56F8346 Hybrid Controller

56F8346 Digital Power Factor Correction using Processor Expert™

Targeting Document

8346DPFCTD/D
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MOTOROLA.COM/SEMICONDUCTORS

Digital Power Factor Correction

This application exercises simple control of the Power Factor Correction (PFC) without motor control on the56F8346EVM board and the EVM Motor Kit.

1. Specifications

The Digital PFC application performs power factor correction for 3-Phase AC/BLDC High-Voltage Power Stage hardware without motor drive. This demonstration evaluates the basic algorithm of power factor correction for the current hardware implementation. PFC software was designed for use with motor control applications; the Digital PFC application allows target memory configuration of RAM and Flash.

The input power line must meet the following requirements:

- Input voltage value 115V and 60Hz
- Input voltage value 230V and 50Hz

The applications run at 230V, 50Hz by default. To switch to 115V, 60Hz comment this line in *Digital_PFC.c*:

```
#define MILESTONE_OFFSET MKS_TO_TICK(570L)    //For 50 Hz, 230 V
```

And uncomment this line:

```
//#define MILESTONE_OFFSET MKS_TO_TICK(1498L) //For 60 Hz, 115 V
```

The Digital PFC application may be used in the Manual Operating Mode. The remote control functionality of the PC master software application is not implemented.

The application can run on:

- External RAM
- Flash

1.1 Manual Operating Mode

The PFC conversion is controlled by the RUN/STOP switch (S3); see **Figure 1-1**. The green USER LED (LED2; see **Figure 1-2**) indicates the application states. When the application is ready, the USER LED blinks at a 2Hz frequency.

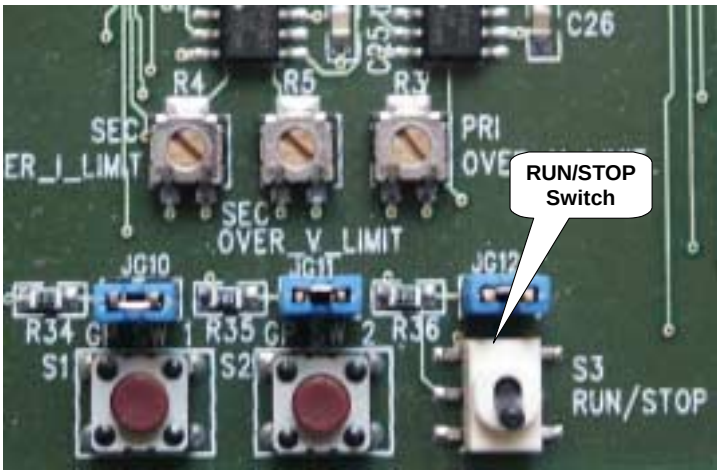

Figure 1-1. RUN/STOP Switch on the Daughter Card

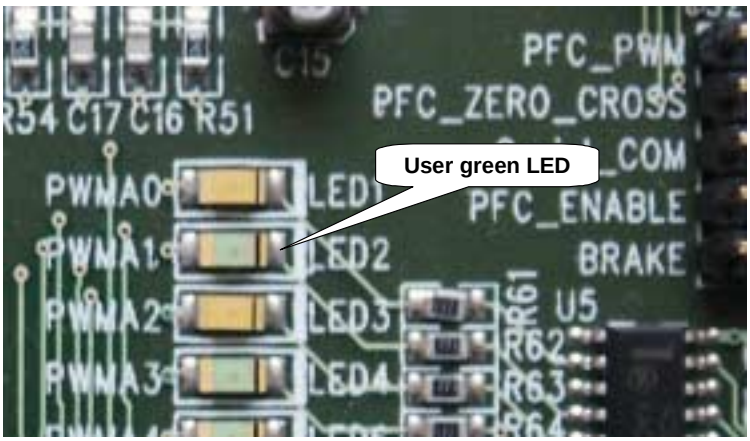

Figure 1-2. USER LED on the Daughter Card

The PFC conversion can be enabled after the RUN/STOP switch is moved to the RUN position. The normal PFC conversion process is indicated by the green USER LED, which will light continuously. To disable PFC conversion, the RUN/STOP switch must be moved to the STOP position.

Table 1-1. Motor Application States

Application State	Digital PFC State	LED State
Stopped	Stopped	Green LED blinking Red LED off
Running	Spinning	Green LED on Red LED off
Fault	Stopped	Green LED off, Red LED on

1.2 PC Master Software (Remote) Operating Mode

The drive is monitored remotely from a PC through the SCI communication channel of the device via an RS-232 physical interface.

PC master software displays the following information:

- Application mode
- Application status
- DCBus Voltage

Application Mode Project files for the PC master software are located in:

..\pcmaster\sdm_external_memory.pmp, uses Map file to run in the small memory model of the external memory

..\pcmaster\ldm_external_memory.pmp, uses Map file to run in the large memory model of the external memory

..\pcmaster\sdm_pROM-xRAM.pmp, uses Map file to run in the small memory model of the internal memory

..\pcmaster\ldm_pROM-xRAM.pmp, uses Map file to run in the large memory model of the internal memory

..\pcmaster\sdm_xROM-xRAM.pmp, uses Map file to run in the small memory model of the internal memory

..\pcmaster\ldm_xROM-xRAM.pmp, uses Map file to run in the large memory model of the internal memory

Start the PC master software window's application, *sdm_external_memory.pmp*. **Figure 1-3** illustrates the PC master software control window after this project has been launched.

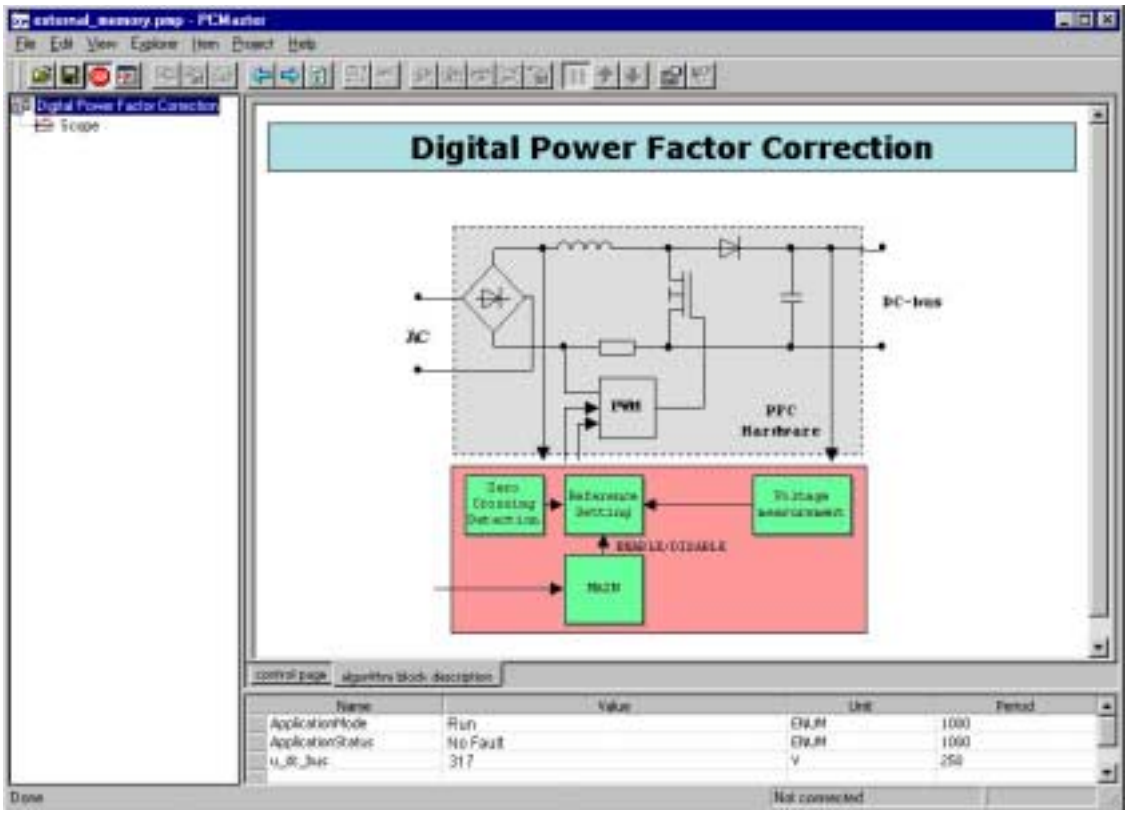

Figure 1-3. PC Master Software Control Window

2. Hardware Set-up

Figure 2-1 illustrates the hardware set-up for the Digital PFC application, which requires a motor drive. The 3-Phase AC/BLDC High-Voltage Power Stage board contains the JP201 jumper that selects the power supply device. Pins 2 and 3 of the JP201 connection correspond to a simple rectifier-capacitor power stage. The PFC hardware set-up requires closing pins 1 and 2 of the JP201 connection; see **Figure 2-2**.

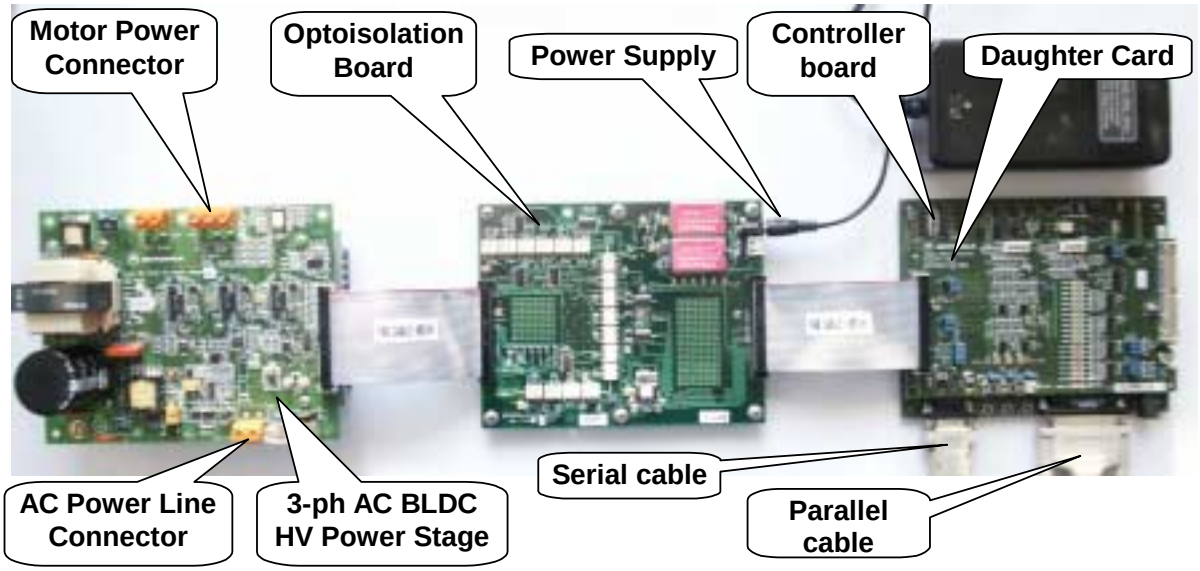

Figure 2-1. Digital PFC Application Set-up

The system is comprised of the following components:

- Controller board for 56F8346
  - — Supplied as 56F8346EVM
  - — Described in **56F8346 Evaluation Module Hardware User's Manual**
- 3-Phase AC BLDC High-Voltage Power Stage, 180W
  - — Supplied in a kit with optoisolation board as ECOPTHIVACBLDC
  - — Described in **3-Phase Brushless DC High-Voltage Power Stage**
- Optoisolation Board
  - — Supplied with 3-Phase AC/BLDC High-Voltage Power Stage as ECOPTHIVACBLDC

  or

  - — Supplied alone as ECOPT - optoisolation board
  - — Described in **Optoisolation Board User's Manual**

Warning: It is strongly recommended that optoisolation (optocouplers and optoisolation amplifiers) be used during development to avoid damage to the development equipment.

Note: Documentation for all components can be found at: **http://motorola.com/semiconductors**

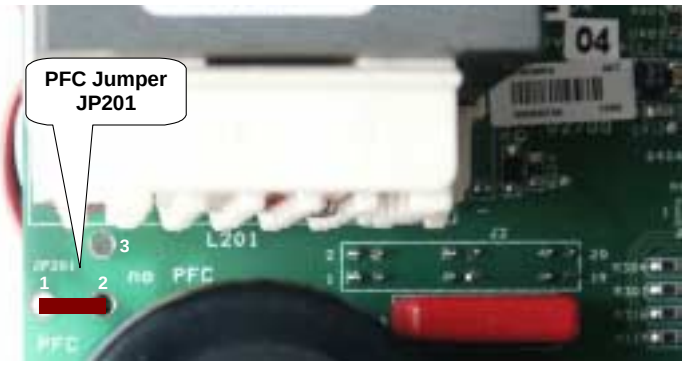

Figure 2-2. Jumper JP201 on the 3-Phase AC BLDC Power Stage

For detailed information, see the **56F8346 Evaluation Module Hardware User's Manual**. The serial cable is needed for the PC master software debugging tool only.

2.1 EVM Jumper Settings

To execute the Digital PFC application, the 56F8346EVM board requires the strap settings shown in **Figure 2-3** and **Table 2-1**; the daughter card requires the strap settings shown in **Figure 2-4** and **Table 2-2**.

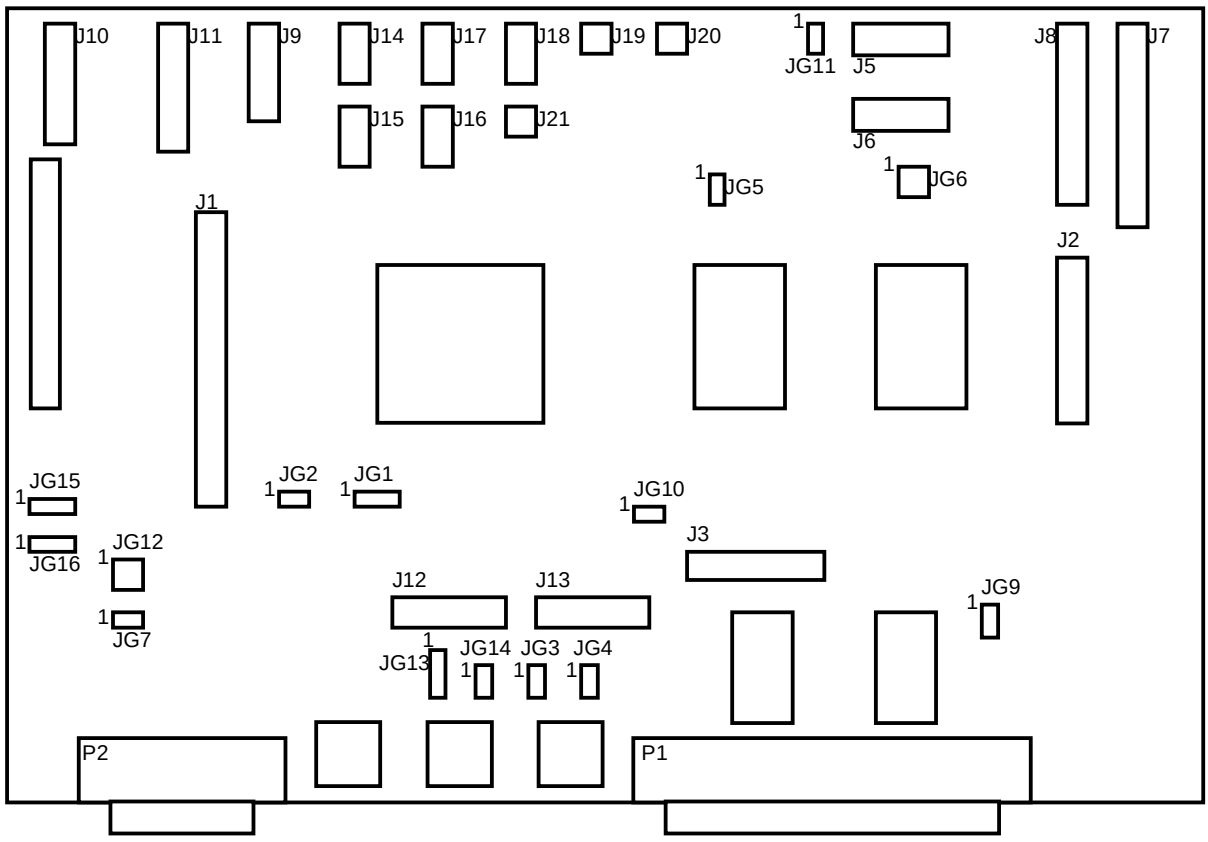

Figure 2-3. 56F8346EVM Jumper Reference

Table 2-1. DSP56F8346EVM Jumper Settings

Jumper Group	Comment	Connections
JG1	Uses on-board EXTAL crystal input for oscillator	1-2
JG2	Uses on-board XTAL crystal input for oscillator	1-2
JG3	Enables Internal Boot Mode	1-2
JG4	Enables A0 - A19 for external memory accesses	NC
JG5	Enables SRAM Memory Bank 0 (use CS0)	1-2
JG6	Enables SRAM Memory Bank 1 (use CS1 & CS2)	1-2, 3-4
JG7	Enables RS-232 Disable	NC
JG8	SPI #0 Daisy Chain (Optional--not populated on board by default)	NC
JG9	Enables on-board Parallel JTAG Host/Target Interface	1-2
JG10	Connects Analog Ground to Digital Ground	1-2
JG11	Selects CAN termination	1-2
JG12	Passes RXD0 & TXD0 to RS-232 level converter	1-2, 3-4
JG13	Enables Crystal Mode	1-2
JG14	Passes Temperature Diode to ANA7	1-2
JG15	User Jumper #0	1-2
JG16	User Jumper #1	1-2

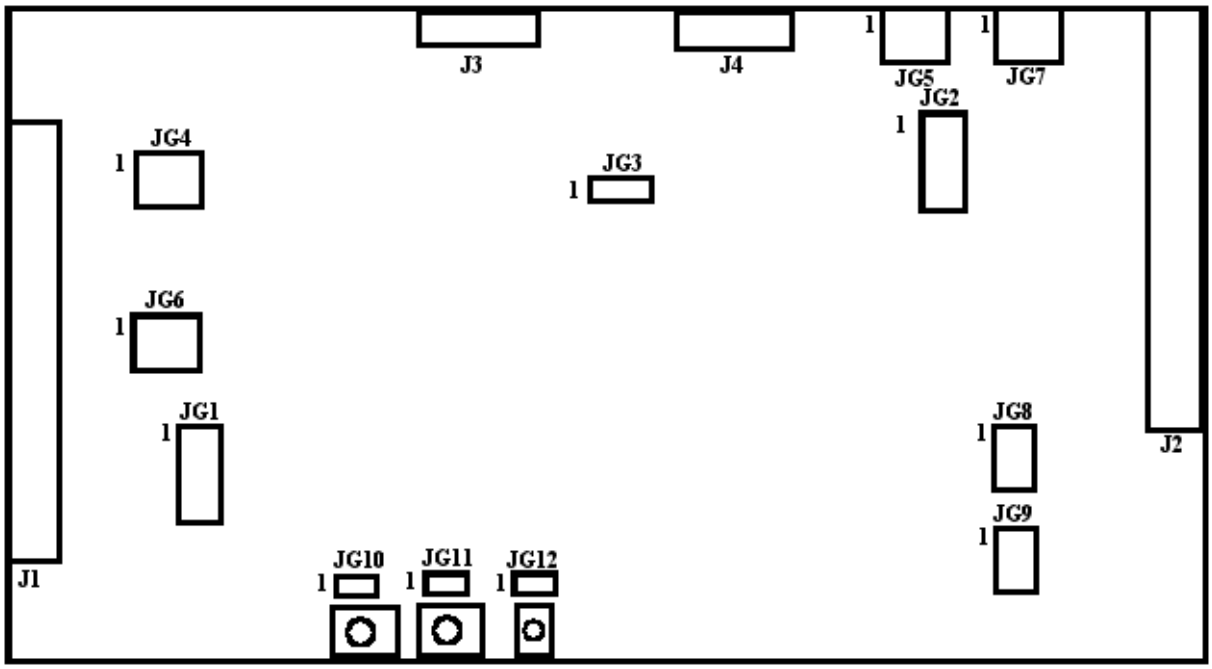

Figure 2-4. 56F8346EVM - Daughter Card Jumper Reference

Table 2-2. 56F8346EVM Daughter Card Jumper Settings

Jumper Group	Comment	Connections
JG1	Primary PFC	1-2, 3-4, 5-6, 7-8, 9-10
JG2	Secondary PFC	NC
JG3	Phase_IS / Over_I	1-2
JG4	Primary Zero-Crossing / Encoder	2-3, 5-6, 8-9
JG5	Secondary Zero-Crossing / Encoder	NC
JG6	Primary Back-EMF / Phase-IS	1-2, 4-5, 7-8
JG7	Secondary Back-EMF / Phase-IS	NC
JG8	Fault A Monitor	1-2, 3-4, 5-6
JG9	Fault B Monitor	1-2, 3-4, 5-6
JG10	Switch 1	1-2
JG11	Switch 2	1-2
JG12	Switch 3 (Run / Stop)	1-2

Note: When running the EVM target system in a stand-alone mode from Flash, the JG9 jumper must be set in the 1-2 configuration to disable the command converter parallel port interface.

3. Build

When building the Digital PFC Application, the user can create an application that runs from internal Flash or External RAM. To select the type of application to build, open the *digital_PFC.mcp* project and choose the target build type; see **Figure 3-1**. A definition of the projects associated with these target build types may be viewed under the *Targets* tab of the project window.

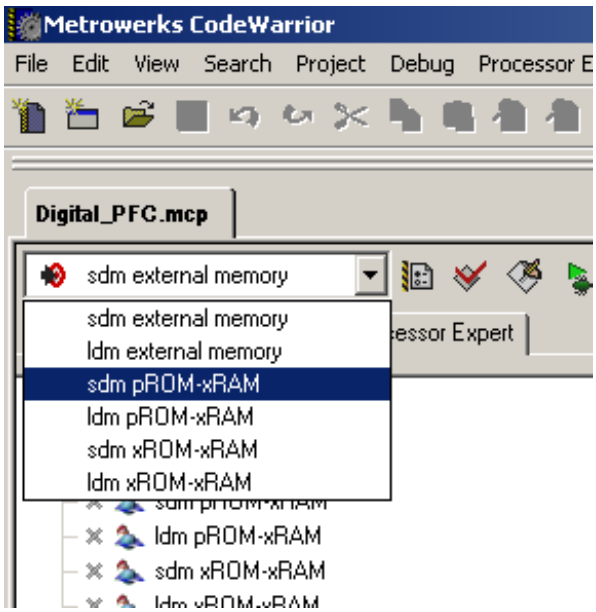

Figure 3-1. Target Build Selection

The project may now be built by executing the *Make* command, as shown in **Figure 3-2**. This will build and link the Digital PFC Application and all needed Metrowerks and Processor Expert libraries.

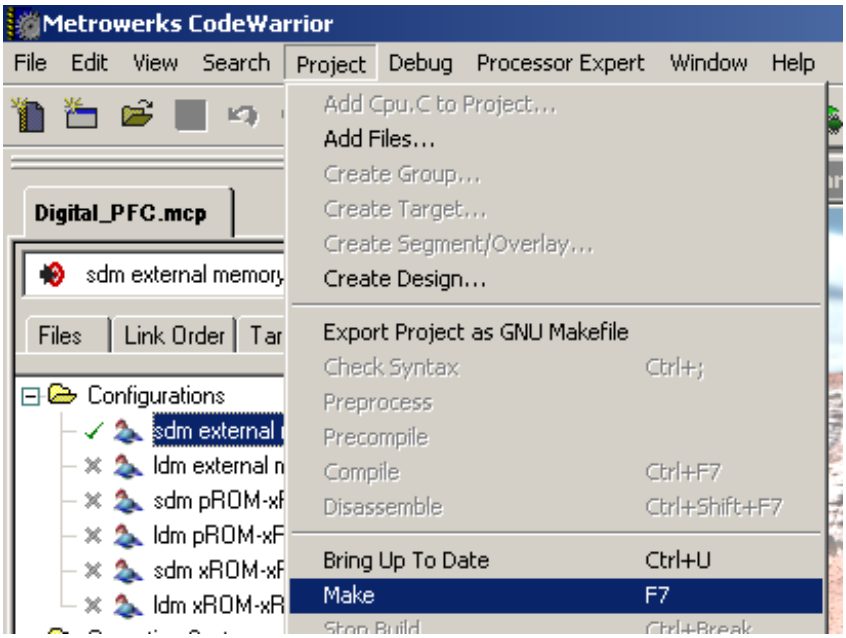

Figure 3-2. Execute *Make* Command

For more information about these commands, see:

<...>\CodeWarrior Manuals\PDF\Targeting_56800E.pdf

4. Projects Files

The Digital PFC application is composed of the following files:

- **...\Project Directory\"Project File Name".mcp**, application project file
- **...\Project Directory\"Project File Name".pe**, Processor Expert software file
- **...\Project Directory\"Project File Name".G_C**, Processor Expert software file
- **...\Project Directory\"Project File Name".dsk**, Processor Expert software file
- **...\Project Directory\bin*.xMAP**, map file
- **...\Project Directory\bin*.elf**, standard binary file
- **...\Project Directory\startup*.c, *.h, *.asm**, initialization files
- **...\Project Directory\Code\adcPrimary.*** files generated by the PE for *adcPrimary* bean
- **...\Project Directory\Code\PC_M1.***, files generated by the PE for *PC_M1* bean
- **...\Project Directory\Code\tiAux.***, files generated by the PE for *tiAux* bean
- **...\Project Directory\Code\tmrD1.***, files generated by the PE for *tmrD2* bean
- **...\Project Directory\Code\Cpu.***, files generated by the PE for the CPU used
- **...\Project Directory\Code\Events.***, files generated by the PE for events
- **...\Project Directory\Code\PE_Const.***, PE internal definitions of the constants
- **...\Project Directory\Code\PE_Error.***, PE internal definitions of the error constants
- **...\Project Directory\Code\PE_Types.***, PE internal definitions of the types
- **...\Project Directory\Code\PESL.***, configuration file for PESL library
- **...\Project Directory\Code\Vectors.***, definitions of the interrupt vectors

5. Execute

To execute the Digital PFC Application, select the *Project/Debug* command in the CodeWarrior IDE, followed by the *Run* command. For more help with these commands, refer to the CodeWarrior tutorial documentation in the following file, located in the CodeWarrior installation directory:

<...>\CodeWarrior Manuals\PDF\Targeting_56800E.pdf

If the Flash target is selected, CodeWarrior will automatically program the device's internal Flash with the executable generated during *Build*. If the External RAM target is selected, the executable will be loaded to off-chip RAM.

Once Flash has been programmed with the executable, the EVM target system may be run in a stand-alone mode from Flash. To do this, set the JG9 jumper in the 1-2 configuration to disable the parallel port, and press the RESET button.

To enable the PFC conversion, set the RUN/STOP switch to the RUN position. If this switch was in the RUN position before the application started, move it to the STOP position first, then back to the RUN position. The USER LED should light continuously when the PFC conversion is enabled. To disable the PFC conversion, move the RUN/STOP switch to the STOP position, causing the USER LED to blink again.

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