Hartcran House, 231 Kenton Lane, Harrow, Middlesex, HA3 8RP, England
Tel: +44 (0) 20 8909 9595, Fax: +44 (0) 20 8909 2233, www.radiometrix.com

NTX2B

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UHF Narrow Band FM Transmitter

The NTX2B transmitter offers a low power, reliable, narrowband transmitter in a Radiometrix SIL standard pin out and foot print. Paired with a suitable receiver (such as the NRX2 or LMR2) this forms a high performance radio link, ideally suited to those low power applications where existing single frequency wideband UHF modules have insufficient range.

Figure 1: NTX2B-434.650-10

Features

- Conforms to ETSI EN 300 220-3 (radio) and EN 301 489-3 (EMC)
- NTX2/NRX2 equivalent standard frequencies - 434.075MHz, 434.650MHz and 458.700MHz
- Factory programmable custom frequency (425 - 480MHz). No crystal lead-times
- Custom frequencies available in 433MHz (EU) and 458MHz (UK) band
- Data rates up to 10kbps
- Usable range over 500m (with matching LMR2)
- 12.5kHz / 20kHz / 25kHz Channel spacing (factory set)
- Feature-rich interface (true analogue and/or digital baseband)
- Longer range compared to Wide Band FM modules

Available for licence-exempt operation in the 433MHz (EU) and 458MHz (UK) bands, the NTX2B module combine effective screening with internal filtering to minimise spurious radiation and susceptibility thereby ensuring EMC compliance. It can be used in existing low data rate (<10kbps) applications where the operating range of the system using TX2 transmitter and RX2 receiver need to be extended. They are particularly suitable for point-to-point and point-to-multipoint wireless links where longer ranges are required at low data rates. Applications include sensor nodes, EPOS and inventory tracking, remote industrial process monitoring, telemetry, telecommand and telecontrol. Because of their small size and low power consumption, this module is ideal for use in battery-powered portable applications such as handheld terminals.

Technical Summary

Transmitter – NTX2B

- Fully integrated sigma-delta PLL synthesizer based design
- High stability TCXO reference
- Supply 2.9V - 15V @ 18mA (internal 3.0V LDO voltage regulator)
- Data bit rate: 10kbps max.
- Transmit power: +10dBm (10mW)
- Dimensions 43 x 15 x 5mm (fully screened)

Evaluation platforms: Universal Evaluation Kit or Narrow Band Evaluation Kit with SIL carrier board

Functional description

The NTX2B transmitter consists of a highly integrated sigma delta (fractional N) synthesizer based single chip RF device, configured over an SPI serial bus by an on-board microcontroller. The primary frequency reference for the transmitter is a 26MHz VC-TCXO. Modulation is applied directly to this reference via an AF baseband filter (rather than using the chip's internal modulator) to permit a wider range of baseband data rates and waveforms. Operation is controlled by the EN (Enable) line, the transmitter achieving full RF output typically within 5ms of this line being pulled high. The RF output is filtered to ensure compliance with the appropriate radio regulations and fed to the 50 ohm antenna pin.

NTX2B Transmitter

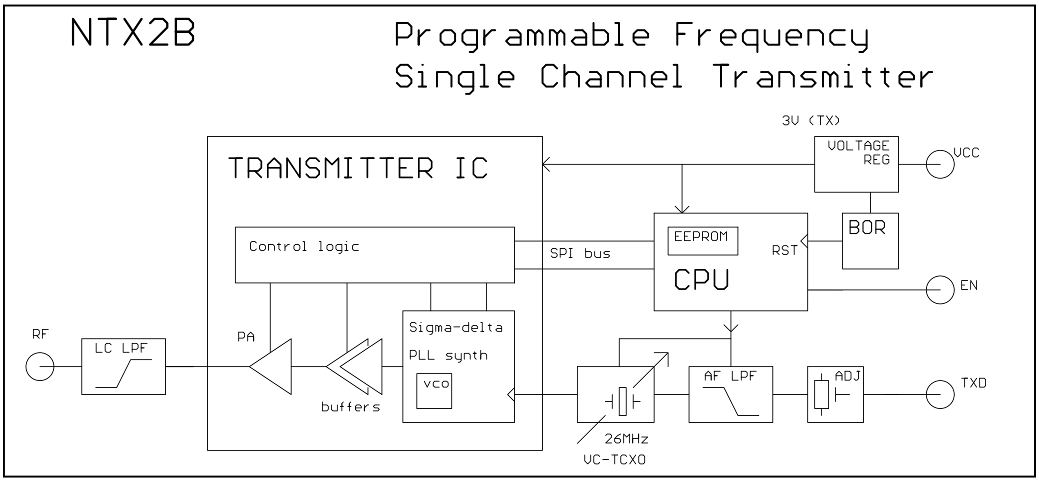

Figure 2: NTX2B block diagram

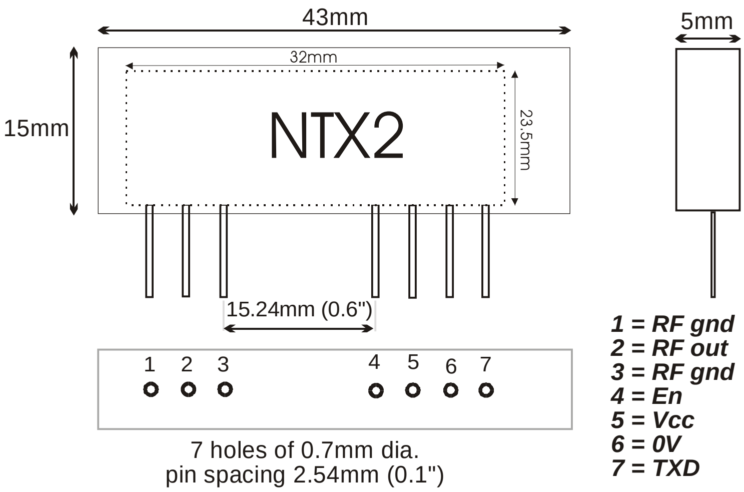

Figure 3: NTX2B pin-out and dimension

User interface

NTX2B pin	Name	Function
1, 3	RF GND	RF ground is internally connected to the module screen and pin 6 (0V). These pins should be directly connected to the RF return path - e.g. coax braid, main PCB ground plane etc.
2	RF out	50Ω RF output to the antenna
4	EN	Pull high to enable Transmitter (3V CMOS logic)
5	VCC	2.9V – 15V DC power supply
6	0V	Ground
7	TXD	DC coupled input for 3V CMOS logic. R_{in} = 100kΩ

***Notes**:*

1. Pinout footprint is as TX1H.

2. Compatible with RX2M, RLC2, LMR2 and NRX2 receivers

Absolute maximum ratings

Exceeding the values given below may cause permanent damage to the module.

Operating temperature	-20°C to +70°C
Storage temperature	-30°C to +70°C
NTX2B	
Vcc, TXD (pins 5,7)	-0.3V to +16.0V
En (pin 4)	-0.3V to +VCC V
RF out (pin 2)	±50V @ <10MHz, +20dBm @ >10MHz

Performance specifications: NTX2B transmitter
(Vcc = 3.3V / temperature = 20°C unless stated)

General	pin	min.	typ.	max.	units	notes
DC supply						
Supply voltage	5	2.9	3.3	15	V	
TX Supply current (10mW)	5		18	-	mA	
Antenna pin impedance	2	-	50	-	Ω	
RF						
RF centre frequency		-		-	MHz	1
NTX2B-434.650-10			434.650			
NTX2B-434.075-10			434.075			
NTX2B-458.700-10			458.700			
Channel spacing		-	12.5 / 20 / 25	-	kHz	2
Number of channels		-	1	-		3
RF power output (10mW)	2	9	10	11	dBm	
Spurious emissions	2	-	-	-40	dBm	
Adjacent channel TX power		-	-	-37	dBm	
Frequency accuracy			±1.5		kHz	
Peak FM deviation (25kHz channel)		±2.5	±3.0	±3.5	kHz	
Baseband						
Modulation type		-	FSK	-		F3D
Modulation bandwidth @ -3dB		0	-	5	kHz	
TXD input level (logic low)	7	-	0	-	V	
TXD input level (logic high)	7	-	3.0	-	V	
Distortion			5		%	4
Dynamic timing						
TX Enable to full RF		-	2.5	5	ms	5
Power on to full RF				25	ms	6

Notes:

1. Factory programmable to any custom frequency within 420MHz - 480MHz band
2. Channel spacing is factory preset
3. Factory programmable
4. adjusted for 3V peak-to-peak sinewave signal
5. When EN pin is used to control transmitter while VCC pin is connected to supply
6. When both EN and VCC are tied together and switched ON/OFF

Applications information

Power supply requirements

This module has a built-in regulator which deliver a constant 3.0V to the module circuitry when the external supply voltage is 3.1V or greater, with 40dB or more of supply ripple rejection. This ensures constant performance up to the maximum permitted rail, and removes the need for external supply decoupling except in cases where the supply rail is extremely poor (ripple/noise content >100mVpk-pk).
Below 3.1v the transmitter continues to function (down to at least 2.8v), although at this point the regulator is no longer functional and ripple rejection is dependant on internal decouplers. Below 2.9v the power output will reduce slightly

The Enable pin allows the TX module to be turned on or off under 3V logic control with a constant DC supply to the Vcc pin. The module current in power-down mode (Vcc present, EN pin low) is less than 3uA.

If the rail is switch instead of using the enable pin, then EN should be tied directly to the Vcc pin.
In this mode the fastest (<5mS) switching speed is NOT obtained.

TX modulation requirements

The module is factory-set to produce the specified FM deviation with a TXD input to pin 7 of 3V amplitude, i.e. 0V “low”, 3V “high

If the data input level is greater than 3V, a resistor must be added in series with the TXD input to limit the modulating input voltage to a maximum of 3V on pin 7. TXD input resistance is 100kΩ to ground, giving typical required resistor values as follows:

Vcc	Series resistor
≤3V	-
3.3V	10 kΩ
5V	68kΩ
9V	220kΩ

Expected range

Predicting the range obtainable in any given situation is notoriously difficult since there are many factors involved. The main ones to consider are as follows:

- Type and location of antennas in use
- Type of terrain and degree of obstruction of the link path
- Sources of interference affecting the receiver
- “Dead” spots caused by signal reflections from nearby conductive objects
- Data rate and degree of filtering employed

Data formats and range extension

The NTX2B's TXD input is normally driven directly by logic levels but will also accept analogue drive (e.g. 2-tone signalling). In this case it is recommended that the modulation ac-coupled onto TXD (pin 7), and limited to a maximum of 3Vp-p to minimise distortion over the link. The modulator in the NTX2B is considerably more linear than that used in the older NTX2

The NTX2B in standard form incorporates a low pass filter with a 5kHz nominal bandwidth. In conjunction with similar filtering in the receiver an overall system bandwidth of 5kHz is obtained. This is suitable for transmission of data at raw bit rates up to 10kbps.

Antennas

The choice and positioning of transmitter and receiver antennas is of the utmost importance and is the single most significant factor in determining system range. The following notes are intended to assist the user in choosing the most effective antenna type for any given application.

Integral antennas

These are relatively inefficient compared to the larger externally-mounted types and hence tend to be effective only over limited ranges. They do however result in physically compact equipment and for this reason are often preferred for portable applications. Particular care is required with this type of antenna to achieve optimum results and the following should be taken into account:

1. Nearby conducting objects such as a PCB or battery can cause detuning or screening of the antenna which severely reduces efficiency. Ideally the antenna should stick out from the top of the product and be entirely in the clear, however this is often not desirable for practical/ergonomic reasons and a compromise may need to be reached. If an internal antenna must be used try to keep it away from other metal components and pay particular attention to the “hot” end (i.e. the far end) as this is generally the most susceptible to detuning. The space around the antenna is as important as the antenna itself.

2. Microprocessors and microcontrollers tend to radiate significant amounts of radio frequency hash which can cause desensitisation of the receiver if its antenna is in close proximity. The problem becomes worse as logic speeds increase, because fast logic edges generate harmonics across the UHF range which are then radiated effectively by the PCB tracking. In extreme cases system range may be reduced by a factor of 5 or more. To minimise any adverse effects situate antenna and module as far as possible from any such circuitry and keep PCB track lengths to the minimum possible. A ground plane can be highly effective in cutting radiated interference and its use is strongly recommended.

A simple test for interference is to monitor the receiver RSSI output voltage, which should be the same regardless of whether the microcontroller or other logic circuitry is running or in reset.

The following types of integral antenna are in common use:

Quarter-wave whip. This consists simply of a piece of wire or rod connected to the module at one end. At 434MHz the total length should be 164mm from module pin to antenna tip including any interconnecting wire or tracking. Because of the length of this antenna it is almost always external to the product casing.

Helical. This is a more compact but slightly less effective antenna formed from a coil of wire. It is very efficient for its size, but because of its high Q it suffers badly from detuning caused by proximity to nearby conductive objects and needs to be carefully trimmed for best performance in a given situation. The size shown is about the maximum commonly used at 434MHz and appropriate scaling of length, diameter and number of turns can make individual designs much smaller.

Loop. A loop of PCB track having an inside area as large as possible (minimum about 4cm^2), tuned and matched with 2 capacitors. Loops are relatively inefficient but have good immunity to proximity detuning, so may be preferred in shorter range applications where high component packing density is necessary.

Integral antenna summary:

Feature	whip	helical	loop
Ultimate performance	***	**	*
Ease of design set-up	***	**	*
Size	*	***	**
Immunity to proximity effects	**	*	***

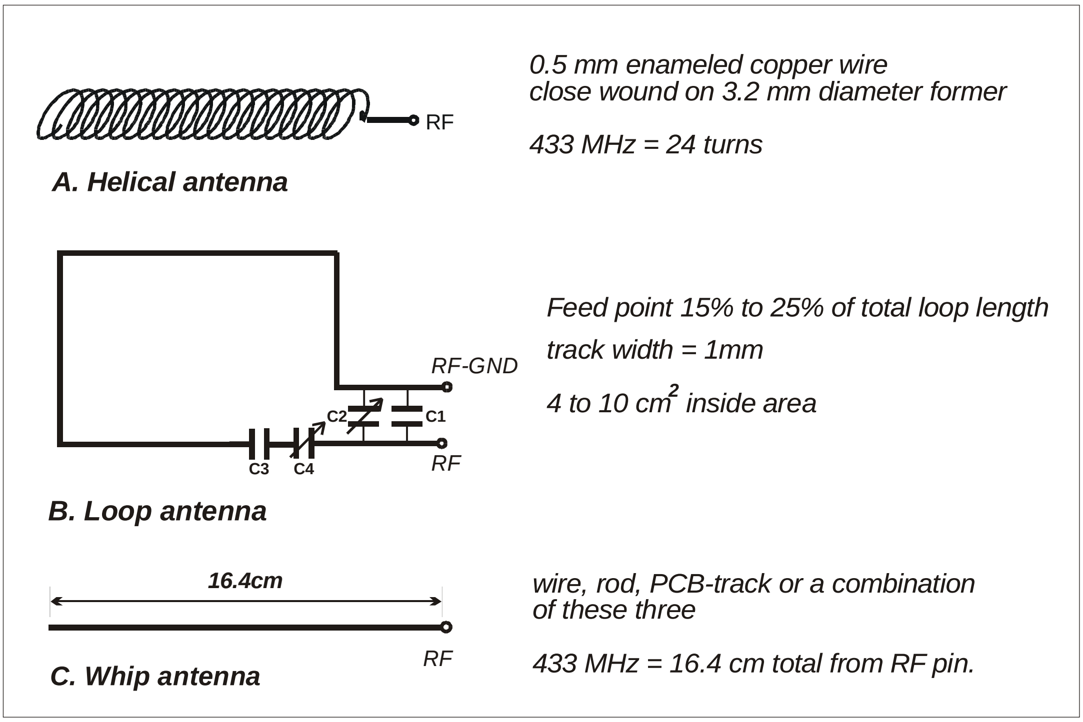

Figure 7: integral antenna configurations

External antennas

These have several advantages if portability is not an issue, and are essential for long range links. External antennas can be optimised for individual circumstances and may be mounted in relatively good RF locations away from sources of interference, being connected to the equipment by coax feeder.

Helical. Of similar dimensions and performance to the integral type mentioned above, commercially-available helical antennas normally have the coil element protected by a plastic moulding or sleeve and incorporate a coax connector at one end (usually a straight or right-angle BNC/SMA type). These are compact and simple to use as they come pre-tuned for a given application, but are relatively inefficient and are best suited to shorter ranges.

Quarter-wave whip. Again similar to the integral type, the element usually consists of a stainless steel rod or a wire contained within a semi-flexible moulded plastic jacket. Various mounting options are available, from a simple BNC/SMA connector to wall brackets, through-panel fixings and magnetic mounts for temporary attachment to steel surfaces.

A significant improvement in performance is obtainable if the whip is used in conjunction with a metal ground plane. For best results this should extend all round the base of the whip out to a radius of the length of the whip used (under these conditions performance approaches that of a half-wave dipole) but even relatively small metal areas will produce a worthwhile improvement over the whip alone. The ground plane should be electrically connected to the coax outer at the base of the whip. Magnetic mounts are slightly different in that they rely on capacitance between the mount and the metal surface to achieve the same result.

A ground plane can also be simulated by using 3 or 4 quarter-wave radials equally spaced around the base of the whip, connected at their inner ends to the outer of the coax feed. A better match to a 50Ω coax feed can be achieved if the elements are angled downwards at approximately 30-40° to the horizontal.

Module mounting considerations

The modules may be mounted vertically or bent horizontal to the motherboard. Note that the components mounted on the underside of the NTX2B are relatively fragile - avoid direct mechanical contact between these and other parts of the equipment if possible, particularly in situations where extreme mechanical stresses could routinely occur (as a result of equipment being dropped onto the floor, etc).

Good RF layout practice should be observed. If the connection between module and antenna is more than about 20mm long use 50 ohm microstrip line or coax or a combination of both. It is desirable (but not essential) to fill all unused PCB area around the module with ground plane.

Variants and ordering information

The NTX2B transmitters are manufactured in the following variants as standard:

Part No.	Frequency (MHz)	RF Power (mW)	Duty Cycle	Country
NTX2B-434.075-10	434.075	10	<100%	EU
NTX2B-434.650-10	434.650	10	<100%	EU
NTX2B-458.700-10	458.700	10	<100%	UK

25kHz channel spacing Narrow Band FM NTX2B transmitters can be operated without duty cycle restriction on 10mW e.r.p 434.040-434.790MHz sub-band.
http://www.erodocdb.dk/Docs/doc98/official/pdf/REC7003e.pdf

Other frequency variants can be programmed to individual customer requirements in the range 425MHz to 480MHz.

Versions operating on other frequency bands may also be available. Contact Radiometrix for details

Radiometrix Ltd
Hartcran House
231 Kenton Lane
Harrow, Middlesex
HA3 8RP
ENGLAND
Tel: +44 (0) 20 8909 9595
Fax: +44 (0) 20 8909 2233
sales@radiometrix.com
www.radiometrix.com

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The Intrastat commodity code for all our modules is: 8542 6000

R&TTE Directive

After 7 April 2001 the manufacturer can only place finished product on the market under the provisions of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may demonstrate compliance to the essential requirements specified in Article 3 of the Directive, as appropriate to the particular equipment.
Further details are available on The Office of Communications (Ofcom) web site:
http://www.ofcom.org.uk/

Information Requests
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Tel: +44 (0)300 123 3333 or 020 7981 3040
Fax: +44 (0)20 7981 3333
information.requests@ofcom.org.uk

European Communications Office (ECO)
Peblingehus
Nansensgade 19
DK 1366 Copenhagen
Tel. +45 33896300
Fax +45 33896330
ero@ero.dk
www.ero.dk