Glomation

Embedded CPU Module

GECM-9G25

User's Manual

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Chapter 1 – Introducing the GECM-9G25 CPU Module

GECM-9G25 Overview

The GECM-9G25 is a low cost compact sized CPU Module based on Atmel AT91SAM9G25 processor. It integrates all the core components and is mounted onto an application-specific carrier board using the standard SODIMM form factor. This approach allows the customer to design a customer carrier board, that meets the customer's I/O, dimensional, and connector requirements without having to go through complicated design process of the processor, memory, and standard I/O functionality. This approach can significantly reduce the development time and simplifying the process of developing a complete customer product. With a large peripheral set targeted to a variety of applications, the GECM-9G25 is well suited for industrial controls, digital media servers, audio jukeboxes, thin clients, set-top boxes, point-of-sale terminals, biometric security systems, and GPS devices.

Figure 1. GECM-9G25 CPU Module

Advanced Features

The heart of the GECM-9G25 is the AT91SAM9G25 which is the one in a series of ARM926EJ-S-based processors. The AT91SAM9G25 microcontroller features DSP Instruction Extensions, ARM Jazelle® Technology for Java® Acceleration. It has separate 32 Kbyte instruction and data caches with write buffer. The ARM926EJ-S on the AT91SAM9G25 functions with a maximum operating clock rate of 400MHz and a power usage between 20mW and 80mW (dependent upon clock speed). The ARM core operates from a 1V supply while the I/O operates at 3.3V. The low power consumption makes it an idea platform for battery operated applications.

The list below summarizes the features of the GECM-9G25.

- 400MHz Processor Core – ARM926EJ-S with MMU
- 128 MB DDR2RAM
- 256MB ~ 1GB NAND FLASH
- 1 10/100 Mbps Ethernet MAC
- 12 channel 10-bit Analog-to-Digital Converter (ADC
- 4 Universal Asynchronous Receiver / Transmitters (UARTs)
- 2 USB Host Port
- 1 USB Device Port
- Real-Time Clock
- Watchdog Timer
- Hardware Debug Interface
- SD/MMC Socket
- I2C Port
- SPI Port

Chapter 2 – GECM-9G25 Function Blocks

The GECM-9G25 is designed as the heart of the system. It connects to the application specific carrier board through the SODIMM 200 interface. It consists of the processor and external memory and the board itself servers as a minimal CPU sub-system. The signals of a full suite of peripheral functions, such as USB, SD/MMC, I2C, I2S, Ethernet, etc, are routed to the SODIMM connector to be passed to the application specific carrier board. The following diagram shows the board architecture.

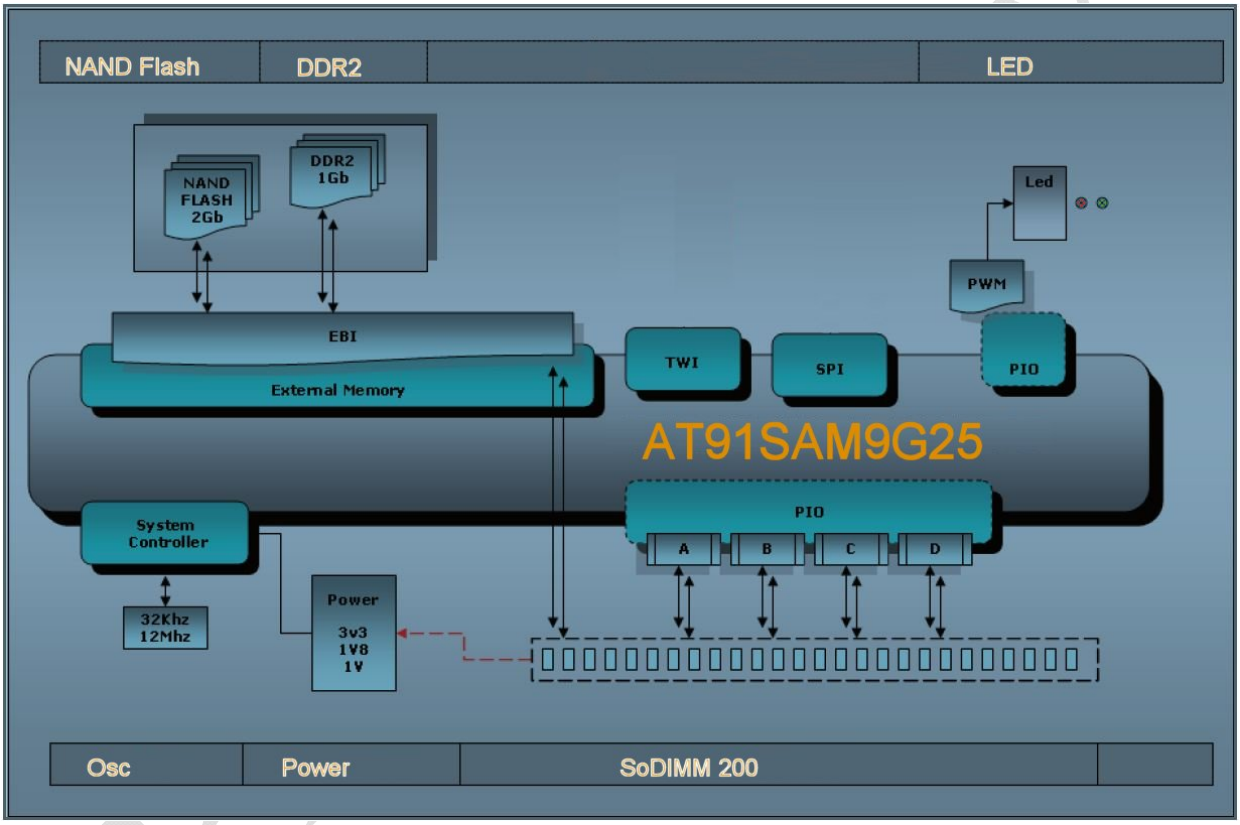

Figure 1. GECM-9G25 Block Diagram

AT91SAM9G25

The GECM-9G25 CPU Module uses the Atmel AT91SAM9G25 as the core processor on the computer module. The top-level features of AT91SAM9G25 processor are the following:

- ARM926EJ-S RISC Core Processor
- 400 MHz / 400 MIPS Performance
- 16Kbyte Instruction Cache

- 16Kbyte Data Cache
- Linux and Windows CE enabled MMU
- 133 MHz System Bus
- 32 bit External Bus Interface Supporting 8-banks DDR2/LPDDR, SDR/LPSDR, Static Memory
- MLC/SLC NAND Controller, with up to 24bit Programmable Multi-bit Error Correcting Code (PMECC)
- Serial EEPROM Interface
- 10 / 100 Mbps Ethernet MAC
- USB High Speed Host Port, USB Full Speed Host Port, USB High Speed Device Port
- Two High Speed Memory Card Hosts
- 4 UART
- Two-port USB Host (High Speed & Full Speed)
- 12 channel 10 bit ADC
- 2 Master/Slave SPI Port
- Serial Audio Interface
- JTAG Interface

More detailed information regarding the AT91SAM9G25 processor can be found at www.atmel.com.

DDR2 RAM

The GECM-9G25 is equipped with 128MByte of DDR2RAM (double data rate synchronous dynamic memory). With the system clock running at 133MHz it can achieve a maximum transfer rate of ~ 1066 MB/S.

FLASH

The GECM-9G25 is shipped with 256 Mbytes of NAND FLASH memory. The GECM-9G25 can be also ordered with optional 512MB ~ 1GB NAND FLASH.

Clock Circuitry

The GECM-9G25 CPU Module includes tow clock sources, 32.768KHz crystal for RTC and 12MHz crystal for main system clock.

Reset Circuitry

The reset sources for the GECM-9G25 are,

- Power on reset
- Push button reset (from carrier board)
- JTAG reset from an in-circuit emulator (option JTAG interface on carrier board)

Power Supply

The GECM-9G25 CPU Module contains its own power supply generation circuit to generate necessary power source for the processor and main memory. Additional power source for other peripheral functions should be provided by carrier board to the CPU module through the SODIMM interface. The following table lists the power source and functionality.

Table 1 Power Sources

Nominal	Name	Powers	Source
3.3V	VDDNF	NAND Flash and D16 ~ D32 Multiplex SMC Data Lines	Derived from 3.3V From SODIMM connector. Output to the SODIMM as VDDNF for carrier board voltage shifter (if needed).
3.3V	VDDIOP0	Partial Peripheral I/O lines	From SODIMM connector
3.3V	VDDIOP1	Partial Peripheral I/O lines	From SODIMM connector
3.0V	VDDBU	The Slow Clock Oscillator, the 32KHz RC, the Internal 12MHz RC and Part of the System Controller	From SODIMM connector
3.3V	VDDUTMII	The USB Device and Host UTMII+ Interface	From SODIMM connector
3.3V	VDDOSC	The Main Oscillator Cell	From SODIMM connector
3.3V	VDDANA	The Analog to Digital Converter	From SODIMM connector
1.8V	VDDIOM	The External Memory Interface	On-board Power Supply
1.0V	VDDUTMIC	DC Supply UDPHS and UHPHS UTMI+ Core	On-board Power Supply
3.3V	VDDPLLUTMI	DC Supply UDPHS and UHPHS UTMI interface	From SODIMM connector
1.0V	VDDPLLA	The PLLA Cell	From SODIMM connector
1.0V	VDDCORE	CPU Core Power Supply	On-board Power Supply
3.0V/3.3V	ADVREF	ADC Reference voltage	From SODIMM connector

SODIMM 200 Interface

The GECM-9G25 CPU Module uses SODIMM card edge connector to interface the application specific carrier board. The pin out of the SODIMM connector is listed in the following table.

Table 2 J1 SODIMM 200 Card Edge Connector

Function	Type	x5 pad and name	SODIMM 200			x5 pad and name	Type	Function
	Front Side		A		B	Back Side		
VCC 3V3		Power Input	1		2	Power Input		VCC 3V3
VCC 3V3		Power Input	3		4	Power Input		VCC 3V3
GND			5		6	Power Input	VBAT	
USBC_DP	I/O	USB Data Positive	7		8		SYSC	JTAGSEL
USBC_DM	I/O	USB Data Negative	9		10		SYSC	WKUP
GND			11		12		SYSC	SHDN
USBB_DM	I/O	USB Data Negative	13		14		SYSC	BMS
USBB_DP	I/O	USB Data Positive	15		16		SYSC	NRST
GND			17		18		SYSC	NTRST
DIBP	I/O		19		20		RSTJTAG	TDI
DIBN	I/O		21		22		RSTJTAG	TCK
GBN			23		24		RSTJTAG	TMS
USBA_DM	I/O	USB Data Negative	25		26		RSTJTAG	TDO
USBA_DP	I/O	USB Data Positive	27		28		RSTJTAG	RTCK
GND			29		30	Power Enable Input		PWR_EN
RFU		RFU	31		32	RFU		RFU
RFU		RFU	33		34	RFU		RFU
RFU		RFU	35		36	RFU		RFU
RFU		RFU	37		38	RFU		RFU
RFU		RFU	39		40	RFU		RFU
GND			41		42			GND
RFU		RFU	43		44	RFU		RFU
RFU		RFU	45		46	RFU		RFU
RFU		RFU	47		48	RFU		RFU
RFU		RFU	49		50	RFU		RFU
GND			51		52			GND
RFU		RFU	53		54	RFU		RFU
RFU		RFU	55		56	RFU		RFU
RFU		RFU	57		58	RFU		RFU
RFU		RFU	59		60	RFU		RFU
VDDNF	NAND FLASH Power Domain		61		62	NAND FLASH Power Domain		VDDNF
PD0	GPIO D	NANDOE	63		64	NANDWE	GPIO D	PD1
PD2	GPIO D	A21/NANDALE	65		66	A22/NANDCLE	GPIO D	PD3
PD4	GPIO D	NCS3	67		68	NWAIT	GPIO D	PD5
PD6	GPIO D	D16	69		70	D17	GPIO D	PD7
PD8	GPIO D	D18	71		72	D19	GPIO D	PD9
GND			73		74			GND
PD10	GPIO D	D20	75		76	D21	GPIO D	PD11
PD12	GPIO D	D22	77		78	D23	GPIO D	PD13
PD14	GPIO D	D24	79		80	D25/A20	GPIO D	PD15
PD16	GPIO D	D26/A23	81		82	D27/A24	GPIO D	PD17
PD18	GPIO D	D28/A25	83		84	D29/NCS2	GPIO D	PD19
PD20	GPIO D	D30/NCS4	85		86	D31/NCS5	GPIO D	PD21
VDDIOP0	POWER INPUT		87		88	POWER INPUT		VDDIOP0

PA0	GPIO A	TXD0/SPI1-NPCS1	89		90	RXD0/SPI0-NPCS2	GPIO A	PA1
PA2	GPIO A	MCI1_DA1/E0_ETX0	91		92	CTS0/MCI1_DA2/E0_ETX1	GPIO A	PA3
PA4	GPIO A	SCK0/MCI1_DA3/E0_ETXER	93		94			GND
PA11	GPIO A	SPI0_MISO/MCI1_DA0	95		96	SPI0_MOSI/MCI1_CDA	GPIO A	PA12
PA13	GPIO A	SPI0_SPCK/MCI1_CK	97		98	SPI0_NPCS0	GPIO A	PA14
GND			99		100	TXD2/SPI0_NPCS1	GPIOA	PA7
PA8	GPIO A	RCD2/SPI1_NPCS0	101		102	TIOA0/SPI1_MISO	GPIO A	PA21
PA22	GPIO A	TIOA1/SPI1_MOS1	103		104	TIOA2/SPI1_SPCK	GPIO A	PA23
PA31	GPIO A	TWCK0/SPI1_NPCS2/E0_ETXEN	105		106	TWD0/SPI1_NPCS3/E0_EMDC	GPIO A	PA30
GND			107		108	MCI0_DA0	GPIO A	PA15
PA16	GPIO A	MCI0_CDA	109		110	MCI0_CK	GPIO A	PA17
PA18	GPIO A	MCI0_DA1	111		112	MCI0_DA2	GPIO A	PA19
PA20	GPIO A	MCI0_DA3	113		114			GND
PA5	GPIO A	TXD1/CANTX1	115		116	RXD1/CANRX1	GPIO A	PA6
PA10	GPIO A	DTXD/CANTX0	117		118	DRXD/CANRX0	GPIO A	PA9
GND			119		120	TCLK0/TK	GPIO A	PA24
PA25	GPIO A	TCLK1/TF	121		122	TCLK2/TD	GPIO A	PA26
PA27	GPIO A	TIOB0/RD	123		124	TIOB1/RK	GPIO A	PA28
PA29	GPIO A	TIOB2/RF	125		126			GND
VDDOIP1	POWER INPUT		127		128	POWER INPUT		VDDIOP1
PC0	GPIO C	LCDDAT0/ISI_D0	129		130	LCDDAT1	GPIO C	PC1
PC2	GPIO C	LCDDAT2/ISI_D2	131		132	LCDDAT3	GPIO C	PC3
PC4	GPIO C	LCDDAT4	133		134	LCDDAT5	GPIO C	PC5
GND			135		136	LCDDAT6	GPIO C	PC6
PC7	GPIO C	LCDDAT7	137		138	LCDDAT8	GPIO C	PC8
PC9	GPIO C	LCDDAT9	139		140	LCDDAT10	GPIO C	PC10
PC11	GPIO C	LCDDAT11	141		142			GND
PC12	GPIO C	LCDDAT12	143		144	LCDDAT13	GPIO C	PC13
PC14	GPIO C	LCDDAT14	145		146	LCDDAT15	GPIO C	PC15
GND			147		148	LCDDAT16	GPIO C	PC16
PC17	GPIO C	LCDDAT17	149		150	LCDDAT18	GPIO C	PC18
PC19	GPIO C	LCDDAY19	151		152	LCDDAT20	GPIO C	PC20
PC21	GPIO C	LCDDAT21	153		154			GND
PC22	GPIO C	LCDDAT22	155		156	LCDDAT23	GPIO C	PC23
PC24	GPIO C	LCDDSIP	157		158		GPIO C	PC25
PC26	GPIO C	LCDPWM	159		160	LCDVSYNC	GPIO C	PC27
GND			161		162	LCDHSYNC	GPIO C	PC28
PC29	GPIO C	LCDDEN	163		164	E1_MDC	GPIO C	PC30
PC31	GPIO C	E1_MDIO	165		166			SELCONFIG
VDDANA	POWER INPUT		167		168	POWER INPUT		VDDANA
PB0	GPIO B	E0_RX0	169		170	E0_RX1	GPIO B	PB1
PB2	GPIO B	E0_RXER	171		172	E0_RXDV	GPIO B	PB3
PB4	GPIO B	E0_TXCK	173		174	E0_MDIO	GPIO B	PB5
PB6	GPIO B	E0_MDC	175		176	E0_TXEN	GPIO B	PB7
PB8	GPIO B	E0_TXER	177		178	GNDANA		
PB9	GPIO B	E0_TX0	179		180	E0_TX1	GPIO B	PB10
PB11	GPIO B	E0_TX2	181		182	E0_TX3	GPIO B	PB12
PB13	GPIO B	E0_RX2	183		184	E0_RX3	GPIO B	PB14

PB15	GPIO B	E0_RXCK	185		186	E0_CRS	GPIO B	PB16
PB17	GPIO B	E0_COL	187		188	GNDANA		
PB18	GPIO B	IRQ	189		190	A/D Voltage Reference		POWR_REF
GND			191		192			LED0
ETH0_TX+			193		194			LED1
ETH0_TX-			195		196			LED2
ETH0_RX+			197		198			AVDDT
ETH0_RX-			199		200			GND_ETH

Please note the PD0 ~ PD13 are used by the GECM-9G25/35 module for on-board NAND FLASH. The on-board NAND FLASH can be disabled by disconnecting the NAND CE signal so the NAND control signals can be used on the carrier board. The PB18 and PD21 are used by the GECM-9G25/35 for the on-board LED. They can be reclaimed by removing the LEDs on the GECM-9G25/35 board.

Connector

The GECM-9G25 CPU Module uses SODIMM card edge connector to interface the carrier board. The board dimensions is shown below.

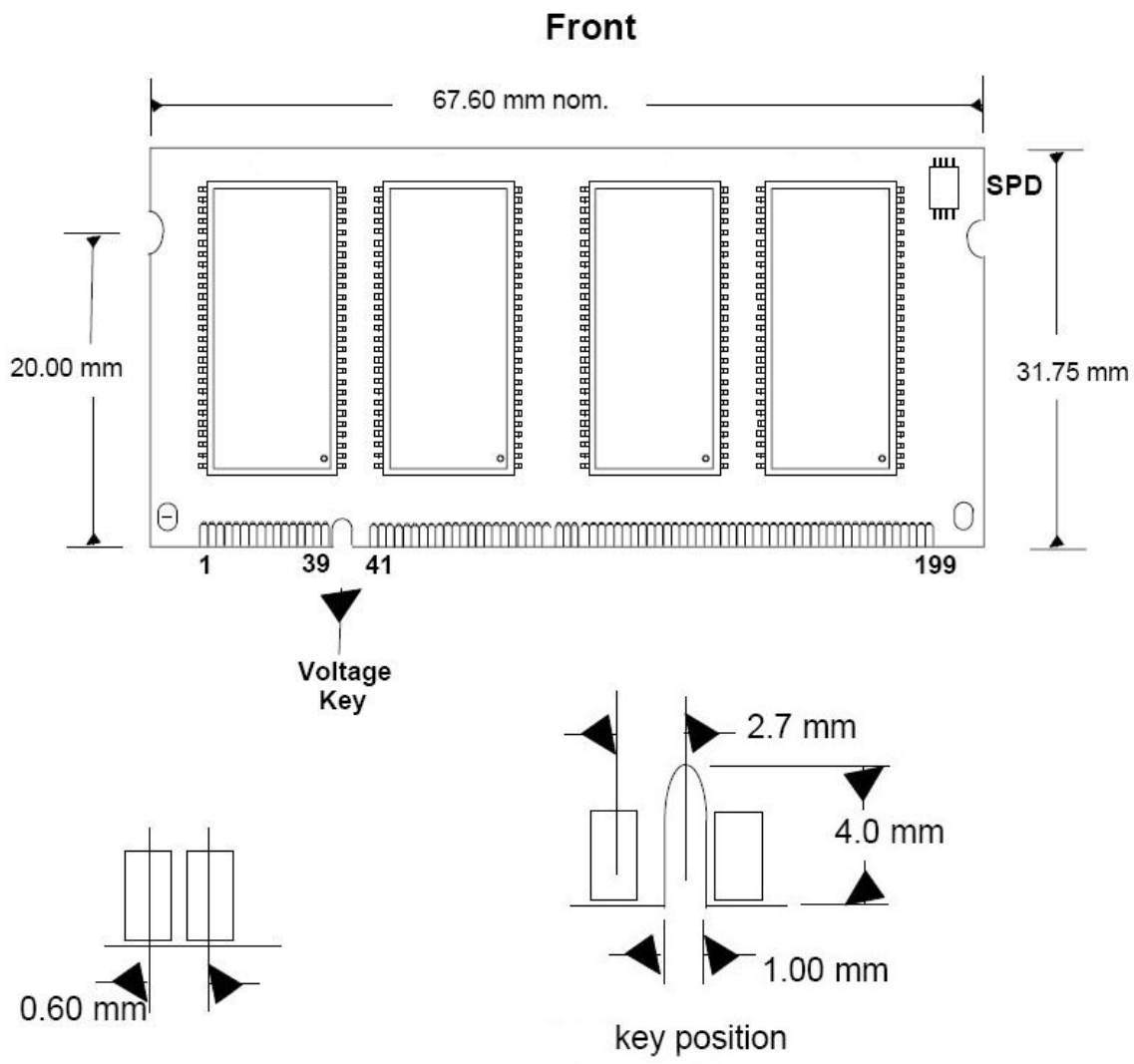

Figure 1. SODIMM 200 Dimensions

Chapter 3 – Software Description

Overview

This chapter provides information regarding the software that is shipped with the GECM-9G25 Board. The software included with the board is U-Boot boot loader, Linux kernel 2.6.39, and an embedded root file system.

Data Storage on GECM-9G25

The default configuration of the GECM-9G25 CPU Module uses on board NAND FLASH for all data storage requirements, including boot strap code, boot loader, Linux kernel, and Linux file system.

The following table is the factory default storage map on the NAND FLASH.

Table 3 NAND FLASH Storage Map

Start Address	Size	Usage
0x00000000	0x20000	Boot strap code
0x00040000	0x40000	U-Boot
0x000C0000	0x20000	U-Boot primary environment storage range
0x000E0000	0x20000	U-Boot secondary environment storage range
0x00200000	0x300000	Linux kernel
0x00800000	--	Root file system

GECM-9G25 Linux Code

The GECM-9G25 is shipped with Linux 2.6.39 kernel pre-installed. This software is programmed into the system FLASH located on the board prior to shipment. The Linux kernel is configured with most of the device drivers included for the GECM-9G25 board.

U-boot

U-Boot provides a simple interface for loading operating systems and applications onto the GECM-9G25 board. U-Boot uses a serial console for its input and output. The default serial port setting is 115200,8,N,1. It also supports the built-in Ethernet port and general flash programming.

The board is shipped with U-Boot pre-installed. Please refer to U-Boot user's manual regarding detailed information of U-Boot.

U-Boot Booting Linux

The following shows the default U-Boot setup for booting Linux.

```
U-Boot> printenv
bootargs=mem=128M console=ttyS0,115200 mtdparts=atmel_nand
8M(bootstrap/uboot/kernel)ro,-(rootfs) root=/dev/mtdblock1 rw
rootfstype=ubifs ubi.mtd=1 root=ubi0:rootfs
bootdelay=1
baudrate=115200
ethaddr=00:0c:20:02:0a:5b
ipaddr=192.168.0.200
serverip=192.168.0.102
netmask=255.255.255.0
stdin=serial
stdout=serial
stderr=serial
ethact=macb0

Environment size: 353/131067 bytes
U-Boot>
```

The `bootcmd` setting of the U-Boot reads the Linux kernel from NAND FLASH at address 0x200000 to SDRAM at address 0x22000000 and start executing the kernel code at the same memory address. The NAND FLASH from 0x800000 and up is used for Linux root file system. The U-Boot passes the MTD device partition setting to the Linux kernel via the `bootargs` environment variable.

Loading Linux Kernel and root File System

The U-Boot boot-loader provides many ways to load Linux kernel and file system into FLASH memory. The loading by Ethernet network is shown here. User can consult U-Boot manual for other methods of loading data.

After power on the GECM-9G25 board, stop the U-boot auto-execution by press any key. The following message should be shown on the terminal console on the host PC connected to the GECM-9G25 board.

```
RomBOOT
Start AT91Bootstrap...
Init DDR...  ba_offset = 0xb ... Done!
Loading 1-Wire info...
Enumerate all roms:
Rom#0x0: 0xa3 0x0 0x0 0x3 0x21 0x88 0x63 0x2d
Done, 0x1 1-wire chips found!

Board name: SAM9x5-EK [B0]; Vendor name: FLEX
sn: 0x4000023;   rev: 0x8401
Downloading image...
chip id: 0xecda
Copy 0x50000 bytes from 0x40000 to 0x26f00000
Done!


U-Boot 2010.06 (Jun 23 2011 - 16:05:54)

DRAM:  128 MiB
NAND:  256 MiB
```

The network address and server address must be set before network transfer can take place. The following commands will set the SBC IP address and server IP address,

```
set ipaddr xxx.xxx.xxx.xxx
set serverip xxx.xxx.xxx.xxx
```

The server IP is the IP address where a TFTP server must be run. To load Linux kernel type in the following command,

```
tftp 0x22000000 uImage
```

The U-Boot will load uImage file from the TFTP server whose IP address is specified by the `serverip` environment variable.

The NAND FLASH sectors must be erased first before new kernel image can be stored. The following command will erase the NAND FLASH sectors reserved for Linux kernel,

```
nand erase 0x200000 0x200000
```

The use the flowing command to store the kernel image from SDRAM to NAND FLASH,

```
nand write.jffs2 0x22000000 0x200000 0x200000
```

The following commands can be used to load root file system into the FLASH memory,

```
nand erase 0x800000 [available_nand_flash_memory_size]
tftp 0x21000000 rootfs.img
nand write.jffs2 0x21000000 0x800000 $(filesize)
```

Please be noted that the image is first loaded into the SDRAM and then stored into the FLASH memory. The image size can not exceed the available SDRAM on the board.

After the kernel and root file system have been updated the board can be simply reboot by recycle the power.

Chapter 4 – Development Tools

Glomation provides a pre-configured VMWare image based Linux Debian distribution that includes cross development tool chain, Eclipse IDE, sample project and sample program. The user and password pairs for the VMWare image are root:root and user:user. The VMWare image is available in the support page at Glomation website, http://www.glomationinc.com/support.html