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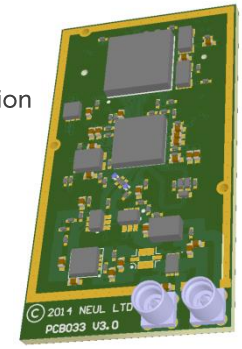
Weightless™ Communications Module

Key Features



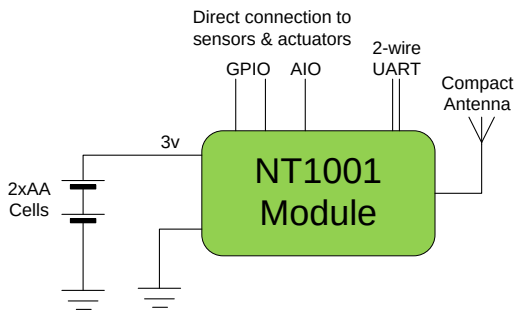
- Fully integrated Weightless™ compliant terminal modem
- Small form factor (42mm x 23mm)
- Excellent link budget (162dB) for superior in-building penetration
- Low-power operation (20uA in sleep mode)
- Designed for communication with the NN2510 Basestation
  - 458MHz EN300 220 compliant uplink
  - TVWS EN301 598 compliant downlink
- Simple configuration
  - Via Cloud based NeulNET™ Connect Device Platform
  - Via simplified AT command set, over UART
- UART data or GPIO Profile interfaces

Applications

- Smart Metering
- Parking Sensors
- Environmental Monitors
- Traffic Management and Monitoring
- Home and Industrial Automation
- Security and Asset Tracking
- Automotive Service Data and Diagnostics
- Smart Agriculture
- Tele health and Patient Monitoring

Functional Overview

The NT1001 communications module is designed to communicate with NN2510 basestation transceivers, using the Weightless™ open standard. The NT1001 will scan for an available basestation upon initial power up, and provision itself with the NeulNET™ Connected Device Platform (CDP). Users can navigate to the NeulNET™ CDP from their web browser, register a user account and claim the end-point via the globally unique identifier (GUID) printed on the module, or readable via the AT command interface. Subsequent network communication can be configured over the UART interface, via AT commands, or via the cloud interface and can take the form of event driven, or scheduled network communication.



The integrated Weightless™ stack running on the NT1001 takes care of all communication with the network, packetizing the serial data presented on the UART or interpreting profile events, such as a falling or rising edge events on a GPIO, and negotiating it's communication to the NeulNET™ CDP. NeulNET™ networks utilise adaptive modulation, adaptive spreading and advanced error correction techniques to enable long range, non-line of sight communication with the network. The PHY parameters used by an NT1001 module in the field are entirely under the control of the network with which it connects. As such, the period for which the NT1001 module is in active receive or active transmit mode will vary depending on the link quality it can achieve with the basestation to which it is attached.

Functional Specification

Module Interfaces

The NT1001 module supports UART and IO device profiles, which can be configured via the NeulNET™ CDP. UART parameters can be configured via the CDP, or via the UART interface itself, following initial communication with settings of 115.2kbaud, 8 data bits, 1 stop bit and no-parity. UART configuration of the module is achieved via a restricted AT command set, which includes Send, Receive and Debug commands. The list of supported commands can be received via the AT LIST command. Details of the supported commands, including syntax, can be found in the NT1001 application note. The NT1001 support optional 'Wake-on-GPIO' for low-power operation modes.

In device IO profile mode, the NT1001 has up to 6 configurable event-trigger digital input pins and up to 21 output pins which can be configured in a variety of ways:

- Input Function mode can configure pins as a digital input or digital frequency sensor.
- Interrupt Type mode can be configured to trigger on rising or falling edges, or on a programmed number of edges (edge counter mode).
- Output-Enable mode, where all pins can be read as inputs, with output capability enabled.
- Output Function enables pin configuration as an Open Drain or Push Pull.
- Pins can also be configured as pull-up or pull downs.
- Analogue input pins can have an optional, configurable low-pass filter applied.

Weightless™ Message channel

NT1001 modules provide an acknowledged bidirectional data channel with a Weightless™ network, based on NN2510 basestations deployed and managed by network operators. The network manages message fragmentation, retransmission and reassembly automatically. NT1001 modules can support message sizes up to 255 bytes in length. Messages longer than 255bytes must be fragmented at the application layer.

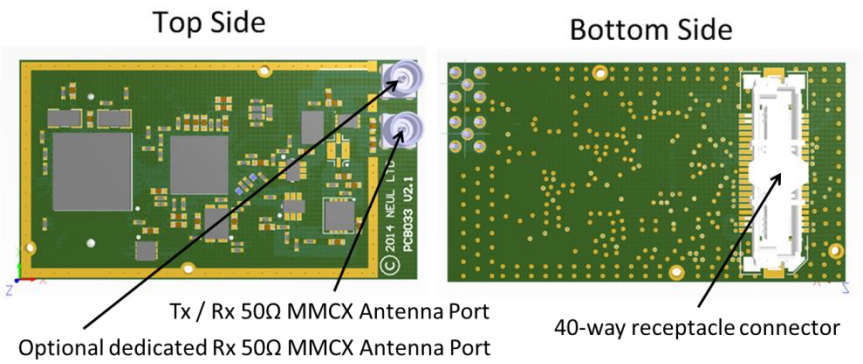
Message Latency Performance

The latency is dependent on network loading. It is possible to configure maximum tolerable latencies between reception of a message presented to the UART of the NT1001 module and delivery to the NeulNET™ message queue via the Quality of Service (QoS) settings in the NeulNET™ CDP. The observed end-to-end latencies for a given message will be a product of the QoS settings, the message length (messages are broken into 24 byte fragments for communication with the network), and the network loading. Typical single-direction latencies are less than 10 seconds, for unfragmented uplink messages.

Connecting to the NT1001 Module

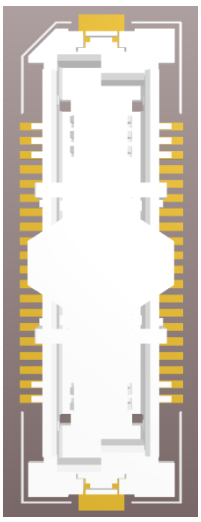
The NT1001 uses a Molex 40-way 0.635mm pitch receptacle connector, part number 52885-0474. This receptacle allows for the use of a number of different Molex headers to give different stack heights. Neul uses the uses part number 55091-0474 for connecting the module to the NeulTRINO development kit, giving a 6mm mated height.

The NT1001 module has dual antenna ports, a combined transmit and receive port, for single antenna applications, and a dedicated receive port for dual antenna applications (where each antenna is tuned for uplink or downlink operating frequencies).



Connector Pin-Out Diagram

Signal	Pin No.		Pin No.	Signal
VDD	1		2	VDD
VDD	3		4	VDD
GND	5		6	GND
GND	7		8	GND
GPIO0_UART0RX	9		10	SWD_CLK[1]
GPIO1_UART0TX	11		12	SWD_DIO[1]
GPIO2	13		14	GPIO13
GPIO3	15		16	GPIO14_UART1RX
GPIO4	17		18	GPIO15_UART1TX
GPIO5	19		20	GPIO16
GND	21		22	GND
MODULE_RSTB	23		24	GPIO17
GPIO6	25		26	GPIO18
GPIO7	27		28	GPIO19_I2CDATA
GPIO8	29		30	GPIO20_I2CCLK
GND	31		32	GND
GPIO9_SPIMISO	33		34	ICENI_DBG_MOSI[1]
GPIO10_SPIENB	35		36	ICENI_DBG_CLK[1]
GPIO11_SPICLK	37		38	ICENI_DBG_CSB[1]
GPIO12_SPIMOSI	39		40	ICENI_DBG_MISO[1]



1. Do not connect to this pin.

Electrical Specification

Recommended Operating Conditions

Symbol	Description	Min	Max	Notes
VDD	Supply Voltage			
	• RF System OFF	1.8V	3.4V	
	• RF System ON	3.2V	3.4V	
V_{IH}	GPIOx Input High Voltage			
	• 2.7V ≤ VDD ≤ 3.4V	0.7 x VDD	-	
	• 1.8V ≤ VDD ≤3.4V	0.75 x VDD	-	
V_{IL}	GPIOx Input Low Voltage			
	• 2.7V ≤ VDD ≤ 3.4V	-	0.35 x VDD	
	• 1.8V ≤ VDD ≤3.4V	-	0.3 x VDD	
V_{OH}	GPIOx Output High voltage – normal drive pin			2
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = -5mA	VDD – 0.5V	-	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = -2.5mA	VDD – 0.5V	-	
V_{OH}	GPIOx Output High voltage – high drive pin			2
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = -20mA	VDD – 0.5V	-	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = -10mA	VDD – 0.5V	-	
V_{OL}	GPIOx Output Low voltage – normal drive pin			2
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = 5mA	-	0.5V	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = 2.5mA	-	0.5V	
V_{OL}	GPIOx Output Low voltage – high drive pin			2
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = 20mA	-	0.5V	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = 10mA	-	0.5V	

2. GPIO0_UART0RX, GPIO_UART0TX and GPIO18 have high drive capability. All other GPIOs are normal drive only.

Symbol	Description	Min	Max	Notes
V_{OL}	GPIOx Output Low voltage – normal drive pin			3
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = 5mA	-	0.5V	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = 2.5mA	-	0.5V	
V_{OL}	GPIOx Output Low voltage – high drive pin			3
	• 2.7V ≤ VDD ≤ 3.4V, I_{OH} = 20mA	-	0.5V	
	• 1.8V ≤ VDD ≤3.4V, I_{OH} = 10mA	-	0.5V	

3. GPIO0_UART0RX, GPIO_UART0TX and GPIO18 have high drive capability. All other GPIOs are normal drive only.

Switching Specifications

Symbol	Description	Min	Max	Notes
MODULE_RSTB	Module Reset	100ns	-	
GPIO	Interrupt width – normal run mode	65ns		
GPIO	Interrupt width – low power modes	1.5µs	-	
GPIO	Rise/Fall time	-	36ns	

Power Consumption

Symbol	Description	Min	Typ	Max	Unit	Notes
IDD_TX	Transmit current - PA switched on during transmission	300	300	500	mA	4
IDD_RX	Receive current – RX RF switched on during active frame	88	90	100	mA	
IDD_SLEEP	Sleep current – radio idle	12	20	200	uA	5
IDD_CONN	Average operational current – 5 unfragmented uplink messages per day	61	76	150	uA	4, 5, 6
E_ULMSG	Energy consumed to transmit and acknowledge an unfragmented uplink message	0.3	0.5	1.0	J	6
E_DLMSG	Energy consumed to receive and acknowledge an unfragmented downlink message	0.3	0.5	1.0	J	6

4. Transmit current is affected by the matching characteristics of the antenna (50 Ohm).
5. Sleep current may be affected by active Profiles, UART baud rates and Wake-on-GPIO settings.
6. Energy for message transfer may be affected by radio signal strength.

Absolute Maximum Ratings

Symbol	Description	Min	Max	Notes
VDD	Supply Voltage	-0.3V	3.6V	
V_{IO}	GPIO Pin Voltage	-0.3V	VDD + 0.3V	
T_A	Ambient Temperature	0°C	70°C	

Mechanical Dimensions

Height	Width	Depth
42mm	23mm	3mm / 9mm[7]

7. Depth with connectors.

Ordering information

Part number	Description	Package type
NT1001	Weightless™ Terminal Modem	Adapter Mounted