



BHX2

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NBFM Multi-channel 500mW UHF Transceiver

The BHX2 transceiver module offers a 500mW RF power output in the UK 458MHz band. This makes the BHX2 ideally suited to those low power applications where existing multi-channel narrow band devices like TR2M have insufficient range.



Figure 1: BHX2-458-5-SMA

Features

- Conforms to EN 300 220-3 and EN 301 489-3
- Any 5MHz band module from 420 - 480MHz available as factory tuned custom variant
- High performance double superhet, 128 channel PLL Synthesizer with TCXO
- Data rates up to 5 kbps for standard module
- Usable range over 5km
- Fully screened
- Feature-rich interface (RSSI, automatic noise squelch, analogue and digital baseband)
- Incorporates a 1200baud dumb modem
- User configurable via RS232 interface
- Low power requirements

Applications

- Handheld terminals
- Heavy vehicle/machine remote controls
- EPOS equipment, barcode scanners
- Data loggers
- Industrial telemetry and telecommand
- In-building environmental monitoring and control
- High-end security and fire alarms
- Vehicle data up/download

Technical Summary

- Operating frequency: 458.5-459.1MHz
- Custom variants from 420MHz to 480MHz on any 5MHz band
- 23 channels in 458MHz band (128 channels max.)
- Transmit power: +27dBm (500mW) nominal
- Supply range: 5.5V - 15V
- Current consumption: 350mA transmit, 30mA receive
- Data bit rate: 5kbps max. (standard module)
- Receiver sensitivity: -118dBm (for 12 dB SINAD)
- Size: 85 x 39 x 13 mm (RF pin version)

Evaluation platforms: NBEK + BHX carrier

BHX2 458 500mW transceiver

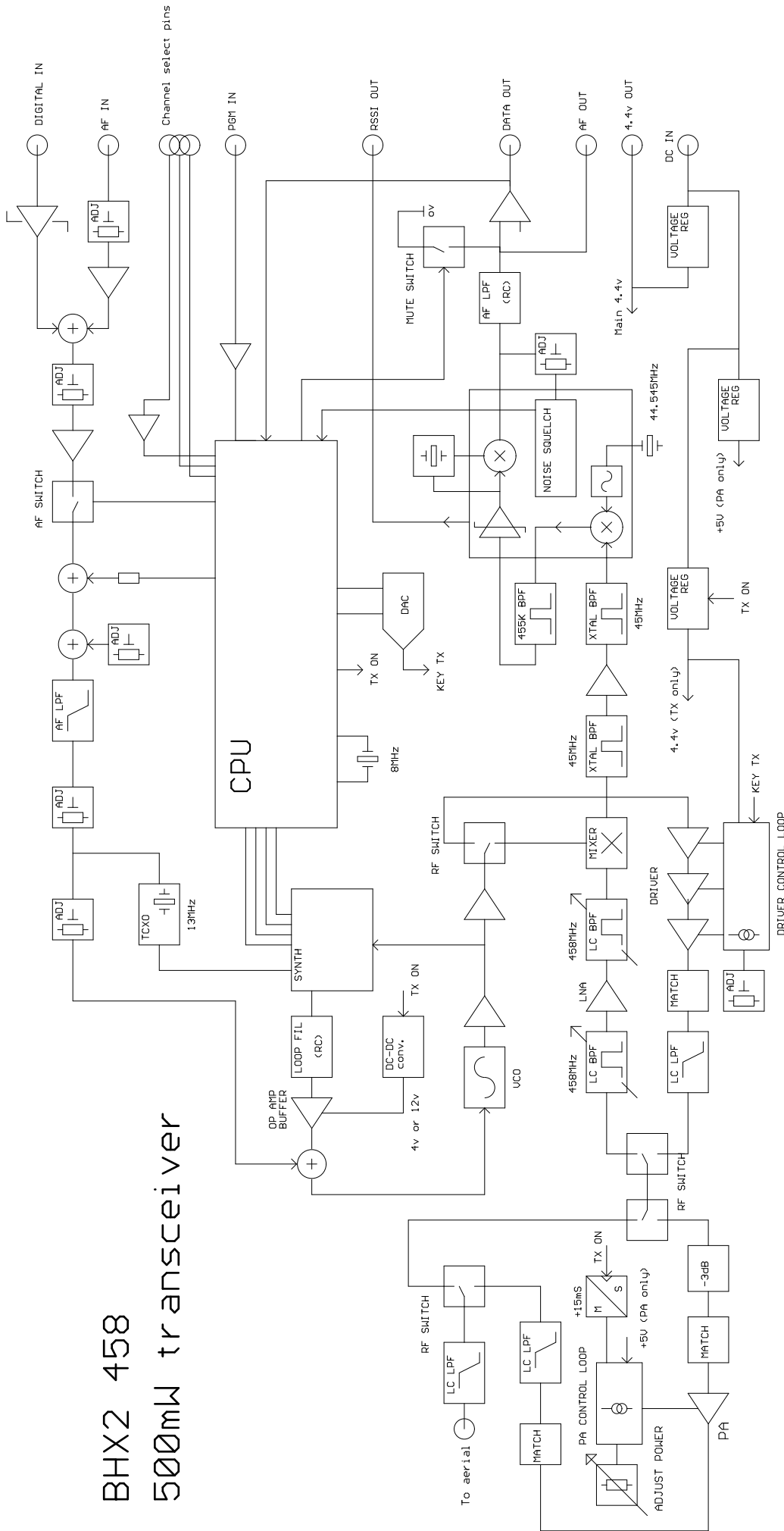


Figure 2: BHX2 block diagram

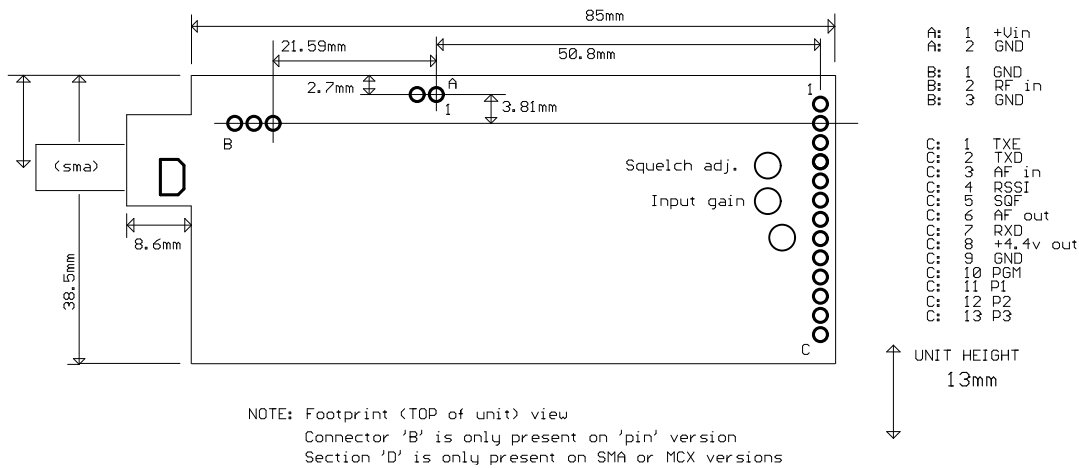


Figure 3: BHX2 Footprint (Top) view

User Interface

Pins	Name	Function
1	TXE	Transmitter Enable. Low = ON, Open = RX mode. Internal 10kΩ pull-up to 4V
2	TXD	DC coupled digital data input for 3-12V CMOS logic. Leave open if unused
3	AF in	50mV - 2.5v p-p AC coupled input. Variable gain
4	RSSI	DC level between 0.5V and 2.5V. 60dB dynamic range
5	SQF	Noise operated carrier detect. Open collector. ON/low = no signal
6	AF out	200mV _{pk-pk} audio. DC coupled, approx 1V bias. Muted by squelch
7	RXD	Open collector output of data slicer suitable for Biphase codes
8	+4.4V out	Regulated DC supply. 75mA max. drain. Present if unit is powered
9	0V	Ground
10	PGM	Serial programming/configuration input at RS232 level
11	P1	Parallel frequency select inputs. Inverted logic, internal 10kΩ pullups to 4.4V
12	P2	
13	P3	

Notes:

1. BHX2 transmitter section inverts sense of the baseband stream, so a logical inversion is present between input of TX and output on RX
2. Carrier detect mutes the AF and DATA outputs. It can be disabled by rotating the level set trimmer fully ACW.
3. There are no pullups on the open collector outputs.
4. The software incorporates a 1200baud dumb modem, compatible with that implemented in TX2M, RX2M, TR2M, SMX2 and UHX2 radios (i1200 tones and format).
5. RS232 input pins (10 and 11) tolerate true +/- levels. No buffering is required.
6. This unit actually consists of a TR2C RF board and an AFS2-458 amplifier module, combined with a 5v LDO
7. In future versions of the software, pin 13 will have a modem handshake function
8. The BHX2 has the same footprint/pinout/function as the TR2M (TR2B), but the case is longer, and the RF output is a coaxial connector. Compared to an TR2M, the minimum supply voltage is higher (5.5v vesus 4.5v).

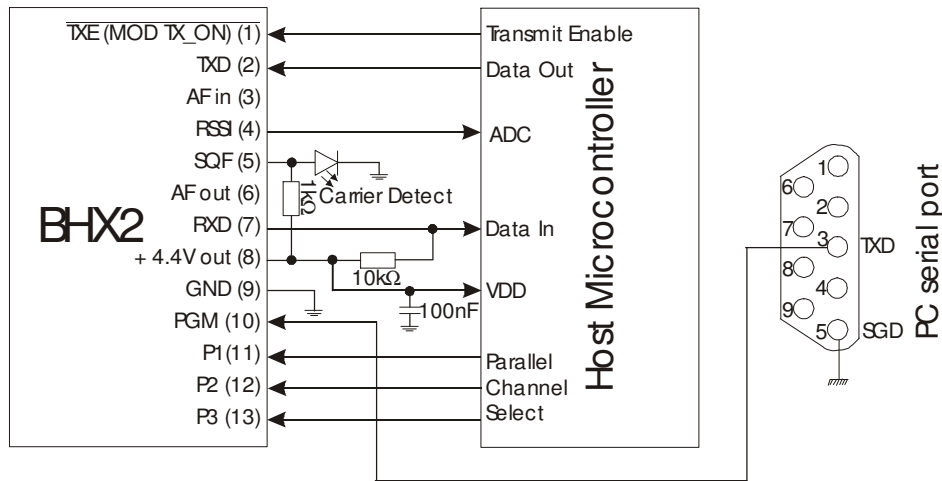


Figure 4: BHX2 interfaced to host microcontroller and serial port for configuration

BHX2 can be directly interfaced to a host microcontroller which can generally be powered by the regulated +4.4V output on pin 8 of BHX2. Three I/O pins on the microcontroller port can be assigned to select the first 8 channels on frequency table of the appropriate band for which the module is configured by pulling the P1-P3 pins low. Channel select pins of BHX2 have internal pull-up to 4V supply rail, hence channel selection operate on inverted logic.

Channel	P3:P2:P1	458MHz band
0	111	458.525
1	110	458.550
2	101	458.575
3	100	458.600
4	011	458.625
5	010	458.650
6	001	458.675
7	000	458.700

Digital Received Data Output (RXD) pin is an open collector output, which should be pulled-up to required voltage swing level (e.g. +4.4V or Vcc).

BHX2 has an automatic noise squelching function which is activated when there is not any RF signal at detectable level on the channel or if the non-coherent noise like interference level is high enough to block any weak RF signal from being received. SQF is provided as an open-collector output for monitoring which should be pulled-up to required voltage swing level. SQF output will jump to pull-up voltage level if received RF signal level at the RF In/Out pin of the module is about 3dB below the level required to produce 12dB SINAD level on demodulated AF Output signal. SQF pin can be connected to an LED to act as a Carrier Detect indicator. Pull-up resistor value should be reduced (e.g. 1kΩ) according to the current requirement to produce satisfactory brightness on the LED used.

BHX2 can be configured using any PC/Laptop/PDA having a serial port and modem/terminal program. TXD (pin 3) of DB9M connector can be directly wired to PGM (pin C10) of the BHX2 and SGN (pin 5) of DB9M connector should be either connected to common ground or pin C9 of the BHX2.

The whole frequency/channel table is user reconfigurable to 128 channels within 5MHz band of supplied frequency subject to regulatory band limits. Serial Channel Selection via PGM pin gives access to the whole of regulatory band allocation for 458.525MHz-458.925MHz (23 channels).

Received Signal Strength

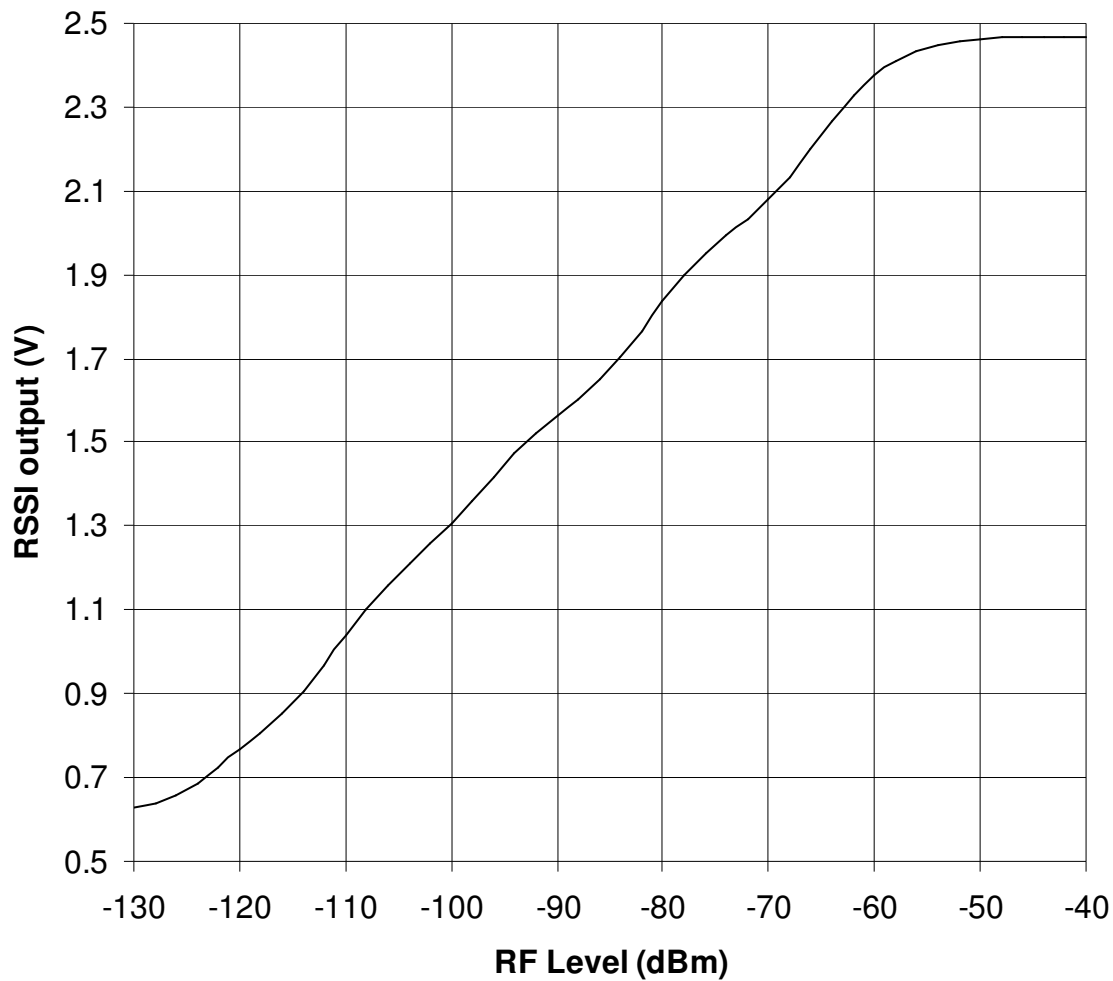


Figure 5: RSSI voltage variation with respect to RF level at BHX2

If the microcontroller has a built-in Analogue to Digital Converter (ADC), the Received Signal Strength Indicator (RSSI) output voltage level can be read by the microcontroller to estimate its distance from transmitting BHX2 unit or identify areas of weak signal reception.

RSSI can also be used to make a decision to switch to the second antenna in fixed installations within building where the probability of null-spots are higher.

BHX2 serial configuration commands

2400 baud RS232. 8 bit data, no parity, 1 start bit, 1 or 2 stop bits, No flow control

SINGLE nnnn	Set value of N for single channel operation
GOCHAN xx	Serial select of channel xx (0 to 127)
LOADMX xx	Set highest permitted (serial selected) channel xx (others default to ch0)
LOAD aa nnnn	Set value of N for channel aa (channels 0 to 15)
LOADTB nnnn	Set value of N for channel 16 (channels 17 to 127 then in sequence)
RVALUE rrrr	Enter value for R register
SETPAR	Channel selected by 3 bit parallel input (0 to 7). Disable modem
SETSER	Channel selected by most recent 'gochan' operation
SETMOD	Enable internal modem. Frequency selected by most recent 'gochan' or 'single'
OFFSET	Set receive frequency offset (for 25KHz this is 1800)
GOTEST	250Hz test tone transmission
<cr>	Process entry
/	Clear all buffers

xx = channel number from 00 to 127

aa = two digit channel number from 00 to 15

nnnn = synthesizer N register value, (up to 65535)

rrrr = synthesizer R register value, (up to 16383)

$$N = \frac{f_{RF}}{f_{Channelspacing}} = \frac{458.525MHz}{25kHz} = 18341 \qquad R = \frac{f_{TCXO}}{f_{channelspacing}} = \frac{13MHz}{25kHz}, \text{ So } R=520$$

On receive, the local oscillator operates at 45MHz (the first IF) below the carrier.

An OFFSET value is subtracted from the channel's N value when the unit is switched into RX

$$OFFSET = \text{First IF} / F_c, \text{ so, } OFFSET = 45MHz / 25KHz = 1800 \text{ (usually)}$$

Notes:

1. A pause of at least 50ms must be allowed between command strings (EEPROM programming time)
2. SINGLE mode does not store the N value in EEPROM. Therefore the unit is inoperative after a power down until either another valid SINGLE command is received, or mode is changed by a GOCHAN, SETPAR or SETSER command. SINGLE mode is intended for frequency agile applications.
3. /SETPAR command should be issued at the end of channel programming to put the module back into parallel frequency select mode
4. In 458MHz band, channel 12 (458.825MHz) and channel 15 (458.900MHz) are allocated specifically for fixed alarm and radio keys/vehicle paging applications respectively and should not be used for general purpose applications.
5. User can modify the frequency table of 128 channels to any desired frequency by changing N, R values of synthesizer within $\pm 2.5MHz$ of factory set Channel 0 frequency subject to the Radio Regulatory Band Allocation in the country of intended use.
6. All other frequency, power, analogue input gain and automatic noise squelching adjustment will be treated as custom variants of the module to be set by factory.

Pin description of BHX2 with Modem mode selected

The 'modem' mentioned is a 1200 baud RS232 semi-intelligent unit (Transmit keyed when valid serial data is present, so no separate TX control needed. Coding in the datastream also permits the receiver to ignore noise and only output valid serial data). This is a half duplex unit, so collisions between transmitted and received packets must be dealt with by the user.

Pin	Name	Function
1	MOD TX_ON	Open = normal modem operation. Low = constant TX (for test). 10k pullup to 4V
2	MOD NC	Leave open
3	MOD NC	Leave open
4	RSSI	DC level between 0.5V and 2.5V. 60dB dynamic range
5	MOD NC	Leave open
6	AF out	Modem tones or noise present
7	NC	Leave open
8	+4.4V out	Regulated DC supply. 75mA max. drain. Present if unit is powered
9	0V	Ground
10	PGM	Serial programming/configuration input at RS232 level
11	MOD TXD	RS232 data input (true). 10k pullup to 4V
12	MOD RXD	Inverted RS232 data out (to inverting buffer like MAX232)
13	MOD NC	Leave open

BHX2s on both ends should be configured to required operating frequency using GOCHAN command before starting to use the internal 1200 baud modem, because the P1-P3 pins will be used as Modem Data pins and the modem will operate on the last serially selected channel after SETMOD command is used to enable the Modem.

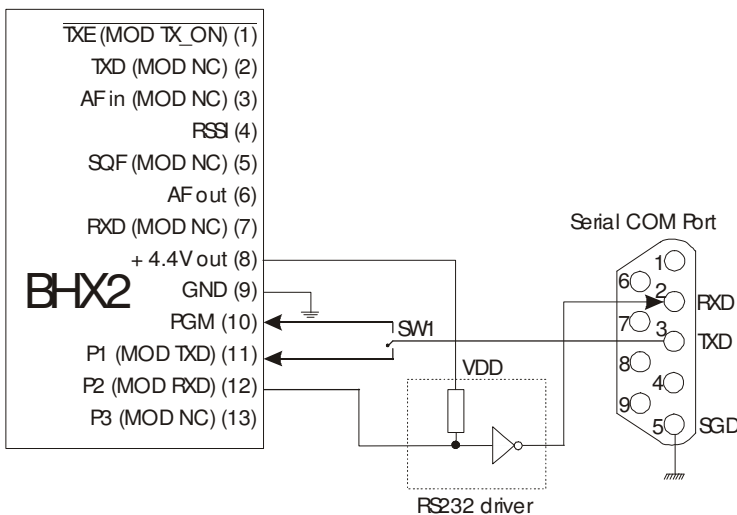


Figure 6: BHX2 interfaced to PC serial port in modem mode

Note:

Baud rate used for Modem is half that of used for serial configuration. Attached RS232 devices should be set with the following:

1200bps, 8 Data bits, No Parity, 1/2 stop bits, no flow control

TXD (Pin 3) of a Serial Port can be switched from PGM (Pin C10) to MOD TXD (Pin C11) with no RS232 driver in between. However, MOD RXD (Pin C12) requires an RS232 line driver before it can be connected to RXD (pin 2) of a serial port. Some of the RS232 line drivers can be powered from the regulated +4.4V out (Pin C8).

Condensed specifications

Frequency	458.5-459.1MHz (any 5MHz band from 420-480MHz) and any 3MHz band from 210 – 270MHz	
<i>Frequency stability</i>	+/- 1.5kHz	
<i>Channel spacing</i>	25kHz (12.5kHz by special order)	
<i>Number of channels</i>	128 channels controlled via RS232 interface (8 parallel selected)	
Transmit		
Output power	+27dBm (500mW) ±1dB	
TX on switching time	50 ms	
Modulation type	FM, FSK (F1D, F3D)	
TX modulation bandwidth	DC – 3kHz	
Adjacent channel TX power	-37dBm	
Inputs	analogue, data (CMOS/TTL compatible)	
Receive		
Sensitivity	-118dBm for 12 dB SINAD	
<i>image / spurious</i>	-70dB	
<i>blocking</i>	-85dB	
<i>adjacent channel</i>	<-65dB (Tested per. ETSI EN 301 489-3)	
Outputs	RSSI, carrier detect, audio, data	
Spurious radiations	Compliant with ETSI EN 300 220-3 and EN 301 489-3	
Power on to valid audio	28ms (no noise mute)	
Power on to valid audio	45ms (with noise mute)	
Power on to stable data out (50:50 mark / space)	50ms (with or without mute)	
Supply		
<i>Voltage</i>	5.5 - 15V (+5V regulated version available)	
<i>Current</i>	350mA nominal transmit	
	30mA receive	
Interface		
<i>user</i>	13pin 0.1" pitch molex	
<i>Power</i>	2pin 0.1" pitch molex	
<i>RF</i>	3pin 0.1" pitch molex or SMA (long, bulkhead mounted type) or MCX	
Recommended PCB hole size	1.2mm (min.)	
Size	85 x 39 x 13 mm Case only (RF pins version) 92 x 39 x 13mm (including MCX) 105 x 39 x 13mm (including SMA)	
Operating temperature	-20 to +60 °C (Storage -30 to +70 °C)	
Intended approval	ETSI Radio standard EN 300 220-3 and EMC standard EN 301 489-3	

- Notes:** 1. The data slicer cannot be depended upon for data waveform frequencies below 250Hz
2. When RX is on and a transmitter keys up, again a 50ms period is required to stabilise data output mark/space. i.e. allow at least 50ms of preamble

Ordering Information:

Part No.	Antenna connector	Frequency band
BHX2-458-5	RF pins	458.5 - 459.1MHz
BHX2-458-5-SMA	SMA	458.5 - 459.1MHz
BHX2-458-5-MCX	MCX	458.5 - 459.1MHz
BHX2-xxx-5	Where xxx is any 5MHz band from 420-480MHz) and any 3MHz band from 210 – 270MHz	
BHX2-xxx-5-SMA		
BHX2-xxx-5-MCX		

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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:

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