MAID-000002-ID0001

RFID WiFi Asset Tag

M/A-COM Products
Rev 1.2. 10/5/08

Features

- Equivalent feature set and performance to the G2 Microsystems 501RT01 reference tag
- ISO 24730 RTLS functionality
- Single-axis 125kHz Magnetic receiver for sign post functionality
- EPC Generation 1, Class One passive RFID interface
- Motion & temperature sensing
- Sensor expansion connector
- General purpose pushbutton
- Bicolor LED
- CR123A replaceable battery
- Dual UARTS for application and debug
- External power interface/control via a TIM module
- Multiple means for attaching the tag to people and equipment

Description

The 501 WiFi Reference tag is intended as a demonstration and pilot vehicle to fully expose the many features and benefits of the G2 Microsystems family of silicon products. The tag allows easy developer access via an externally available expansion header which mates with the TIM (Tag Interface Module).

The total cost of ownership (TCO) of wireless 802.11b-based systems is lower than solutions based on proprietary technology because the 802.11b-based system leverages existing infrastructure and fixed maintenance costs.

Product Image

Temperature Ratings

Parameter	Absolute Maximum
Storage Temperature	-40ºC to +85ºC
Operating Temperature	-20ºC to +70ºC

Electrical Specifications

Parameter	Units	Typical	Condition
		20ºC	
Maximum Leakage Current	uA	< 20	Tag in sleep mode
Operating Current	mA	60	WiFi RX enabled
		580	WiFi TX enabled @ 20dBm output power
		30	RISC core operating, WiFi RX & TX disabled
WiFi Output Power	dBm	20 ± 1 dB	To antenna input, across all channels
ISO 24730-2 Output Power	dBm	20	2.4 GHz, to antenna input, across all channels

ADVANCED: Data Sheets contain information regarding a product M/A-COM is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
PRELIMINARY: Data Sheets contain information regarding a product M/A-COM has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

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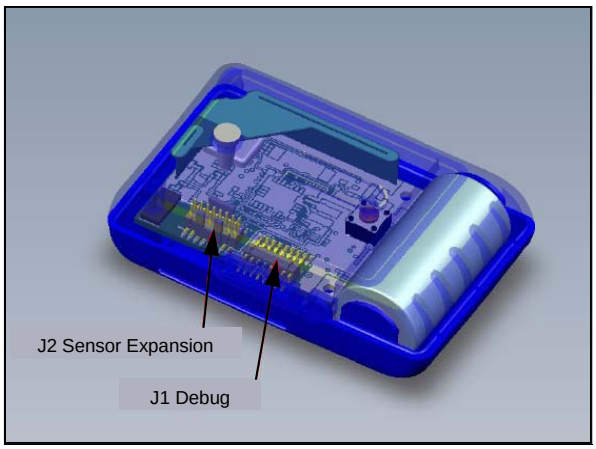
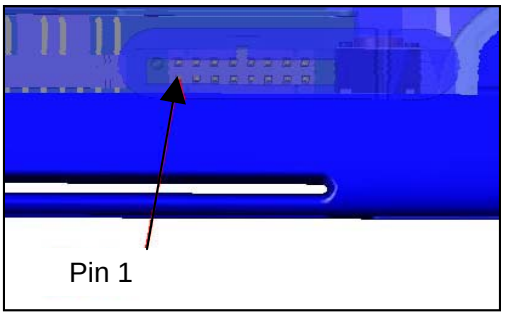


Debug Interface, External, J1

- Connector type: 1.27mm Samtec FTSH-108-01-F-MT
- Mating connector/cable: Samtec FFSD-08-S-09.00-01-N-RW



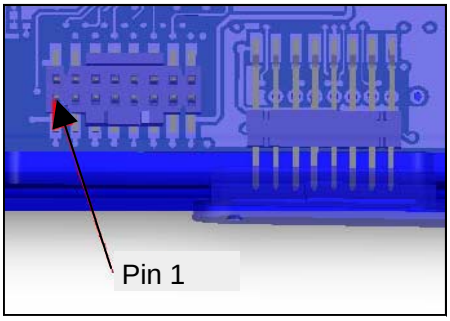
Pin	Description
1	Tag GND
2	VDD_BATT (1.8 -3.6V)
3	UART: Debug Tx
4	UART: User Rx
5	SHDN_Regs
6	RESET (Active –low)
7	UART: Debug Rx
8	UART: User Tx

Pin	Description
9	VDD_BATT (1.8-3.6V)
10	Tag GND
11	JTAG: TRST
12	JTAG: TMS
13	JTAG: TDI
14	JTAG: TDO
15	JTAG: TCK
16	PWRDN (Active-low). Disconnects the battery automatically when the TIM2 module is plugged into the debug header

All of the J1 signals except power and ground are bypassed for ESD protection by a 5.5V varistor, Inpaq MLVS0402M04, to tag ground followed by a 220 ohm series resistor to the chip pin.

Sensor Expansion Header, internal, J2

- Connector Type: Samtec FTSH-108-01-F-DV-K
- Mating Connector: Samtec FFSD



Pin	Description
1	Tag GND
2	VDD_3V3 from on-chip regulator
3	SENSOR IF0- Normally open- shared with thermistor calibration resistor onboard tag
4	Sensor IF6
5	SENSOR IF1- Normally open- shared with onboard thermistor
6	Sensor IF7
7	Sensor IF2
8	GPIO2
9	SENSOR IF3- Normally open- shared with onboard tilt/ motion sensor
10	GPIO4 – Normally open- shared with red LED
11	SENSOR IF4- Normally open- shared with magnetic receiver
12	GPIO5- Normally open- shared with green LED
13	SENSOR IF5- Normally open- magnetic receiver return
14	GPIO6
15	VDD_3V3_SW- Switched 3.3V output from GC501, pin 43
16	MAG_ACT – Internally connected to VDD_DIG with 10K resistor

Caution: The internal sensor expansion connector does not have ESD bypass on the sensor/GPIOs. See 501 RT01 reference tag schematic for details on sensor stuff options.

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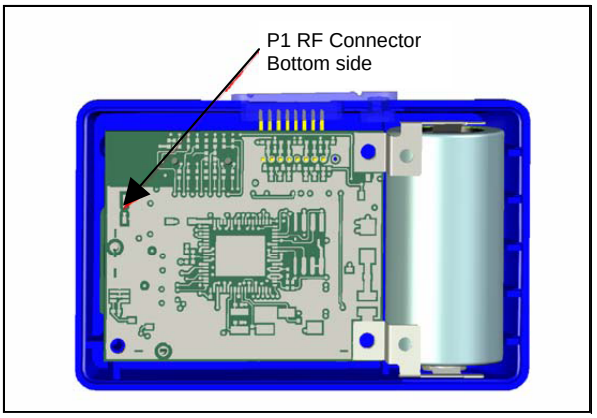


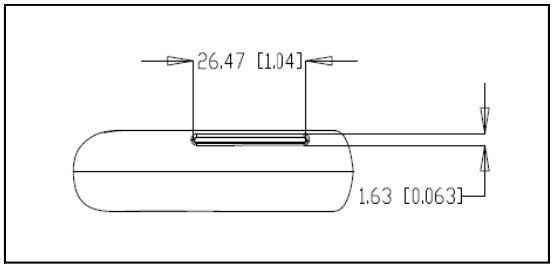
P1 connector type: Murata MM8430-2600B
Mating Cable: Murata MXGS83RK3000

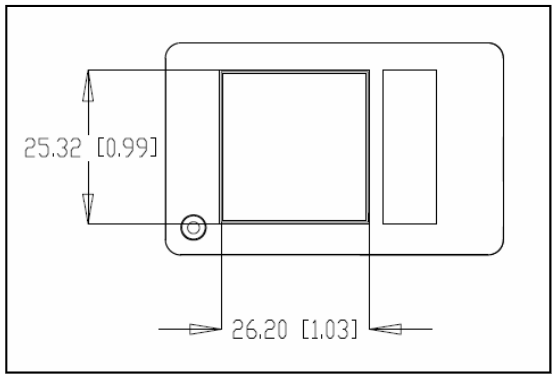
Mechanical Specifications

Parameter	Units	Typical	Condition
Length	mm	65.4	
Width	mm	41.4	
Height	mm	19.0	
Weight	grams	42	With battery installed

Mounting details and dimensions

- The rear of the tag has a cutout for using nylon tie wraps, Velcro, sticky-backed tape, and/or nylon webbing for attachment to various surfaces and objects.





Signal	Description
GPIO_0	UART: User Tx
GPIO_1	UART: User Rx
GPIO_2	Connected to expansion header
GPIO_3	Antenna diversity switch: Logic low selects ANT1; logic high selects ANT2
GPIO_4	Red LED, shared with expansion header
GPIO_5	Green LED, shared with expansion header
GPIO_6	Connected to expansion header
GPIO_7	Antenna diversity switch. Hardware control only via overlay function. Logic high during Rx, logic low during Tx
GPIO_8	Antenna diversity switch. Hardware control only via overlay function. Logic high during Tx, logic low during Rx.
GPIO_9	Power Amp Enable. Hardware control only via overlay function. Logic high during Tx, logic low during Rx

Signal	Description
Sensor_IF0	10K calibration resistor, shared with exp. connector
Sensor_IF1	Thermistor, shared with exp. connector
Sensor_IF2	Push button, shared with exp. connector
Sensor_IF3	Tilt/vibration sensor, shared with exp. connector
Sensor_IF4	Magnetic Receiver, shared with exp. connector
Sensor_IF5	Magnetic Receiver return, shared with exp. connector
Sensor_IF6	Expansion connector
Sensor_IF7	Expansion connector

Environmental

- Humidity: 10- 90%, non-condensing- no hermetic sealing
- International Protection standards rating per IEC60529: IP61- Protected against dust and dripping water
- Shock (target): 50G; DIN IEC 68-2-27
- Vibration (target):
  - 3 G; 20 sine wave cycles; 5 Hz to 150 Hz; DIN IEC 68-2-6
  - 5 G; noise 5Hz to 1000Hz; 30 minutes; DIN IEC 68-2-64
- Drop (target): 1 meter multiple drops to concrete on corners and edges

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Additional Features

- Power-On Reset (POR): The POR circuit effectively guarantees reliable tag operation during low-battery/ brownout conditions.
- Two dedicated antennas are connected to the 2.4GHz path through a diversity switch: a multi-layer ceramic antenna and an IFA (Inverted F Antenna).
- A 125KHz magnetic receiver coil is oriented along the long axis of the tag. The recommended component is a Coilcraft 4308TC-335XGB RFID transponder coil (or equivalent).
- The diversity switch allows for selection of the monopole or chip antenna, depending on the configuration of GPIOs 3, 7 and 8.
- A bicolor LED module is used for both general-purpose signaling and debug status. There are four possible states: red, green, amber and off.
- Sensors include tilt/vibration and temperature
- An SPI-based 4 Mbit serial flash is used. The flash size is easily adjusted for 1Mbit, 2Mbit or 4Mbit storage This product RoHS compliant and is lead-free in both components and assembly processes
- G2-based tags must establish a network connection through the nearest access point which may be owned by the asset's owner, a partner or any third party such as an urban network. Depending on the level of security for thenetwork, a G2-based tag can send information to the location server via the following methods:
  - Direct via an open network (no authentication is required).
  - Full authentication in a highly secured network using 802.11i security protocols such as WEP, WPA, and EAP-TLS.
  - One-way communication protocols on a highly secured network to send small amounts of position and sensor data from a tag to the location server. These protocols are supported by various network vendors and do not require the tag to authenticate with the WLAN access point.
  - Virtual Local Area Networks (VLANs) which can separate network traffic into multiple virtual networks on the same physical infrastructure such as an authenticated LAN and a non-authenticated LAN. This ensures network security of the authenticated traffic is not compromised eliminating the need for keys with the inherent problems of key management and distribution. To secure the communications, application-level cryptography can be used between the tags and the location server.
- FCC
  - FCC Part 15, sub-part C, Class B Digital Devices
  - FCC Part 15.247 Operation in the 2400 to 2483.5 MHz Frequency range
  - FCC ID: VXW-35657C18
  - FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment to an outlet on a circuit different from that to which the
receiver is connected.
4. Consult the dealer or an experienced radio/TV technician.
This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation.

- FCC Warning

Modifications not expressly approved by the manufacturer could void the users authority to operate the equipment under FCC Rules

- Radio Frequency Exposure Level

This equipment has been evaluated in accordance with the FCC bulletin 56 "Hazards of radio frequency and electromagnetic fields" and bulletin 65 " Human exposure to radio frequency and electromagnetic fields. Safe operation in an uncontrolled environment will result if the following distances from the device are maintained as a minimum.

A distance greater than or equal to 20 cm from the device should be maintained.

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Additional Features (cont'd)

- MULTIPLE LOCATION TECHNOLOGIES

G2-based tags support multiple location technologies allowing the user to choose the best one based on the accuracy requirements and environment for example, inside an office building, outdoors, in a factory or warehouse. Although leveraging Wi-Fi results in the lowest cost solution, in some situations other technologies work better.

– 125 KHZ SIGN POST

The G2C501 also has integrated support for 125 kHz sign post technology. Conceptually similar in operation to EPC, sign post technology sends a signal from the tag with identification information when a tag passes within 25-feet of a sign post. These sign posts can also reconfigure tags or send information to them, which is important in some applications. Sign post systems require a dedicated infrastructure to be deployed.

– TDOA

For outdoor or factory environments, or where greater location accuracy is required, G2-based tags support the ISO 24730 standard (which is a superset of the ANSI 371.1 standard and is in the process of being ratified). This standard utilizes TDOA (Time Delay of Arrival) for location computation and can achieve 6-foot accuracy.

Since the G2C501 integrates support for multiple location technologies, a single G2-based tag can travel through different environments, using the location technology that is best suited for each application or environment.

For example, a tagged automobile engine could be identified by EPC as it arrives at a manufacturing facility. It could be tracked through the manufacturing line and out to the finished goods lot with the ISO 24730 protocol. The tag could be reprogrammed with the 125 kHz sign post, and the automobile can then be tracked to the dealer lot via Wi-Fi.

Configuring tags over- the-air using an 802.11 connection saves set-up time. This benefit becomes quite important when the number of tags in a deployment scales to the thousands. It is also key for reprogramming a group of tags - if you want to turn off all the tags in a warehouse; you can do this most easily with 802.11 since the range is up to 600 feet.

- ULTRA LOW-POWER CONSUMPTION

For an active RFID tag solution to be viable, it must be capable of operating without maintenance for long periods of time, often measured in years. A major design focus of G2 Microsystems has been the minimization of power consumption to obtain the maximum possible battery life.

The power conservation architecture operates in two modes: an active mode and a sleep mode. In active mode, the G2C501 manages all functions of the tag so that power is supplied to a particular function only for the time needed. This is particularly important as the frequency of reporting increases.

Having ultra-low standby power allows the tags to extend battery life to years compared to similar devices that today last for just months or even weeks. Depending on the battery selected for the tag, the reporting frequency, and the application requirements, battery life can be as high as seven years.

- SENSOR INPUTS

In addition to real-time locating services and WiFi communications, the G2C501 is equipped with sensor inputs and control outputs. The sensor inputs provide a mechanism for a tagged asset and its environment to be monitored, thus allowing identification of improperly stored goods before damage occurs. For example, if food products are stored outside their recommended temperature, the tag can send an alarm before the item deteriorates allowing the situation to be rectified.

Typical parameters that can be monitored include temperature, humidity, pressure, security seals, motion, shock, light, and radiation. The tags can be designed to monitor temperature to a fraction of a degree, humidity to within several percent, and shock over the ranges that are useful for detecting damage induced by mishandling (for example, dropping).

A tag may be programmed to monitor certain sensor inputs on a routine basis and store the measurements for subsequent reporting. Alternatively, an event may trigger the transmission of a report, for example, the breaking of a security seal or a temperature reaching a pre-set alarm value. Since the tag can store sensor data, a full tracking history of a tagged asset is available and may be accessed whenever the tag establishes a suitable wireless connection. Tags can also store the limits for monitored parameters, only sending reports when such limits are exceeded.

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