

## SHX1

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### 500mW Multichannel VHF transceiver

**SHX1 is small multi-channel narrow band VHF transceiver with 500mW RF power output.**

**It is usable for 144MHz band amateur, 151MHz US MURS and European 169MHz band high power applications.**



Figure 1: SHX1-154-5-12K5-MURS

#### Features

- Conforms to ETSI EN 300 220-3 and EN 301 489-3
- High performance double superhet PLL synthesizer
- +27dBm (500mW) RF power output
- Data rates up to 5 kbps for standard module
- Usable range over 5km
- Fully screened. Low profile
- Feature-rich interface (RSSI, analogue and digital baseband)
- Incorporate a 1200baud modem
- Re-programmable via RS232 interface
- Low power requirements

#### Applications

- Amateur Radio
- Remote Meter Reading
- Asset Tracking and Tracing
- Multi-Use Radio Service (MURS)

#### Technical Summary

- Operating frequency: Any 3MHz segment in 140 - 175MHz
- 8 parallel or 255 serial channels
- Channel spacing: 12.5kHz / 20kHz / 25kHz
- Transmit power: 500mW (+27dBm) nominal
- Supply range: +5V regulated
- Current consumption: 280mA (at 500mW output) transmit, 20mA receive
- Data bit rate: 5kbps max. (standard module)
- Receiver sensitivity: -118dBm (for 12 dB SINAD)
- Size: 67 x 30 x 9mm

**Evaluation platforms:** NBEK + UHX carrier

# SHX1 500mW VHF multichannel transceiver

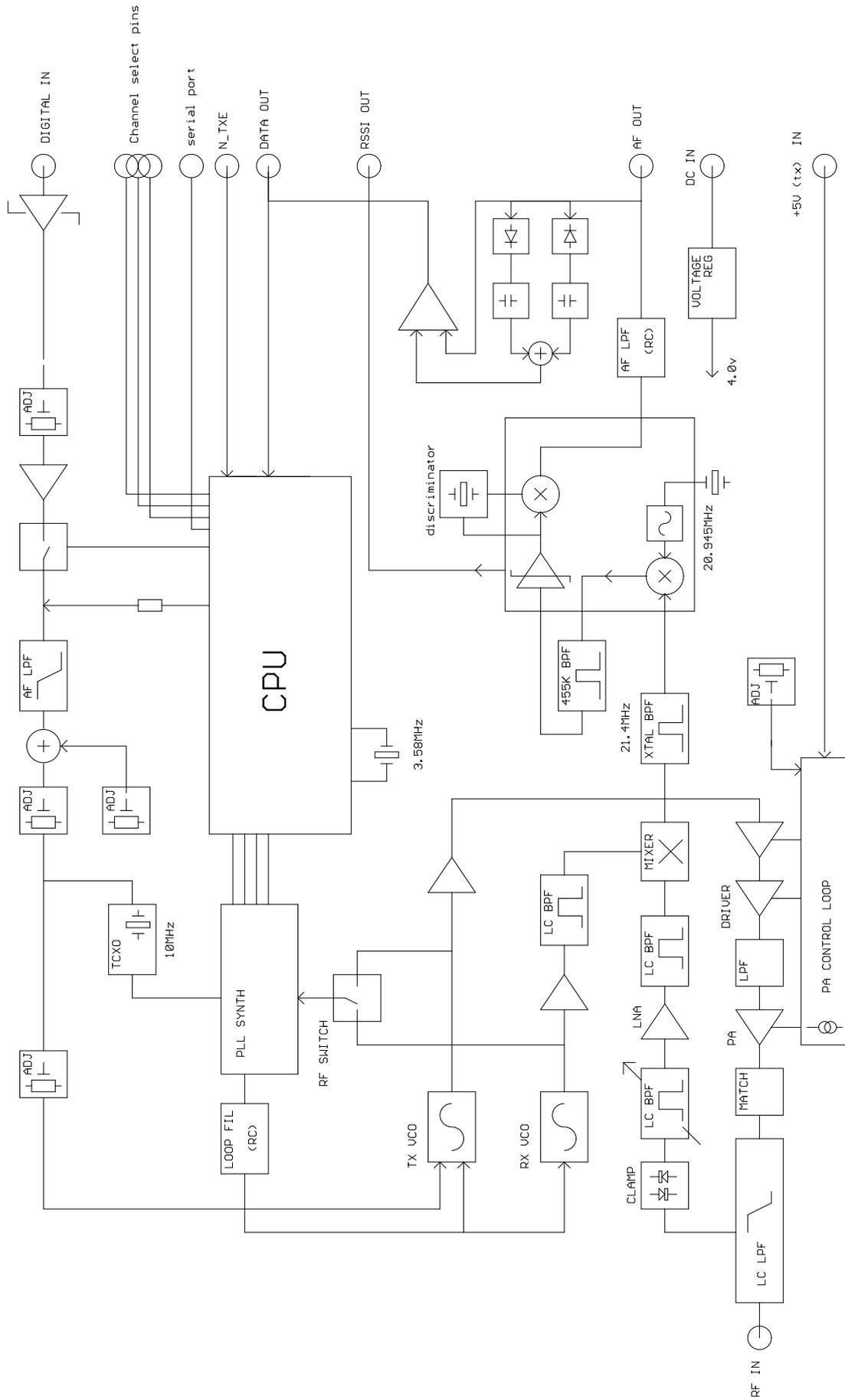
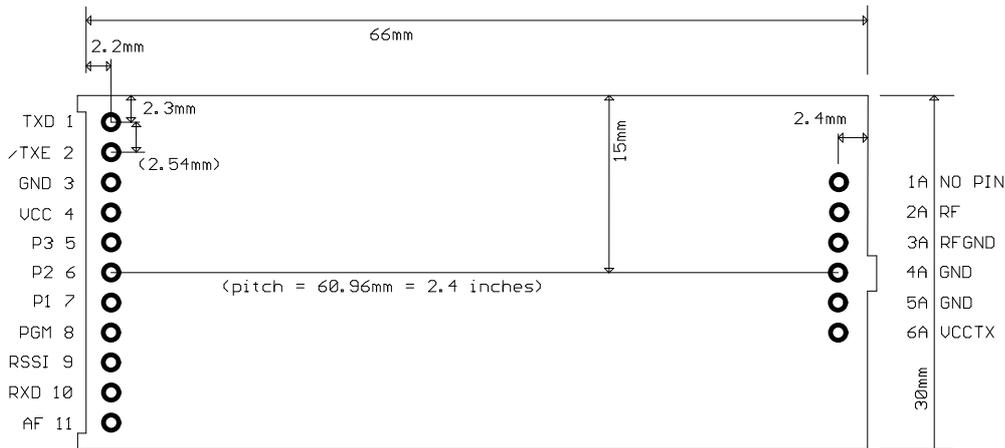


Figure 2: SHX1 block diagram

## SHX FOOTPRINT



**Figure 3: SHX1 footprint (Top) view**

### Pin Description

Pins		Normal mode	Modem mode
<b>RF</b>			
1A	NO PIN		
2A	RF in/out	To the antenna	
3A	RF Gnd	RF ground	
4A	GND	0V	
5A	GND	0V	
6A	VCCTX	+5V regulated supply for TX <sup>7</sup>	
<b>User</b>			
1	TXD	DC coupled input for TTL / CMOS logic	NC
2	TXE	Transmit enable. Low = TX mode	NC
3	GND	0V	
4	Vcc	DC supply input (+5V regulated) <sup>8</sup>	
5	P3	Parallel channel select	BUSY
6	P2	Parallel channel select	MOD TXD
7	P1	Parallel channel select	MOD RXD
8	PGM in	Serial programming/control input (inverted logic level RS232)	PGM in
9	RSSI	DC level between 0.5V and 2.5V. 60dB dynamic range	
10	RXD	Open collector output of data slicer. 47K pullup to 4V	NC
11	AF out	500mV p-p audio. DC coupled, approx 0.8V bias	NC

### NOTES:

1. No inversion occurs between TXD and RXD. However, AF out is inverted relative to TXD.
2. PGM, P0 - P3 (parallel channel selects) and TXE are active LOW and have internal 47K pullups to 4v.
3. Open collector output RXD has a 47K pullup to 4V.
4. The software incorporates a 1200baud dumb modem, compatible with that implemented in other Radiometrix narrowband units ( i1200 tones and format ). Modem operation is selected by a serial command.
5. Main serial port (PGM) operates at 2400 baud. (Command set is the same as SMX (USA) version). The unit is capable of operating in 'basic' parallel channel select only mode, or in serial controlled 'expanded' mode.
6. If analogue transmit modulation is needed, then connect a series 1uF cap + 500K trimmer (a multiturn is advised) in the 'baseband TXD' circuit. Adjust trimmer for 90% of peak deviation (+/- 2.7kHz) at mean input level.
7. The high current (280mA max.) transmitter supply (5v regulated) is fed to a separate pin, on the RF out connector (pin 6A).  
The Vcc (pin 4 on the user connector) can tolerate 4.1 - 15v, and draws up to 25mA. Both pins must be supplied at all times (most users connect them to a common +5v supply)

## Serial interface commands

Serial data is sent to the unit on the programming input (PGM).  
To successfully program the unit, it must be powered

Once 'modem' mode has been selected, the unit locks into serial command mode (and the parallel port pins have other functions) until a SETPAR command returns the unit to ordinary parallel operation.

Unlike earlier Radiometrix multichannel units, the SHX1 (like the QPX1 and USA versions of SMX1) has separate N and R registers for each channel, on transmit and on receive. In other words, the frequency of each channel is individually programmed in every mode.  
Channels 8-255 then constitute a sequential table, starting from channel 7

Functionally, the N value for any 'table' channel is derived by multiplying the STEP value by the (channel number -7) and adding it to the N value programmed for channel 7 (the chan 7 " R value" is used throughout the table).

The LOADMX command sets an upper limit for usable channel numbers, beyond which the unit reverts to channel 0

Unless a complex frequency map has been selected, all the R value registers are likely to be programmed with the same value

### Commands include:

Commands	Function
GOCHAN a	empty command buffer
LDTXN a nnnnn	set value of N for channel a , for transmit
LDRXN a nnnnn	set value of N for channel a , for receive
LDTXR a nnnnn	set value of R for channel a , for transmit
LDRXR a nnnnn	set value of R for channel a , for receive
LOADST ss	set per-channel increment step for table (channels 8 and up)
LOADMX aaa	set highest valid channel (all channels above this point default to ch0)
SETMOD	Enable internal modem. Frequency selected by most recent 'gochan' or 'single'
SETPAR	channel selected by 3 bit parallel input 3
SETSER	channel selected by most recent 'gochan' operation
RVALUE rrrrr	set R register value used by FORCE command
FORCE nnnnn	set value of N for single channel operation. N value NOT stored in EEPROM. It is necessary to send a FORCE command with a different value of nnnnn when changing from tx to rx or vice versa.
GOTEST	lock transmitter on, sending 250Hz squarewave (nothing overrides this command: you must power-off the unit)
<cr>	process entry
/	clear all buffers
#	disable command mode

### Volatile channel set up:

A byte with bit 7 set puts the ls nibble into the high 4 bits of a holding register.

A byte with bits 6 and 7 set puts the ls nibble into the low 4 bits of the holding register and the uses this value as a channel number to program the PLL. This function does not work if set to parallel mode.

At power-up the unit reverse back to the last E2prom stored GOCHAN value

a = single digit channel number from 0 to 7

aaa = channel number from 0 to 255

nnnnn = a synthesizer N register value, (up to 65535)

rrrrr = the synthesizer R register value, (up to 16383)

### ALL COMMANDS MUST BE IN UPPER CASE.

For transmit:  $N = \text{channel frequency} / (10\text{MHz} / R)$

For receive:  $N = (\text{channel frequency} - 21.4\text{MHz}) / (10\text{MHz} / R)$

$10\text{MHz} / R = 25\text{KHz}$ , so  $R = 400$  (usually)

**NOTE:**

- In 'FORCE' mode the unit is inoperative after a power down until either another valid FORCE command is received, or until mode is changed by a GOCHAN, SETPAR or SETSER command.
- FORCE mode does not apply any receive frequency offset.
- Different values need to be sent when changing from transmit to receive and vice versa.
- FORCE is intended mainly for test/diagnostic operation.
- A pause of at least 50ms must be allowed between command strings (EEPROM programming time)

**Modem mode**

The 'modem' mentioned is a 1200baud 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

If greater modem functionality is needed, then a version (SHZ1) is available which includes a full-function M48A modem device inside the unit, replacing the i1200 functions (case height is increased by 3mm to accommodate the extra circuitry). This "SHZ1" only operates in 'modem' mode (no parallel channel select, no independent transceiver operation)

**Ordering Information**

Part No.	Application	Channel spacing	Frequency band (MHz)
SHX1-144-5	Amateur Radio (e.g. APRS)	25kHz	144.000 - 146.000
SHX1-151-5-12k5-MURS	Multi-Use Radio Service (MURS) in USA, Canada	12.5kHz	CH0:151.820 – CH4:154.600MHz
SHX1-169-5-12K5	Meter Reading, Asset Tracking and Tracing	12.5kHz	CH0:169.40625 – CH15:169.59375 CH16:169.61875- CH31:169.806250
SHX1-169-5		25kHz	CH0:169.412500- CH7:169.587500 CH8:169.62500- CH15:169.8000

## Condensed specifications (All details are provisional)

Frequency	Any 3MHz segment in 140 - 175MHz (TX and RX frequencies need not be the same)
<i>Frequency stability</i>	+/-5ppm (better than $\pm 1.5$ kHz)
<i>Channel spacing</i>	12.5kHz / 20kHz / 25kHz (factory set)
<i>Number of channels</i>	8 parallel or 255 serial channels
Supply	
Receive	5.0V regulated at 20mA
Transmit:	5.0V regulated at 280mA for 500mW output
Operating temperature	-20 to +70 °C (Storage -30 to +70 °C)
Spurious radiations	Compliant with ETSI EN 300 220-3 and EN 301 489-3
Interface	
<i>User</i>	11 pin 0.1" pitch molex
<i>RF and TX supply</i>	5 pin 0.1" pitch molex
Recommended PCB hole size	1.2mm (min.)
Size	67 x 30 x 9mm
<b>Transmitter</b>	
Output power	+27dBm (500mW)
TX on switching time	<50 ms
Modulation type	FM, FSK (F1D, F3D)
TX modulation bandwidth	DC – 3kHz
Deviation	$\pm 3$ kHz ( $\pm 1.5$ kHz for 12.5kHz channel variant) nominal
Adjacent channel TX power	-37dBm
TX spuri	<-40dBm
Inputs	Data (CMOS/TTL compatible)
<b>Receiver</b>	
Sensitivity	-118dBm for 12dB SINAD
image / spurious	-65dB
blocking	-86dB
adjacent channel	-65dB (tested per ETSI EN300 086)
Outputs	RSSI, Audio, Data

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

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**<http://www.ofcom.org.uk/radiocomms/ifi/>**

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