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VX2M

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NBFM Vibration resistant Category 1 Multi-channel Transceiver

VX2M is a 400MHz band transceiver conforming to the Radiometrix TR2M pinout. It uses a sophisticated combination of techniques to produce a very robust device with excellent resistance to vibration.

It meets the ETSI Category 1 high performance receiver specification to be used where the operation of a SRD may have inherent safety of human life implications.

It retains all the pin-functions of the parent TR2M (including noise operated squelch/carrier detect and separate digital/analogue inputs and outputs). It also supports the same internal i1200 modem as the TR2M.

Figure 1: VX2M-458-5

Features

- Conforms to EN 300 220-3 and EN 301 489-3
- ETSI EN 300 220-1 Category 1 High performance level receiver
- Any 3MHz band module from 400MHz to 475MHz 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 1km (with 100mW variant)
- Fully screened
- Feature-rich interface (RSSI, automatic noise squelch, analogue and digital baseband)
- Incorporates a 1200baud dumb modem
- User configurable via RS232 interface

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 or 433.05-434.79MHz
- Custom variants from 400MHz to 475MHz on any 3MHz band
- 23 channels in 458MHz band, 69 channels in 433MHz band (128 channels max.)
- Transmit power: +20dBm (100mW) nominal
- Supply range: 4.5V - 16V
- Current consumption: 130mA transmit, 50mA receive
- Data bit rate: 5kbps max. (standard module)
- Receiver sensitivity: -118dBm (for 12 dB SINAD)
- Size: 59 x 38 x 10mm

***Evaluation platforms**: NBEK + xx2M Series carrier*

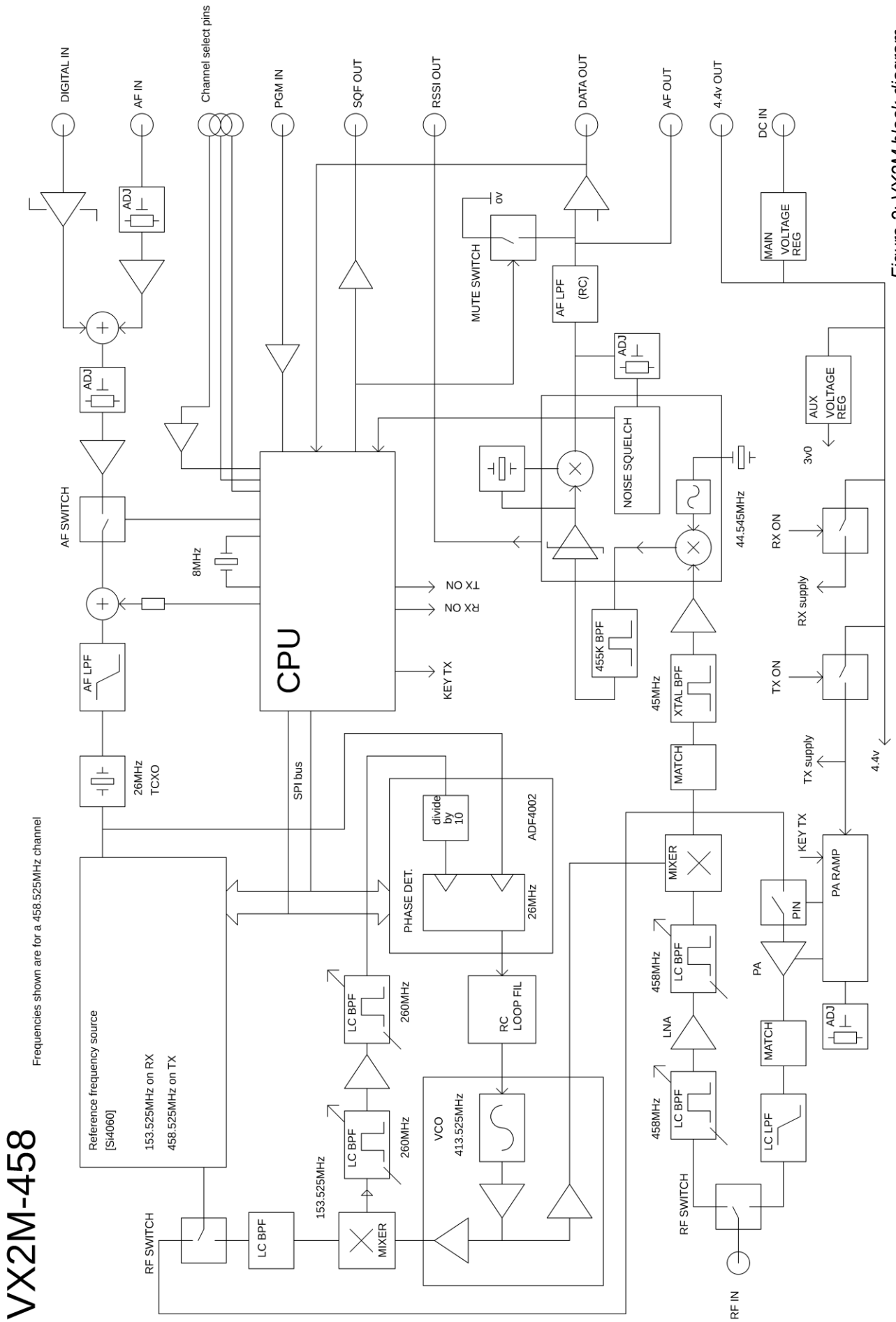

Figure 2: VX2M block diagram

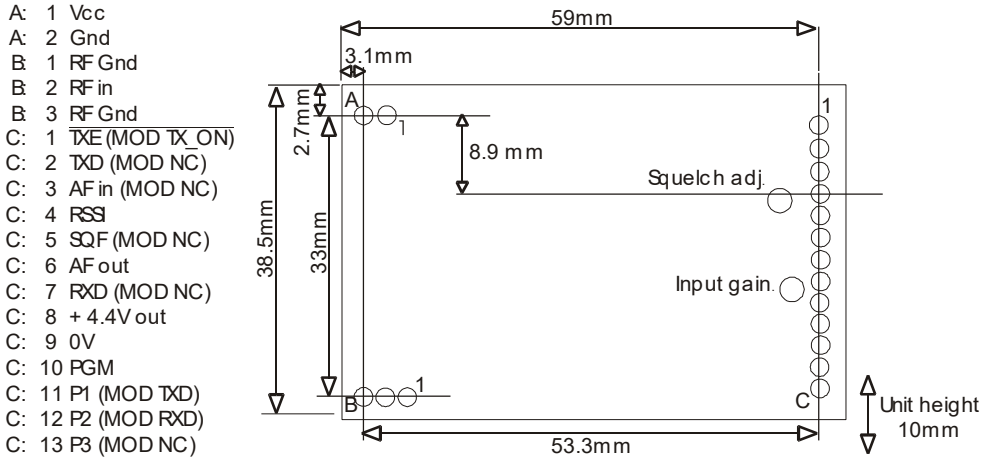

Figure 3: VX2M Footprint (Top) view

Pin Description - VX2M

Pins	Name	Function
A1	Vcc	4.5V-16V
A2	GND	Ground
B1	RF GND	RF ground
B2	RF	To the antenna
B3	RF GND	RF ground
C1	$\overline{\text{TXE}}$ (MOD $\overline{\text{TX\_ON}}$)	Transmitter Enable. Low = ON, Open = RX mode. Internal 10kΩ pull-up to 4V
C2	TXD (MOD NC)	DC coupled digital data input for 3-12V CMOS logic. Leave open if unused
C3	AF in (MOD NC)	AC coupled Analogue Input Limit to $1V_{pk-pk}$ ±10% to keep distortion <1.5% and peak deviation >2.5kHz
C4	RSSI	DC level between 0.5V and 2.5V. 60dB dynamic range
C5	SQF (MOD NC)	Noise operated carrier detect. Open collector. ON/low = no signal
C6	AF out	$600mV_{pk-pk}$ audio. DC coupled, approx 1V bias. Muted by squelch
C7	RXD (MOD NC)	Open collector output of data slicer suitable for Biphase codes
C8	+4.4V out	Regulated DC supply. 75mA max. drain. Present if unit is powered
C9	0V	Ground
C10	PGM	Serial programming/configuration input at RS232 level
C11	P1 (MOD TXD)	Parallel frequency select inputs. Inverted logic, internal 10kΩ pullups to 4V
C12	P2 (MOD RXD)	
C13	P3 (MOD NC)	

Notes:

1. *Carrier detect on VX2M mutes the AF Out and RXD outputs. It can be factory disabled.*
2. *All the open collector outputs must be connected to Vcc/+4.4V out via a pull-up resistor.*
3. *The software incorporates a 1200baud dumb modem, compatible with that implemented in TX2M, RX2M radios (I1200 tones and format)*
4. *With 1200baud modem mode enabled, parallel selection of channel is unavailable as the P1-P3 lines are used for modem input/output operations.*
5. *PGM and MOD TXD (pin 10 and 11) tolerate true ±RS232 levels. No buffering is required.*

VX2M can be directly interfaced to a host microcontroller which can generally be powered by the regulated +4.4V output on pin 8 of VX2M. 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 VX2M have internal pull-up to 4V supply rail, hence channel selection operate on inverted logic.

Channel	P3:P2:P1	433MHz band	458MHz band
0	111	433.050	458.525
1	110	433.075	458.550
2	101	433.100	458.575
3	100	433.125	458.600
4	011	433.150	458.625
5	010	433.175	458.650
6	001	433.200	458.675
7	000	433.225	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).

VX2M 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.

VX2M 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 VX2M and SGN (pin 5) of DB9M connector should be either connected to common ground or pin C9 of the VX2M.

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 433.05MHz - 434.790MHz (69 channels) or 458.525MHz - 458.925MHz (23 channels).

Received Signal Strength

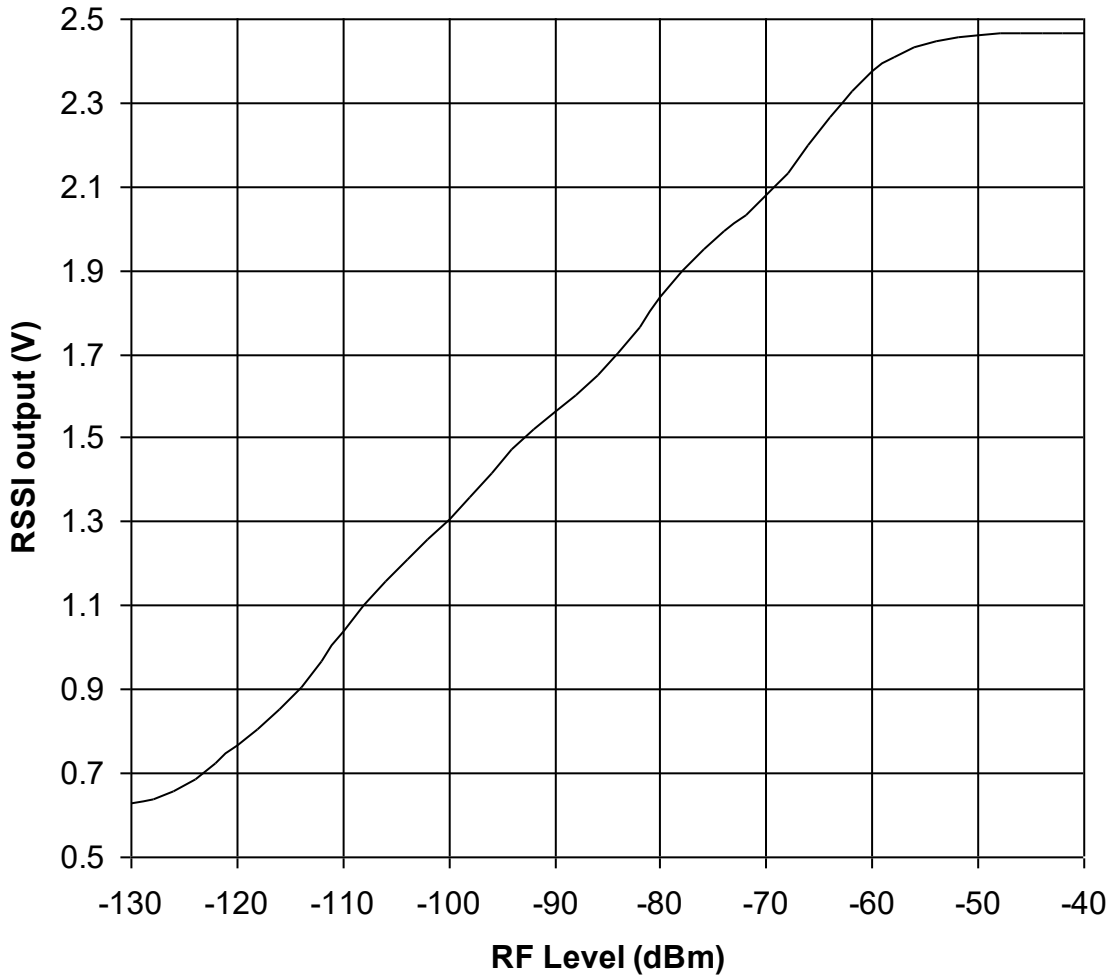

Figure 4: RSSI voltage variation with respect to RF level at VX2M

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 VX2M 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.

Regulatory Restrictions

There is a generic 10% duty cycle restriction on the 433MHz ISM band through out European countries with few exceptions. Annex 1 Band E, Band E2 of European Radio Communications Committee (ERC) Recommendation 70-03 dated February 2004 specifies the following:

433.050MHz (Ch0)	**434.050MHz (Ch40)**	**433.775MHz (Ch69)**
10mW ERP, 10% duty cycle for Channelised Narrow Band and Wide Band usage		
	10mW ERP, 100% duty cycle for <25kHz Channelised Narrow Band usage	
433.05MHz	**434.040MHz**	**434.79MHz**

433.050 - 434.790 MHz, Non Specific Short Range Device, band is primarily intended for Telemetry, Telecommand, Alarms, Data in general and other similar applications. Audio and Voice signals should be avoided in the band.

VX2M serial configuration commands

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

SINGLE nnnnn	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 nnnnn	Set value of N for channel aa (channels 0 to 15)
LOADTB nnnnn	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'
GOTEST	250Hz test tone transmission
OFFSET ooo	Set receive frequency offset (for 25KHz this is 1800)
<cr>	Process entry
/	Clear all buffers

xx = channel number from 00 to 127
aa = two digit channel number from 00 to 15
nnnnn = synthesizer N register value, (up to 65535)
rrrr = synthesizer R register value, (up to 16383)
000 = frequency offset

$$N_{TX} = \frac{f_{RF}}{f_{Channelspacing}} = \frac{433.050MHz}{25kHz} = 17322 \qquad R = \frac{f_{TCXO}}{f_{channelspacing}} = \frac{13MHz}{25kHz}$$, *So R=520*

$$RX\ OFFSET = \frac{IF}{f_{channelspacing}} = \frac{45MHz}{25kHz}$$ = 1800

Channel Number	433MHz band	N value for TX	458MHz band	N value for TX
0	433.050	/LOAD00 17322	458.525	/LOAD00 18341
1	433.075	/LOAD01 17323	458.550	/LOAD01 18342
2	433.100	/LOAD02 17324	458.575	/LOAD02 18343
3	433.125	/LOAD03 17325	458.600	/LOAD03 18344
4	433.150	/LOAD04 17326	458.625	/LOAD04 18345
5	433.175	/LOAD05 17327	458.650	/LOAD05 18346
6	433.200	/LOAD06 17328	458.675	/LOAD06 18347
7	433.225	/LOAD07 17329	458.700	/LOAD07 18348
8	433.250	/LOAD08 17330	458.725	/LOAD08 18349
9	433.275	/LOAD09 17331	458.750	/LOAD09 18350
10	433.300	/LOAD10 17332	458.775	/LOAD10 18351
11	433.325	/LOAD11 17333	458.800	/LOAD11 18352
12	433.350	/LOAD12 17334	458.825	/LOAD12 18353
13	433.375	/LOAD13 17335	458.850	/LOAD13 18354
14	433.400	/LOAD14 17336	458.875	/LOAD14 18355
15	433.425	/LOAD15 17337	458.900	/LOAD15 18356
16	433.450	/LOADTB 17338	458.925	/LOADTB 18357
F max	434.775	/LOADMX 69	459.100	/LOADMX 23

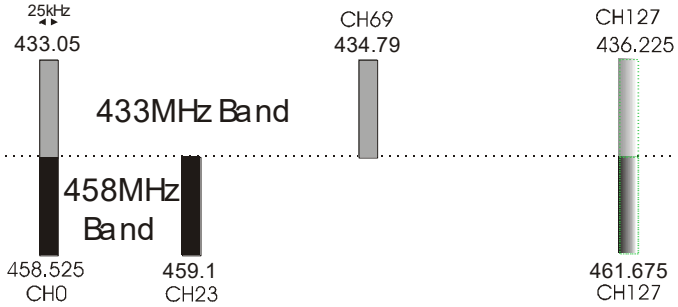

Figure 5: Maximum regulatory and user accessible sequential channels

Notes:

1. *A pause of at least 50ms must be allowed between command strings (EEPROM programming time) 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.*
2. */SETPAR command should be issued at the end of channel programming to put the module back into parallel frequency select mode*
3. *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.*
4. *User can modify the frequency table of 128 channels to any desired frequency by changing N, R values of synthesizer within ±1.5MHz of factory set Channel 0 frequency subject to the Radio Regulatory Band Allocation in the country of intended use.*
5. *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 VX2M 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

VX2Ms 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.

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 or 433-434MHz (any 3MHz band from 400-475MHz)
Frequency stability	+/- 1.5kHz
Channel spacing	25kHz (12.5kHz by special order)
Number of channels	128 channels controlled via RS232 interface (8 parallel selected)
Supply *voltage*	4.5 - 16V
Current	130mA nominal transmit
	50mA receive
Operating temperature	-20 to +70 °C (Storage -30 to +70 °C)
Size	59 x 38 x 10 mm
Spurious radiations	Compliant with ETSI EN 300 220-3 and EN 301 489-3
Interface	
user	13pin 0.1" pitch molex
Power	2pin 0.1" pitch molex
RF	3pin 0.1" pitch molex
Recommended PCB hole size	1.2mm (min.)
Intended approval	ETSI Radio standard EN 300 220-3 and EMC standard EN 301 489-3
Transmitter	
Output power	+20dBm (100mW) ±1dB (factory adjustable 1-100mW)
TX on switching time	< 15 ms
Modulation type	FM, FSK (F1D, F3D)
TX modulation bandwidth	DC – 3kHz
Adjacent channel TX power	<-37dBm (<200nW)
TX spurii	better than -40dBm
Inputs	analogue, data (CMOS/TTL compatible)
Receiver	
Sensitivity	-118dBm for 12 dB SINAD (-115dBm for 12 dB SINAD for 12k5 variant)
adjacent channel	65dB
-910kHz spurios	69dB
½ IF	>80dB
image / spurious	>80dB
blocking	86dB or better
Outputs	RSSI, carrier detect, audio, data
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)
Switching time (TX→ RX and RX→ TX)	Under 15ms (no noise mute)

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.	Description	Frequency band	Data rate (max)
VX2M-433-5	VX2M transceiver (non inverted RXD output)	433.05MHz - 434.790MHz	5kbps
VX2I -433-5	VX2I transceiver (inverted RXD output)	433.05MHz - 434.790MHz	5kbps
VX2M-458-5	VX2M transceiver (non inverted RXD output)	458.525MHz - 459.100MHz	5kbps
VX2I-458-5	VX2I transceiver (inverted RXD output)		5kbps
VX2M-458-10	VX2M transceiver (non inverted RXD output)	458.525MHz - 459.100MHz	10kbps
VX2I-458-10	VX2I transceiver (inverted RXD output)	458.525MHz - 459.100MHz	10kbps

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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/radiocomms/ifi/

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