

GMCE Firmware and LED Reference Document

A Quick GMCE Firmware Reference

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Revision History

Revision	Date	Author	Comments
1.00	March 17, 2006	Dean Lowe	First Draft
1.01	March 20, 2006	Dean Lowe	Incorporated comments from GMCE development team.

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CONTENTS

Revision History i

1. Introduction 1

2. GMCE Status LEDs Description 1
   - 2.1 LEDs That Are Independent of Firmware State 1
     - 2.1.1 GMCE Power LEDs 1
     - 2.1.2 Ethernet Interface Status LEDs 2
     - 2.1.3 USB 2
     - 2.1.4 Fibre Optic Interface Status LEDs 2
   - 2.2 LEDs That are Directly under Firmware Control 3
     - 2.2.1 HCS12 Status LEDs 3
     - 2.2.2 PowerPC Status LEDs 3

3. GMCE Board Startup 4
   - 3.1 Simplified Firmware-Centric Board Architecture 4
   - 3.2 Startup Sequence and Corresponding LED Usage 4

4. Downloading New Code 8
   - 4.1 HCS12 Boot Code 8
   - 4.2 HCS12 Main Code 8
   - 4.3 Xilinx Image 8
   - 4.4 Power PC Boot Code 9

5. Troubleshooting 9
   - 5.1 Special LED States 9
   - 5.2 What to do if the GMCE is Stuck in Boot Mode 11
     - 5.2.1 Can't Ping the GMCE 12
     - 5.2.2 The GMCE Responds to Pinging 13
   - 5.3 USB Diagnostic Prompt Latency 13

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1. INTRODUCTION

This document is a firmware-centric document, explaining in detail what each of the LEDs on the GMCE board does, and how their states can be used to understand what the GMCE board is doing. The document also explains the startup sequence, as well as troubleshooting information.

This document should be the first point of reference for anyone trying to debug GMCE firmware problems in production, in the field, and in the response centre.

2. GMCE STATUS LEDS DESCRIPTION

The GMCE board has the 2 banks of firmware status LEDS that are useful in determining what is happening with the firmware and what firmware module is currently running. These LEDs are controlled by firmware and can be found here:



There are also LEDs on the GMCE board that are not under firmware control. These are described in this document also.

2.1 LEDs That Are Independent of Firmware State

There are some LEDs that are independent of firmware state. They work regardless of the state of the firmware.

2.1.1 GMCE Power LEDs

The two LEDs on the left of the reset button are power indicators. They must both be lit all the time for the board to function. If one of them is out, there is a serious hardware problem with the board and it should be replaced.

Name:	Ref Des	Colour:	Usage:
OTHER PWR	LED6	Green	Lit when all of the following power supplies are okay: • 1.25V DDR SDRAM termination • 1.5V • 2.5V • 3.3V

+5V PWR	LED7	Green	Lit when the 5V on-board power supply is on

2.1.2 Ethernet Interface Status LEDs

Connector J42 has LEDs built into it to indicate the status of the Ethernet interface. If you look closely at the silkscreen text right beside the connector, it can be seen that the side nearest the edge of the board is marked "Link" and the other side is marked "Activity." These two LEDs can change colour.

Note that when the link LED is on, this only indicates that the GMCE "sees" a computer at the other end of the cable. It does NOT imply that any network parameters have been set up!

Name:	**Ref Des**	**Color:**	**Usage:**
LINK	N/A	Green Light Green Yellow	A 1000Mbps connection has been established A 100 Mbps connection has been established A 10 Mbps connection has been established
ACTIVITY	N/A	Green Yellow	On when full duplex data is flowing On when half-duplex data is flowing

The activity LED on Ethernet connector J42 will flash when data is sent from the workstation before Power PC boot code is running, but the Power PC is not capable of responding until boot code is running.

2.1.3 USB

Finally, there is also an LED to indicate USB communication. It only flashes for a brief instant when USB data flows in either direction.

Name:	**Ref Des**	**Color:**	**Usage:**
ACTIVITY	LED16	Green	Flashes when data travels over USB

Similar to the Ethernet activity LED, the USB activity LED will flash when data is sent from the workstation before Power PC boot code is running, but the Power PC is not capable of responding until boot loader code is running.

2.1.4 Fibre Optic Interface Status LEDs

Although these LEDs are not directly under Firmware control, they are only activated once boot code is running, at which point they indicate the status of the fibre interface. Before boot code is running, they are for the most part meaningless as they turn on and off as part of the boot process. They are also meaningless if no fibre cable is connected.

Name:	**Ref Des**	**Color:**	**Usage:**
FB_CARRIER	LED13	Green	On when there is light at the other end of the fibre cable (similar to an Ethernet "link" indicator)
FB_RX	LED14	Yellow	On when the GMCE is receiving data over fibre
FB_TX	LED15	Yellow	On when the GMCE is transmitting data over fibre

2.2 LEDs That are Directly under Firmware Control

While the above LEDs are more useful in diagnosing hardware problems, the LEDs in this section are especially useful in diagnosing firmware problems. The combinations of each of these LEDs can be a critically important tool in understanding unexpected firmware behaviour.

2.2.1 HCS12 Status LEDs

The five status LEDs on the left side of the picture (at the beginning of this chapter) are used by the GMCE's HCS12 slave MCU processor. Their firmware usage is as follows:

Name	Ref Des	Colour	Usage
CAN COMMS	LED1	Green	Indicates CAN Bus (SCON) Communications are occurring. Will flash depending upon how often the CAN bus is being accessed
HEARTBT	LED2	Green	Flashes at 1Hz for Boot code, and .5Hz for Main code running
IDLE	LED3	Yellow	On when the HCS12 MCU is not running firmware tasks. Should normally be illuminated fairly brightly
IRQ	LED4	Yellow	On when HCS12 MCU is responding to interrupts. Should normally be on only very dimly
SRVC	LED5	Red	On when performing Service operations. This LED will be on when erasing or programming GMCE board flash memory

2.2.2 PowerPC Status LEDs

The five status LEDs on the right side of the blue reset button in the picture are used by the GMCE's Power PC processor. Their firmware usage is as follows:

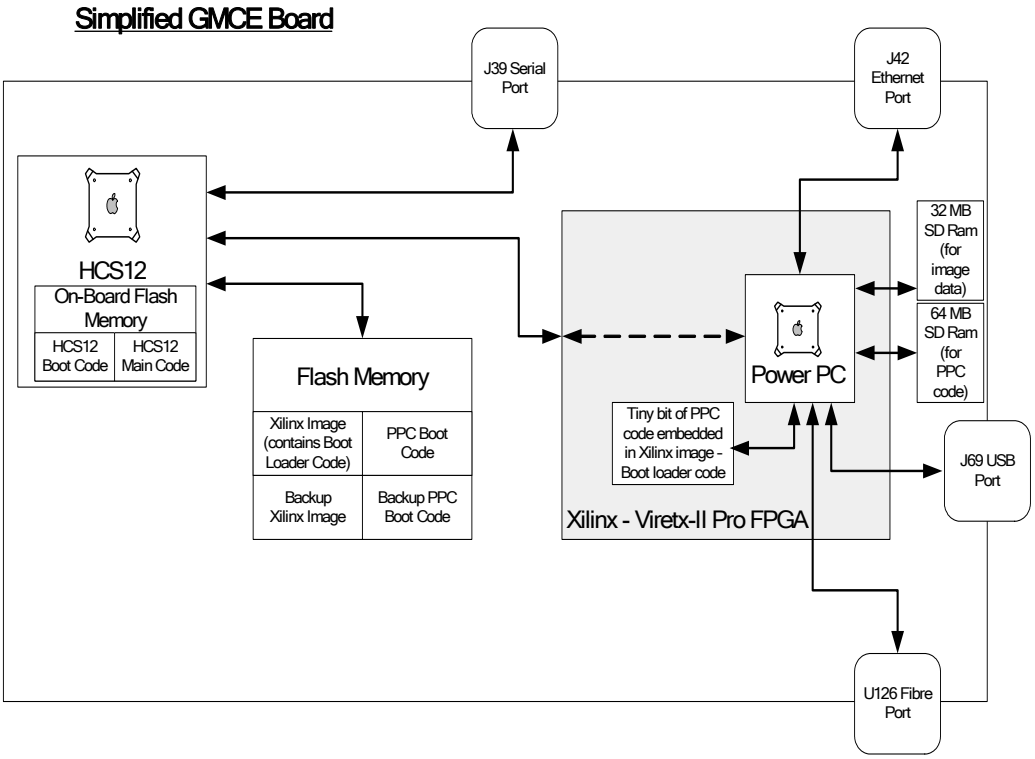
Name:	Ref Des	Color:	Usage:
W/S COMMS	LED8	Green	Indicates WorkStation Communications are occurring. Will flash depending upon how often communication with the host computer is being performed
HEARTBT	LED9	Green	Flashes at 2.5Hz for Boot loader code, 1Hz for Boot code, and .5Hz for Product code running
IDLE	LED10	Yellow	On when the Power PC CPU is not running firmware tasks. Should normally be illuminated fairly brightly, but may flash off at certain times. Should not be off for long periods of time
IRQ	LED11	Yellow	On when Power PC CPU is responding to interrupts. Should normally be on only very dimly. May not be easily visible
SRVC	LED12	Red	On when performing Service operations. This LED will be on when erasing or programming SCON (Satellite) board's flash memory

3. GMCE BOARD STARTUP

In order to get a good feeling for what the board is doing during startup, it helps to have a feeling for the architecture of the board as it relates to firmware. Once this information is introduced, the actual detailed startup sequence is given.

3.1 Simplified Firmware-Centric Board Architecture

The GMCE board has two processors, a small microcontroller from Freescale's HCS12 family, and a more powerful processor placed *inside* the FPGA: the Power PC (PPC). The HCS12 has on-board programmable flash memory, so that all of its code is run from its local flash, but the board also has a separate flash chip which contains the Xilinx image/code and the Power PC boot code. The simplified diagram below gives some understanding about where the firmware "lives" on the board, and how it is accessed. Notice that the Power PC cannot access the flash directly, but relies on the HCS12 for this.



From the above diagram, it can be seen that the Power PC cannot run until the Xilinx image is loaded, since that image contains the small bit of boot-loader code which is the first code executed by the Power PC upon start-up.

3.2 Startup Sequence and Corresponding LED Usage

The following is a brief description of the GMCE board Startup sequence along with the corresponding LED states at each stage. With this information, it can be understood exactly what phase of start-up the board is in for troubleshooting purposes. Refer to the above diagram in conjunction with the sequence below in order to get a good understanding of the process.

Please note that the key below will help you to understand the LED states in the sequence.

- 0 → LED is off
- 1 → LED is on
- X s → LED is blinking with a period of X seconds. It toggles state (off/on) at half of this time. (Ex: An LED blinking with a period of 2 seconds is on for 1 second and then off for 1 second).

HCS12 LEDs					Power PC LEDs					Approx Phase Duration	Description
LED1 – CAN_COMMS	LED2 – HEARTBT	LED3 – IDLE	LED4 – IRQ	LED5 – SRVC	LED8 – W/S COMMS	LED9 – HEARTBT	LED10 – IDLE	LED11 – IRQ	LED12 – SRVC		
1	1	1	1	1	1	1	1	1	1	0.5 s	In reset; no code is running
← Sweep to the left ←					1	1	1	1	1	0.5s	HCS12 boot code starts
0	0	0	0	0	1	1	1	1	1	2 s	HCS12 boot code loads HCS12 main code, then HCS12 main code loads the Xilinx image from flash into the Xilinx. If the Xilinx image is corrupted, it loads the backup Xilinx image instead
0	2 s	1	0	0	0.4 s	0	0	0	0.4 s	16 s	Boot loader code (embedded within the Xilinx code) starts, and tests the 64MB SD RAM (which will later store Power PC code). It is at this point that the USB interface becomes active
0	2 s	1	0	0	0.4s	0.4s	0	0	0.4s	13 s	Boot loader code tests the 32MB SD RAM (which is later used for image data)
0	2 s	1	0	0	0.4s	0.4s	0.4s	0	0.4s	12 s	Boot loader code requests the Power PC boot code from the HCS12 (which gets it from flash) and puts it into the 64MB SD RAM. If this code is corrupted, the backup Power PC code is sent instead
0	2 s	1	0	0	0	0	0	0	0	2 s	Power PC boot code initializes. When finished initializing, the Ethernet connection (J42) becomes activated from the GMCE side.

Continued from previous page…

HCS12 LEDs					Power PC LEDs						
LED1 – CAN_COMMS	**LED2 – HEARTBT**	**LED3 – IDLE**	**LED4 – IRQ**	**LED5 – SRVC**	**LED8 – W/S COMMS**	**LED9 – HEARTBT**	**LED10 – IDLE**	**LED11 – IRQ**	**LED12 – SRVC**	**Approx Phase Duration**	**Description**
0	2 s	1	0	0	0	1 s	1	0	0	10 s	Power PC boot code broadcasts over Ethernet, "I'm awake, and my name is GMCE0[*]. Is there a bootp server out there? What are my network connection settings and NVS parameters? The bootp server inside the workstation answers back with the appropriate information, taken from the [GMCE0] section of the CreoBootp.ini file (Located at C:\Creo\Firmware) Power PC boot code loads the network connection settings and NVS parameters into the 64MB SD RAM, and asks the workstation, "Send me my product-specific main code" The bootp server sends down the product-specific main code specified in the CreoBootp.ini file, which Power PC boot code immediately puts into the 64MB SD RAM
0	2 s	1	0	0	0	0	0	0	0	3.5 s	Power PC product-specific main code initializes
0	2 s	1	0	0	0	2 s	1	0	0	N/A	Product-specific main code is running (out of the 64MB SD RAM)

[*] The GMCE number (also called logical unit number or LUN) is set by jumpers in the cable built into the 16-pin SCON connector, J8. Its value can be 0-15, but for single GMCE systems, it's generally set to zero. It can be read by issuing the command "List version all" and looking at the end of the board version line:
GMCE Board PCB Version:XX Population Option:XX ***Lun:XX***

4. DOWNLOADING NEW CODE

In general, code can be downloaded using the GMCE installer program. Below, each piece of code is described in more detail. *How* to download the code is not discussed here (the installer is quite clear about what to do). Instead, the sections below focus on *what* actually happens, to lend understanding about how the system works.

4.1 HCS12 Boot Code

The HCS12 boot code is the lowest level of code on the board, and is the first firmware to be programmed when the board is manufactured[†]. It requires special programming equipment, and was designed such that it cannot be updated or deleted without the equipment.

4.2 HCS12 Main Code

The HCS12 main code lives inside the HCS12 microcontroller internal flash and is also executed from there. It can only be updated through serial port J39. When the installer updates this code, it first downloads a small piece of "recovery" code, which has within it directions on how to burn the HCS12 internal flash memory. It then downloads the actual main code.

4.3 Xilinx Image

The Xilinx image resides in the GMCEs flash memory (separate from the flash inside the HCS12). Two Xilinx images are stored in the flash memory: a primary and a backup copy. When the board is booting, the HCS12 checks the primary image. If it is corrupt, it loads the backup image (if one has been previously downloaded). When a new image is downloaded to the board, the new image becomes the primary one, and the previous image becomes the backup one, regardless of version number. This means that the version numbers may be the same or different, depending on what versions were downloaded last, and what order they were downloaded in. **The last image downloaded will always become the primary image the next time the board boots.**

In a normal download of a Xilinx image, the GMCE installer relies on the fact that there is already *some* version of code running on the board, and therefore the Ethernet port is active. It resets the board into boot mode (so that no product-specific code is running) and then sends the code down to the GMCE, where it is stored in SD RAM. Only after *all* of the code is stored in SD RAM does the Power PC give it to the HCS12 to be burned into flash.

To see the primary and backup versions of code, type the "list version all" command and watch for the Xilinx version (highlighted below):

```
Magnus VLF>> list version all
Version Information:
-----------------------------------------------------
FW: 5981 Mar 10 2006 15:35:28 5981
    Version: 1.19.01 Build No: 18840
```

[†] To be absolutely proper, the CPLD image is downloaded using JTAG first, but this isn't technically firmware, nor can it be updated in the field.

```
    Built using Baseline #3687 - Mar 10 2006
HW: Gigabit Master Control Electronics Hardware Board (GMCE)
    Version: 2.00
Xilinx Version: 1.86
Machine Serial Number: **Not Available**
Head Information: Not Available
GMCE Board PCB Version:02 Population Option:00 Lun:00
 Firmware Modules (00h) XILINX: 1.86 Backup: 1.86 Logic: 00.37.00 BootLoader: 1.20
 Firmware Modules (00h) BOOT:   1.22 Backup: 1.22
 Firmware Modules (00h) MAIN:   1.19.01
 Firmware Modules (00h) HCS12:  1.10.00 Mask:4L40K FlashUpdates:3
No satellite boards detected.
*** Command Complete
```

4.4 Power PC Boot Code

The Power PC boot code is requested by the boot loader code embedded within the Xilinx image. Although the boot code resides in the flash memory, it is copied into the 64MB SD RAM during startup, and it actually executes from there during normal operation. With regards to primary/backup copies, it is treated the same as the Xilinx image. If the primary code is corrupt, the backup code is loaded (if it was previously downloaded). If there is still a problem, the board stays in boot loader mode with the USB port active, but the Ethernet port inactive. Downloading is done the same as the Xilinx image, with the installer program relying on the fact that *some* version of code is already running, and therefore code can be downloaded over Ethernet.

To see the primary/secondary versions of code on the board, use the "list version all" command (see sample output in the previous section, and look just below the highlighted text for boot code version information).

5. TROUBLESHOOTING

There are several reasons why the GMCE may not power up as expected. In order to know what to do, it is critical to understand exactly what stage of startup the board the board has achieved. This can be done by closely following the sequence described in Section 3.2. The LEDs will be a big help in understanding exactly what the board is doing.

5.1 Special LED States

There are some LED states that indicate special operations are going on, or that the firmware may be stopped in a particular mode. These are described below. Please note that these states do not occur in a sequence (as they did when describing the boot sequence); each one is independent of the others in the list. However, *they are placed in order of most likely first*. The solution for some of the problems is simple and is listed below. Other problems are a bit more tricky however:

HCS12 LEDs					Power PC LEDs					
LED1 – CAN_COMMS	**LED2 – HEARTBT**	**LED3 – IDLE**	**LED4 – IRQ**	**LED5 – SRVC**	**LED8 – W/S COMMS**	**LED9 – HEARTBT**	**LED10 – IDLE**	**LED11 – IRQ**	**LED12 – SRVC**	**Description/Solution**
0	2 s	1	0	0	0	1 s	1	0	0	The Power PC is stuck in boot mode. The Ethernet port may or may not be working. See "What to do if the GMCE is Stuck in Boot Mode", Section 5.2.
0	Erratic (~2s)	0	dim	Flashing quickly	0	1 s	Flashing quickly	0	0	LED5 indicates that the HCS12 is burning GMCE flash memory. It could be either a Xilinx image or Power PC boot code downloaded over Ethernet.
0	1s	0	0	Flashing quickly	0	0	0	0	0	In this case, the HCS12 is burning its own internal flash memory. The heartbeat LED indicates it is in boot code, and it is burning HCS12 main code.
0	1 s	1	0	0	1	1	1	1	1	The HCS12 is in boot mode. This indicates one of the following: • missing or corrupted HCS12 main code – New main code should be downloaded using the installer • A jumper is present on J52

HCS12 LEDs					Power PC LEDs					
LED1 – CAN_COMMS	LED2 – HEARTBT	LED3 – IDLE	LED4 – IRQ	LED5 – SRVC	LED8 – W/S COMMS	LED9 – HEARTBT	LED10 – IDLE	LED11 – IRQ	LED12 – SRVC	Description/Solution
0	2 s	1	0	0	1	1	1	1	1	The HCS12 is in main code, but was not able to load the Xilinx image. This would indicate that both the primary and backup Xilinx images are missing/corrupted. In this case, the installer program can't download new code, since the Power PC isn't running. Code will have to be downloaded serially through J39 (instructions for this are not in this document).
0	2 s	1	0	0	0	0.4 s	0	0	0	The power PC is in Boot Loader mode. This indicates one of the following: • Both the primary and backup copies of boot code are missing or corrupted. - Code will have to be downloaded serially through J39 (instructions for this are not in this document). • A jumper is present on J51 near the reset button.

5.2 What to do if the GMCE is Stuck in Boot Mode

By far, the most common problem observed is when the board is "stuck" in boot mode, meaning that the board is not able to download its main code. Note that some of the troubleshooting can be omitted by finding out whether or not there is a valid IP connection.

To test the IP connection, go to a command prompt (This is outside of service shell. You can find the command prompt by going to Start→ Run… and then type "command" in the box that comes up). At the prompt, type "ping 192.168.100.193" This is the equivalent of the workstation asking the GMCE "Are you there?" You'll get one of two responses:

If the GMCE can *not* "hear" the workstation, you'll get this:

```
C:\>ping 192.168.100.193

Pinging 192.168.100.193 with 32 bytes of data:
```

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.100.193:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

If you get the above, go to the Section 5.2.1 below: "Can't Ping the GMCE."

If the GMCE *can* "hear" the workstation, you'll get this:

```
C:\>ping 192.168.100.193

Pinging 192.168.100.193 with 32 bytes of data:

Reply from 192.168.100.193: bytes=32 time<1ms TTL=255
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255
Reply from 192.168.100.193: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.100.193:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

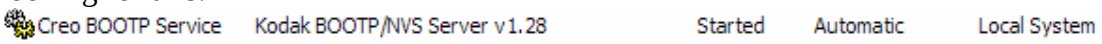
If you get the above, go to Section 5.2.2 below: "The GMCE Responds to Pinging."

5.2.1 Can't Ping the GMCE

In this case, the GMCE has a lower level problem and there are several things that can go wrong. Check the following:

- The Link LED on J42 should be on solid green.
  If not, there may be a problem with the cable connection from the GMCE to the workstation. If the cable is connected, try a different cable. If there's still no response, the GMCE may have a linking problem. Replace the board.

- Check the CreoBootp.ini file (in C:\Creo\Firmware) under the [GMCEX] heading (where X is the Logical unit number of the GMCE (usually 0 – See the footer at the bottom of page 7 for more information)). Confirm the following:
  - ACTIVE should =Yes
  - The IP address you tried to ping should match the address listed for IPADDR_CO

- Check that the bootp service is running on the workstation
  Go to Control Panel → Administrative Tools → Services and scroll through the list looking for this:
  

  If it is missing, or not started, run the GMCE installer.

- In Windows XP, check that the Windows Firewall is disabled. If it is enabled, it must have rules established that would allow the BOOTP message packets to travel to/from the GMCE firmware. This is discussed in the GMCE Core Firmware release notes.

- Go to the diagnostic monitor prompt through the USB port on the GMCE and check that "net bootp" is on. This is a firmware "switch" that keeps the GMCE from requesting network configuration information from the bootp server. Type "prm all" at the command prompt, and look for the bootp line:
  ```
  net          BootpStartup[1] True              False
  ```
  You only care that the next thing after "BootpStartup[1]" is "True" (don't worry

about the “False” later in the line). If it doesn’t, or you’re in any doubt, type “net bootp on.”

5.2.2 The GMCE Responds to Pinging

In this case, the communication is working, but the main code is still not downloading. There are only a few things to check here.

- Perform the last step of the previous section (turning net bootp on). If this is off, you might still be able to ping the board (using defaults programmed into firmware), but the GMCE won’t be able to ask the bootp server for its main code.
- Check the GMCE monitor prompt upon boot-up. If you get the warning below, check that the bootp service is running on the workstation, and check the Windows XP firewall settings as explained in the previous section.

```
|=========================================================================|
|                        !!! Attention !!!                                |
|-------------------------------------------------------------------------|
|                                                                         |
|                     BOOTP Server Does Not Respond !                     |
|                                                                         |
|       NVS Parameters And Product Firmware Will Not Be Available !       |
|                                                                         |
|=========================================================================|
```

- Go to the diagnostic monitor prompt through the USB port on the GMCE and check that “gmce boot” is on. This is a firmware “switch” that keeps the GMCE from requesting the product specific main code. Type “gmce boot” at the command prompt. You should get this:

```
GbootENG>> gmce boot
GMCE Boot of Main code is enabled
*** Command Complete
```

  If you don’t, type “gmce boot on.”

- Check the CreoBootp.ini file (in C:\Creo\Firmware) under the [GMCEX] heading (where X is the Logical unit number of the GMCE (usually 0 – See the footer on page 7)). Confirm the following:
  - FWFILE_GMCE should be set to the filename of the main code you want to download from the workstation. Check that the file exists in the directory indicated by BIN_PATH_GMCE (usually C:\Creo\Firmware).
  - While you’re in the .ini file, it’s a good idea to do the same thing you did for FWFILE_GMCE for NVSFILE_GMCE. This will confirm that you don’t have NVS file problems later.

5.3 USB Diagnostic Prompt Latency

There is a known (to us) problem where after a GMCE board is reset, the diagnostic monitor prompt (accessed through USB) doesn’t come up right away. Often there is a delay of about 30 seconds or so. This is a problem with Windows being slow to detect the disconnection of the USB interface when the board resets. Since this is a Windows problem, the only solution for it is to simply wait until Windows realizes what happens and brings the USB interface back online.

<END>