G400S

Overview

The G400S System on Module (SoM) is the surface mount version of the G400D. Originally designed for .NET Micro Framework, it now runs several other platforms including TinyCLR.

Pricing, purchasing and other information can be found on the G400S Page on our main website.

Ordering Part Number

- G400S SoM: G400S-SM-480

Specifications

Spec	Value
Processor	Atmel AT91SAM9X35 ARM 926
Speed	400 MHz
Internal RAM	32 KByte (SRAM)
Internal Flash	0 KByte
External RAM	128 MByte (DDR2 SDRAM)
External Flash	4 MByte (SPI)
Dimensions	48.3 x 33.1 x 4.6 mm
Temperature Range	-40 C to +85 C

Note: Not all memory will be available for your application.

Peripherals

Note: Many peripherals share I/O pins. Not all peripherals will be available to your application.

- TinyCLR OS ready
- .NET Micro Framework
- RoHS Lead Free
- 400 MHz ARM 9 Atmel SAM9X35
- 64 Mbytes available RAM
- 1.4 Mbytes available flash
- Embedded LCD controller
- 89 interrupt capable GPIO
- 2 SPI
- 1 I2C
- 6 UART
- 2 CAN
- 4 PWM
- 12 10-bit analog output
- 4-bit SD/MMC memory card interface
- Low power modes
- RTC
- Watchdog
- Threading
- USB host
- USB client
- SQLite database
- TCP/IP with SSL
    - Full .NET socket interface
    - Ethernet
    - PPP
- Graphics
    - Images
    - Fonts
    - Controls
- File System
    - Full .NET file interface
    - SD cards
    - USB drives
- Native extensions
    - Runtime Loadable Procedures
    - Device register access
- Signal controls
    - Generation
    - Capture
    - Pulse measurement

G400S Pinout

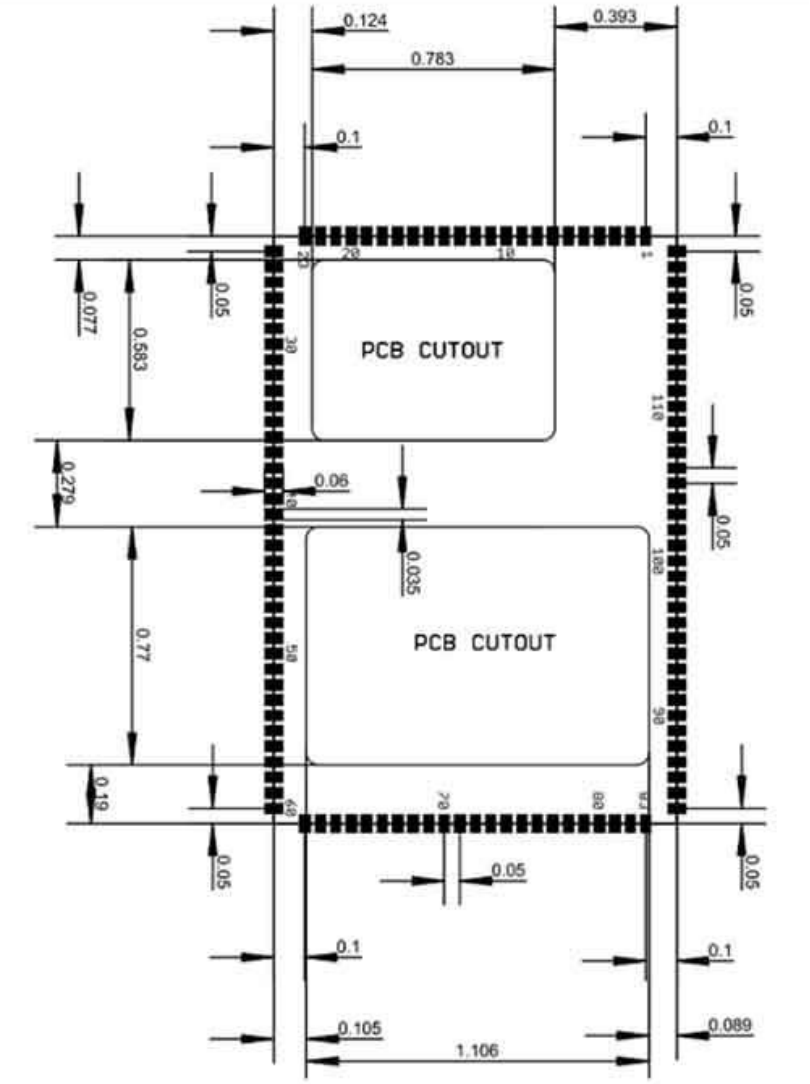
Many signals on the G400 are multiplexed to offer multiple functions on a single pin. Developers can decide on the pin functionality to be used through the provided libraries. Any pin with no name, function, or note must be left unconnected.

Pin	Name	Function	Pin	Name	Function	Pin	Name	Function
1	PD0		41	PB10	ADC11	81	PA23	SPI2 SCK
2	PD4		42		3.3 V	82	PA28	
3			43		VBAT	83[1]	PA31	I2C SCL
4	PA27		44	PB7	ADC8	84		3.3 V
5	PA16	SD CMD	45	PB2		85		
6	PA8	COM4 RX	46	PC0	LCD B0	86		USBC D+
7	PA3	COM2 CTS	47	PC6	LCD G1	87		USBC D-
8	PA2	COM2 RTS	48		1.8 V	88		USBH0 D+
9	PC28	LCD HS	49	PC10	LCD G5	89		USBH0 D-
10	PC23		50	PC3	LCD B3	90		USBH1 D+
11	PC5	LCD G0	51	PC15	LCD R4	91		USBH1 D-
12	PC1	LCD B1	52	PC18	PWM0	92		
13		1.8 V	53		1.0 V	93		RESET
14			54	PC13	LCD R2	94		
15			55	PC31		95		
16		GND	56		GND	96		
17	PB3		57	PC26		97		GND
18	PB1		58	PC30	LCD CLK	98		SPI1 SCK
19			59		SPI1 MOSI	99	PA19	SD D2
20	PB18		60	PB16	ADC5	100	PA21	SPI2 MISO
21	PB8	ADC9	61	PB17	ADC6	101	PA24	LDR0
22	PB14	ADC3	62	PB9	ADC10	102	PA25	MODE
23	PB12	ADC1 / TOUCH YU	63	PB4		103		1.0 V
24	PB6	ADC7	64	PC4	LCD B4	104		
25	PB15	ADC4	65	PC7	LCD G2	105		
26	PB0		66	PC8	LCD G3 / COM5 TX	106	PA6	COM3 RX / CAN2 RD
27	PB5		67	PC14	LCD R3	107	PA17	SD CLK
28	PC2	LCD B2	68	PC16	COM6 TX	108	PA22	SPI2 MOSI
29	PC9	LCD G4 / COM5 RX	69	PC20	PWM2	109	PA26	
30	PC11	LCD R0	70	PC17	COM6 RX	110[1]	PA30	I2C SDA
31	PC12	LCD R1	71	PC27	LCD VS	111	PA29	
32	PC24		72	PC29	LCD OE	112		
33	PA0	COM2 TX	73	PA5	COM3 TX / CAN2 TD	113		
34	PC21	PWM3	74	PA1	COM2 RX	114	PD2	TOUCH XR
35	PC19	PWM1	75		SPI1 MISO	115	PD1	TOUCH YD
36	PC22		76	PA10	COM1 TX / CAN1 TD	116	PD7	
37	PA7	COM4 TX	77	PA9	COM1 RX / CAN1 RD	117	PD3	
38	PA4	LDR1	78	PA15	SD D0	118	PD5	
39	PB11	ADC0	79	PA18	SD D1	119	PD6	
40	PB13	ADC2 / TOUCH XL	80	PA20	SD D3	120		GND

[1]Open drain requiring a 2.2 kΩ pull-up resistor

Footprint

G400S Recommended Footprint



Device Startup

The G400 is held in reset when the reset pin is low. Releasing it will begin the system startup process. It is pulled high internally

There are four different components of the device firmware:

1. GHI Bootloader: initializes the system, updates TinyBooter when needed, and executes TinyBooter.
2. TinyBooter: executes TinyCLR, updates TinyCLR when needed, and updates the system configuration.
3. TinyCLR: loads, debugs, and executes the managed application.
4. Managed application: the program developed by the customer.

Which components get executed on startup can be control by manipulating the LDR0 and LDR1 pins. LDR0 and LDR1 are pulled high on startup.

LDRO	LDR1	Effect
Ignored	High	Execute the managed application
High	Low	Wait in TinyBooter
Low	Low	Wait in GHI Bootloader

Additionally, the communications interface between the host PC and the G400 is selected on startup through the MODE pin, which is pulled high on startup. The USB interface is selected when MODE is high and COM1 is selected when MODE is low.

The above discussed functions of LDR0, LDR1, and MODE are only during startup. After startup, they return to the default GPIO state and are available to use as GPIO in the user application.

.NET Micro Framework (NETMF)

The NETMF software on G400 is mature and complete. For more information on NETMF you can go to the NETMF Introduction page. The NETMF Getting Started page covers NETMF from setup of the host computer to program deployment on both an emulator and target device.

Bootloader v1 is needed for G400 to work with NETMF. It is available in the NETMF SDK.

TinyCLR OS

TinyCLR OS provides a way to program the G400 in C# or Visual Basic from the Microsoft Visual Studio integrated development environment. To get started you must first install the bootloader and TinyCLR OS firmware (instructions below) and then go to the TinyCLR Getting Started page for instructions.

Loading Bootloader Version 2

Download the G400 bootloader v2 file and load onto the dataflash. The SAM-BA Bootloader has the details.

Loading the Firmware

1. Activate the bootloader, hold the LDR0 signal (pin 101) low while resetting the board.
2. Open TinyCLR Config tool.
3. Click the loader tab.
4. Select the correct COM port. If you are not seeing it then the device is not in the loader mode.
5. Click the `Update to Latest` button.

You can also update the firmware manually. Download the firmware and learn how to use the GHI Bootloadermanually.

Start Coding

Now that you have installed the bootloader and firmware, you can setup your host computer and start programming. Go to the TinyCLR Getting Started page for instructions.

Code Samples

For some examples of using TinyCLR, take a look at the TinyCLR Samples repo. You may also find the TinyCLR tutorials useful.

Native Code

TinyCLR OS also lets you use native code that works alongside your managed application. Native code can be used to provide improved performance or access to advanced features not exposed through TinyCLR. For more information check out Native Code on TinyCLR.

The memory area reserved for native code in TinyCLR OS on G400S starts at 0x26700000 and its length is 0x16FFFF8.

Datasheet

This documentation page replaced the legacy datasheet PDF but it is here for reference.

CAN Bit Timing Settings

The following CAN bit timing parameters were calculated for a G400 driving the SN65HVD230 CAN driver chip. See the Configuring the Bus section of the CAN Tutorial for more information.

Baud	Propagation	Phase1	Phase2	Baudrate Prescaler	Synchronization Jump Width	Use Multi Bit Sampling	Sample Point	Max Osc. Tolerance	Max Cable Length
83.333K	7	4	1	99	0	False	87.5%	0.31%	845M
125K	7	1	1	81	0	False	84.6%	0.38%	499M
250K	7	1	1	40	0	False	84.6%	0.38%	222M
500K	7	7	1	13	1	False	89.5%	0.41%	92M
1M	7	7	1	6	1	False	89.5%	0.41%	19M

Note: Maximum Oscillator Tolerance and Maximum Cable Length are theoretical maximums and must be tested to ensure reliability.

Design Considerations

Required Pins

Exposing the following pins is required in every design to enable device programming, updates, and recovery:

- LDR0
- LDR1
- Reset
- Desired debug interface(s)
- MODE if required to select a debug interface
- SPI1 MISO to update TinyBooter in SDK 2015 R1 and earlier and to install the GHI Bootloader once for SDK 2016 R1 and later

Power Supply

A typical clean power source, suited for digital circuitry, is needed to power the G400. Voltages should be within at least 10% of the needed voltage. Decoupling capacitors of 0.1 µF are needed near every power pin. Additionally, a large capacitor, typically 47 µF, should be near the G400 if the power supply is more than few inches away. Additionally, the G400 requires additional voltages beyond the typical 3.3 V to function properly. See the pinout table for details.

Crystals

The G400 includes the needed system and RTC crystals and their associated circuitry.

SPI Channels

SPI1 is shared internally with the flash memory on the G400. Use of a chip select with devices on this channel is required or the G400 will not function properly. The use of another SPI channel is recommended.

Ethernet

The built in Ethernet available on the G400D includes all needed Ethernet circuitry internally. However, an appropriate magnet and connector, like the J0011D or similar, are required.

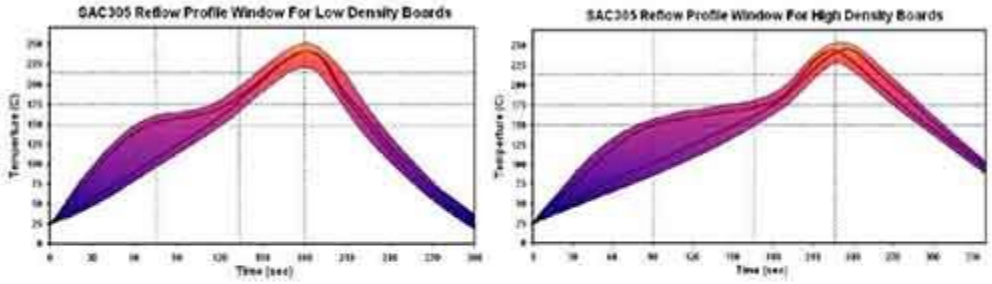
Soldering the G400S

The G400S is designed to be easily machine-placed or hand-soldered. Static sensitive precautions should be taken when handling the module.

Oven Reflow

The G400S is not sealed for moisture. Baking the module before reflow is recommended and required in a humid environment. The process of reflow can damage the G400 if the temperature is too high or exposure is too long.

The lead-free reflow profile used by GHI Electronics is shown below. The profiles shown are based on SAC 305 solder (3% silver, 0.5% copper). The thermal mass of the assembled board and the sensitivity of the components on it affect the total dwell time. Differences in the two profiles are where they reach their respective peak temperatures as well as the time above liquids (TAL). The shorter profile applies to smaller assemblies, whereas the longer profile applies to larger assemblies such as back-planes or high-density boards. The process window is described by the shaded area. These profiles are only starting-points and general guidance. The particulars of an oven and the assembly will determine the final process.



RATE OF RISE 2°C / SEC MAX	*RAMP TO 150°C (302°F)*	*PROGRESS THROUGH 150°C-175°C (302°F-347°F)*	*TO PEAK TEMP 230°C-245°C (445°F-474°F)*	*TIME ABOVE 217°C (425°F)*	*COOLDOWN ≤ 4 °C / SEC*	*PROFILE LENGTH AMBIENT TO COOL DOWN*
Short Profiles	≤ 75 Sec	30-60 Sec	45-75 Sec	30-60 Sec	45± 15 Sec	2.75-3.5 Min
Long Profiles	≤ 90 Sec	60-90 Sec	45-75 Sec	60-90 Sec	45± 15 Sec	4.5-5.0 Min

Legal

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