



BTM420/421 DATA MODULE

USER MANUAL

VERSION 3.0

global solutions: local support™

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REVISION HISTORY

| Revision | Date | Description | Approved By |
|----------|--------------|--|---------------|
| 1.0 | 22 June 2010 | Initial Release | Jonathan Kaye |
| 2.0 | 28 May 2012 | Changes and Revisions | Jonathan Kaye |
| 3.0 | 04 Jan 2013 | Formatting, New Hardware Diagrams, FCC Statement updates | Jonathan Kaye |

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OVERVIEW AND KEY FEATURES

The BTM420 and BTM421 Bluetooth modules from Laird Technologies have been designed to meet the needs of developers who wish to add robust, short range Bluetooth data connectivity to their products and who are using embedded Bluetooth stacks within their products. They are based on the market leading Cambridge Silicon Radio BC04 chipset, providing exceptionally low power consumption with outstanding range. They support the latest Bluetooth Version 2.1 Specification with EDR (Enhanced Data Rate). As well as increasing data throughput up to 2.1 Mbps, this provides the important advantage of Secure Simple Pairing, which improves security and enhances the ease of use for end customers.

With physical sizes as small as 12.5mm x 18.0mm and best of class, low power performance, these modules are the ideal choice for applications where designers need both performance and minimum size. For maximum flexibility in systems integration, the modules are designed to support separate power supplies for I/O and the USB interface.

These modules present an HCI interface through a USB interface and are fully qualified as Bluetooth Controller Subsystem Products. This allows designers to integrate them existing pre-approved Bluetooth Host and Profile subsystem stacks to gain a Bluetooth END product approval for their product.

A low cost developer's kit is available for prototyping. This ensures that the choice of Laird Technologies Bluetooth modules guarantees the fastest route to market.

Features and Benefits

- Bluetooth v2.1+EDR
- Adaptive Frequency Hopping to cope with interference from other wireless devices
- Support for Secure Simple Pairing
- External or internal antenna options
- HCI Interface over USB
- Bluetooth controller subsystem product qualified
- Compact size
- Class 2 output – 4dBm
- Low power operation
- USB interface
- Multipoint Support
- PCM & SCO for external codec
- Wi-Fi coexistence hardware support

Application Areas

- Embedded devices
- Phone accessories
- Security devices
- Medical and wellness devices
- Automotive applications
- Bluetooth® advertising
- ePOS

SPECIFICATIONS

Detailed Specifications

Table 1: Detailed Specifications

| Categories | Feature | Implementation |
|---------------------------|-----------------------------|--|
| Wireless Specification | Bluetooth® | Version 2.1+EDR |
| | Transmit Class | Class 2 |
| | Frequency | 2.402 – 2.480 GHz |
| | Channels | 79 channels Frequency Hopping Adaptive Frequency Hopping |
| | Max Transmit Power | +4 dBm at antenna pad – BTM420 +4 dBm (TBC) from integrated antenna – BTM421 |
| | Receive Sensitivity | -84dBm |
| | Range | 30m |
| | Data Transfer Rate | Up to 2.1 Mbps |
| | | |
| Antenna Modes | External Antenna | 50 Ohm matched SMT pad – BTM420 |
| | Integrated Antenna (option) | +0 dB multiplayer ceramic (TBC) – BTM421 |
| USB Interface | Compliance | Version 1.1 |
| | Support | Version 2.0 |
| | Supply Voltage | 3.1 V to 3.3 V |
| General Purpose Interface | I/O | 2 general purpose I.O pins for LEDs |
| Audio | Support | 3 PCM Channels @ 64kbps |
| | SCO Channels | Support SCO and eSCO |
| | PCM Interface | Configurable as master or slave |
| | | 8 bit A-law 8 bit μ -law 13 bit linear PCM Clock available when in slave mode |
| Protocols and Firmware | Bluetooth Stack | V2.1 compliant |
| | Connection Modes | Point to point (cable replacement) Multipoint – max 7 slaves |

BTM420/421

Bluetooth® Data Module

Table 2: Detailed Specifications

| Categories | Feature | Implementation |
|-----------------------------|-----------------------|---|
| Current Consumption | Data Transfer | Typically 32 mA |
| | Low Power Sniff Mode | Less than 2.5 mA |
| Supply Voltage | Supply | 3.0 V – 3.3 V DC |
| Coexistence / Compatibility | WLAN (802.11) | 2-wire and 3-wire hardware coexistence schemes supported |
| Connections | Interface | Surface Mount Pads |
| | External Antenna | Pad for 50 Ohm antenna – BTM420 |
| Physical | Dimensions | 12.5 mm x 18.0 mm x 3.4 mm – BTM420 12.5 mm x 24.0 mm x 3.4 mm – BTM421 |
| | Weight | 3 grams |
| Environmental | Operating Temperature | -30°C to +70°C |
| | Storage Temperature | -40°C to +85°C |
| Approvals | Bluetooth | Qualified as a Controller Subsystem Product |
| | FCC | Limited Modular Approval – BTM420 Modular approval (Integrated Antenna option – BTM 421) |
| | CE & R&TTE | Meets CE and R&TTE requirements |
| Miscellaneous | Lead free | Lead-free and RoHS compliant |
| | Warranty | 12 Months |
| Development Tools | Development Kit | Development board |

Pin Definitions

Table 3: Pin Definitions

| Pin | Signal | Description | Voltage Specification |
|-----|------------------|-------------------------------------|-----------------------|
| 1 | Unused | | |
| 2 | GND | | |
| 3 | Unused | | |
| 4 | Unused | | |
| 5 | Unused | | |
| 6 | Unused | | |
| 7 | GND | | |
| 8 | SPI_CSB | SPI bus chip select I/P | VIO |
| 9 | SPI_MISO | SPI bus serial O/P | VIO |
| 10 | SPI_MOSI | SPI bus serial I/P | VIO |
| 11 | SPI_CLK | SPI bus clock I/P | VIO |
| 12 | VDD_USB | USB & UART supply voltage | |
| 15 | GND | | |
| 16 | PCM_IN | PCM clock I/P | VIO |
| 17 | PCM_SYNC | PCM sync I/P | VIO |
| 18 | PCM_CLK | PCM click I/P | VIO |
| 19 | PCM_OUT | PCM Data O/P | VIO |
| 20 | RESET | Module reset I/P | See note 2 |
| 21 | Unused | | |
| 22 | GPIO2 / UART_DCD | I/O for host | VIO |
| 23 | GND | | |
| 24 | Unused | | |
| 25 | Unused | | See note 3 |
| 26 | Unused | | See note 3 |
| 27 | Unused | | See note 3 |
| 28 | GND | | See note 3 |
| 29 | ANT (BTM420) | Antenna connection (50 ohm matched) | See note 3 |
| 30 | GND | | See note 3 |
| 31 | Unused | | See note 3 |
| 32 | Unused | | See note 3 |
| 33 | Unused | | See note 3 |
| 34 | Unused | | See note 3 |
| 35 | Unused | | See note 3 |
| 36 | Unused | | See note 3 |
| 37 | Unused | | See note 3 |
| 38 | Unused | | |
| 39 | Unused | | |
| 40 | Unused | | |

| Pin | Signal | Description | Voltage Specification |
|-----|-----------------|--------------|-----------------------|
| 41 | GND | | |
| 42 | GPIO1 / UART_RI | I/O for hose | VIO |
| 43 | Unused | | |
| 44 | Unused | | |
| 45 | GND | | |
| 46 | D- | USB D- | VUSB |
| 47 | D+ | USB D+ | VUSB |
| 48 | Unused | | |
| 49 | Unused | | |
| 50 | Unused | | |

1. Unused pins may have internal connections and must not be connected.
2. Reset input is active low. Input is pulled up to VDD_IN via 22k. Minimum reset pulse width is 5 ms.
3. Pins 25-37 should be left not connected on modules with integrated antennae (BTM411, BTM421 and BTM431)

Operating Parameters

Table 4: Recommended Operating Conditions

| Recommended Operating Conditions | | |
|--|-----|-----|
| OPERATING CONDITION | MIN | MAX |
| VDD_USB (USB compatibility not required) | 1.7 | 3.6 |
| VDD_USB (USB compatibility required) | 3.1 | 3.6 |
| VDD_IO | 1.7 | 3.3 |
| VDD_IN | 3.0 | 3.3 |

Voltage Specifications

Table 5: Logic Levels (VUSB)

| Logic Levels (VUSB) | | | |
|---|---------------|-----|------|
| INPUT VOLTAGE LEVELS | MIN | TYP | MAX |
| V_{ih} | 0.7VDD_USB | | |
| V_{il} 2.7 < VDD_USB < 3.0 | -0.4 | | +0.8 |
| 1.7 < VDD_USB < 1.9 | -0.4 | | +0.4 |
| Output Voltage Levels (1.7 < VDD_USB < 1.9) | | | |
| V_{oh} (Iout = -4mA) | VDD_USB – 0.4 | | |
| V_{ol} (Iout = 4mA) | | | |
| Output Voltage Levels (2.7 < VDD_USB < 3.0) | | | |
| V_{oh} (Iout = -4mA) | VDD_USB – 2.0 | | |
| V_{ol} (Iout = 4mA) | | | 0.2 |

Note: VDD_USB must be connected to power the USB and UART interfaces.

Table 6: Logic Levels (VIO)

| Logic Levels (VIO) | | | |
|--|--------------|-----|------|
| INPUT VOLTAGE LEVELS | MIN | TYP | MAX |
| V_{ih} | 0.7VDD_IO | | |
| V_{il} 2.7 < VDD_IO < 3.0 | -0.4 | | +0.8 |
| 1.7 < VDD_IO < 1.9 | -0.4 | | +0.4 |
| Output Voltage Levels (1.7 < VDD_IO < 1.9) | | | |
| V_{oh} (Iout = -4mA) | VDD_IO – 0.4 | | |
| V_{ol} (Iout = 4mA) | | | 0.4 |
| Output Voltage Levels (2.7 < VDD_IO < 3.0) | | | |
| V_{oh} (Iout = -4mA) | VDD_IO – 0.2 | | |
| V_{ol} (Iout = 4mA) | | | 0.2 |

FCC REGULATORY STATEMENTS

BTM420 FCC and Industry Canada Statements

The Final Equipment user manual must show the following statements:

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

Considerations for OEM integration:

This module has a limited modular approval. Approval with any other antenna configuration or layout other than that approved will necessitate additional radiated emission testing to be performed.

To inherit the modular approval, the antennas for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This module was approved with the following antenna:

- RF Solutions: ANT-24G-WHJ-SMA 0 dBi

Operation of this module with any other antenna will require additional testing to be performed.

Co-location with other radio transmitting devices operating concurrently in the same band will require additional testing and certification.

Designers should note the distinction that the FCC makes regarding portable and mobile devices. Mobile devices are defined as products that are not used closer than 20 cm to the human body, whereas portable devices can be used closer than 20 cm to the body. A device may be used in portable exposure conditions with no restrictions on host platforms when the averaged output power is less than the low power threshold for an uncontrolled environment $\leq 60/f(\text{GHz})$ i.e. 25 mW for a 2.4 GHz device. The Maximum Power Exposure for the BTM420 has been evaluated and found to comply with the low power threshold for an uncontrolled environment.

Refer to FCC document KDB 447498 for more information on RF exposure procedures and equipment authorization policies for mobile and portable devices.

FCC Labelling requirement

If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PI4420B" or "Contains FCC ID: PI4420B." Any similar wording that expresses the same meaning may be used.

BTM421 FCC and Industry Canada Statements

The user manual must show the following statements:

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

Considerations for OEM integration:

To inherit the modular approval, the antennas for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Co-location with other radio transmitting devices operating concurrently in the same band will require additional testing and certification.

Designers should note the distinction that the FCC makes regarding portable and mobile devices. Mobile devices are defined as products that are not used closer than 20 cm to the human body, whereas portable devices can be used closer than 20 cm to the body. A device may be used in portable exposure conditions with no restrictions on host platforms when the averaged output power is less than the low power threshold for an uncontrolled environment $\leq 60/f(\text{GHz})$ i.e. 25 mW for a 2.4 GHz device. The Maximum Power Exposure for the BTM421 has been evaluated and found to comply with the low power threshold for an uncontrolled environment.

Refer to FCC document KDB 447498 for more information on RF exposure procedures and equipment authorization policies for mobile and portable devices.

FCC Labelling requirement

If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PI4421B" or "Contains FCC ID: PI4421B." Any similar wording that expresses the same meaning may be used.

EU DECLARATION OF CONFORMITY – BTM420

| | |
|------------------------|--------------------|
| Manufacturer: | Laird Technologies |
| Product: | BTM420 |
| EU Directive: | RTTE 1995/5/EC |
| Conformity Assessment: | Annex IV |

Reference standards used for presumption of conformity:

| Article Number: | Requirement: | Reference standard(s): |
|-----------------|---|---|
| 3.1a | Health and Safety | EN 60950-1:2006 |
| 3.1b | Protection requirements with respect to electromagnetic compatibility | EN 301 489-1 V1.8.1 EN 301 489-17 V2.1.1 Emissions: EN55022:2006/A1:2000/A2:2006 (ClassB) Immunity: EN61000-4-2:1995/A1:1998/A2:2001 EN61000-4-3:2002/A1:2002 |
| 3.2 | Means of the efficient use of the radio frequency spectrum | EN 300 328 V1.7.1 (2006-10) |

Declaration:

We, Laird Technologies, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Directive 1995/5/EC, when used for its intended purpose.

| | |
|----------------------------|---|
| Place of Issue: | Laird Technologies Saturn House, Mercury Park Wooburn Green HP100HH, United Kingdom tel: +44 (0)1628 858 940 fax: +44 (0)1628 528 382 |
| Date of Issue: | October 2009 |
| Name of Authorised Person: | Tim Wheatley, Director of Engineering |
| Signature: | |

EU DECLARATION OF CONFORMITY – BTM421

| | |
|------------------------|--------------------|
| Manufacturer: | Laird Technologies |
| Product: | BTM421 |
| EU Directive: | RTTE 1995/5/EC |
| Conformity Assessment: | Annex IV |

Reference standards used for presumption of conformity:

| Article Number: | Requirement: | Reference standard(s): |
|-----------------|---|--|
| 3.1a | Health and Safety | EN 60950-1:2006 |
| 3.1b | Protection requirements with respect to electromagnetic compatibility | EN 301 489-1 V1.8.1 EN 301 489-17 V2.1.1 Emissions: EN55022:2006/A1:2000/A2:2006(ClassB) Immunity: EN61000-4-2:1995/A1:1998/A2:2001 EN61000-4-3:2002/A1:2002 |
| 3.2 | Means of the efficient use of the radio frequency spectrum | EN 300 328 V1.7.1 (2006-10) |

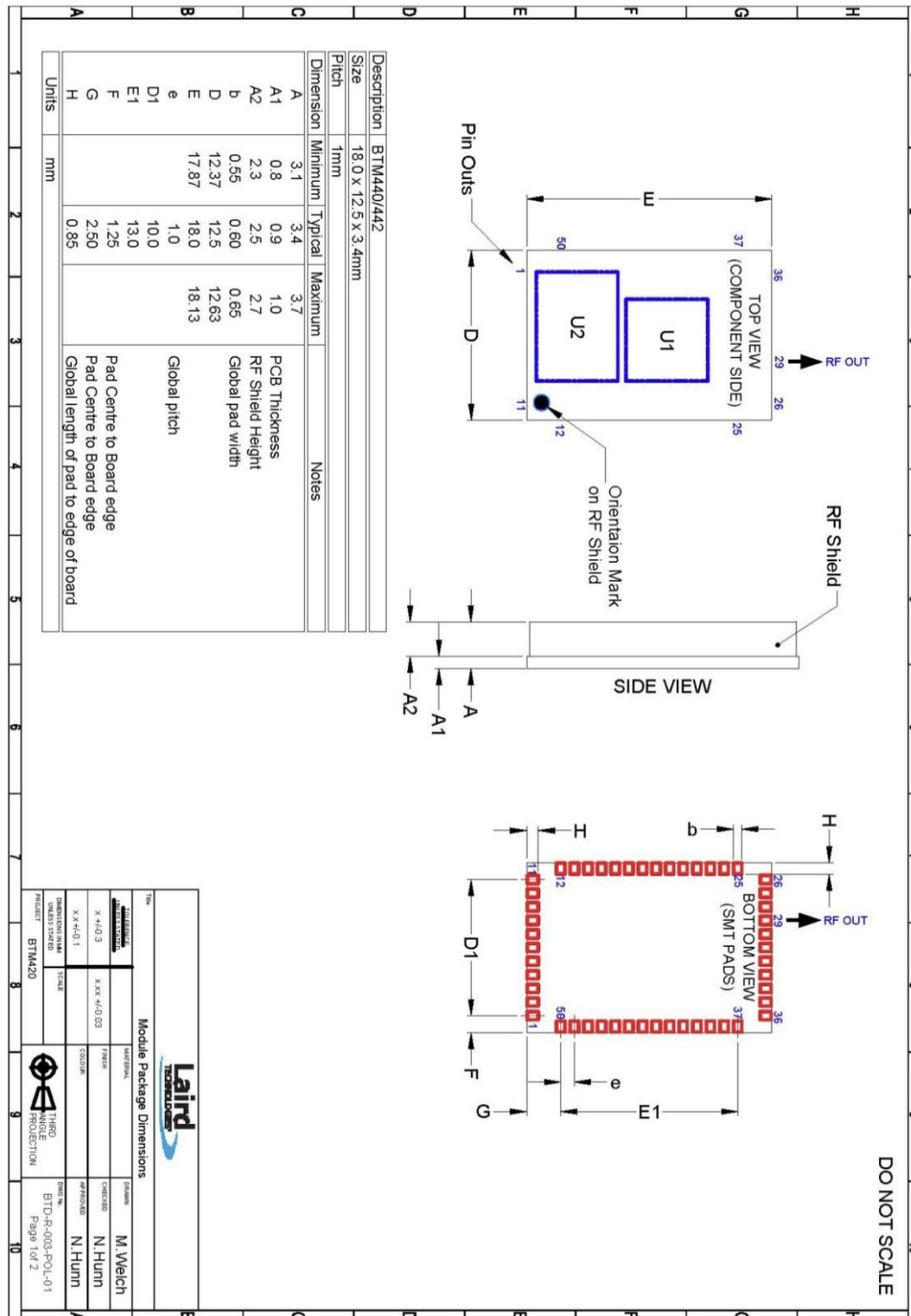
Declaration:

We, Laird Technologies, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Directive 1995/5/EC, when used for its intended purpose.

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|----------------------------|---|
| Place of Issue: | Laird Technologies Saturn House, Mercury Park Wooburn Green HP100HH, United Kingdom tel: +44 (0)1628 858 940 fax: +44 (0)1628 528 382 |
| Date of Issue: | October 2009 |
| Name of Authorised Person: | Tim Wheatley, Director of Engineering |
| Signature: | |

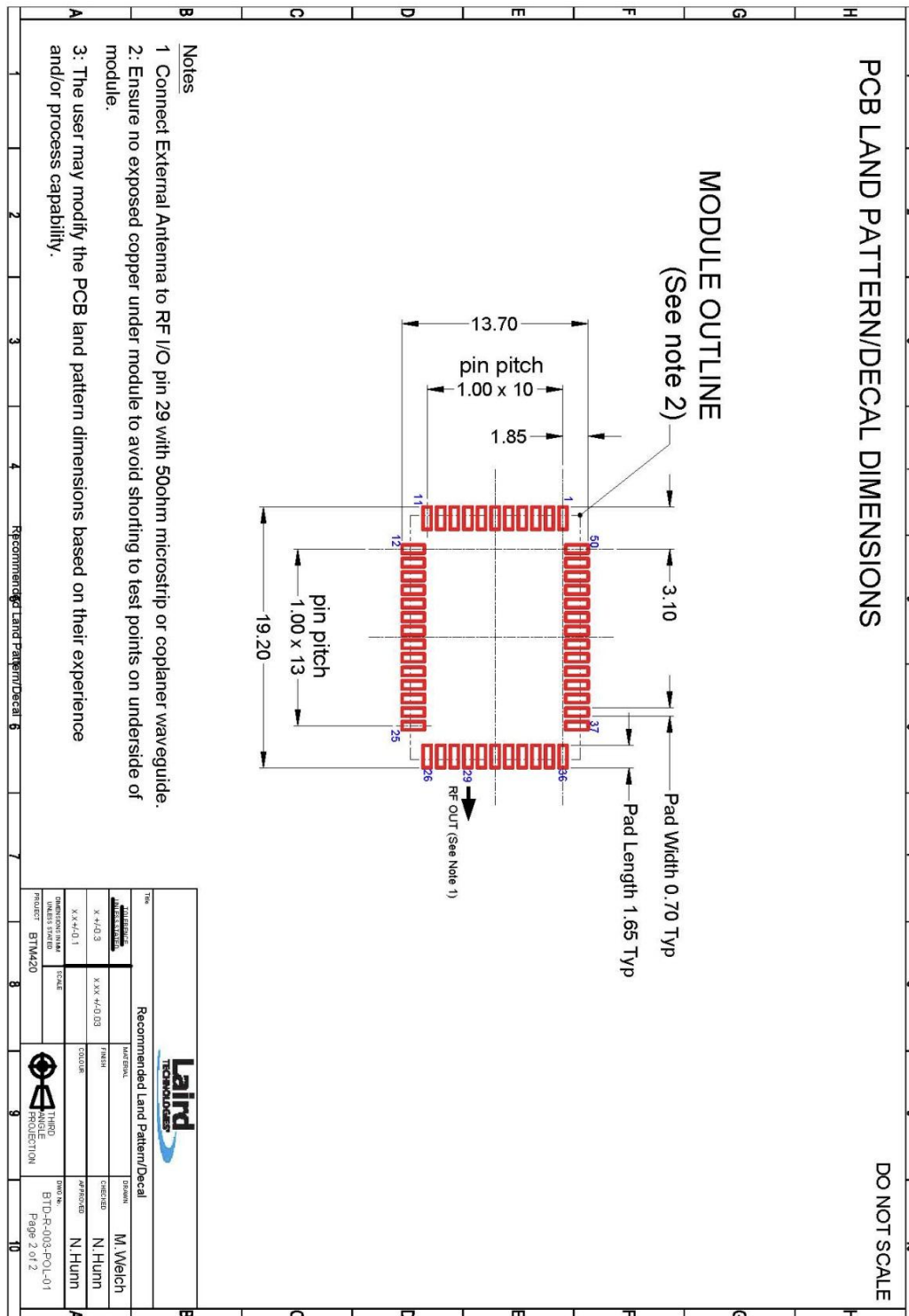
MECHANICAL DRAWINGS

BTM420 Mechanical Details



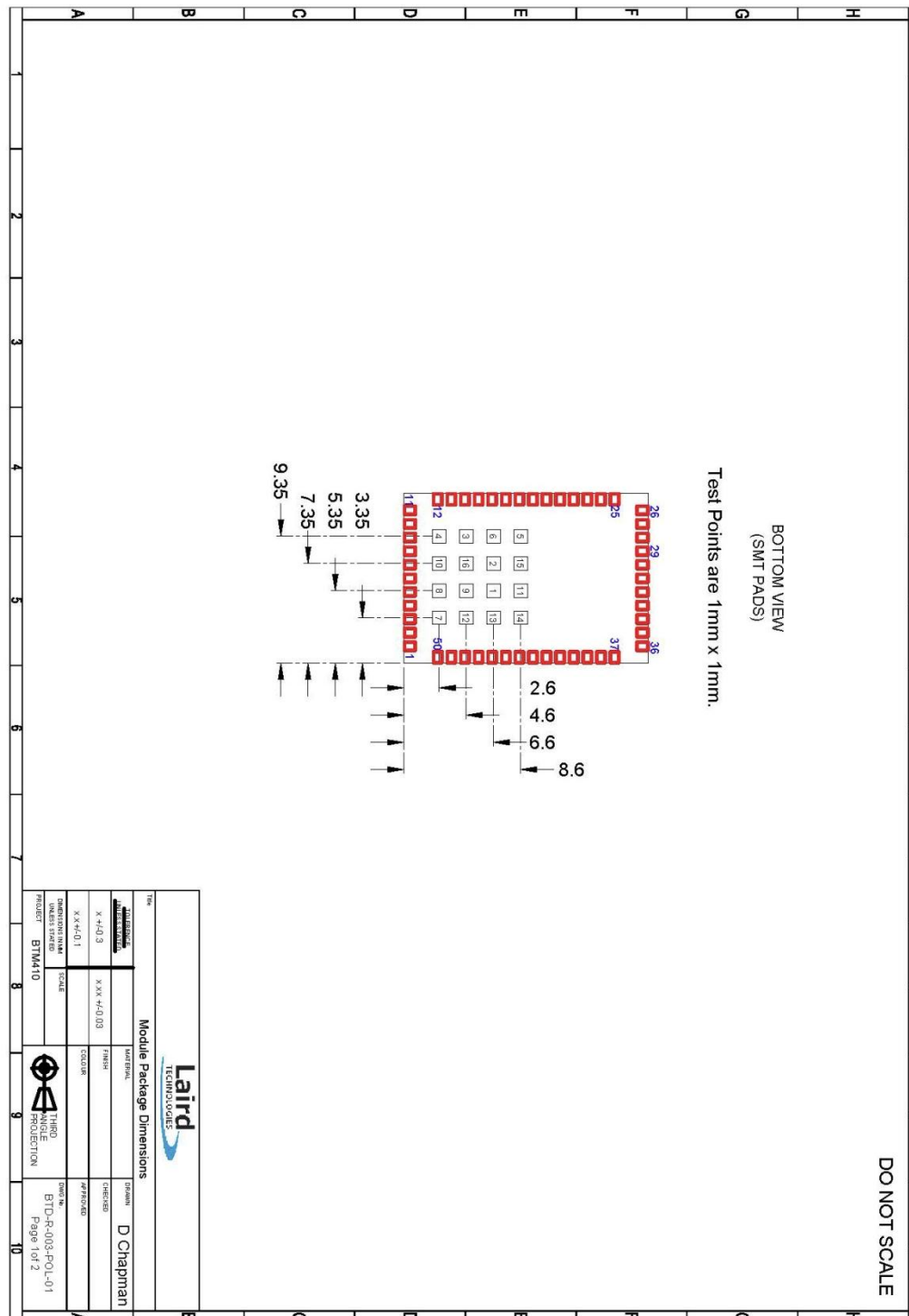
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM420 Mechanical Details



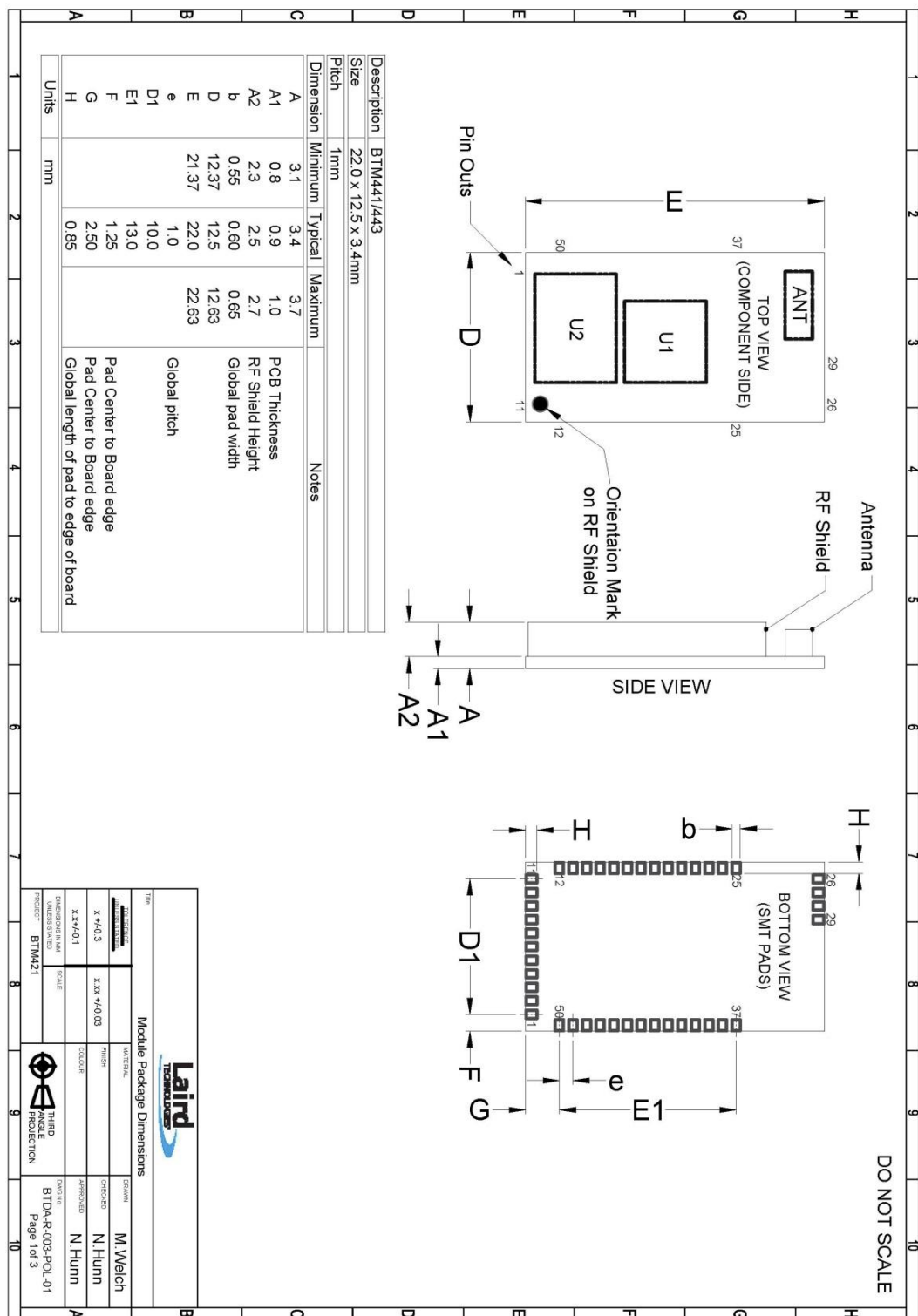
Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM420 Mechanical Details



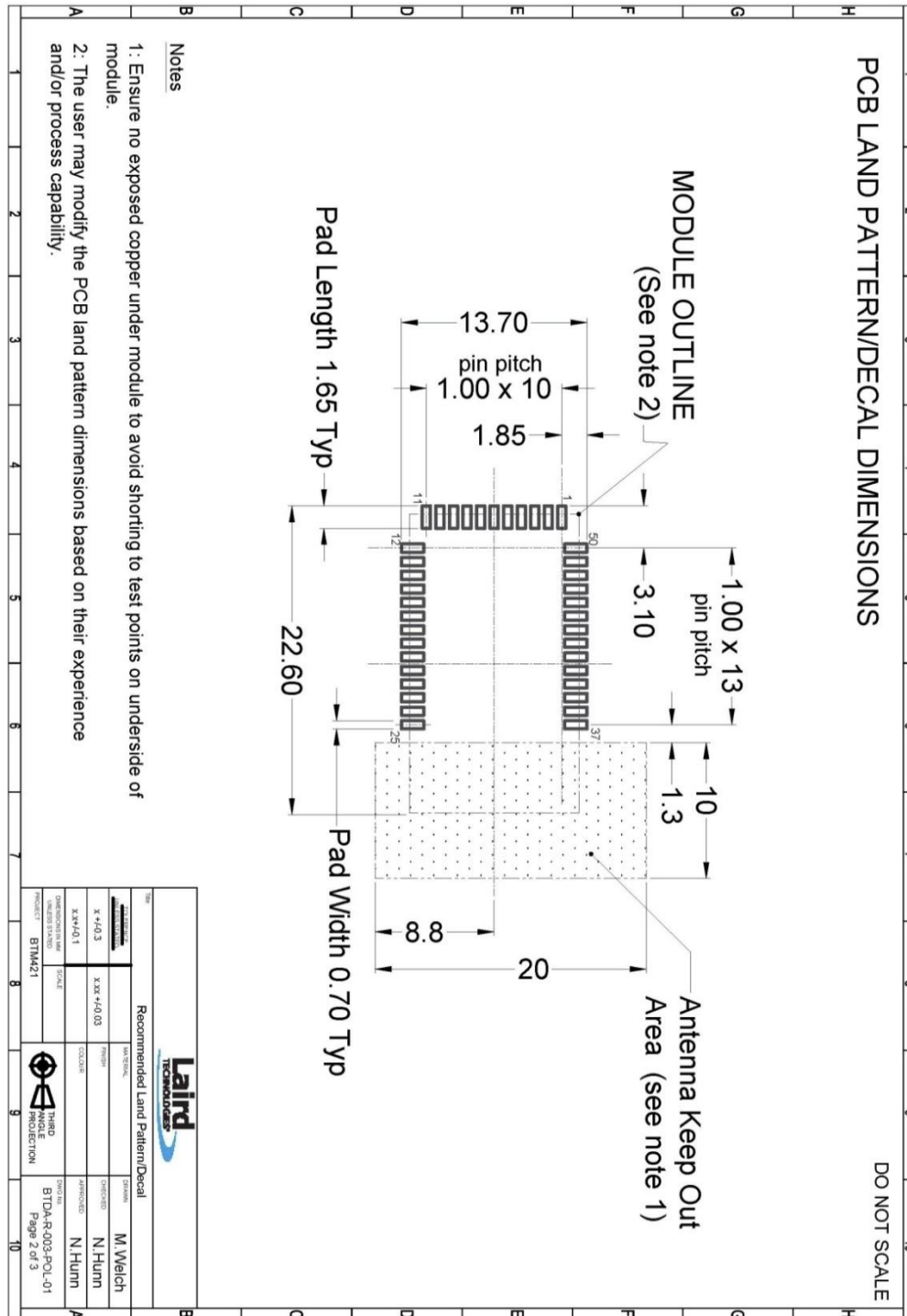
WARNING: Test point dimensions are for reference only. *DO NOT* make electrical connections to these test points, this will void the warranty. Laird does not recommend routing on the top layer underneath the module.

BTM421 Mechanical Details



Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details



Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details

APPLICATION NOTES

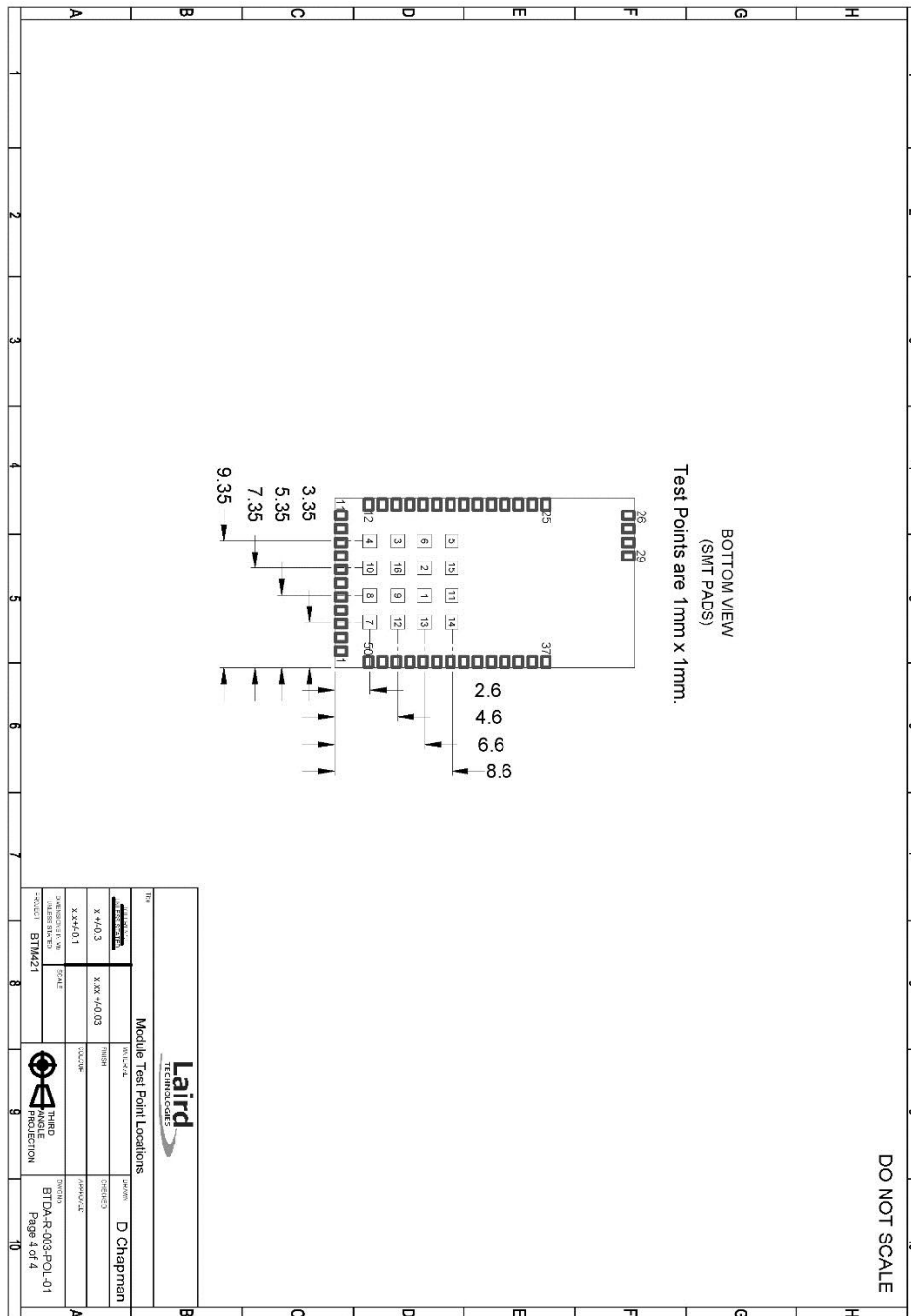
DO NOT SCALE

- 1.) Ensure there is no copper in the antenna keep out area on any layers of the host p.c. board. Also keep all mounting hardware or any metal clear of this area to prevent affecting proper antenna radiation.
- 2.) For best antenna performance the module should be placed on the edge of the host p.c. board and preferably in the corner with the antenna facing the corner.
- 3.) Antenna keep out area definition comes from the module's Developer Kit board which was used for module development and antenna performance evaluation.
- 4.) Ensure no exposed copper under module on host p.c. board to avoid shorting to test points on underside of module.
- 5.) The user may modify the PCB land pattern dimensions based on their experience and/or process capability.

| Title | | | |
|--|---|---|---|
| Application Notes | | | |
| <div style="border: 1px solid black; padding: 2px;"> ANTENNA KEEP OUT AREA </div> | <div style="border: 1px solid black; padding: 2px;"> DATE/REV. </div> | <div style="border: 1px solid black; padding: 2px;"> DRAWN </div> | <div style="border: 1px solid black; padding: 2px;"> M. Welch </div> |
| <div style="border: 1px solid black; padding: 2px;"> X +/-0.3 </div> | <div style="border: 1px solid black; padding: 2px;"> XXX +/-0.03 </div> | <div style="border: 1px solid black; padding: 2px;"> FINISH </div> | <div style="border: 1px solid black; padding: 2px;"> CHECKED </div> |
| <div style="border: 1px solid black; padding: 2px;"> XXX +/-0.1 </div> | <div style="border: 1px solid black; padding: 2px;"> TOTAL </div> | <div style="border: 1px solid black; padding: 2px;"> ECO/GRN </div> | <div style="border: 1px solid black; padding: 2px;"> APPROVED </div> |
| <div style="border: 1px solid black; padding: 2px;"> DIMENSION NAME </div> | <div style="border: 1px solid black; padding: 2px;"> UNLESS SPEC'D </div> | <div style="border: 1px solid black; padding: 2px;"> PART NO. </div> | <div style="border: 1px solid black; padding: 2px;"> N. Humm </div> |
| <div style="border: 1px solid black; padding: 2px;"> PROJECT </div> | <div style="border: 1px solid black; padding: 2px;"> BTM421 </div> | <div style="border: 1px solid black; padding: 2px;"> TI INFO PROTECTION </div> | <div style="border: 1px solid black; padding: 2px;"> BTDA-R-003-POL-01 Page 3 of 3 </div> |

Note: An area of 1.5 mm around the module should be reserved as a keep-out area.

BTM421 Mechanical Details



WARNING: Test point dimensions are for reference only. *DO NOT* make electrical connections to these test points, this will void the warranty. Laird does not recommend routing on the top layer underneath the module.

The Development Kit Schematics for this product can be accessed from the following link:
[Development Kit Schematics – BTM420 / BTM421](http://www.lairdtech.com/bluetooth)

ORDERING INFORMATION

| Part Number | Description |
|--------------|--|
| BTM420 | Bluetooth AT Data Module (external antenna) |
| BTM421 | Bluetooth AT Data Module (with integrated antenna) |
| DVK – BTM420 | Development board with BTM420 module soldered in place |
| DVK – BTM421 | Development board with BTM421 module soldered in place |

GENERAL COMMENTS

All information in this document is subject to change. Please check with Laird Technologies for the latest information before commencing a design. If in doubt, ask.

Refer to the schematic BTMDM-R-001.pdf for the Development Kit on the following two pages for examples of typical pin connections. A PDF of the schematic can be downloaded from the product web page.



Laird Technologies is the world leader in the design and manufacture of customized, performance-critical products for wireless and other advanced electronics applications. Laird Technologies partners with its customers to find solutions for applications in various industries such as:

- Network Equipment
- Telecommunications
- Data Communications
- Automotive Electronics
- Computers
- Aerospace
- Military
- Medical Equipment
- Consumer Electronics

Laird Technologies offers its customers unique product solutions, dedication to research and development, as well as a seamless network of manufacturing and customer support facilities across the globe.

global solutions: local support™

LWS-UM-BTM420-421_v3.0_0313

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