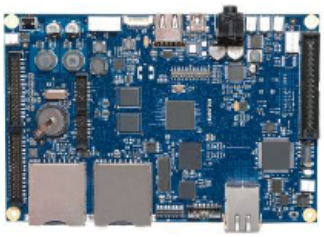
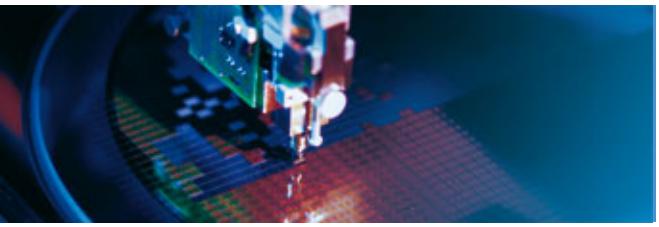
USER MANUAL





Graphics ClientM

PXA320 Single Board Computer

Rev. A - July 2009

DIGITAL TECHNOLOGIES FOR A BETTER WORLD

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Revision History

Issue no.	*PWB*	*Date*	*Comments*
1		Jul-2008	Preliminary release
2		Feb-2009	Second preliminary release Style and formatting updates Hardware and System Specifications added Revision 4 updates
A		Jul-2009	Initial release Rev A updates

For contact details, see page 61.

Contents

Introduction

The Graphics ClientM (GCM) is a low-power single-board computer based on the Marvell® PXA320 processor. The PXA320 processor integrates scalable general-purpose processing, 2D graphics acceleration, and wireless technology to provide hardware-accelerated graphics display and high-powered computing capabilities. The GCM is ideal for running graphics-intensive applications, especially those requiring wireless connectivity, and is targeted towards hand-held, medical, fleet management, and embedded markets.

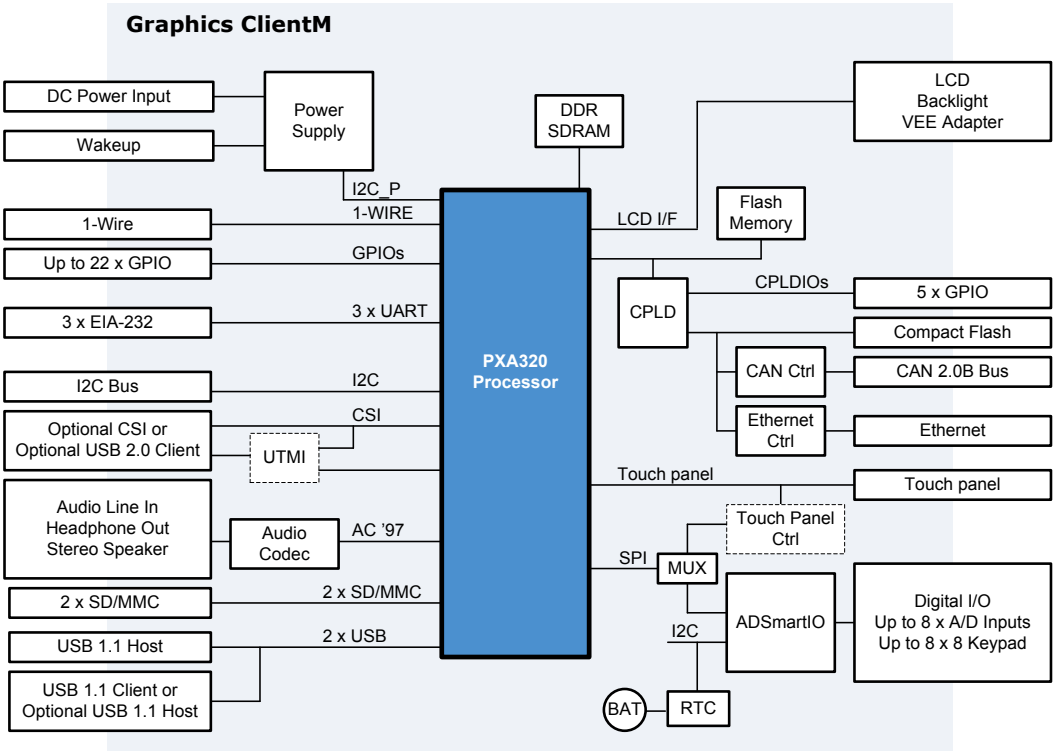
In addition to industry-standard interfaces, the GCM includes the ADSmartIO™. The ADSmartIO extends GCM capabilities by providing a wide array of customizable functions and I/O.

This manual provides details about the various features of the GCM and about how they create a system that meets your application needs. It is intended for embedded system integrators and software application developers. Design details apply to the revision listed in Appendix C – Board Revision, page 57.

Block Diagram

The following diagram illustrates the system organization of the GCM. The functionalities shown with dotted lines or labelled as optional are available as volume production options. The following sections provide further details about these various options.

For detailed mechanical drawings of the GCM, see Mechanical, page 26.



Features

Processor

- Marvell® PXA320 processor
- 32 kB instruction and 32 kB data L1 cache, 256 kB L2 cache
- Hardware 2D graphics accelerator
- Intel® Wireless MMX™ 2 technology
- Clock rates up to 624 MHz

Memory

- 128 MB DDR SDRAM with support for up to 256 MB
- 128 MB NAND Flash memory with support for up to 1 GB
- Battery-backed real-time clock
- External memory support
  - CompactFlash®, Type I and II, 3.3 V
  - USB disk drive
  - SD/MMC card

Communications

- USB support
  - One USB 1.1 host port and one USB 1.1 client port
  - Optional second USB 1.1 host port and optional USB 2.0 client port (For further details, see USB Ports, page 14.)
- Three serial ports
  - Serial 1: 9-wire, EIA-232 or optional EIA-422/485
  - Serial 2: 5-wire, EIA-232 or optional 3.3 V with IrDA support
  - Serial 3: 5-wire, EIA-232 or optional 3.3 V with Bluetooth support
- 10/100 BT Ethernet interface
- Two SD/MMC sockets
- CAN 2.0B bus
- 1-Wire bus
- I^2C bus master

User Interface and Display

- LCD interface
- External VEE adapter support
- Backlight interface with control signals for intensity and on/off
- Resistive touch panel interface with 4- or 5-wire options
- Optional Camera Sensor Interface (CSI)
  (For further details, see Camera Sensor Interface, page 20.)

Audio Interface

- AC ’97 codec
- Audio line in
- Headphone output
- Stereo speaker output

Inputs and Outputs

- Nineteen ADSmartIO ports
  - Digital inputs and outputs
  - Up to eight A/D inputs
  - Up to a 8x8 keypad
- Up to twenty seven general-purpose digital inputs and outputs

Power Supply

- 6-15 V main power input
- Optional 5 V power input
- Optional independent backlight power input
- Power management

Mechanical

- 102 mm x 152 mm dimensions

Handling Your Board Safely

Anti-Static Handling

The GCM contains CMOS devices that could be damaged by electrostatic discharge (ESD). Observe industry-standard electronic handling procedures when handling the board. Where possible, work on a grounded anti-static mat. At a minimum, touch an electrically grounded object before handling the board or touching any components on the board.

Packaging

Please ensure that, should a board need to be returned to Eurotech, it is adequately packed, preferably in the original packing material.

Electromagnetic Compatibility

The GCM is classified as a component with regard to the European Community Electromagnetic Compatibility (EMC) regulations. Because Eurotech supplies only the single-board computer and not fully integrated systems, Eurotech cannot provide meaningful system-level emissions test results. It is the responsibility of the user to ensure that systems using the GCM are compliant with the appropriate EMC standards.

RoHS Compliance

The European RoHS Directive (Restriction on the use of certain Hazardous Substances – Directive 2002/95/development system) limits the amount of six specific substances within the composition of the product. The GCM fully complies with the RoHS directive. A full *RoHS Compliance Materials Declaration Form* for the GCM is included as Appendix B – RoHS Compliance, page 56. Further information regarding RoHS compliance is available on the Eurotech web site at www.eurotech.com.

Conventions

The following table lists the symbols used in this document.

Symbol	Explanation
	Note – information that requires your attention
	Warning – proceeding with a course of action may damage your equipment or result in loss of data

The following table describes the conventions for signal names used in this document.

Convention	Explanation
GND	digital ground plane
#	active low signal
+	positive signal in differential pair
-	negative signal in differential pair

The following table describes the abbreviations for direction and electrical characteristics of a signal used in this document.

Type	Explanation
I	signal is an input to the system
O	signal is an output from the system
IO	signal may be input or output
P	power and ground
A	analog signal
OD	open-drain
LVCMOS	1.8 V CMOS
3.3	3.3 V signal levels
5	5 V signal level
nc	no connection
reserved	use is reserved to Eurotech

Software Specification

Operating System Support

The GCM is compatible with the following operating systems:

- Windows® CE
- Linux

Hardware Specification

Core Processor

The GCM is a low-power single-board computer based on the Marvell PXA320 processor. This 32-bit processor is optimized for power-efficient, graphics-intensive applications.

The following are the key features of the PXA320:

- Scalable general-purpose processing up to 624 MHz
- 32 kB instruction and 32 kB data L1 cache, 256 kB L2 cache
- Marvell Scalable Power Manager technology
- Multimedia acceleration with Intel® Wireless MMX™ 2 technology
- 768 kB frame buffer
- Integrated support for industry-standard interfaces and wireless technologies
- Quick Capture interface supporting camera sensors up to 3 megapixels

PXA320 GPIO Cross-Reference

The PXA320 general-purpose input and output lines (GPIO*n*) control various discrete I/O on the GCM such as interrupts, enables, and controls. The following table lists the signals that are specific to the GCM.

GPIO	Name	Type	Description
0	GPIO1_8V_0	O	LED D3 control
1	GPIO1_8V_1	O	LED D4 control
13	TS_IRQ#	I	5-wire touch screen interrupt (optional)
14	USB2DET#	I	USB 2.0 Client sense connection (optional)
34	SD1_WP#	I	SD/MMC 1 Write Protect
36	SD2_WP#	I	SD/MMC 2 Write Protect
49..58	GPIO49..58	IO	GPIO or CSI (optional)
74	PNL_ENA	O	LCD panel enable
75	CARD_DET#	I	CompactFlash card presence
76	CARD_RDY	I	CompactFlash card ready
77	ETH_IRQ	I	Ethernet controller interrupt
78	IRQ_ARM#	I	ADSmartIO interrupt
79	CARD_RESET	O	CompactFlash reset
80	AVR_RESET#	O	ADSmartIO reset
81	CAN_IRQ#	I	CAN 2.0B bus controller interrupt

GPIO	Name	Type	Description
82	IRQ_AVR	O	Interrupt to ADSmartIO
84	BT_EN	O	Off-board Bluetooth transceiver enable
85	USBH_PWR2#	I	USB Host 2 over current detection (optional)
86	IR_EN	O	Off-board IrDA transceiver enable
93	SSPFRMSEL	O	Selection control for SPI interface to 5-wire touch screen controller or ADSmartIO
97	FF_EN	O	Selection control for EIA-232 or EIA422/485 operation on Serial 1 and EIA-232 transceiver shutdown control
99	CFON#	O	CompactFlash power control
100	GPIO100	IO	GPIO
104	SD2_CD#	I	SD/MMC 2 Card Detect
107	USBC_DET#	I	USB 1.1 Client sense connection
108	SD1_CD#	I	SD/MMC 1 Card Detect
113..117	GPIO113..117	IO	GPIO
118	MIC_LINE#	O	Microphone power enable
119	AUDIO_ON	O	AC ’97 codec power control
120	AUDIOPA_ON	O	Speaker power amplifier shutdown control
121..125	GPIO121..125	IO	GPIO
126	BL_ON	O	Backlight on and off control
127	LCD_ON	O	Display power control and display data buffer enable
4_2	GPIO4_2	IO	GPIO
5_2	VEE_ON	O	VEE adapter on and off control

Memory

This section describes the different types of memory available on the GCM.

Synchronous DRAM

The GCM includes Double Date Rate Synchronous DRAM (DDR SDRAM) for kernel, application, and display frame buffer use. The standard memory configuration is 128 MB. Up to 256 MB is available as a volume production option. Data bus width supports 32-bit accesses while also allowing access to individual bytes.

Non-volatile Memory

Non-volatile memory included on the GCM supports application data storage and a real-time clock function.

Flash Memory

Flash memory is the primary site for non-volatile data storage on the GCM. The standard configuration is 128 MB. Up to 1 GB is available as a volume production option. Eurotech systems store the operating system, applications, and system configuration settings in the on-board flash. Most operating systems configure a portion of the flash as a flash disk, which acts like a hard disk drive.

Real-Time Clock

The GCM uses a real-time clock (RTC) chip to retain the system date and time when the system is powered down. For general specifications, see Real-Time Clock, page 53.

The operating system typically reads the RTC on boot or on wakeup and sets the RTC when the system time or date is changed. The PXA320 communicates with the RTC on the I^2C bus. For details about the I^2C bus, see I2C Bus, page 18.

External Memory

Three types of external memory interfaces provide mass storage options for the GCM: a CompactFlash socket, two SD/MMC sockets, and up to two USB host ports. This section describes the three options.

CompactFlash Card

CompactFlash cards provide removable storage in a wide variety of capacities. The GCM supports Type I and II, 3.3 V cards installed in socket J2, page 31. This capability can be a cost-effective means to expand system storage. Normally, the socket is de-energized. The processor is responsible for turning the socket on when a card is inserted and turning it off when the card is removed.

SD/MMC Card

You can use a SD/MMC card in socket J10, page 35 or socket J9, page 34 to provide mass storage on the GCM. For a description of the various modes of operation for the SD/MMC interface, see SD/MMC Interface, page 17.

USB Disk Drive

A USB disk drive can connect to the USB host ports on socket J4, page 31. Any USB device that has USB drivers installed on the GCM can connect to this port. For details about the USB ports, see USB Ports, page 14.

Communications

The GCM has several industry-standard channels for communication with peripheral and peer devices. These include up to three USB ports, three serial ports, an Ethernet port, two SD/MMC interfaces, a CAN 2.0B bus, a 1-Wire bus, and an I^2C bus.

USB Ports

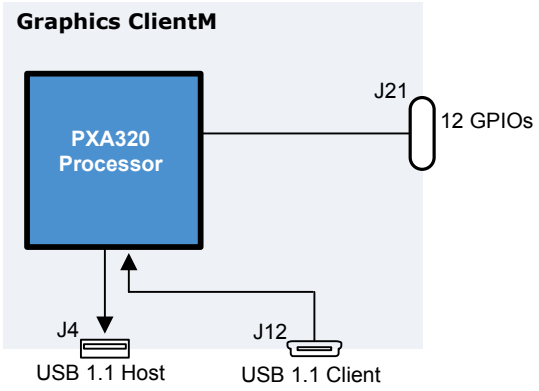
The GCM is available in a standard configuration and three volume production options providing up to three Universal Serial Bus (USB) ports. In all configurations, the USB 1.1 host ports support low (1.5 Mbps) and full (12 Mbps) speeds, while the USB 1.1 and USB 2.0 client ports support full speed.

The USB host ports include power switches and transient voltage suppressors. The PXA320 controls the power switch enables. The GCM supplies 5 V power to the USB host ports through the power switch with over-current detection. The USB protocol allows client devices to negotiate the power they need from 100 mA to 500 mA in 100 mA increments. Make sure to account for power used through USB in your power budget. USB mouse, keyboard, and storage are the most common client devices, but you can connect any device that has USB drivers installed on the GCM.

Standard Configuration

A standard GCM includes a USB 1.1 host port on socket J4, a USB 1.1 client port on socket J12, and twelve PXA320 GPIOs on socket J21.

The following diagram illustrates a standard GCM.

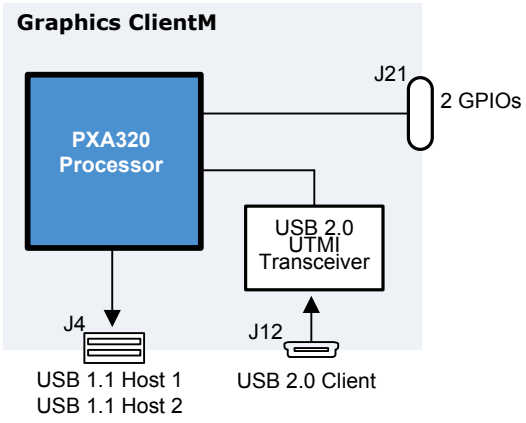


Volume Production Options

Three volume production options are available providing additional USB ports and a Camera Sensor Interface (CSI). Contact your Eurotech sales representative if your application requires one of these options.

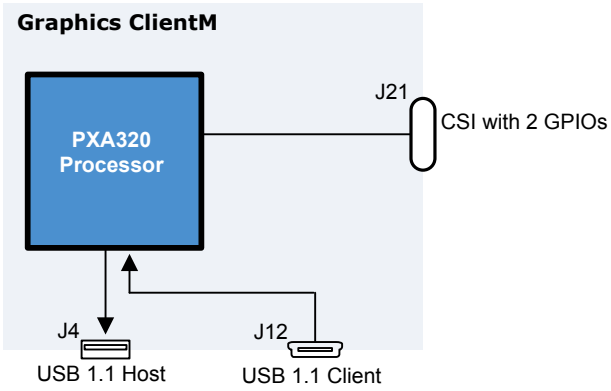
The first option provides two USB 1.1 host ports on socket J4 (dual socket option) and a USB 2.0 client port on socket J12. The USB 2.0 client interface uses ten of the twelve GPIOs. In this option, only two GPIOs are available for application use on socket J21.

The following diagram illustrates the first volume production option.



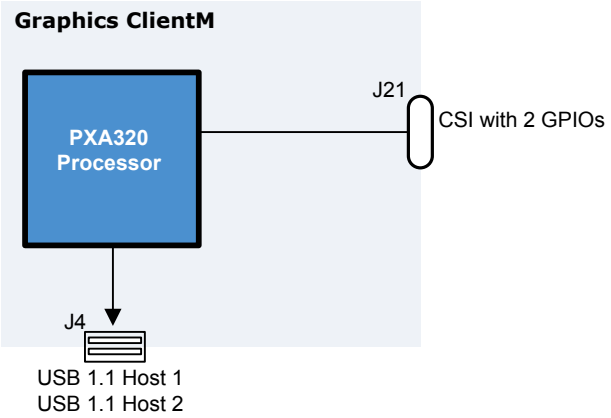
The second option provides a USB 1.1 host port on socket J4, a USB 1.1 client port on socket J12, and a CSI on socket J21. The CSI uses ten of the twelve GPIOs. In this option, only two GPIOs are available for application use on socket J21.

The following diagram illustrates the second volume production option.



The third option provides two USB 1.1 host ports on socket J4 (dual socket option) and a CSI on socket J21. The CSI uses ten of the twelve GPIOs. In this option, socket J12 is not populated, and only two GPIOs are available for application use on socket J21.

The following diagram illustrates the third volume production option.



Serial Ports

The PXA320 includes three serial ports which are available externally on the GCM. The following table describes these serial interfaces.

Serial	Header	Description	
		Standard	Option
1	J15: Serial 1, page 38	EIA-232, 9-wire	
	J22: GPIO and Serial 1 (EIA-422/485), page 43		EIA422/485
2	J16: Serial 2, page 39	EIA-232, 5-wire	3.3V, 5-wire
3	J14: Serial 3, page 38	EIA-232, 5-wire	3.3V, 5-wire

Serial 1 interfaces to the PXA320 full-function UART supplying the full complement of modem control signals. This port is available at EIA-232 levels on header J15 or at EIA422/485 levels on header J22. The processor selects the mode of operation using a control signal mapped to GPIO97. For further details, see PXA320 GPIO Cross-Reference, page 11.

Serial 2 interfaces to the PXA320 IrDA UART. A standard GCM supports a 5-wire interface at EIA-232 levels. A 3.3 V logic level volume production option supporting an off-board IrDA transceiver is available. This option includes an additional 3.3 V logic level enable signal and 3.3 V output.

Serial 3 interfaces to the PXA320 Bluetooth UART signals providing a 5-wire interface. A standard GCM supports EIA-232 levels, while a 3.3 V logic level volume production option supporting an off-board Bluetooth transceiver is available. This option includes an additional 3.3 V logic level enable signal and 3.3 V output.

Ethernet

An on-board Ethernet controller provides a 10/100 BT Ethernet port on J3, page 31. This RJ-45 socket includes integrated magnetics and indicators. For a description of the Ethernet LEDs, see LED Indicators, page 30.

SD/MMC Interface

Two Secure Digital and MultiMediaCard (SD/MMC) sockets enable mass storage and I/O expansion on the GCM: J10, page 35 and J9, page 34. These interfaces support Secure Digital Memory (SD), Secure Digital I/O (SDIO), MultiMediaCard (MMC), and synchronous serial (SPI) modes of operation. SD and SDIO cards can run in 4-bit, 1-bit, and SPI modes. MMC cards run in 1-bit or SPI modes. This manual lists the signals for use in 4-bit SDIO mode. Operating system drivers may not be available for all modes of operation. Contact your local Eurotech technical support for driver availability for the operating system that you are using.

The following table illustrates how the signals are mapped differently depending on the mode of operation. Signal names and types denote the direction of the signal relative to the GCM. Notice that the SD standard references SPI-mode signals with respect to the card with pin 2 of the SD header listed as "Data In". This manual and PXA320 documents reference the signals with respect to the socket. In the table, pin 2 is listed as "Data Out".

SD Socket		Eurotech	Description					
Pin	Name	Name	4-bit Mode		1-bit Mode		SPI Mode	
1	DAT3	SD_DAT3	Data 3	IO	unused	-	MMC_CS1#	O
2	CMD	SD_CMD	Command	IO	Command	IO	Data Out	O
3	VSS1	ground	-	P	-	P	-	P
4	VDD	SD_PWR	-	PO	-	PO	-	PO
5	CLK	SD_CLK	Clock	O	Clock	O	Clock	O
6	VSS2	ground	-	P	-	P	-	P
7	DAT0	SD_DAT0	Data 0	IO	Data	IO	Data In	I
8	DAT1	SD_DAT1	Data 1	IO	Interrupt	I	Interrupt	I
9	DAT2	SD_DAT2	Data 2	IO	unused	-	MMC_CS0#	O

Pin 9 of an SD/MMC card is unused in SPI mode. Chip Select 0 is shown in this row to illustrate the alternate signal mapping to SD_DAT2.

Some SD sockets supply the following signals, which are not part of the SD/SDIO standard. These signals are connected on sockets J9 and J10.

SD Socket Pin	Eurotech Name	Description	Type
10	SD_CD#	Card Detect	I
11	SD_WP#	Write Protect	I

Power to the SD/MMC sockets is software-controlled. A standard GCM supports 3.3 V cards. Support for 1.8 V cards is available as a volume production option.

CAN 2.0B Bus

The GCM supports a direct connection to a CAN (Controller Area Network) bus compliant with the CAN 2.0B specification. The CAN 2.0B bus provided on header J23, page 44 is driven by an on-board controller and includes a CAN transceiver, common mode filter, and ESD protection.

1-Wire Bus

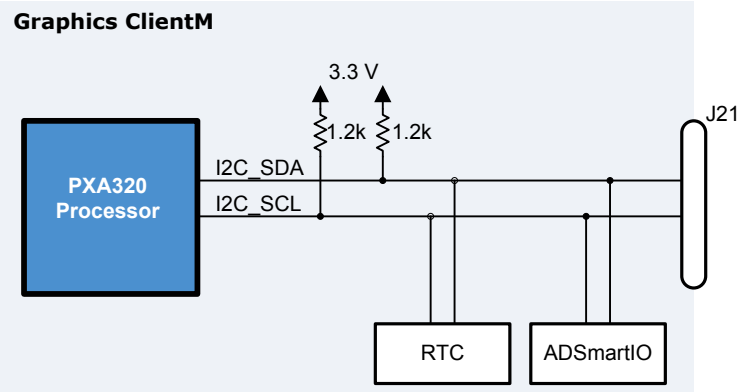
A 1-Wire bus provides a low-speed, single-wire communication bus to external devices. Typically, this bus is used to communicate with small inexpensive devices such as batteries and security components. The PXA320 supports a 1-Wire bus on header J11, page 35. For electrical specifications, see PXA320 Processor, page 47.

I²C Bus

I²C (Inter-IC) is a multi-master, two-wire synchronous serial bus for communications between integrated circuits and for addressing peripherals in a system. The bus master addresses devices using the data line and provides a synchronous clock for reading and writing devices. Client devices respond only when queried by the master device.

The GCM uses the PXA320 as the I²C bus master to communicate with on-board devices. In addition, connector J21, page 40 includes an external connection to the I²C bus.

The following diagram illustrates the I²C architecture on GCM. For electrical specifications, see PXA320 Processor, page 47.



The following table lists the addresses of the I²C devices.

Device	Address	Function
DS1307	1101 000	Real-time clock
ADSmartIO	reserved	Various I/O functions

The DS1307 supports a maximum bit rate of 100 kbps. Do not use the I²C bus at rates faster than 100 kbps.

User Interface and Display

The PXA320 includes an integrated PXA320 display controller to drive liquid crystal displays (LCDs). These data and control signals, as well as display power, backlight power and control, VEE adapter control, and touch panel signals are available on the GCM. In addition, the GCM includes an audio subsystem providing an audio line in, headphone output, and stereo speaker output.

Display

Displays are available in a variety of types and sizes and have a range of voltage and data requirements. To meet these various requirements, the GCM provides a 16-bit (565 RGB) LCD interface, an adjustable display power supply, and adjustable display signal voltage levels.

The following table summarizes the display capabilities.

Feature	Description
Resolution	Up to 1024 x 768
Display Power	5 V (optional 3.3 V)
Display Buffer	3.3 V signal levels (optional 5 V)
Scan Direction	Optional settings for PNL_RL (right-to-left) and PNL_UD (up-and-down) signals for active displays
Contrast Control	Contrast control of some passive displays

Features are set at time of production. Contact your local Eurotech technical support if your application requires any of the volume production options.

The display interface is available on header J6, page 32. For electrical specifications, see Display, VEE Adapter, and Backlight, page 49.

VEE Adapter

Many passive panels require a positive or negative bias voltage in the range of fifteen to thirty volts to bias the passive LCD. Some displays include a VEE generator and require a low-voltage analog signal to control the contrast.

The GCM supports an external VEE power supply adapter on header J7, page 33. This header supplies power and three control signals driven by the PXA320 to the adapter and receives VEE power from the adapter. For electrical specifications, see Display, VEE Adapter, and Backlight, page 49.

The following table describes the VEE adapter control signals.

J7 Pin	Name	Type	PXA320 Signal	Description
3	VEE_CTL	O	GPIO4_2	VEE adapter on and off control
5	VCON	O	PWM1	Low-voltage contrast control
6	VPCLK	O	LPCLK	Display controller pixel clock

Backlight

Most LCDs include one or more cold-cathode fluorescent lamp (CCFL) tubes to backlight the displays. Backlight inverters drive the panel backlights. These circuits are typically external to the display and generate the several hundred volts required to drive the CCFL tubes. Backlights can easily become the greatest source of power consumption in a portable system.

Typically, backlight inverters include control signals to dim and turn off the backlight. To reduce power consumption, header J8, page 34 provides two backlight control signals driven by the PXA320. For electrical specifications, see Display, VEE Adapter, and Backlight, page 49.

The following table describes the backlight control signals.

J8 Pin	Name	Type	PXA320 Signal	Description
5	BKLT_ON#	OD	GPIO126	Turns power on or off
6	BKLT_PWM	AO	PWM0	Controls backlight intensity

For details about the backlight power, see Power Supply Architecture, page 25.

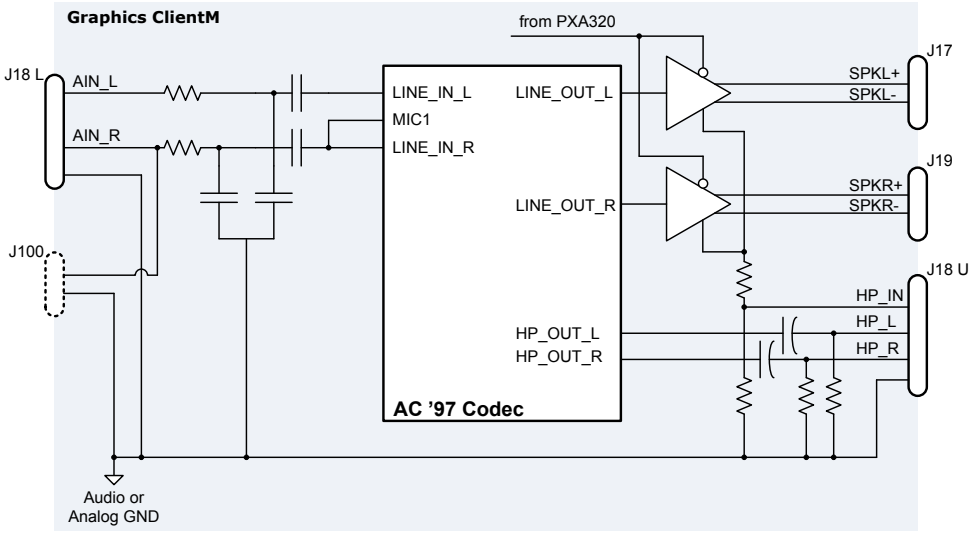
Touch Panel

The GCM supports a 4-wire or 5-wire resistive touch panel on header J5, page 32. Standard GCMs use the integrated PXA320 touch screen controller to drive a 4-wire touch panel. For electrical specifications, see PXA320 Processor, page 47. An on-board 5-wire controller is available as a volume production option.

Audio Interface

For its audio subsystem, the GCM uses an AC '97 stereo codec combined with a dual audio amplifier. This subsystem supports an audio line in, headphones, and stereo speakers. For electrical specifications, see Audio Interface, page 52.

The following diagram illustrates the audio subsystem.



Audio Inputs: Audio Line In or Microphone

The GCM supports an audio line in or self-powered microphone on stereo jack J18, page 40. The audio signals run through a low-pass filter before being passed to the audio codec. The line in ground on J18 connects to an analog ground plane on the GCM for improved signal-to-noise ratio.

For systems that do not require headphones, stereo jack J18 can be removed and header J100, page 45 can be populated providing a mono audio line in only. This configuration is available as a volume production option.

Audio Outputs: Stereo Speakers and Headphones

The GCM supports stereo speakers on header J17, page 39 and header J19, page 40. The audio amplifier drives the differential outputs directly delivering the output power required by stereo speakers.

Stereo jack J18, page 40 provides a direct connection to stereo headphones. The pull-down resistors shown in the diagram drain any charge that builds up on the headphone outputs when headphones are not connected.

Camera Sensor Interface (optional)

As a volume production option, socket J21, page 41 can provide a Camera Sensor Interface (CSI) supporting camera sensors of up to 3 megapixels. For electrical specifications, see PXA320 Processor, page 47.

Note: The CSI option is mutually exclusive with the USB 2.0 client option and uses ten of the twelve GPIOs on socket J21. For further details about these volume production options, see USB Ports, page 14.

Inputs and Outputs

To meet the requirement for general-purpose I/O and specialized I/O capabilities, the GCM includes up to twenty seven GPIOs and the ADSmartIO. The following sections describe these capabilities.

General-Purpose Inputs and Outputs

The GCM supplies up to twenty seven GPIOs. Up to twenty two GPIOs interface to the PXA320, while five interface to the on-board CPLD. For electrical specifications, see PXA320 Processor, page 47 and CPLD, page 48.

The following table describes the GPIO signals.

Header	Number of GPIO	Device
J21: GPIO, I2C, and CSI (optional), page 41	up to 12	PXA320
J22: GPIO and Serial 1 (EIA-422/485), page 43	10	PXA320
	5	CPLD

Note: The CSI option and USB 2.0 client option each use ten of the twelve GPIOs on socket J21. For further details about these volume production options, see USB Ports, page 14.

ADSmartIO

ADSmartIO is a RISC microcontroller programmed to provide additional I/O functionality for specialized tasks. It can perform a wide variety of functions; however, the actual functions implemented depend on the firmware loaded on your GCM. Contact your local Eurotech technical support for a complete list of the ADSmartIO functionality.

The following are the ADSmartIO functions supported on the GCM:

- Digital I/Os
- A/D inputs
- Keypad scan

The ADSmartIO controller has four, 8-pin I/O ports named PA, PB, PC, and PD. Some of these ports' pins are used internally, while nineteen I/O ports are available for your application. Generally, ADSmartIO ports are referenced by port and pin number (for example PA2), but I/O signals may go by several names based on functionality. For the cross reference between functionality and ADSmartIO signal names, see header J11, page 35.

The *ADSmartIO Programmer's Reference* (Eurotech document 110110-4004) gives information about how to use the ADSmartIO features. For electrical specifications, see ADSmartIO, page 50.

Digital I/O

Ports designated as digital I/O on the ADSmartIO controller can be individually configured as inputs or outputs. If you write a "1" (logic level high) to an I/O port when it is configured as an input, it enables an internal pull-up resistor.

A/D Inputs

Each of the Port A I/Os (PA0-PA7) includes an analog-to-digital (A/D) converter. The converters give full-scale readings when the input voltage is equal to voltage reference V_{REF} (e.g. $V=V_{REF}$•reading/1023).

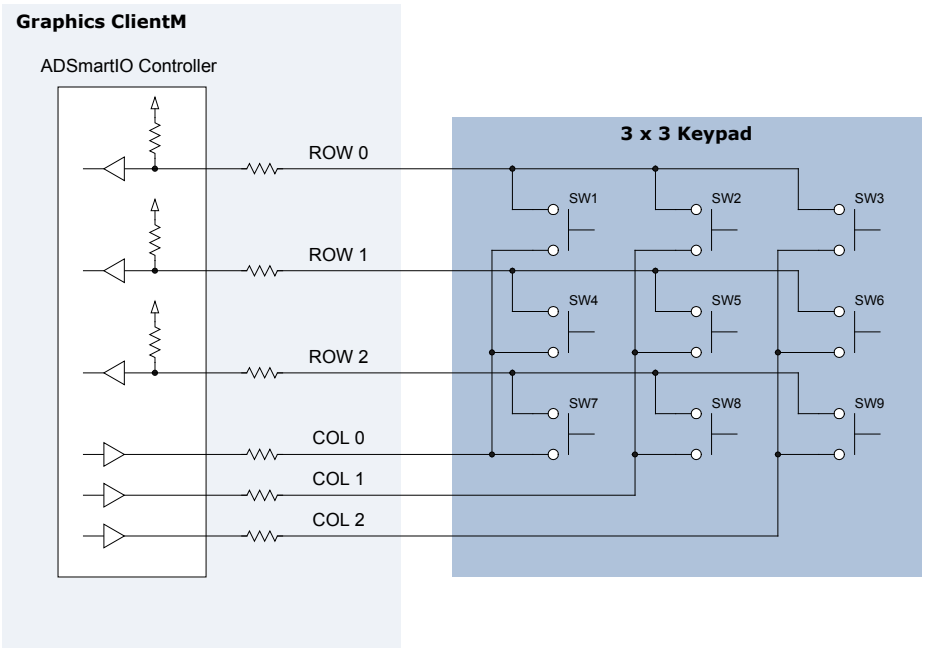
Keypad Scan

The ADSmartIO can scan a matrix keypad up to eight by eight keys in size. Matrix keypads are simpler, cost less than full keyboards, and can be easily customized for your application. Also, you can create a keypad matrix from a collection of normally-open switches.

When used to scan a keypad, the ADSmartIO configures the ROWn lines as inputs with software pull-ups enabled and configures the COLn lines as outputs set to "1" (logic level high). For the scan, the keypad scanner sets successive COLn outputs to "0" (logic level low), then looks for a "0" on one of the ROWn inputs. The scanner re-reads the pressed key after a delay to debounce the key press.

Unused column lines can be used for digital I/O or A/D inputs. Unused row lines can be used for digital I/O only.

The following diagram illustrates how to connect a 3x3 keypad matrix. The pull-ups on the inputs are the software-activated internal resistors of the ADSmartIO, while the series resistors are located on the GCM.



Power and Power Management

Power management is especially critical in portable and handheld applications where power is at a premium. The GCM includes advanced power management features, including the low power PXA320 processor, the ability to operate in power-saving modes, and partitioned power distribution.

This section summarizes the GCM power management system and provides an overview of the GCM power supply architecture.

Power Management Modes

Handheld and portable systems available today never really turn "off." They make use of power management techniques that cycle the electronics into power-saving modes, but never fully remove power from the full system.

The PXA320 uses Marvell Scalable Power Manager technology to maximize the MIPS/mW power efficiency. This technology uses hardware and software processing to dynamically change the voltage and frequency of the processor depending on the application. In addition, the PXA320 supports several power-saving modes reducing the power dissipation and extending the battery life in handheld and portable systems.

Power Management on the GCM

The GCM can actively be configured to be in Run or Sleep mode. Other power modes are controlled by the operating system and are typically transparent to the application. The operating system is also responsible for adjusting the core voltage for optimal power consumption in each mode.

In Run mode, the power supply is in its standard, full-power state, and applications run normally on the system. Specific subsystems may be selectively disabled to conserve power during normal operation. For a list of these subsystems, see Power Supply Architecture, page 25.

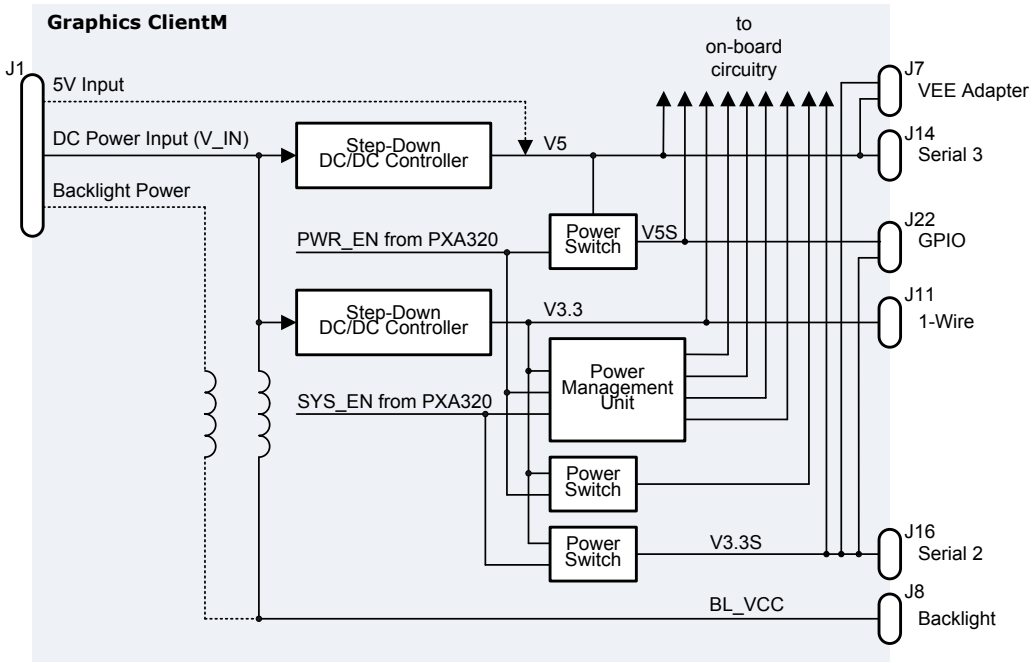
In Sleep mode, the processor puts the DDR SDRAM in a low-power, self-refresh mode, the processor core shuts off, most peripheral subsystems are shut down, and the power supply drops into a low-power state or turns off entirely. In this mode, the GCM consumes very little power, most of which is dedicated to the maintenance of the DDR SDRAM. Applications can put the GCM to sleep programmatically. Operating systems may also put the GCM to sleep if the system has not been used for a certain amount of time or for other reasons.

The GCM can be "awakened" and returned to normal operation by initiating a system wakeup. The following methods will wake the GCM:

- External Wakeup
  Shorting the WAKEUP# signal available on J13, page 37 to ground will wake the GCM. For electrical specifications, see Reset and Wake Up Inputs, page 48.
- Timed Wakeup
  The PXA320 can wake up at a predetermined time. This feature is controlled by software.

Power Supply Architecture

The following diagram illustrates the GCM power supply.



The GCM power supply is designed for high efficiency and low noise. It utilizes two high-efficiency step-down DC/DC controllers to regulate the incoming DC power from J1, page 30 generating 3.3 V and 5 V. A multi-function, programmable power management unit provides additional power regulation generating all other voltages required by the on-board circuitry. For electrical specifications, see Power Supply Specification, page 46.

For systems that supply regulated 5 V power, the 5 V step-down DC/DC controller can be removed as a volume production option.

In the standard configuration, the DC power input V_IN also provides the backlight power on header J8, page 34. As a volume production option, the GCM supports a backlight power input on J1 that is independent of V_IN.

It is the responsibility of the designer or integrator to provide surge protection on the input power line. This is especially important if the power supply wires will be subject to EMI/RFI or ESD.

Subsystem Partitioning

Specific subsystems may be selectively disabled to conserve power. Applications and the operating system determine how selective power management is utilized.

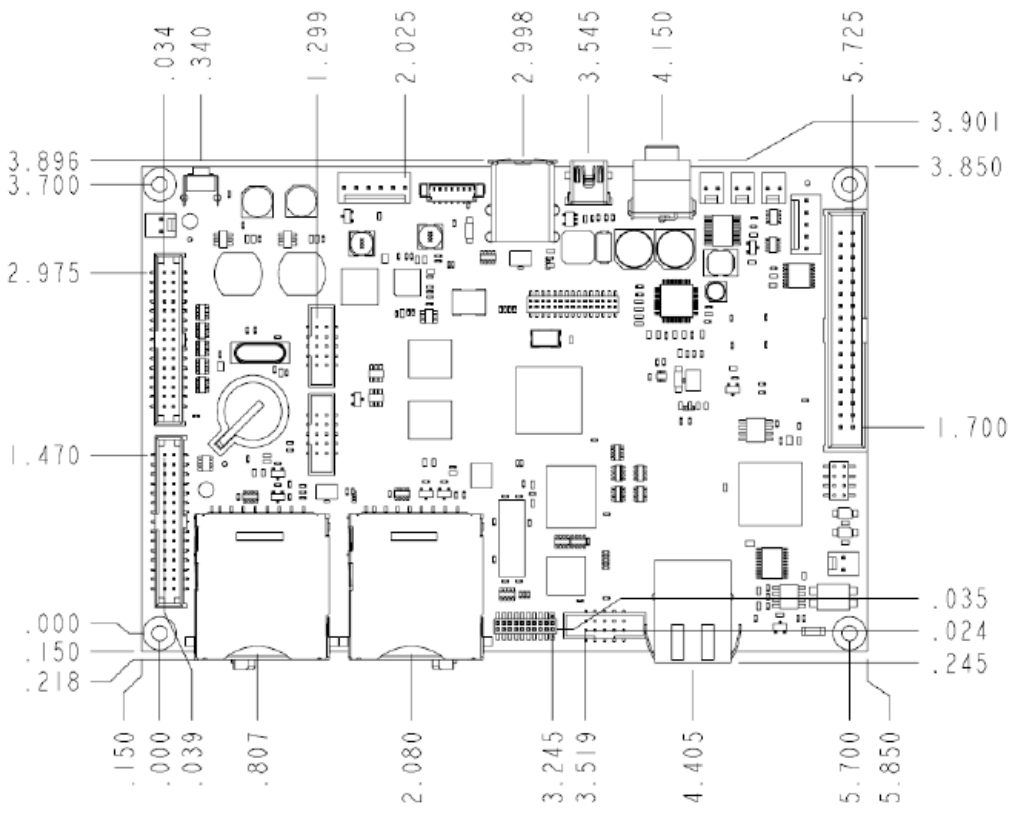
The following are the subsystems that can be disabled selectively:

- Display
- Backlight
- VEE adapter
- Audio codec
- Audio amplifier
- Serial EIA-232 buffers
- USB ports
- CompactFlash
- SD/MMC

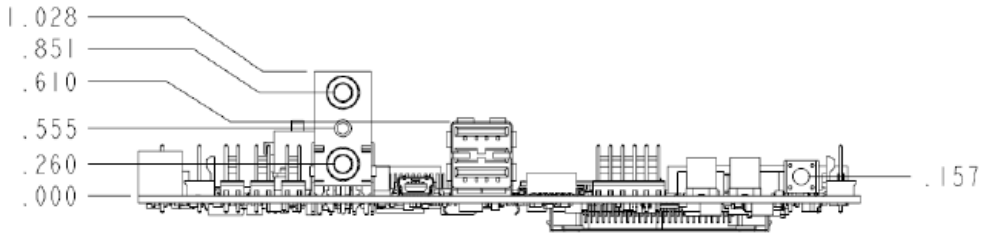
Mechanical

The following mechanical drawings specify the dimensions of the GCM, as well as locations of key components on the board. All dimensions are in inches.

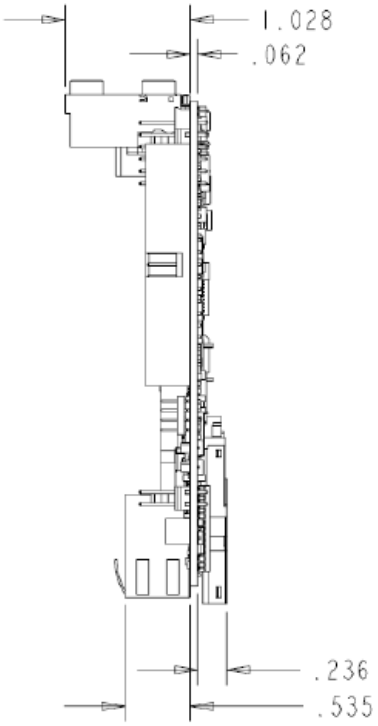
The first view illustrates the component side.



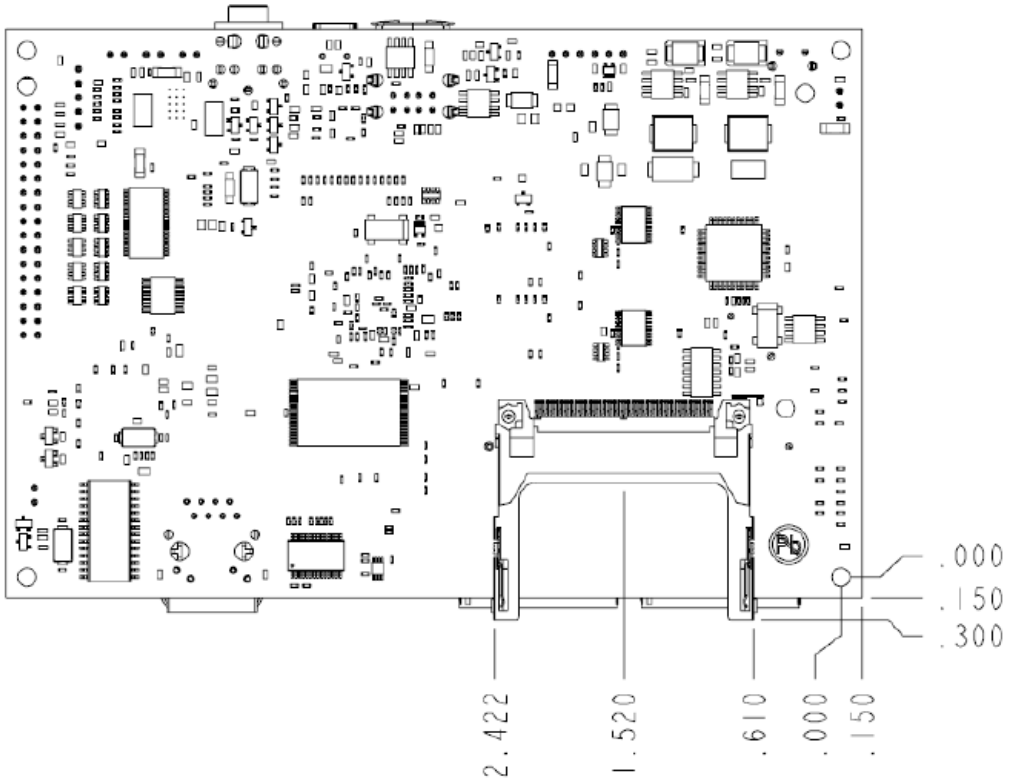
The next diagram illustrates the front view of stereo jack J18 and socket J4.



The next diagram illustrates the side view.



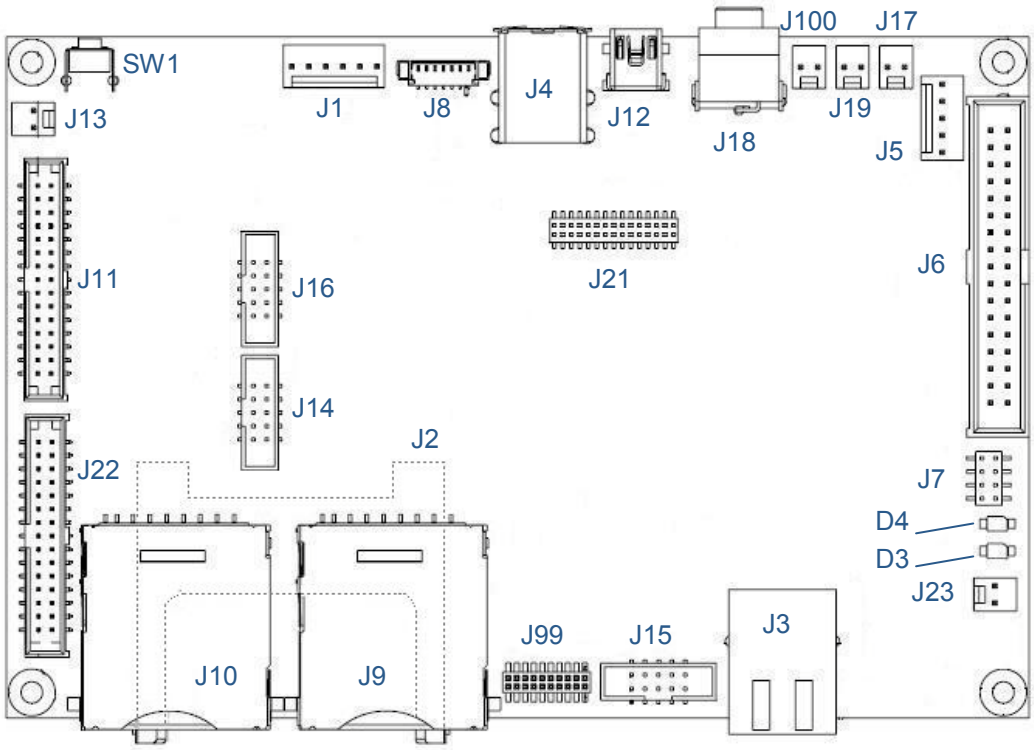
The final view illustrates the underside. Notice socket J2 is located on the underside.



Connectors, LEDs, and Jumpers

Identifying Connectors

The following diagram illustrates the location of key components on the GCM. Socket J2 is located on the underside of the board indicated by a dashed line.



Switches, Controls, and Indicators

This section describes the switches, controls, and indicators available on the GCM.

SW1: Reset

SW1 is the reset button for the GCM. Pressing SW1 shorts the RESET_IN# signal to ground issuing a hardware reset to the processor and system peripherals. Press this button to restart the GCM without cycling power.

The RESET_IN# signal is also available on J22, page 43.

LED Indicators

The GCM has two on-board light-emitting diodes (LEDs) and two LEDs integrated with the Ethernet socket to indicate system operation. This section describes the LED functionalities.

D3 and D4: Software-Controllable LEDs

LED	Type	Description
D3	green	Controlled by PXA320 GPIO0
D4	red	Controlled by PXA320 GPIO1

Ethernet LEDs

Socket J3, page 31 integrates system status LEDs with the socket. These LEDs indicate valid Ethernet connection, speed, and bus activity.

Signal Headers

The following tables describe the electrical signals available on the connectors of the GCM. Each section provides relevant details about the connector including part numbers, mating connectors, signal descriptions, and references to related sections.

J1: Power Input

Board connector: 6-pin header with friction lock, 0.1-inch, Molex 22-23-2061

Mating connector: Molex 22-01-3067

Header J1 accepts input power from an external supply. V_IN is the main power input to the GCM. Other voltages required by the processor and peripherals are generated from V_IN. For details about the power supply architecture including descriptions of the volume production options, see Power Supply Architecture, page 25.

Pin	Name	Type	Description
1	5V_IN	PI	5 V power input (production option)
2	GND	P	ground
3	BL_VCC	PI	Backlight power input (production option)
4	V_IN	PI	DC power input
5	nc		
6	nc		

J2: CompactFlash

Board connector: Type I and II CompactFlash card socket, Molex 55359-5029

Mating connector: CompactFlash card

The 50-pin CompactFlash socket J2 conforms to the CompactFlash standard for Type I and II cards operating at 3.3 V. Header shields are tied to chassis ground. For a description of the external memory interfaces available on the GCM, see External Memory, page 13.

J3: Ethernet

Board connector: RJ-45 socket, Pulse J0026D21BNL

Mating connector: RJ-45 plug, CAT5E cable

Socket J3 is a RJ-45 type with integrated magnetics and indicators that provides a 10/100 BT Ethernet port. Shields are tied to chassis ground. For further details, see Ethernet, page 17.

J4: USB Host 1 and USB Host 2 (optional)

Board connector: USB Type A receptacle, Tyco Electronics 292303-1

Mating connector: USB Type A plug

Socket J4 provides the signals for a USB 1.1 host port. As a volume production option, J4 can be populated with a dual socket providing a second USB 1.1 host port. Shields are tied to chassis ground. For further details, see USB Ports, page 14.

Pin	Name	Type	Description
A1	USB_HOST2_PWR	PO	5 V DC power output (optional)
A2 A3	USB_HOST2- USB_HOST2+	IO	USB Host 2 (optional)
A4	GND	P	ground (optional)
B1	USB_HOST1_PWR	PO	5 V DC power output
B2 B3	USB_HOST1- USB_HOST1+	IO	USB Host 1
B4	GND	P	ground

J5: Touch Panel

Board connector: 4-pin header with friction lock, 0.1-inch, Molex 22-23-2041

Mating connector: Molex 22-01-3047

Header J5 supplies the signals for a 4- or 5-wire touch panel. A standard GCM supports a 4-wire touch panel. For further details, see Touch Panel, page 20.

Pin	Name	Type	4-Wire	5-Wire	Description
1	TSMX	AIO	left	LL	
2	TSPX	AIO	right	UL	
3	TSPY	AIO	bottom	UR	Touch panel
4	TSMY	AIO	top	LR	
5	WIPER	AI		wiper	

J6: LCD

Board connector: 2x17 shrouded header, 0.1-inch, OUPIIN 3012-34G-00S

Mating connector: OUPIIN 1001-34G00B1

Header J6 supplies the power, control, and data signals required to drive a LCD. The following table describes the signals included on the header. Signal names shown are for TFT active matrix color LCDs at 16 bits per pixel (bpp). For further details, see Display, page 19.

Pin	Color Active TFT Display at 16 bpp		
	PXA320 Signal Name	Eurotech Signal Name	Description
1		PNL_VEE	VEE power output
2		GND	ground
3	LPCLK	PNL_PIXCLK	Pixel clock
4	LLCLK	PNL_HSYNC	Horizontal sync
5	LFCLK	PNL_VSYNC	Vertical sync
6		GND	ground
7	LDD15	PNL_RED0	
8	LDD11	PNL_RED1	
9	LDD12	PNL_RED2	Red data
10	LDD13	PNL_RED3	
11	LDD14	PNL_RED4	
12	LDD15	PNL_RED5	
13		GND	ground

Pin	PXA320 Signal Name	Color Active TFT Display at 16 bpp Eurotech Signal Name	Description
14	LDD5	PNL_GREEN0	Green data
15	LDD6	PNL_GREEN1	
16	LDD7	PNL_GREEN2	
17	LDD8	PNL_GREEN3	
18	LDD9	PNL_GREEN4	
19	LDD10	PNL_GREEN5	
20		GND	ground
21	LDD4	PNL_BLUE0	Blue data
22	LDD0	PNL_BLUE1	
23	LDD1	PNL_BLUE2	
24	LDD2	PNL_BLUE3	
25	LDD3	PNL_BLUE4	
26	LDD4	PNL_BLUE5	
27		GND	ground
28	LBIAS	PNL_LBIAS	Data enable
29 30		PNL_PWR	5 V (default) or 3.3 V
31		PNL_RL	Horizontal mode select
32		PNL_UD	Vertical mode select
33	GPIO74	PNL_ENA	Panel enable
34	Filtered PWM1	VCON	Low-voltage contrast control

J7: VEE Adapter

Board connector: 2x4 header, 2 mm, NSXD MXD2-4PBXX1X

An external VEE power supply adapter connects to the GCM on header J7. This header supplies power and control signals to the adapter and receives VEE power from the adapter. For further details, see VEE Adapter, page 19.

Pin	Name	Type	Description
1	V5	PO	5 V power output
2	V3.3S	PO	Switched 3.3 V power output
3	VEE_CTL	O	VEE on/off control
4	PNL_VEE	PI	VEE power input
5	VCON	O	Low-voltage contrast control
6	VPCLK	O	Pixel clock
7	GND	P	ground
8	GND	P	ground

J8: Backlight

Board connector: 7-pin header, 1.25 mm, Molex 53398-0771

Mating connector: Molex 51021-0700

Header J8 includes the power and control signals required by an external LCD backlight inverter. For a description about the backlight power options, see Power Supply Architecture, page 25. For further details about the control signals, see Backlight, page 20.

Pin	Name	Type	Description
1 2	BL_VCC	PO	Backlight power output
3 4	GND	P	ground
5	BKLT_ON#	OD	Backlight on/off
6	BKLT_PWM	AO	Backlight intensity
7	GND	P	ground

J9: SD/MMC 2

Board connector: SD/MMC socket, 3M SD-RSMT-2-MQ

Mating connector: SD/MMC card

Socket J9 provides SD/MMC 2 for memory and I/O expansion. Shields are tied to chassis ground. A standard GCM supports 3.3 V cards with a volume production option for 1.8 V cards. For further details, see SD/MMC Interface, page 17.

Pin	Name	Type	Description
1	SD2_DAT3	IO	SD/MMC 2 Data
2	SD2_CMD	IO	SD/MMC 2 Command
3	GND	P	ground
4	SD2_PWR	PO	Software-controlled 3.3 V power output
5	SD2_CLK	O	SD/MMC 2 Clock
6	GND	P	ground
7	SD2_DAT0	IO	SD/MMC 2 Data
8	SD2_DAT1	IO	SD/MMC 2 Data
9	SD2_DAT2	IO	SD/MMC 2 Data
10	SD2_CD#	I	SD/MMC 2 Card Detect
11	SD2_WP#	I	SD/MMC 2 Write Protect

J10: SD/MMC 1

Board connector: SD/MMC socket, 3M SD-RSMT-2-MQ

Mating connector: SD/MMC card

Socket J10 provides SD/MMC 1 for memory and I/O expansion. Shields are tied to chassis ground. A standard GCM supports 3.3 V cards with a volume production option for 1.8 V cards. For further details, see SD/MMC Interface, page 17.

Pin	Name	Type	Description
1	SD1_DAT3	IO	SD/MMC 1 Data
2	SD1_CMD	IO	SD/MMC 1 Command
3	GND	P	ground
4	SD1_PWR	PO	Software-controlled 3.3 V power output
5	SD1_CLK	O	SD/MMC 1 Clock
6	GND	P	ground
7	SD1_DAT0	IO	SD/MMC 1 Data
8	SD1_DAT1	IO	SD/MMC 1 Data
9	SD1_DAT2	IO	SD/MMC 1 Data
10	SD1_CD#	I	SD/MMC 1 Card Detect
11	SD1_WP#	I	SD/MMC 1 Write Protect

J11: ADSmartIO and 1-Wire

Board connector: 2x15 shrouded header, 2 mm, Samtec STMM-115-02-S-D-SM

Mating connector: Samtec TCSD series socket

ADSmartIO extends the GCM capabilities by providing additional functions, inputs, and outputs on header J11. For further details, see ADSmartIO, page 22. A 1-Wire bus providing a low-speed, single-wire external communication bus is also available on header J11. For further details, see 1-Wire Bus, page 18.

Pin	Name	Pin	Type	Description
1	COL0		IO	PA0
3	COL1		IO	PA1
5	COL2		IO	PA2
7	COL3		IO	PA3
9	COL4		IO	PA4
11	COL5		IO	PA5
	COL6	12	IO	PA6
13	COL7		IO	PA7

ADSmartIO

Pin	Name	Pin	Type	Description	
		2			
		4			
	ADGND	6	P		Analog ground
		8			
		10			
14	GND		P		ground
15	ROW0		I	PD0	ADSmartIO
	ROW1	16	O	PD1	
17	GND		P		ground
	ROW2	18	IO	PC2	
19	ROW3		IO	PC3	
	ROW4	20	IO	PC4	
21	ROW5		IO	PC5	
	ROW6	22	IO	PC6	ADSmartIO
23	ROW7		IO	PC7	
	UCIO0	24	IO	PD5	
	UCIO1	26	IO	PD6	
	UCIO2	28	IO	PD7	
25	V3.3		PO		3.3 V power output
27	ONE_WIRE		OD		1-Wire bus
29	GND		P		ground
	reserved	30	I	PD2	

J12: USB 1.1 Client or USB 2.0 Client (optional)

Board connector: Mini USB Type B receptacle, FCI 10033526-N3215LF

Mating connector: Mini USB Type B plug

Socket J12 supports a USB 1.1 client port. As a volume production option, socket J12 can support a USB 2.0 client port. Shields are tied to chassis ground.

Note: The USB 2.0 client option uses ten of the twelve GPIOs on socket J21 and is mutually exclusive with the CSI option on header J21. For further details about the USB ports and the various options, see USB Ports, page 14.

Pin	Name	Type	Description
1	USB_FCN_CNCT	PI	DC power input (sense connection)
2	USB_FCN-	IO	USB Client data
3	USB_FCN+		
4	nc		
5	USB_GND	P	ground

J13: Wakeup

Board connector: 2-pin header with friction lock, 0.1-inch, Molex 22-23-2021

Mating connector: Molex 22-01-3027

The WAKEUP# signal provides the capability to wake the GCM. For further details, see Power Management Modes, page 24.

Pin	Name	Type	Description
1	GND	P	ground
2	WAKEUP#	I	Wakeup

J14: Serial 3 (EIA-232)

Board connector: 2x5 shrouded header, 2 mm, OUPIIN 3112-10G00DBA

Mating connector: OUPIIN 1101 series IDC socket

Header J14 provides the PXA320 Bluetooth UART signals including hardware flow control at EIA-232 levels. An additional enable signal and 5 V output support an off-board Bluetooth transceiver in a volume production option. For further details, see Serial Ports, page 16.

Pin	Name	Type	Description
1	nc		
2	nc		
3	RXD3	I	Receive Data 3
4	RTS3	O	Ready To Send 3
5	TXD3	O	Transmit Data 3
6	CTS3	I	Clear To Send 3
7	V5	PO	5 V power output
8	nc		
9	GND	P	ground
10	BTEN	O-3.3	Bluetooth enable

J15: Serial 1 (EIA-232)

Board connector: 2x5 shrouded header, 2 mm, OUPIIN 3112-10G00DBA

Mating connector: OUPIIN 1101 series IDC socket

Header J15 supplies the PXA320 full-function UART signals including hardware flow control at EIA-232 levels. For further details, see Serial Ports, page 16.

Pin	Name	Type	Description
1	DCD1	I	Data Carrier Detect 1
2	DSR1	I	Data Set Ready 1
3	RXD1	I	Receive Data 1
4	RTS1	O	Ready To Send 1
5	TXD1	O	Transmit Data 1
6	CTS1	I	Clear To Send 1
7	DTR1	O	Data Terminal Ready 1
8	RIBI1	I	Ring Indicator 1
9	GND	P	ground
10	nc		

J16: Serial 2 (EIA-232)

Board connector: 2x5 shrouded header, 2 mm, OUPIIN 3112-10G00DBA

Mating connector: OUPIIN 1101 series IDC socket

Header J16 includes the PXA320 IrDA UART signals at EIA-232 levels. An additional enable signal and 3.3 V output support an off-board IrDA transceiver in a volume production option. For further details, see Serial Ports, page 16.

Pin	Name	Type	Description
1	nc		
2	nc		
3	RXD2	I	Receive Data 2
4	RTS2	O	Ready To Send 2
5	TXD2	O	Transmit Data 2
6	CTS2	I	Clear To Send 2
7	V3.3S	PO	Switched 3.3 V power output
8	nc		
9	GND	P	ground
10	IREN	O-3.3	IrDA enable

J17: Stereo Speaker: Left Channel

Board connector: 2-pin header with friction lock, 0.1-inch, Molex 22-23-2021

Mating connector: Molex 22-01-3027

The GCM drives a stereo speaker on header J17 and header J19. Header J17 provides the left channel. For details of the operation of the speaker, see Audio Interface, page 20.

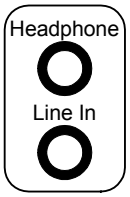
Pin	Name	Type	Description
1	SPKL-	AO	Stereo Speaker, left channel
2	SPKL+	AO	

J18: Headphone Out and Audio Line In

Board connector: dual stack stereo jack, 3.5 mm, CUI SJD-3510-45

Mating connector: 3.5 mm stereo plug

The audio codec included on the GCM provides a stereo headphone output and audio line input on the dual stack stereo jack J18. The headphones are wired to the upper socket of the dual stack, while the audio line in is wired to the lower socket. The diagram at the right illustrates stereo jack J18. In the following table, pins in the upper socket are indicated by a “U” and pins in the lower socket are indicated by an “L”.



The HP_IN input determines the output mode of the on-board audio amplifier. An on-board pull-down forces this signal low supporting stereo headphones only.

For further details, see Audio Interface, page 20.

Pin	Name	Pin	Type	Description
1U	HP_L		AO	Headphone, left channel
3U	HP_IN			Pulled low by on-board resistor
4U	HP_R		AO	Headphone, right channel
5U	AGND		P	Analog ground
	AIN_L	1L	AI	Audio in, left channel
	nc	2L		
	nc	3L		
	AIN_R	4L	AI	Audio in, right channel (microphone)
	AGND	5L	P	Analog ground

J19: Stereo Speaker: Right Channel

Board connector: 2-pin header with friction lock, 0.1-inch, Molex 22-23-2021

Mating connector: Molex 22-01-3027

The GCM drives a stereo speaker on header J17 and header J19. Header J19 provides the right channel. For details of the operation of the speaker, see Audio Interface, page 20.

Pin	Name	Type	Description
1	SPKR-	AO	Stereo Speaker, right channel
2	SPKR+	AO	

J21: GPIO, I2C, and CSI (optional)

Board connector: 2x15 header, 0.05-inch, OUPIIN 2215-2X15G00D

In the standard configuration, socket J21 includes twelve PXA320 GPIOs and an external connection to the I^2C bus. For further details, see General-Purpose Inputs and Outputs, page 22, and I2C Bus, page 18 respectively.

As a volume production option, socket J21 can support a CSI with two PXA320 GPIOs. For further details, see Camera Sensor Interface, page 20.

Note: The CSI option and the USB 2.0 client option each use ten of the twelve GPIOs on socket J21. For further details about the volume production options, see USB Ports, page 14.

Pin	Name	Pin	Type	Description		
				Standard	CSI Option	USB 2.0 Client Option
1	V1.8		PO	1.8 V	1.8 V	1.8 V
	V3	2	PO	3.0 V	3.0 V	3.0 V
3	GPIO4_2		IO-3.3	PXA320 GPIO	PXA320 GPIO	PXA320 GPIO
	GPIO100	4	IO-3.3			
5	CIFFV		IO	Reserved	Frame start	Reserved
	CIFLV	6	IO	Reserved	Line start	Reserved
	CIFPCLK	8	I	Reserved	Pixel clock	Reserved
	CIFMCLK	10	O	Reserved	Output clock	Reserved
7	GND		P	ground		
9	GND		P			
11	GND		P			
13	GND		P			
15	GND		P			
17	GND		P			
19	GND		P			
21	GND		P			
23	GND		P			
25	GND		P			

Pin	Name	Pin	Type	Description		
				Standard	CSI Option	USB 2.0 Client Option
	GPIO49	12	IO-3.3	PXA320 GPIO	Data 0	Reserved
	GPIO50	14	IO-3.3	PXA320 GPIO	Data 1	Reserved
	GPIO51	16	IO-3.3	PXA320 GPIO	Data 2	Reserved
	GPIO52	18	IO-3.3	PXA320 GPIO	Data 3	Reserved
	GPIO53	20	IO-3.3	PXA320 GPIO	Data 4	Reserved
	GPIO54	22	IO-3.3	PXA320 GPIO	Data 5	Reserved
	GPIO55	24	IO-3.3	PXA320 GPIO	Data 6	Reserved
	GPIO56	26	IO-3.3	PXA320 GPIO	Data 7	Reserved
	GPIO57	28	IO-3.3	PXA320 GPIO	Data 8	Reserved
	GPIO58	30	IO-3.3	PXA320 GPIO	Data 9	Reserved
	I2C_SCL	27	IO	I^2C clock	I^2C clock	I^2C clock
	I2C_SDA	29	IO	I^2C data	I^2C data	I^2C data

J22: GPIO, Serial 1 (EIA-422/485), and Reset

Board connector: 2x15 shrouded header, 2 mm, Samtec STMM-115-02-S-D-SM

Mating connector: Samtec TCSD series socket

Header J22 includes fifteen GPIO for application use. Each GPIO can be configured as an input or as an output. Five of the GPIOs interface to the CPLD, while the remaining ten GPIOs interface to the PXA320. For further details, see General-Purpose Inputs and Outputs, page 22.

This header also provides the PXA320 full-function UART signals at EIA 422/485 levels. This port is available at EIA-232 levels on header J15 or at EIA422/485 levels on header J22. The processor selects the mode of operation using a control signal mapped to GPIO97. For further details, see Serial Ports, page 16 and PXA320 GPIO Cross-Reference, page 11.

Two reset inputs are available on header J22. The RESET_IN# signal forces a hardware reset to the processor and system peripherals. This signal also connects to the reset button SW1: Reset, page 29. For electrical specifications, see Reset and Wake Up Inputs, page 48. The GPIO_RESET# signal issues a “soft” reset to the PXA320. For electrical specifications, see PXA320 Processor, page 47.

Pin	Name	Type	Description
1	GND	P	ground
2	TX1-	O	EIA-422/485 Transmit Data
3	TX1+		
4	GND	P	ground
5	V5S	PO	Switched 5 V power output
6	RX1-	I	EIA-422/485 Receive Data
7	RX1+		
8	GND	P	ground
9	V3.3S	PO	Switched 3.3 V power output
10	RESET_IN#	I	System reset
11	GPIO_RESET#	I	Processor “soft” reset
12	GND	P	ground
13	CPLDIO0	IO - LVCMOS	CPLD GPIO
14	CPLDIO1		
15	CPLDIO2		
16	CPLDIO3		
17	CPLDIO4		
18	GND	P	ground

Pin	Name	Type	Description
19	GPIO113	IO-3.3	PXA320 GPIO
20	GPIO114		
21	GPIO115		
22	GPIO116		
23	GPIO117		
24	GND	P	ground
25	GPIO121	IO-3.3	PXA320 GPIO
26	GPIO122		
27	GPIO123		
28	GPIO124		
29	GPIO125		
30	GND	P	ground

J23: CAN 2.0B Bus

Board connector: 2-pin header with friction lock, 0.1-inch, Molex 22-23-2021

Mating connector: Molex 22-01-3027

Header J23 supplies a CAN 2.0B bus. For further details, see CAN 2.0B Bus, page 18.

Pin	Name	Type	Description
1	CAN+	IO	CAN 2.0B
2	CAN-		

J99: In-System Programming

Board connector: 2x10 socket, 0.05-inch, Samtec SFMC-110-02-S-D

Mating connector: Samtec FTS series header

Socket J99 is used during manufacturing for programming and debug; otherwise, it is not supported for application use. Production customers may use this connector to reprogram boot code.

Pin	Name	Type	Description
1	SRST#	I	External Reset
2	TRST#	I	JTAG
3	TMS	I	
4	GND	P	
5	TCK	I	
6	GND	P	
7	TDI	I	
8	GND	P	
9	TDO	O	
10	GND	P	
11	nc		
12	VREF	PO	
13	PRG	I	ATMega/ADSmartIO
14	VREF	PO	
15	MISO	O	
16	nc		
17	MOSI	I	
18	GND	P	
19	SCK	I	
20	GND	P	

J100: Audio Line In (Mono)

Board connector: 2-pin header with friction lock, 0.1-inch, Molex 22-23-2021

Mating connector: Molex 22-01-3027

As a volume production option, the GCM can provide a connection to a microphone on header J100. For details about the audio input options, see Audio Interface, page 20.

Pin	Name	Type	Description
1	AIN_R	AI	Microphone
2	AGND	P	Analog ground

System Specification

Power Supply

Power Supply

The GCM accepts a main power input from an external supply on J1, page 30. Other voltages required by the processor and peripherals are generated by the on-board power supply. For further details, see Power Supply Architecture, page 25.

Symbol	Parameter	Min	Typ.	Max	Units
Main Power Input (note 1)					
V_IN	Supply voltage	6	12	15	V
Power Outputs					
V5	Primary supply voltage		5.0		V
V3.3	Primary supply voltage		3.3		V
V5S	Switched operating power		5.0		V
V3.3S	Switched operating power		3.3		V

Notes:

1. A backward-compatibility package allows the GCM to operate with a 5V-only Graphics Client Plus power supply. This legacy alternative is available as a volume production option.

Power Consumption

The following table lists typical power consumption for the various power modes of the GCM.

Symbol	Parameter	Min	Typ.	Max	Units
I sleep	Sleep mode current (note 2)		3.4		mA
P idle	Idle mode power (note 3)		2.3		W
P run	Run mode power (note 4)		2.8		W

Notes:

2. GCM in Sleep mode, Vsleep=12.0V
3. GCM running only the Windows CE desktop (predominantly in Idle mode; <5% CPU utilization).
4. Typical measurement indicates full utilization (95-100%) of processor core, achieved by running multiple instances of a graphical application under Windows CE with no Ethernet use.

Electrical

This section provides electrical specifications for the GCM.

PXA320 Processor

Several PXA320 signals are available externally on the GCM. All PXA320 signals include ESD protection.

The processor provides up to twenty two GPIOs. Up to twelve GPIOs are available on J21, page 41 and the remaining ten GPIOs are available on J22, page 43. For a description of the PXA320 GPIOs, see General-Purpose Inputs and Outputs, page 22.

Header J21, page 41 also supplies connections to the PXA320 CSI and I^2C bus. For descriptions of these interfaces, see Optional Camera Sensor Interface, page 20 and I2C Bus, page 18, respectively.

Header J11, page 35 provides an external connection to the PXA320 1-Wire interface. For a description of this interface, see 1-Wire Bus, page 18.

The integrated PXA320 touch screen controller drives a 4-wire touch panel on header J5, page 32. For a description of this interface, see Touch Panel, page 20.

Symbol	Parameter	Min	Typ.	Max	Units
GPIO (note 5)					
V_{CCIO}	Input source voltage		3.3		V
V_{IH}	High-level input voltage	$0.8V_{CCIO}$			V
V_{IL}	Low-level input voltage			$0.2V_{CCIO}$	V
V_{OH}	High-level output voltage (note 6)	$0.9V_{CCIO}$			V
V_{OL}	Low-level output voltage (note 6)			$0.1V_{CCIO}$	V
R_{PU}	Software-selectable pull-ups (see note 7)	20	45	100	kΩ
R_{PD}	Software-selectable pull-downs (see note 8)	20	45	100	kΩ
GPIO_RESET#					
$R_{GPIO\_RESET\#}$	Pull-up resistance on GPIO_RESET#		4.7		kΩ
$V_{GPIO\_RESET\#}$			2.8		V
t_{PW}	Pulse width constraint (note 5)	100			µs
CSI					
VCC_CI	Supply voltage		3.3		V
I^2C					
	Bus clock (note 9)	100	100	400	kHz
$R_{SDA,SCK}$	Pull-up resistance on SDA, SCK		1.2		kΩ
$V_{SDA,SCK}$			3.3		V
1-Wire					
$R_{1\text{-}WIRE}$	Pull-up resistance on 1-Wire		5.1		kΩ
$V_{1\text{-}WIRE}$			3.3		

Symbol	Parameter	Min	Typ.	Max	Units
Touch panel					
VCC_TSI	Supply voltage		3.3		V
---	A/D sample resolution		10		bit

Notes:

5. Specifications are taken from the Marvell PXA3xx (88AP3xx) Processor Family Electrical, Mechanical, and Thermal Functional Specification, Doc. No. MV-S105156-00, Rev. 2.0 Version – April 6, 2009.
6. Multi-Function Pin (MFP) drive strength is programmable using the PXA320 Multi-Function Pin Register (MFPR).
7. Use the MFPR to enable or disable pull-ups.
8. Use the MFPR to enable or disable pull-downs.
9. The PXA320 supports "standard" and "fast" I^2C speeds of 100 kHz and 400 kHz; however, the speed is limited to 100 kHz by the RTC chip.

CPLD

A Xilinx XC2C128 CPLD on the GCM provides five GPIOs on header J22, page 43. For a description of the GPIOs, see General-Purpose Inputs and Outputs, page 22.

Symbol	Parameter	Min	Typ.	Max	Units
GPIO (LVCMOS 1.8V, note 10)					
V_{CCIO}	Input source voltage		1.8		V
V_{IH}	High-level input voltage (note 11)	$0.65V_{CCIO}$		V_{CCIO} + 0.3	V
V_{IL}	Low-level input voltage			$0.35V_{CCIO}$	V
V_{OH}	High-level output voltage I_{OH} = -8 mA, V_{CCIO} = 1.7 V	V_{CCIO} – 0.45			V
V_{OL}	Low-level output voltage I_{OL} = 8 mA, V_{CCIO} = 1.7 V			0.45	V

Notes:

10. Specifications are taken from the Xilinx XC2C128 Cool Runner-II CPLD Product Specification, DS093 (v3.2) March 8, 2007.
11. The $V_{IH\ MAX}$ value is defined by the JEDEC specification for LVCMOS, 1.8V signals. The CPLD input buffer can tolerate up to 3.9V without physical damage.

Reset and Wake Up Inputs

Header J22, page 43 receives two reset signals. The RESET_IN# signal forces a “hard” reset of the GCM. This signal also connects to the on-board reset switch SW1, page 29. The GPIO_RESET# signal provides a “soft” reset to the PXA320. For the GPIO_RESET# electrical specifications, see PXA320 Processor, page 47.

The WAKEUP# signal available on header J13, page 37 will wake the GCM from Sleep mode. For a description of the Sleep mode, see Power Management Modes, page 24.

Symbol	Parameter	Min	Typ.	Max	Units
RESET_IN#, WAKEUP#					
V_{IH}	High-level input voltage	2.3			V
V_{IL}	Low-level input voltage			0.5	V
R_{PU}	Pull-up resistance on RESET_IN#, WAKEUP#		47		kΩ
V_{PU}			3.3		V

Display, VEE Adapter, and Backlight

The GCM provides the power, control, and data signals needed to drive LCDs, as well as controls for brightness and contrast.

Header J6, page 32 includes the display signals. The PXA320 LCD controller signals LDD0 through LDD15, as well as the pixel clock, vertical sync, and horizontal sync, are buffered and EMI/RFI filtered before reaching header J6. For a description of this interface, see Display, page 19.

Header J8, page 34 supports an external LCD backlight inverter. For a description of this interface, see Backlight, page 20.

The GCM also supports an external VEE power supply on header J7, page 33. For a description of this interface, see VEE Adapter, page 19.

Symbol	Parameter	Min	Typ.	Max	Units
LCD					
I_{PNL_PWR}	Current limit	1.0	1.3	1.6	A
Contrast Control (passive displays)					
VCON	Low-voltage contrast adjust	0		3.3	V
Backlight					
V_{BL_VCC}	Backlight supply voltage		(note 12)		V
V_{BKLT_PWM}	PWM control (note 13)	0		5	V
$R_{BKLT\_ON\#}$	Pull-up resistance on BKLT_ON#		12		kΩ
$V_{BKLT\_ON\#}$			BL_VCC		V

Notes:

12. On a standard GCM, V_{BL_VCC}, is driven by the main input power V_IN. As a volume production option, the GCM supports a backlight power that is independent of V_IN.
13. Support for backlight PWM control at 3.3 V and V_IN are available as volume production options.

The following table lists the standard and volume production options for the display and backlight interfaces.

Symbol	Parameter	Standard	Production	Units
LCD (note 14)				
V_{PNL_PWR}	LCD supply voltage (note 15)	5	3.3	V
V_{PNL_DATA}	Display signal voltage (note 16, 17)	3.3	5	V
Scan Direction (active displays)				
R_{PNL_RL}	Pull-up/down resistance on PNL_RL (note 18)	4.7	4.7	kΩ
V_{PNL_RL}		V_{PNL_PWR}	0	V
R_{PNL_UD}	Pull-up/down resistance on PNL_UD (note 19)	4.7	4.7	kΩ
V_{PNL_UD}		V_{PNL_PWR}	0	V
Backlight				
V_{BKLT_PWM}	PWM control (note 20)	0-5	0-3.3, 0-V_IN	V

Notes:

14. The PXA320 enables the display power and display signal buffer.
15. Resistor R121 selects 5 V power, while R120 selects 3.3 V.
16. Inductor L10 selects 3.3 V signal levels, while L11 selects 5 V.
17. A standard GCM is configured for 3.3 V display signal voltage levels.
    5 V displays with VIH <= 0.6•VPNL_PWR (3.0 V) will work reliably with 3.3 V data.
18. PNL_RL is pulled high by R54, while R57 pulls the signal low.
19. PNL_UD is pulled high by R55, while R58 pulls the signal low.
20. Support for backlight PWM control at 3.3 V and V_IN are available as volume production options.

ADSmartIO

The ADSmartIO is an Atmel ATmega8535 microcontroller on the GCM designed to handle I/O functions autonomously. The ADSmartIO signals are available on header J11, page 35. For a description of these I/O capabilities, see ADSmartIO, page 22.

Absolute Maximum Ratings

Input voltage, any pin 3.8 V

Symbol	Parameter	Min	Typ.	Max	Units
V_{CC}	ADSmartIO supply voltage		3.3		V
R_S	Series resistance (note 21)		100		Ω
Digital I/O (note 22)					
V_{IH}	High-level input voltage	$0.6V_{CC}$			V
V_{IL}	Low-level input voltage			$0.2V_{CC}$	V
V_{OH}	High-level output voltage I_{OH} = -10 mA, V_{CC} = 3.0 V	2.2			V
V_{OL}	Low-level output voltage I_{OL} = 10 mA, V_{CC} = 3.0 V			0.5	V
R_{PU}	Software-selectable pull-ups to 3.3 V (note 23)	20		50	kΩ
A/D Inputs (note 22)					
n	Resolution (note 24)			10	bit
R_{IN}	Analog input resistance		100		MΩ
V_{REF}	A/D reference voltage		2.5		V
V_{IN}	A/D input voltage range	0		V_{REF}	V

Notes:

21. Row I/O, column I/O, UCIO 0-2, RX, and TX have series resistance limiting the dc current that any one pin can source or sink.
22. Specifications are taken from the Atmel ATmega8535 Product Datasheet, 2502K-AVR-10/06.
23. Control pull-up resistors by writing to bits of IO port when the port is configured as a digital input (bit mask 1=enable, 0=disable).
24. Digital noise on the board may degrade analog performance under some conditions.

Audio Interface

A Cirrus Logic CS4202 AC '97 codec with a National Semiconductor LM4863 dual audio amplifier provides the audio interface on the GCM. This audio interface supports stereo headphones and an audio line in on stereo jack J18, page 40 and stereo speakers on header J17, page 39. For a description of the audio interface, see Audio Interface, page 20.

Symbol	Parameter	Min	Typ.	Max	Units
D_{VDD}	Digital supply voltage (note 25)		3.3		V
A_{VDD}	Analog supply voltage (note 25)		5.0		V
f_{OUT}	Sample rate, output		48		kHz
f_{IN}	Sample rate, input (note 26)	8		44.1	kHz
Audio Line In (note 27)					
V_{IN}	Full scale input voltage		1		V_{rms}
f_O	Low-pass cutoff		16		kHz
R_{IN}	Input impedance	10			kΩ
C_{IN}	DC blocking capacitor		1		µF
Stereo Headphones (note 27)					
V_{OUT}	Full scale output voltage		1.4		V_{rms}
R_L	External load impedance	32			Ω
C_{OUT}	DC blocking capacitor (note 28)		330		µF
R_{PD}	Pull-down resistance		1		kΩ
Stereo Speakers (note 29)					
R_L	Speaker load	4	8		Ω
P_{OUT}	Output power				
	THD+N = 1%, R_L = 4Ω		1.0	2.2	W
	THD+N = 10%, R_L = 4Ω		1.0	2.7	W
	THD+N = 1%, R_L = 32Ω		1.0	0.34	W

Notes:

25. The PXA270 enables power to the audio subsystem.
26. The output sample rate is fixed, but the input sample rate can be set to 8, 11.025, 22.05, or 44.1 kHz.
27. Specifications are taken from the Cirrus Logic CS4202 Product Datasheet, DS549PP2 July '05.
28. The GCM uses capacitors rated for at least 6.3V.
29. Specifications are taken from the National Semiconductor LM4863 Product Datasheet, DS012881, October 2006.

General

This section provides general specifications for the GCM.

Crystal Frequencies

Agencies certifying the GCM for compliance for radio-frequency emissions typically need to know the frequencies of on-board oscillators. The following table lists the frequencies of all crystals on the GCM.

Crystals	Device	Typ.	Units
X1	PXA320 core	13.000	MHz
X2	PXA320 RTC	32.768	kHz
X3	USB 2.0 Client (optional)	24.000	MHz
X4	AC '97 codec	24.576	MHz
X5	Ethernet	25.000	MHz
X6	RTC	32.768	kHz
X7	ADSmartIO	7.3728	MHz
X8	CAN 2.0B bus	16.000	MHz

Real-Time Clock

The GCM includes a Maxim DS1307 serial real-time clock (RTC) chip to retain the system date and time when the system is powered down. This chip includes non-volatile RAM that is maintained as long as main or backup power is provided to the chip. A long-life battery connected to the RTC supplies backup power. For a description of the RTC function, see Non-volatile Memory, page 13.

Parameter	Typ.	Units
Accuracy per month @ 25°C	+/-55	sec
Internal non-volatile RAM	56	B
Battery	3	V

Environmental

Parameter	Min	Typ.	Max	Units
Commercial operating temperature	0		+70	°C

Appendix A – Reference Information

Product Information

Product notices, updated drivers, support material:

www.eurotech.com

Marvell

Information about the PXA320 processor:

www.marvell.com

CompactFlash

CompactFlash Association and specification:

www.compactflash.org

SDIO Card

SD Card Association and SDIO specification:

www.sdcard.org

MMC Card

JEDEC MMC 4.0 specification:

www.jedec.org

USB

USB specification and product information:

www.usb.org

ISO

International Organization for Standards (ISO) and CAN 2.0B specification:

www.iso.org/iso/home.htm

Xilinx

Information about the control CPLD:

www.xilinx.com

Atmel

Information about the ADSmartIO Controller:

www.atmel.com

Cirrus Logic

Information about the AC ’97 codec:

www.cirrus.com

Maxim

Information about the RTC:

www.maxim-ic.com

National Semiconductor

Information about the audio amplifier:

www.national.com

Appendix B – RoHS Compliance

EUROTECH

The Restriction of the use of certain Hazardous Substances (RoHS) Directive came into force on 1st July 2006. This product shall be designed using RoHS compliant components, and manufactured to comply with the RoHS Directive.

Eurotech has based its material content knowledge on a combination of information provided by third parties and auditing our suppliers and sub-contractor's operational activities and arrangements. This information is archived within the associated Technical Construction File. Eurotech has taken reasonable steps to provide representative and accurate information, though may not have conducted destructive testing or chemical analysis on incoming components and materials.

Additionally, packaging used by Eurotech for its products complies with the EU Directive 2004/12/EC in that the total concentration of the heavy metals cadmium, hexavalent chromium, lead and mercury do not exceed 100ppm.

Appendix C – Board Revision

This manual applies to the current revision of the GCM as given in the following sections.

Identifying the Board Revision

The product revision number of the GCM is etched on the underside of the printed circuit board. That number is 170120-1000x, where "x" is the board revision.

Revision History

The following is an overview of the revisions to the GCM.

Revision 2

Pre-production

Revision 3

Initial release

New Features

Adds support for 1.8 V SD cards

Adds jumper JP1 to JTAG chain

Adds capability to control power to J9 and J10 individually

Adds support for 128 MB NAND Flash memory at 1.8 V

Changes

Improves ESD protection

Changes real-time clock interface from the I^2C_P to the I^2C

Adds embedded Ethernet front end in connector J3

Removes option for 18-bit LCD interface

Revision 4

Second preliminary release

Changes

Changes signals on J6 pin 28 and J6 pin 33

Changes support for USB 2.0 client function as volume production option only

Revision A

Production release

New Features

Adds volume production option for backlight power input

Adds volume production options for USB ports and CSI

Adds additional GPIOs on J21

Adds support for stereo speakers

Changes

Changes SD/MMC 2 from J10 to J9

Changes SD/MMC 1 from J9 to J10

Supports USB 2.0 Client at full speed only

Changes J21 pinout

Changes maximum CPU frequency from 806 MHz to 624 MHz

Removes jumper JP1

Appendix D – Development Kit

GCM development kits are designed to get the developer up and running quickly.

To use the development kit, simply plug the power supply into the receptacle on the GCM.

If the screen does not display anything after five to ten seconds, check the *Frequently Asked Questions*, below. Most operating systems cold boot within twenty seconds.

The GCM development kit consists of the following components:

- GCM single-board computer
- Flat panel display and cable
- Backlight inverter and cable
- Touch panel and cable
- 100-240 VAC power adapter
- Plexiglass mounting
- Developer's Cable Kit including
- Serial Port DB9 adapter (610111-80001)
- DB9 F/F null modem cable
- USB A-B cable
- Operating system of your choice
- User's Guide (this document and operating system guide)

Please make sure you have received ***all*** the components before you begin your development.

Frequently Asked Questions

The following are some of the most commonly asked questions about development kits:

Q: When I plug in power, my screen is white, and nothing comes up on it.

A: Check the connector seating. The flat panel connector may have come loose in shipping. Press it firmly into the panel, and reapply power to your GCM.

Q: When I plug in power, the LEDs do not turn on.

A: Your GCM may still be booting. The LEDs are software-controlled and are not necessarily turned on at boot.

Q: Do I have to turn off the GCM before I insert a CompactFlash card?

A: No. The GCM supports hot swapping of CompactFlash cards. Consult the operating system documentation for details.

Q: Do I need to observe any ESD precautions when working with the GCM?

A: Yes. Where possible, work on a grounded anti-static mat. At a minimum, touch an electrically grounded object before handling the board or touching any components on the board.

Q: What do I need to start developing my application for the GCM?

A: You will need a flash ATA card (32 MB or larger, 128 MB recommended) and the cables supplied with your development kit to interface your development station to the GCM. For further direction, consult the Eurotech guide for the installed operating system.

Q: Who can I call if I need help developing my application?

A: Eurotech provides technical support to get your development kit running. For customers who establish a business relationship with Eurotech, we provide support to develop applications and drivers.

Q: Is there online support?

A: Yes. Information about the GCM hardware and software is available on the Eurotech support site at www.eurotech.com.

Q: Can I upgrade the version of the operating system?

A: Yes. Eurotech provides regular operating system updates on its developers' web site. For operating systems not maintained by Eurotech, contact the operating system vendor.

Q: I would like to interface to a different display panel. How can I do this?

A: Eurotech may have already interfaced to the panel of which you are interested. Consult your local Eurotech sales representative for availability.

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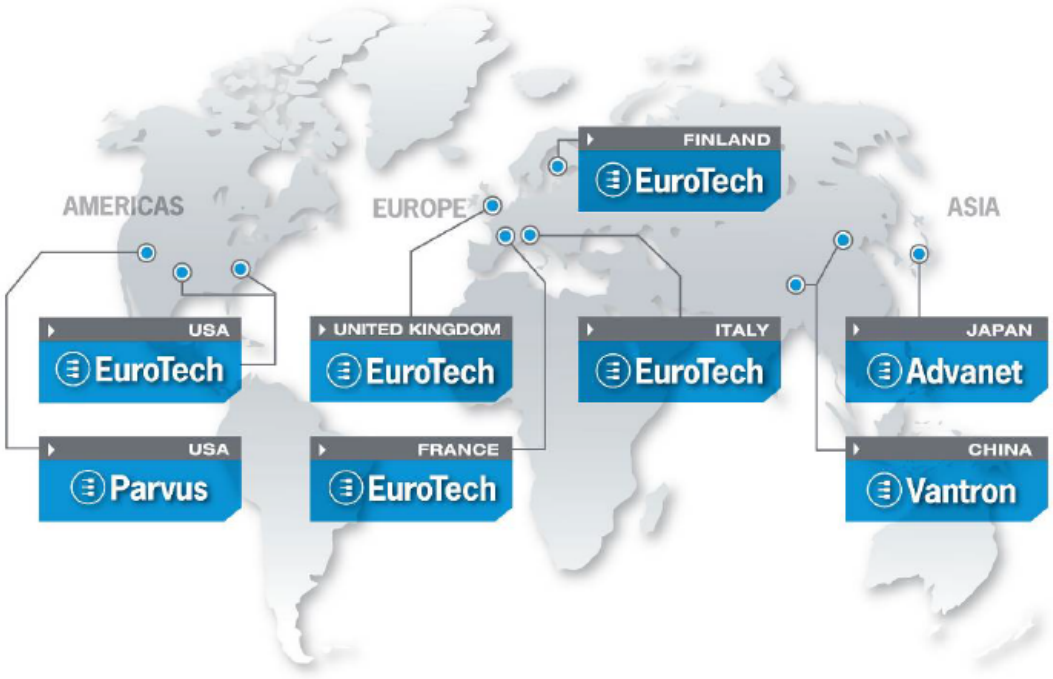

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