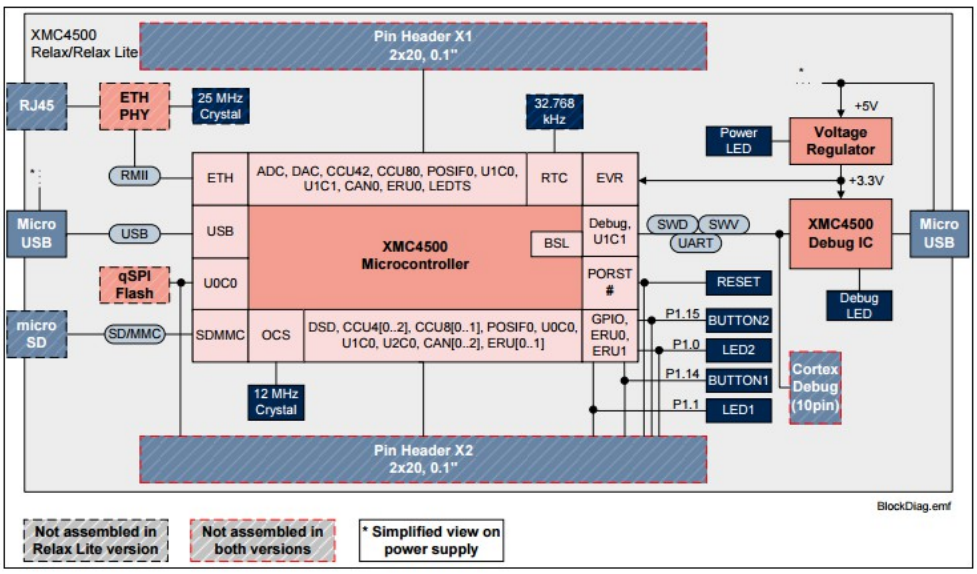
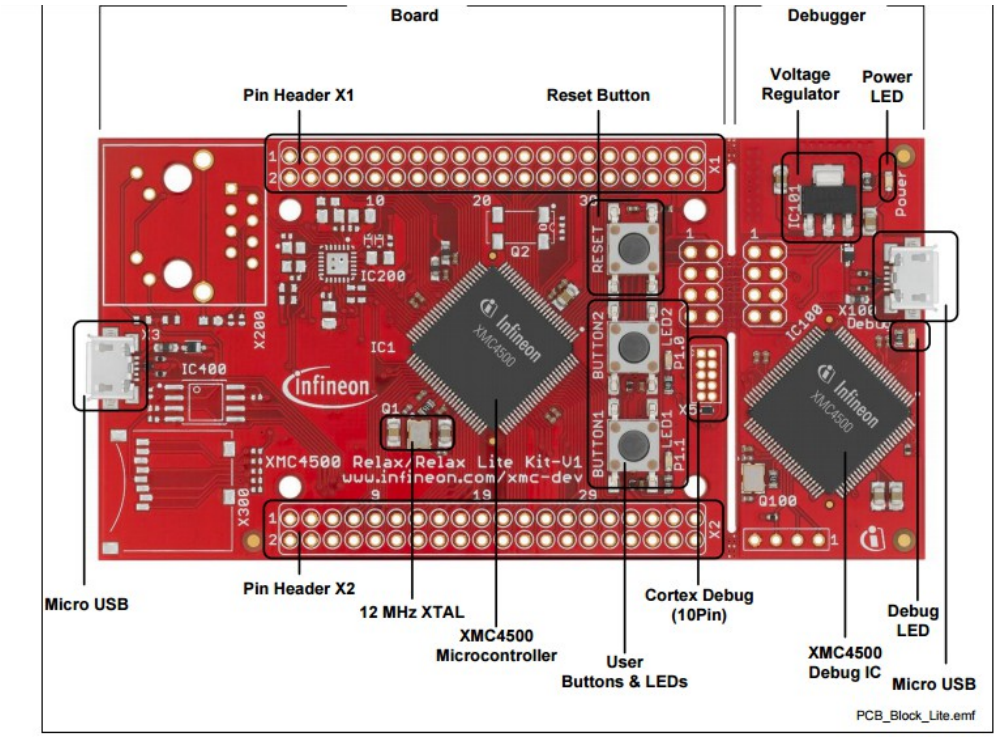
2. *Abstract*

The XMC4500 Relax Kit-V1 and the XMC4500 Relax Lite Kit-V1 are designed to evaluate the capabilities of the XMC4500 Microcontroller and the powerful, free of charge tool chain DAVE™. The XMC4500 Relax Kit extends the feature set with an Ethernet-enabled communication option, e.g. to run an embedded web server. You can store your own HTML web pages on a microSD Card or control the XMC4500 via the web browser on your PC. The XMC4500 Relax Lite Kit-V1 does not support the web server application, because the components for the Ethernet are not assembled. Both boards are marked with “XMC4500 Relax/Relax Lite Kit-V1”. These boards are neither cost nor size optimized and do not serve as a reference design.





4. System overview

Infineon Relax Lite Kit is a 10 Euros development kit based on Infineon XMC4500 Cortex M4 MCU with 160 KB SRAM and 1 MB flash, and featuring 2 USB OTG ports for debugging and powering up the board, 3 buttons (including reset), 2 LEDs, and 2 headers (through holes) giving access to the signals from the MCU such SPI, I2C, I2S, UART, CAN, ADC, DAC and PMW.

3. Introduction, project aims and objectives

I wanted to illustrate in this project the simplicity and also the power of this

board .This project can show how can two different events can be treated at the same time.The basic idea is *Threading .*

There are two events :

1) when button 1 is pressed ,LED nr1 is on
2) when button 2 is pressed ,LED nr2 in on

The two leds can be turned off ,by pressing the same buttons again.

To make this process even simple I introduced the RTX

I am introducing now the benefits of the RTX

Rtx is included in MDK-ARM .
RTX is royalty free.

Flexible Scheduling
Choose the best scheduling for your application .RTX offers three different kernel scheduling options ,allowing you to use the most suitable.

The options are :

1. *Pre-emptie* each task has a different priority and will run until a higher priority task is ready to run .
2. *Round and Robin* each task runs for a fixed period of time
3. *Co-operative* each task will run until it is told to pass control to another task

In my project I have chosen the CO-Operative option.
This can be seen very easily by switching the treads by pressing a button.

Pin Header Connector

	Pin Header X2			(Top View)	Pin Header X1		
	2	1			2	1	
	GND	GND			GND	GND	
4	GND	GND	3		GND	GND	3
6	P5.7	P2.6	5		RESET#	GND	5
8	P5.1	P5.2	7		P2.10	P2.1	7
10	P1.15**	P5.0	9		P14.8	P2.14	9
12	P1.13	P1.14**	11		P14.9	P2.15	11
14	P1.11	P1.12	13		P14.0	VAREF	13
16	P1.5***	P1.10***	15		P14.2	P14.1	15
18	P1.3***	P1.4***	17		P14.4	P14.3	17
20	P1.1*	P1.2***	19		P14.6	P14.5	19
22	P1.9	P1.0*	21		P14.12	P14.7	21
24	P0.8	P1.8***	23		P14.14	P14.13	23
26	P3.4	P0.7	25		P15.2	P14.15	25
28	P0.12	P3.3	27		HIB_IO_0	P15.3	27
30	P0.6	P0.11	29		P3.0	HIB_IO_1	29
32	P0.2	P0.5	31		P3.2	P3.1	31
34	P0.4	P0.3	33		P0.1	P0.9	33
36	GND	GND	35		P0.0	P0.10	35
38	VDD3.3	VDD3.3	37		VDD3.3	VDD3.3	37
40	VDD5	VDD5	39		VDD5	VDD5	39

Here is a brief description of some components the pins that they are connected to

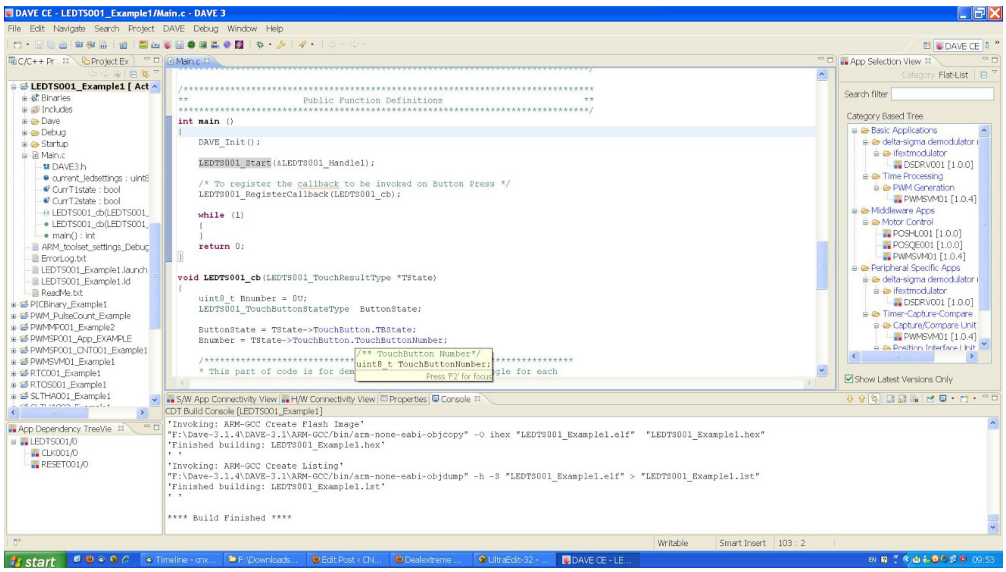
P1.1 is connected to LED1
P1.0 is connected to LED2 (2 mA load, ~2 V clip of input signal)
P1.14 is connected to BUTTON1
P1.15 is connected to BUTTON 2

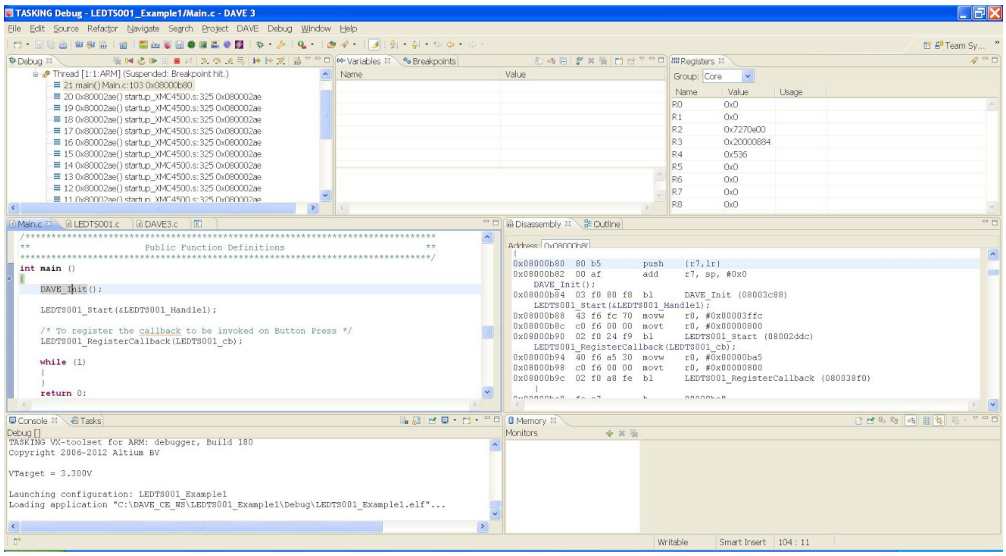
Schematic Software

The most facile and easy way to write programs for the XMC 4500 Relax LITE is the *DAVE PLATFORM*

DAVE (Infineon) Digital Application Virtual Engineer (DAVE™), a C/C++-language software development and code generation tool for microcontroller applications. DAvE is a standalone system with automatic code generation modules and is suited to develop software drivers for Infineon microcontrollers and aids the developer with automatically created C-level templates and user desired functionalities.

Latest releases of DAVE include all required parts to develop code, compile and debug on the target for free (based on the ARM gcc tool suite). Together with several low-cost development boards one can get involved in microcontroller design very easy. This makes Infineon microcontroller products also more usable to small companies and to home-use / DIY projects - similar to established products of Atmel (AVR, SAM) and Microchip (PIC, PIC32) to name a few.





In certain places i have used the automatic generator ,because it was more facile for me.

The code that the whole aplication is based on :

#include <DAVE3.h>

* Function Declarations

void LEDTS001_cb(LEDTS001_TouchResultType *TState);

6. Software

```
static bool CurrT1state = 0;
static bool CurrT2state = 0;
uint8_t current_ledsettings = 0U;


int main ()
{
DAVE_Init();

LEDTS001_Start(&LEDTS001_Handle1);

   /* To register the callback to be invoked on Button Press */
LEDTS001_RegisterCallback(LEDTS001_cb);

while (1)
{
}
return 0;
}

void LEDTS001_cb(LEDTS001_TouchResultType *TState)
{
uint8_t Bnumber = 0U;
LEDTS001_TouchButtonStateType  ButtonState;

ButtonState = TState->TouchButton.TBState;
Bnumber = TState->TouchButton.TouchButtonNumber;

* This part of code is for demo of touch - LED's will toggle for
each
* valid touch.

if(BUTTON_TOUCH_VALID == ButtonState)
{
switch(Bnumber)
```

```
{
case 1:
if(CurrT1state == 0)
{
CurrT1state = 1;
current_ledsettings |=0x04; //Select T1 LED
}
else
{
CurrT1state = 0;
current_ledsettings &=0xFB; //Unselect T1 LED
}
break;

case 2:
if(CurrT2state == 0)
{
CurrT2state = 1;
current_ledsettings |=0x80; //Select T2 LED
}
else
{
CurrT2state = 0;
current_ledsettings &=0x7F; //Unselect T2 LED
}
break;

default:
current_ledsettings |=0x00;
break;
}
LEDTS001_SetRegValues(current_ledsettings, LINE_REGISTER, 1);
LEDTS001_SetRegValues(0xff, LED_COMPARE_REGISTER, 1);
}

  return;
}
```

7. Project results & applications

The project that I have created works properly,and it has illustrate the advantages of RTX and threading .

The DAVE platform has helped me a lot in implementing this project and also the facilities that this platform offers .

8. **Reference: .....**