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AN_EVB1

Motorola MPC555
APPLICATION NOTE

Programming the External Flash on the EVB555 with Trace 32

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Application Note

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Product: ES200 - Evaluationboard MPC555 V1.2

Revision History

Revision	Date	Author
1.0	16.12.1998	Thomas Kirschbaum
Summary of changes: First pass Application Note		
1.1	24.09.1999	Jens Schneider
Summary of changes: Updated Restrictions chapter		

Basic Steps to program the external flash

The EVB555 has an external flash memory device on board. It is a TMS28F033 from Texas Instruments. One possible way to program it, is to use the Lauterbach Debugging program "TRACE 32".
The following basic steps are necessary:

1. Generate an *name*.ELF file containing the code destination address.
2. Power on EVB555.
3. Start TRACE32.
4. Configure the chip select `CS0` with the Memory Controller Registers of the MPC555 to match the address range used for the code in the *name*.ELF file.
5. Configure the flash (once!)
   This step has to be executed after every Power Up of the EVB555. Otherwise the flash will respond to every access to the external bus, ignoring the chip selects. This means, that the EVB555 is not bootable from this external flash device yet. We are working on a bootable solution with another flash.

   Hint: Only configure the flash once after power on. Configuring a second time will cause the flash to fall back in none configured mode!
6. Make the flash known to the debugging tool.
7. Switch on programming voltage (VPP12).

   Hint: If programming voltage is switched on while power up (DIP VPP12 on = 1) the flash will start in Overlay Block Mode and **the code in the Main Array is not visible to reads**. You can toggle between Overlay Block and Main Array by writing the value `0x06` to the flash base address.
8. Assure the flash to be empty. Erase it, if necessary.
9. Switch the debugging tool to “flash programming mode”.
10. Load the *name*.ELF file.

11. Terminate "flash programming mode" of debugging tool.
12. Switch off programming voltage

The external flash is programmed now.

Detailed Example

Here we have a detailed Example with additional Information how to program the external flash.

1. Generate an *name*.ELF file containing the code destination address.
   For example we take a file `xflash.elf` that was created by a linker run locating the code to the address range `0x0` to `0x3000`.
2. Assure DIP-Switch 1 (VPP12 on) to be switched OFF.
   Power on EVB555. The green LED lights. LED "VPP12" is off.
3. Start the Lauterbach Debugging Tool "TRACE32".
4. Configure the chip select `CS0` with the Memory Controller Registers of the MPC555 dependent on the code destination address used in the `xflash.elf` file. A wait state of one cycle is needed. In our case for `CS0`-register `BR` the value `0x00000003` and for the register `OR` the value `0xFFF80010` would be a good choice:
   The base address of the flash is set to `0x0` and with the address mask "`0xFFF8`" the size of the flash (`0x7FFFF`) is announced. Bursts are inhibited and the chip select is marked as valid. One wait state is inserted between every flash access.

   Hint: Assure the internal flash not to overlay the configured address range. Change the ISB-Bits in the IMMR register if necessary!
5. Configure the flash (once!)
   Open a data.dump-window beginning at address `0x0` in TRACE32.

   Double click on the first address displayed (the base address `0x0`).Add the value `96` (`0x96` = flash command: load device-configuration register) in the command line. Type Enter. The status register value of the TI-flash is displayed on all `CS0`- addresses. The value should equal `0x80`.

   Double click on the first address displayed (the base address `0x0`).Add the value `7B` (`0x7B` is the recommended configuration value) in the command line. Type Enter. The status register should still be displayed with the value of `0x80`. Otherwise an error has occurred. In this case start again with step 5.

   Double click on the first address displayed (the base address `0x0`). Add the value `0FF` (`0x0FF` switches back to read array) in the command line. Type Enter. The content of the array is displayed.

   The flash is configured now.
   To verify the configuration write the command `0x90` to the base address. The last column in the dump-window will display the actual configuration value. See the TMS28F033 Manual for further information.

   Hint: Only configure the flash once after power on. Configuring a second time will cause the flash to fall back in none configured mode! Pay attention to the batch file T32.cmm. This one is executed automatically when starting up TRACE32. Perhaps flash has already been configured there!
6. Make the flash known to the debugging tool.
   Type in TRACE32 command line: `flash.create 0++7FFFF T28F033 LONG`
   and type Enter.

   Base address — flash size — flash type — 32 bit data

7. Switch on Programming Voltage (VPP12).
   Switch DIP No.1 (VPP12 on) to ON. The LED "VPP12" lights.
8. If flash is not empty erase it now with the command
   `flash.erase 0++7FFFE` (type Enter)
   The message "`FLASH erase done`" appears in the status line.
9. Switch the debugging tool to "flash programming mode".
   Type in TRACE32 command line:
   `flash.p all`
   and type Enter.
   The message "`FLASH programming ready ...`" appears in the status line.
10. Load the *name*.ELF file.
    Use the menu File – Load – and the following Dialog to Download the `xflash.elf` file.
    The message "`loading ELF/DWARF`" appears in the status line.
11. Terminate "flash programming mode" of debugging tool.
    Type in TRACE32 command line:
    `flash.p off`
    and type Enter.
12. Switch off Programming Voltage
    Switch DIP No. (VPP12 on) to OFF.

The external flash is programmed now. The downloaded code is visible in the dump-window.

Automatic program voltage assignment

To avoid erasing the flash accidentally and not to start the flash in Overlay Block Mode the usage of the automatic program voltage assignment is recommended.
Enable this function by switching DIP No.2 (VPP12 auto) to ON. DIP No.1 (VPP12 on) remains OFF all the time.
Now you can assign and remove programming voltage by writing to a special register in the PRU unit. This register is located at **`0x1100C + <base address of chip select 1>.`**
Assign program voltage by writing one byte with the value of **`0x80`** to this address.
Remove program voltage by writing one byte with the value of **`0x00`** to this address.

Comfortable working with batch files

When programming and erasing the external flash frequently the usage of TRACE32- batch files are useful and time saving. Batch files are called from the menu File – Batchfile – and the following dialog. Create your batch file with a conventional text editor. You can see an example of a batch file to program the external flash below. It substitutes steps 4 to 12 with an unconditional erase in step 8.

```
; move internal registers and internal flash to 00C00000
; by writing to SPR IMMR
 D.S SPR:27E %LONG 04000806

; enable floating point reads in debugging mode
 sys.option.scratch 0ffb800

; configure chip select CS0 for flash 0x00000000–0x0007ffff 1WS
 D.S 00efc100 %l 00000003
 D.S 00efc104 %l 0FFF80010

; configure external flash
 D.S D:00000000 %BE %LONG 96
 D.S D:00000000 %BE %LONG 7B
 D.S D:00000000 %BE %LONG 0ff
```

```
; configure chip select CS1 for RAM & PRU 0x00800000-0x009FFFFF 0WS
 D.S 00efc108 %l  00800003
 D.S 00efc10C %l 0FFE00000

; enable breakpoint abilities in flash area (onchip breakpoints)
 map.readonly 000000000--00007ffff

; erase all previously defined flash devices
 flash.res

; declare new external flash device
 flash.create 00000000++7ffff T28F033 LONG

; apply automatic programming voltage
 D.S 91000C %BE %BYTE 80

; erase all sections in external flash
 flash.erase 000000++0ffff
 flash.erase 0010000++2ffff
 flash.erase 0040000++1ffff
 flash.erase 0060000++1ffff

; switch TRACE in flash programming mode
 flash.p all

; download *.elf file
 data.load.elf ..\run\xflash.elf 0++7ffff /LONG

; terminate flash programming mode
 flash.p off

; remove automatic programming voltage
 D.S 91000C %BE %BYTE 0
```

Restrictions

The maximum allowed bus clock rate for using the external flash is 30 MHz. At higher clock rates the flash might drive out wrong data. The flash configuration has also to be done at a bus speed of 30MHz or less. After configuring the flash it will be possible to use the external memory (except the flash !!) at a bus speed up to 40 MHz.

Additional Information

- EVB555 Quick Reference
- Motorola's MPC555 User's Manual