Discontinued

DNT900

Low Cost 900 MHz FHSS Transceiver Module with I/O

- *900 MHz Frequency Hopping Spread Spectrum Transceiver*
- *Point-to-point, Point-to-multipoint, Peer-to-peer and Tree-routing Networks*
- *Transmitter Power Configurable from 1 mW to 1 W*
- *RF Data Rate Configurable from 38.4 to 500 kb/s*
- *Serial Port Rate up to 460.8 kb/s for Streaming Applications*
- *128-Bit AES Encryption*
- *Separate Serial Port for Diagnostics*
- *Analog and Digital I/O for Sensor Applications*
- *FCC and Canadian IC Certified for Unlicensed Operation*

The DNT900 FHSS transceiver module is a low cost, high-power solution for robust wireless data communications in the 900 MHz ISM band. The DNT900 RF output power can be set from 1 mW to 1 W, and the RF data rate can be set from 38.4 to 500 kb/s. The DNT900 receiver includes a low-noise preamplifier protected by two SAW filters, providing an excellent combination of receiver sensitivity and out-of-band interference rejection. The DNT900 module includes analog, digital and serial I/O, providing the flexibility and versatility to serve applications ranging from cable replacements to sensor networks. The DNT900 transceiver module is easy to integrate and provides reliable wireless communications up to 40 miles in line-of-sight installations.

DNT900 Absolute Maximum Ratings

Rating	Value	Units
All Input/Output Pins	-0.5 to +3.3	V
Non-Operating Ambient Temperature Range	-40 to +85	°C

DNT900 Electrical Characteristics

Characteristic	Sym	Notes	Minimum	Typical	Maximum	Units
Operating Frequency Range			902.75		927.25	MHz
Hop Dwell Time			5		200	ms
Number of RF Channels					50	
Modulation			FSK			
RF Data Transmission Rates		1	38.4, 115.2, 200 and 500			kb/s
Receiver Sensitivity:						
10^{-5} BER @ 38.4 kb/s				-108		dBm
10^{-5} BER @ 200 kb/s			-98			dBm
10^{-5} BER @ 500 kb/s				-94		dBm
Transmitter RF Output Power Levels		1	1, 10, 100, 250, 500, 1000 at 38.4 to 200 kb/s 1, 10, 85 at 500 kb/s			mW
Optimum Antenna Impedance				50		Ω
RF Connection			U.FL Coaxial Connector			
Network Topologies			Point-to-Point, Point-to-Multipoint, Peer-to-Peer, Tree-Routing			
Access Schemes			CSMA and TDMA			

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DNT900 Electrical Characteristics

Characteristic	Sym	Notes	Minimum	Typical	Maximum	Units
Number of Network Nodes:						
TDMA Mode					16	
CSMA Mode					unlimited	
ADC Input Range			0		3.3	V
ADC Input Resolution				10		bits
ADC Sample Rate			10			ms
Signal Source Impedance for ADC Reading					10	KΩ
PWM (DAC) Output Range			0		3.3	V
PWM (DAC) Output Resolution		2			8	bits
PWM Output Period				20		µs
Primary and Diagnostic Serial Port Baud Rates				1.2, 2.4, 4.8, 9.6, 19.2, 28.8, 38.4, 57.6, 76.8, 115.2, 230.4, 460.8		kb/s
Serial Peripheral Interface Data Rate			6.35		80.64	kb/s
Digital I/O:						
Logic Low Input Level			-0.5		0.8	V
Logic High Input Level			2		3.3	V
Logic Input Internal Pull-up Resistor			50		200	KΩ
Power Supply Voltage Range	V_{CC}		+3.3		+5.5	Vdc
Power Supply Voltage Ripple					10	mV$_{P-P}$
Peak Transmit Mode Current, 1 W Output					1200	mA
Average Operating Receive Current:						
Base				105		mA
Remote, No Data Transmission				35		mA
Remote, 9.6 kb/s Continuous Data Stream				40		mA
Remote, 115.2 kb/s Continuous Data Stream				53		mA
Sleep Current		3		50	225	µA
DNT900C Mounting			Reflow Soldering			
DNT900P Mounting			Socket			
Operating Temperature Range			-40		85	^{o}C
Operating Relative Humidity Range, Non-condensing			10		90	%

Notes:

1. The DNT900 achieves regulatory certification under FHSS rules at air data rates of 38.4, 115.2 and 200 kb/s. At 500 kb/s, the DNT900 achieves regulatory certification under "digital modulation" or DTS rules. The DNT900 still employs frequency hopping at 500 kb/s to mitigate the effects of interference and multipath fading, but hops on fewer, more widely spaced frequencies than at lower data rates. Maximum RF power at 500 kb/s is 85 mW.

2. PWM is set with an 8-bit value. DAC resolution is limited to 7 bits by residual ripple at output of low-pass filter.

3. Maximum sleep current occurs at +85 ^{o}C.

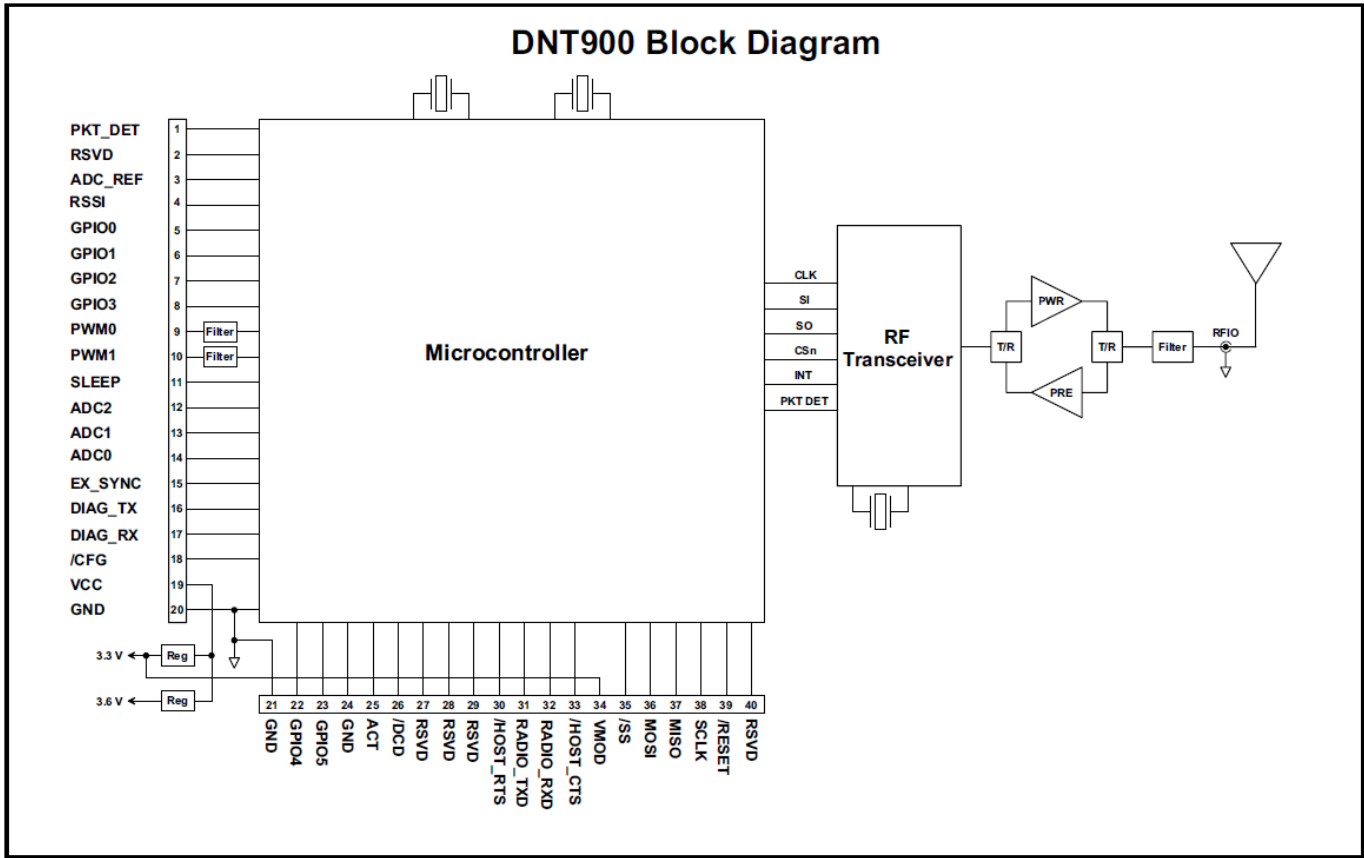**CAUTION: Electrostatic Sensitive Device. Observe precautions when handling.**

DNT900 Block Diagram

Figure 1

DNT900 Hardware

The major components of the DNT900 include a 900 MHz FHSS transceiver and a low current 32-bit microcontroller. The DNT900 operates in the 902 to 928 MHz ISM band. There are a number of selectable hopping patterns including patterns compatible with frequency allocations in North America, South America and Australia. The DNT900 has six selectable RF output power levels: 1, 10, 100, 250 and 500 mW plus 1 W. Also, there are four selectable RF transmission rates: 38.4, 115.2, 200 and 500 kb/s.

The DNT900 includes a low-noise preamplifier protected by two SAW filters, providing an excellent blend of receiver sensitivity and out-of-band interference rejection that is especially important in outdoor applications.

The DNT900 provides a variety of hardware interfaces. There are two serial ports plus one SPI port. Either the primary serial port or the SPI port can be selected for data communications. The second serial port is dedicated to diagnostics. The primary and diagnostic serial ports support baud rates from 1.2 to 460.8 kb/s. The SPI port supports data rates from 6.35 to 80.64 kb/s. Also included are three 10-bit ADC inputs, two 8-bit PWM outputs, and six general-purpose digital I/O ports. Four of the digital I/O ports support an optional interrupt-from-sleep mode when configured as inputs. The radio is available in two mount-

ing configurations. The DNT900C is designed for solder reflow mounting. The DNT900P is designed for plug-in connector mounting.

DNT900 Firmware

The DNT900 firmware can operate using either TDMA or CSMA channel access modes. TDMA supports up to 16 remotes with rapid, deterministic channel latency. CSMA provides carrier-sense managed channel access for an unlimited number of low-traffic remotes. DNT900 firmware will operate "out of the box" using point-to-point transparent serial mode, with point-to-multipoint, peer-to-peer and tree-routing network topologies also supported.

DNT900 firmware provides the user with a rich set of configuration options including a choice of hopping patterns, hopping dwell times, RF data rates, serial or SPI data port operation, serial and SPI data rate selection, RF output power selection, plus configurable analog and digital I/O lines. Data integrity is protected by 24-bit error detection, with optional ACK and automatic transmission retries or redundant transmissions. 128-bit AES encryption provides a high level of data security for sensitive applications. Sensor networks can take advantage of timer or event-based data reporting and remote node sleep cycling for extended battery life.

DNT900 I/O Descriptions

Pin	Name	I/O	Description
1	PKT_DET	O	Packet detect output. Signal switches logic high at the end of the start-of-packet symbol and switches logic low at the end of the end-of-packet symbol on both received and transmitted packets. PKT_DET provides a timing reference for external use in network timing evaluations, etc.
2	RSVD	-	Reserved pin. Leave unconnected.
3	ADC_REF	I	ADC supply and external full scale reference voltage input. Voltage range is 2.4 to 3.3 Vdc. Connect pad 34 to this input to reference the ADC full scale reading to the module's 3.3 V regulated supply.
4	RSVD	-	Reserved pin. Leave unconnected.
5	GPIO0	I/O	Configurable digital I/O port 0. When configured as an input, an internal pull-up resistor can be selected and interrupt from sleep can be invoked. When configured as an output, the power-on state is configurable. The sleep mode direction and state are also configurable.
6	GPIO1	I/O	Configurable digital I/O port 1. Same configuration options as GPIO0.
7	GPIO2	I/O	Configurable digital I/O port 2. Same configuration options as GPIO0.
8	GPIO3	I/O	Configurable digital I/O port 3. Same configuration options as GPIO0.
9	PWM0	O	8-bit pulse-width modulated output 0 with internal low-pass filter. Filter is first-order, with a159 Hz 3 dB bandwidth.
10	PWM1	O	8-bit pulse-width modulated output 1 with internal low-pass filter. Filter is first-order, with a 159 Hz 3 dB bandwidth.
11	SLEEP/DTR	I	Active high module sleep input (active low DTR). When switched low after sleep, the module executes a power on-reset. Usually connected to host DTR. Connect to ground if SLEEP/DTR function not used.
12	ADC2	I	10-bit ADC input 0. Full scale reading is referenced to the ADC_REF input.
13	ADC1	I	10-bit ADC input 1. Full scale reading is referenced to the ADC_REF input.
14	ADC0	I	10-bit ADC input 2. Full scale reading is referenced to the ADC_REF input.
15	EX_SYNC	I	Rising-edge triggered input for synchronizing co-located base stations. Synchronization pulse interval must equal hop dwell time ±10 µs. Pulse width must be in the range of 50 to 800 µs.
16	DIAG_TX	O	Diagnostic UART transmitter output.
17	DIAG_RX	I	Diagnostic UART receiver input.
18	/CFG	I	Protocol selection input. Leave unconnected when using software commands to select transparent/protocol mode (default is transparent mode). Logic low selects protocol mode, logic high selects transparent mode.
19	VCC	I	Power supply input, +3.3 to +5.5 Vdc.
20	GND	-	Power supply and signal ground. Connect to the host circuit board ground.
21	GND	-	Power supply and signal ground. Connect to the host circuit board ground.
22	GPIO4	I/O	Configurable digital I/O port 4. When configured as an input, an internal pull-up resistor can be selected. When configured as an output, the power-on state is configurable.
23	GPIO5	I/O	Configurable digital I/O port 5. Same configuration options as GPIO4.
24	GND	-	Logic ground.
25	ACT	O	Data activity output, logic high when data is being transmitted or received.
26	/DCD	O	Default functionality is data carrier detect output, logic low on a remote when the module is locked to FHSS hopping pattern and logic low on a base station when at least one remote is connected to it. The sleep mode state of this pin and /HOST_CTS is jointly configurable.
27	RSVD	-	Reserved pin. Leave unconnected.
28	RSVD	-	Reserved pin. Leave unconnected.
29	RSVD	-	Reserved pin. Leave unconnected.

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Pin	Name	I/O	Description
30	/HOST_RTS	I	UART flow control input. The host sets this line low to allow data to flow from the DNT900 on the RADIO_TXD pin. When the host sets this line high, the DNT900 will stop sending data to the host.
31	RADIO_TXD	O	UART transmitter output. The DNT900 sends serial data to the host on this pin. The sleep mode state of this pin is configurable.
32	RADIO_RXD	I	UART receiver input. The DNT900 receives serial data from the host on this pin.
33	/HOST_CTS	O	UART/SPI flow control output. The DNT900 sets this line low to indicate it is ready to accept data from the host on the RADIO_RXD or MOSI input. When the DNT900 sets this line high, the host must stop sending data. The sleep mode state of this pin and /DCD is jointly configurable.
34	VMOD	O	+3.3 V regulated supply. Connect to pad 3 to support 3.3 V full scale and/or ratiometric ADC readings, etc. Current drain on this output should be no greater than 5 mA.
35	/SS	I/O	SPI active low slave select. This pin is an output when the DNT900 operating as a master, and an input when it is operating as a slave.
36	MOSI	I/O	SPI master out, slave in function. This pin is an output when the DNT900 is operating as a master, and is an input when the DNT900 is operating as a slave.
37	MISO	I/O	SPI master in, slave out function. This pin is an input when the DNT900 is operating as a master, and is an output when the DNT900 is operating as a slave.
38	SCLK	I/O	SPI clock signal. This pin is an output when operating as a master, and an input when operating as a slave.
39	/RESET	I	Active low module hardware reset.
40	RSVD	-	Reserved pin. Leave unconnected.

Figure 2

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DNT900C PCB Footprint

0.110
(2.79)

1   40

0.070
(1.78)

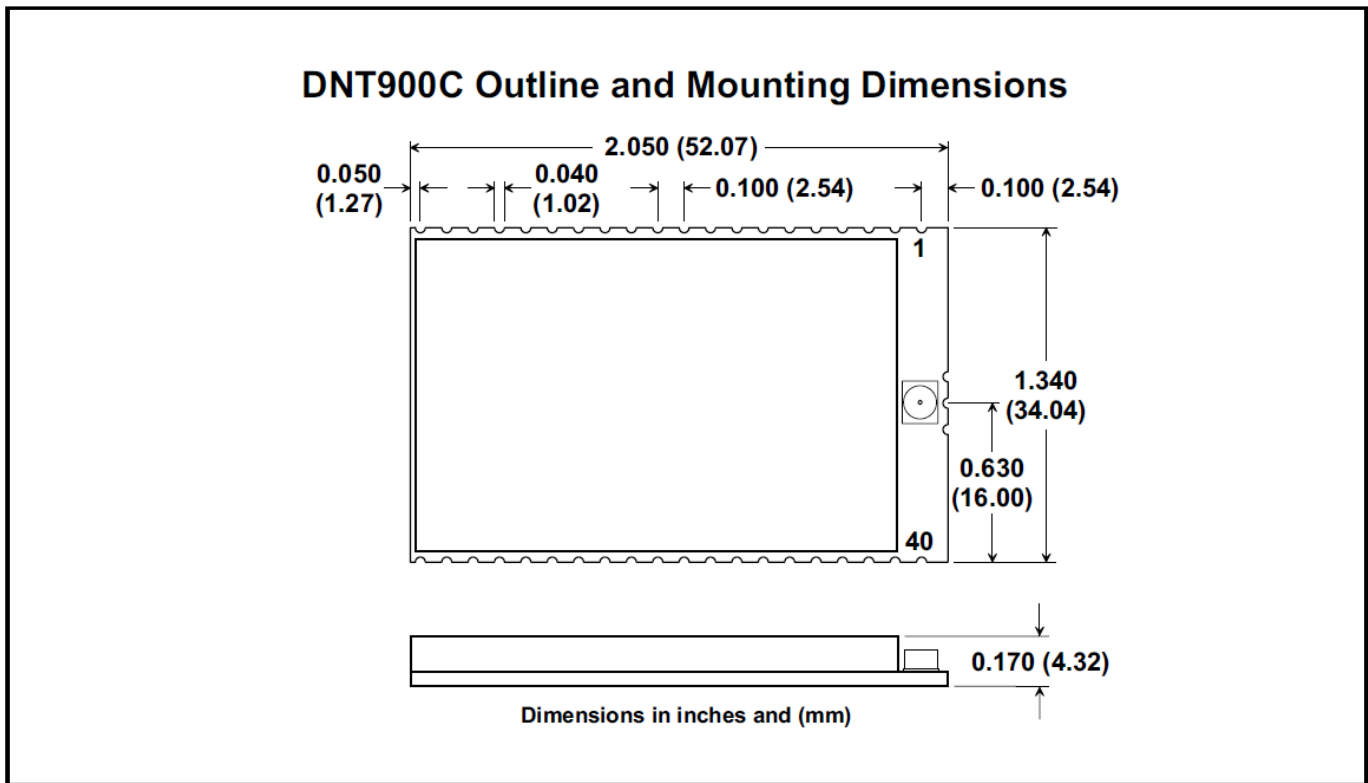0.100
(2.54)
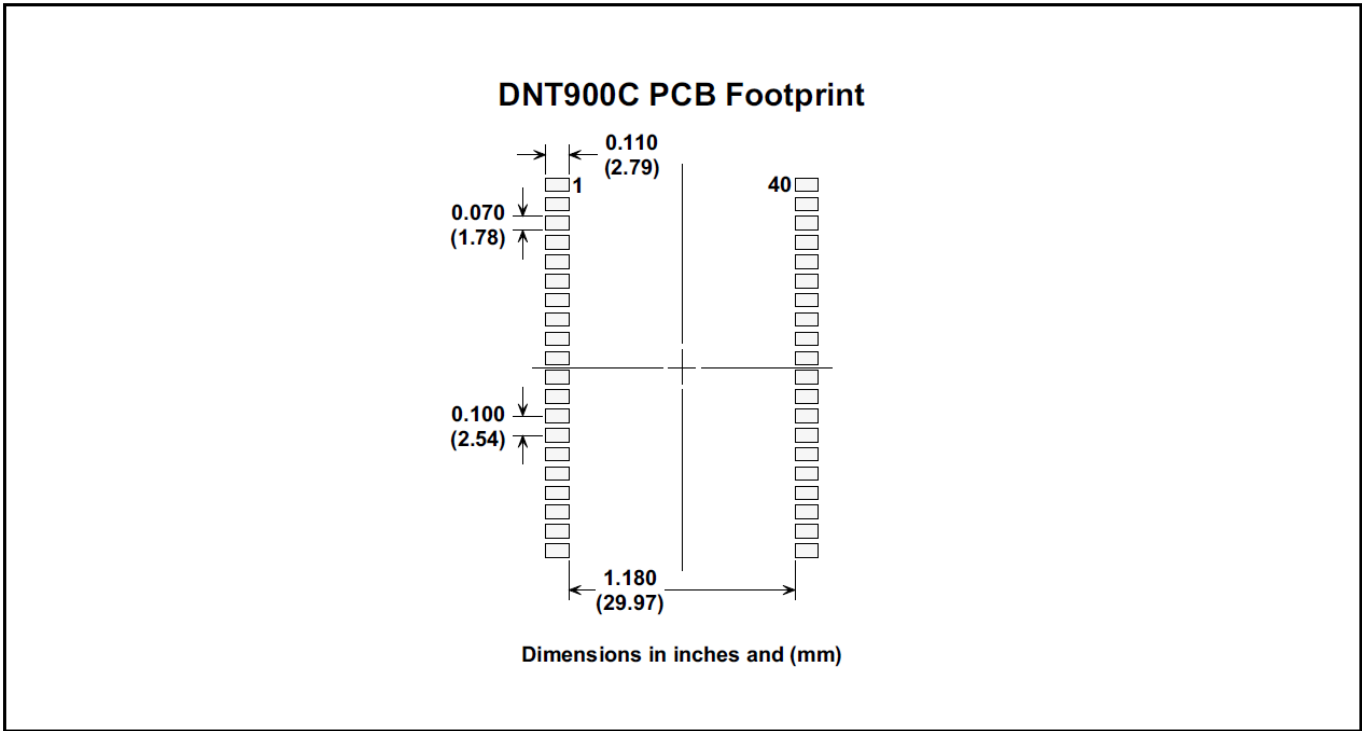
1.180
(29.97)

Dimensions in inches and (mm)

Figure 3

DNT900 Antenna Connector

A U.FL miniature coaxial connector is provided on both DNT900 configurations for connection to the RFIO port. A short U.FL coaxial cable can be used to connect the RFIO port directly to an antenna. In this case the antenna should be mounted firmly to avoid stressing the U.FL coaxial cable due to antenna mounting flexure. Alternately, a U.FL coaxial jumper cable can be used to connect the DNT900 module to a U.FL connector on the host circuit board. The connection between the host circuit board U.FL connector and the antenna or antenna connector on the host circuit board should be implemented as a 50 ohm stripline. Referring to Figure 4, the width of this stripline depends on the thickness of the circuit board between the stripline and the groundplane. For FR-4 type circuit board materials (dielectric constant of 4.7), the width of the stripline is equal to 1.75 times the thickness of the circuit board. Note that other circuit board traces should be spaced away from the stripline to prevent signal coupling, as shown in Figure 5. The stripline trace should be kept short to minimize its insertion loss.
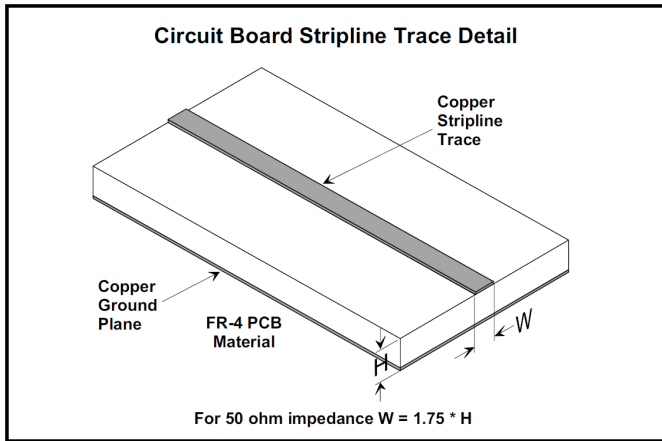

Circuit Board Stripline Trace Detail

Copper Stripline Trace

Copper Ground Plane

FR-4 PCB Material

W

H

For 50 ohm impedance W = 1.75 * H

Figure 4

Trace Separation from 50 ohm Microstrip	Length of Trace Run Parallel to Microstrip
100 mil	125 mil
150 mil	200 mil
200 mil	290 mil
250 mil	450 mil
300 mil	650 mil

Figure 5

DNT900P Outline and Mounting Dimensions

Dimensions in inches and (mm)
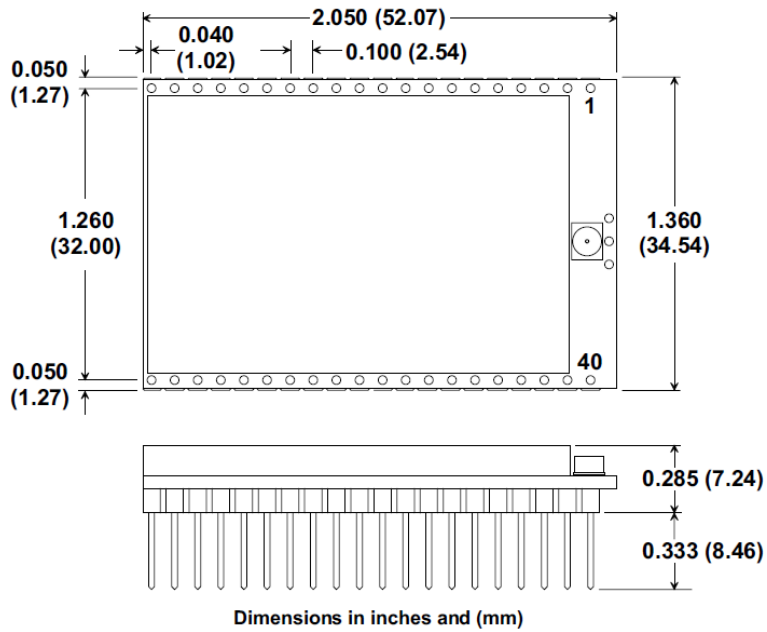
Figure 6

DNT900P Interface Connector
PCB Layout Detail

Connectors are FCI Electronics 75915-420LF or equivalent
Dimensions in inches and (mm)
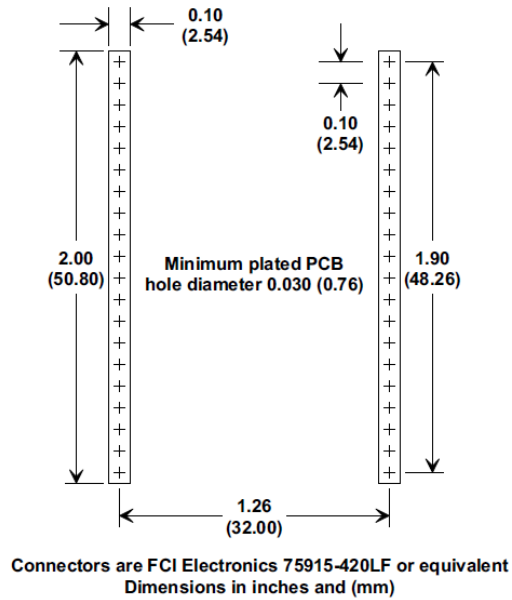
Figure 7

Note: Specifications subject to change without notice.

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