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SR500
RECEIVER

TECHNICAL MANUAL
(1891 1233)

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DRAWINGS

Section 1
An overview

Wood & Douglas are an independent UK company dedicated to the design and manufacture of high quality RF designs for the telemetry, security, broadcast and video markets world-wide.

The company reserves the right to amend or change specifications of its products without prior notice in accordance with the company policy of continued product improvement.

The SR500 is a UHF Narrow band FM receiver intended for a variety of OEM applications. It combines high performance with relatively low cost and small size and is intended for PCB mounting within customer equipment.

NOTE:
This device complies with Part 15 of the FCC Rules.
Operation is subject to the condition that this device does not cause harmful interference.

The unit is labelled with a serial number label as shown below:

ST500 31	980912345
FCC ID ABCSR500	CE

where: 990912345 is the serial number of the unit containing the date code for September 1998

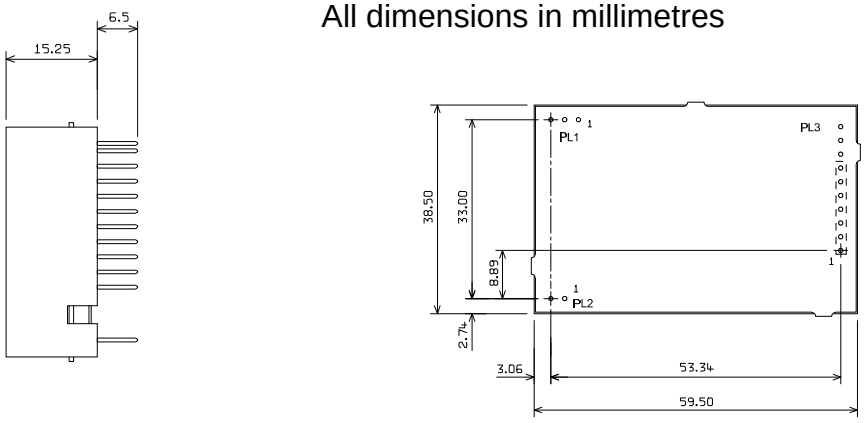
ABC is the Wood & Douglas Ltd FCC code

The approval of the SR500 will still require that the system containing it will also require approval in it's own right.

Section 2
Operation

2.1 INSTALLATION

NOTES: Pin spacing on all connectors is 2.54mm (0.1")
All dimensions in millimetres



2.2 CONNECTION

Connection to the SR500 receiver is via PL1, PL2 and PL3 which plug directly into the user's own equipment. The location of these connectors is shown in the figure above and detailed in the following tables.

PIN	NAME	FUNCTION	REMARKS
1	0V	0 Volts	Not Connected on early units.
2	RF I/P	RF Input	50 ohms
3	OV	0 Volts	common ground

Connector PL1 pin detail

PIN	NAME	FUNCTION	REMARKS
1	+VIN	positive supply	+6.0V to +15.0V
2	0V	0 volts	common ground

Connector PL2 pin detail

PIN	NAME	FUNCTION	REMARKS
1	RSSI	S meter output	0.5 - 2V signal strength indicator, 60dB range

2	SQF	Squelch flag	open collector output, ON (low) = no signal (SR500C: ON = signal received)
3	AUDIO	AF output	250mV p-p baseband audio, no internal blocking capacitor (SR500C: 1.5V p-p audio, no audio muting)
4	DATA	Data output	open collector, no pull-up
5	+5V	+5 volt supply output	50mA maximum current drain
6	0V	0 volts	common ground
7	RS232 I/P	serial programming input	if not used, leave not connected or ground
8	RB1	parallel frequency select	internal pull-up to +5V, active low
9	RB2		
10	RB3		

Connector PL3 pin detail

Section 3
Technical description

Refer to the circuit diagram WD1660 at the rear of this manual.

3.1 POWER SUPPLY

DC power is connected to the transmitter module via PL2. It is fed directly to regulator IC1. This provides a stable output of nominally +5V which is used to power all the remaining sections of the receiver either directly or via R-C decoupling networks. The 5V output from IC1 is also available at PL3 for the powering of external equipment with a current requirement of up to 50mA.

3.2 RF FRONT END & MIXER

The antenna is connected via PL3. The signal passes directly into helical filter F2 which is tuned for the required frequency range. The use of a filter prior to the RF amplifier provides a high level of immunity from overloading by strong out-of-band signals. The signal then passes to a low noise RF amplifier, a bipolar design based around TR3. This circuit is run at relatively high current in order to minimise the possibility of overloading by strong signals, but to reduce overall current consumption it is “voltage stacked” with the synthesiser and VCO in a current sharing arrangement. Thus only ~2V of the 5V supply is dropped across the front end device. After the RF amplifier, the signal passes through a second tuned helical filter F4. Along with F2, this provides sufficient selectivity to give image rejection in excess of 70dB.

The signal then passes to TR1, a dual gate MOSFET which acts as the first mixer.

3.3 VCO & SYNTHESISER

A WD1647 VCO module (U1) is used to generate the first LO. This module is pre-tested prior to assembly if the SR500 and provides an output of ~1mW at a frequency 45MHz lower than the wanted frequency. The VCO is locked onto frequency by a PLL frequency synthesiser based around IC4. X2, a 12.8 MHz TCXO oscillator provides a frequency reference for the synthesiser. This is stable to better than 2.5ppm over the operating temperature range.

The synthesiser is serially programmed by IC6, a PIC microcontroller. D2/C24 are used to provide an out of lock indication from the synthesiser’s LD line. This is input to IC6 to allow synthesiser reprogramming when an out of lock condition is detected. This has been included to protect against malfunction of the unit due to corruption of the data held in the synthesiser (for example during a power supply “brown-out”). The microcontroller includes an internal EEPROM memory which is used to store operating frequency information.

3.4 IF & AF STAGES

From the first mixer TR1, the signal passes directly into F1, a 2 pole 45MHz crystal filter. The output of this filter is buffered by TR2, then passed into a second 45MHz crystal filter F3. The filter configuration used depends upon the channel spacing specified. For 25Khz spacing both F1 & F3 are 15KHz wide parts, whereas for 12.5KHz spacing F1 is 15KHz wide and F3 is 7.5Khz wide. This provides a good compromise between adjacent channel rejection and filter loss.

IC3 is a complete NBFM IF chip. It takes an input at 45MHz which is mixed down on-chip to 455KHz. The 2nd LO of 44.545MHz is provided by a 3rd overtone crystal X1, using IC3's on-chip oscillator transistor. The 455KHz signal is filtered by ceramic filter F5. For 25KHz radios this filter is 15KHz wide, with a narrower (8KHz) filter used for 12.5KHz units.

The 455KHZ signal is then limited and demodulated on-chip. An adjustable quadrature coil is used (L3). The resulting audio output is low pass filtered by R32/C36 to remove any high frequency components (including the 455KHz IF) before being buffered by IC5b and output via PL3.

IC3 provides an RSSI output which is brought out of the SR500 via PL3 without any extra buffering. This provides and output between ~0.5 and 2V for a signal level range of ~60dB. The SR500 also includes squelch circuitry to provide audio muting under no-signal conditions and to drive an open collector “squelch flag” which is also brought out on PL3 for customer use. The squelch circuitry is noise-derived as is normal with NBFM equipment and the level at which it operates is controlled by RV1. Squelch triggering circuitry is provided within IC3, but the actual muting of receive audio is done off-chip by TR6, which effectively shorts out the audio input to IC5 when the squelch is closed.

IC5a acts as a data extractor, limiting the input audio such that simple FSK data may be recovered from it. The output from IC5a drives into TR8 to provide an open collector output on PL3. This can then be externally pulled up to a suitable logic rail to allow direct interfacing to digital equipment.

Section 4
Frequency Programming

4.1 INTRODUCTION

The SR500 has an internal memory which can store up to 128 RF channels (16 randomly programmed and 112 sequentially programmed). The frequency and set-up information is programmed into the unit by a synchronous PCM interface protocol.

The software supplied with the SR500 receiver is the SR500PRG.exe program. The software can be run on a PC with the serial port connected to PL3 of the SR500 receiver via a suitable adaptor as shown in Figure 2. If the read-back function is desired, then PL3 pin 10 of the receiver must be connected to pin 2 of the PC serial port via a buffer circuit. A 1k pull-up resistor to +5V must also be provided as shown.

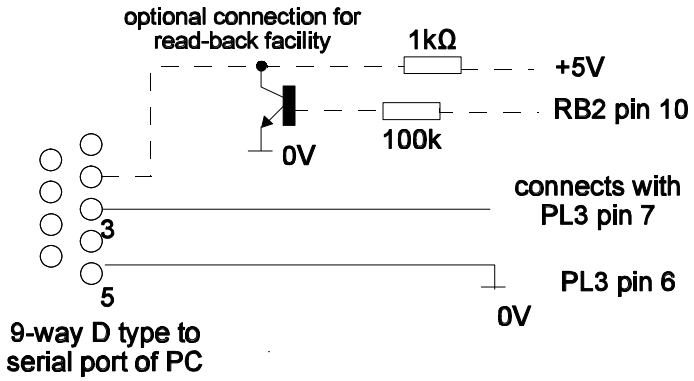


Figure 2 Programming adaptor

4.2 RUNNING THE SOFTWARE

1. Connect SR500 to a suitable supply and to the PC using the programming adaptor.

2. Insert the SR500PRG disk into drive A and type:

   A:SR500PRG <return> then type:

3. The user is then prompted to enter the serial port number of his PC which is used to communicate with the SR500 receiver. Enter 1 or 2.

After the software has successfully loaded the main menu screen is displayed as shown in Figure 3. The screen shows the default settings which are entered at factory set-up. These default settings will be displayed whenever the SR500PRG software is run.

Please note that mouse operation is not supported with this program.

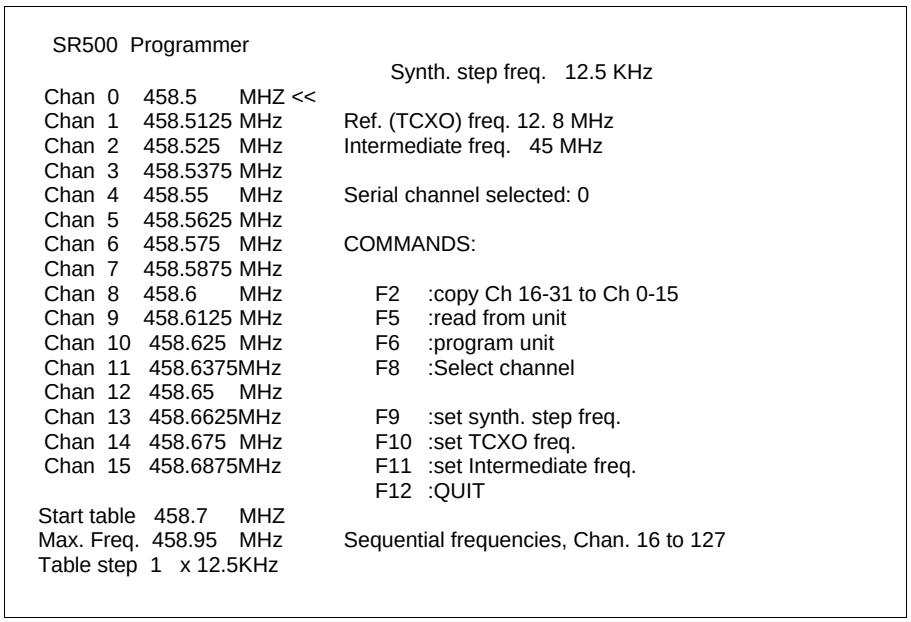


Figure 3

NOTES:

1. The synthesizer step frequency, the reference (TXCO) frequency and the intermediate frequency are non-programmable.

2. Functions F9, F10 and F11 are not enabled and are provided for information only.

3. Function F5 is only enabled when a read-back programming adaptor is used, (refer to Figure 2). This function displays the current frequency table of the connected SR500 receiver.

4. A value for each parameters has to be entered.

5. Only channel 0 to 15 frequencies can be displayed by this software

4.3 SERIAL CHANNEL SELECTION

The unit defaults to serial channel selection whenever the software is run. Selecting the F8 function key prompts the user to enter the new serial channel number which is then displayed in 'Serial channel selected'.

4.4 PARALLEL CHANNEL SELECTION

To enable parallel channel selection mode select the F8 (Select channel) function key and then enter '999' as the new frequency. The screen then displays 'parallel channel selected'.

Three inputs RB1, RB3 and RB3 applied via PL1 to pin 8, pin 9 and pin 10 respectively, select the operating channel as shown in the table right: (1 = logic high)

CHANNEL SELECTION			
PIN 10	**PIN 9**	**PIN 8**	**CHANNEL**
LOW	LOW	LOW	7
LOW	LOW	HIGH	6
LOW	HIGH	LOW	5
LOW	HIGH	HIGH	4
HIGH	LOW	LOW	3
HIGH	LOW	HIGH	2
HIGH	HIGH	LOW	1
HIGH	HIGH	HIGH	0

4.5 PROGRAMMING RANDOM CHANNELS

Random channels between 0 and 15 can be entered using the Up 8 and Down 9 arrow keys and then entering the required operating frequency. The entered value must be an integer multiple of 12.5kHz otherwise an 'invalid' message is displayed.

4.6 PROGRAMMING SEQUENTIAL CHANNELS

To generate a new frequency table the following parameter values must be entered:

- start frequency
- the maximum frequency
- the table step as a multiple of 12.5kHz.

The maximum frequency is calculated from the start table frequency and the table step.. Therefore if the calculation exceeds the maximum frequency then this parameter will be increased automatically.

When the frequency table has been generated the user then selects F6 to program the unit.

The function key F2 can be used to copy the contents of channel 16-31 to channel 0 - 15 to ease sequential programming.

4.7 PROGRAMMING FROM CUSTOMER EQUIPMENT

In the event of a customer wishing to program the SR500 receiver from his own equipment then the following data sequence must be used allowing 5ms between the characters in the data stream:

1200 baud, RS232 interface, 1 start bit - 8 bit data - no parity - 1 stop bit

40 (decimal 64) synchronising code
7 bit channel 0 - 127 (bit 7 = 0)
95 (decimal 149) confirmation byte

Section 5
Technical specifications

Frequency range	:	405 - 450 MHz, 450 - 470 MHz
Switching bandwidth	:	5MHz
Frequency stability	:	+/-1.5kHz
Number of RF channels	:	up to 128 (16 randomly programmed, 112 sequential), serial select/reprogram, 1200 baud RS232 or 1 of 8 parallel select (10 pin option)
Channel switching delay	:	<50mS across switching bandwidth
Channel spacing	:	12.5kHz
Modulation type	:	F1D/F2D/F3D
Spurious emissions (conducted & radiated)	:	in accordance with ETS/CEPT specifications
Supply voltage	:	6-15 DC, -ve earth
Supply current at 7.2V	:	30mA
Interface connections	:	2 + 7 (10) pin 0.1" header
RF connection	:	3 pin 0.1" header
Operating temperature	:	-10^{o}C to +55^{o}C
Storage temperature	:	-30^{o}C to +70^{o}C
Weight	:	40gm
Type approval	:	European approval; ETS 300 220
Sensitivity	:	<-115 dBm for 12dB SINAD
Image/spurii	:	<70dB
Intermodulation response rejection	:	<60dB
Blocking	:	>90dB
Intermediate frequencies	:	45 MHz and 455kHz
Adjacent channel selectivity	:	>60dB for 12.5kHz channel spacing
Audio response	:	9Hz to 6kHz at -3dB
Recovered audio level	:	1.5V p-p typ into 19k ohms
Squelch type	:	Noise operated open collector output (no audio mute)
General facilities	:	RSSI output (1 to +3V nominal) +5V output Independent data output