SX850A/C TRANSCEIVER
OPERATING INSTRUCTIONS

1892 1247

These operating instructions are intended to provide the user with sufficient information to install and operate the module correctly.

The Wood & Douglas SX850 is a synthesized UHF transceiver for use in radio telemetry applications. There are two versions, one with PCB pins (SX850C) and one with two connectors (SX850A). The transceiver provides a maximum power output of 500mW and is approved to European standards EN 300 220 and ETS 300 279. The unit has also been tested to ETS 300 086 and a test report is available for those customers wishing to gain this approval.

The use of this module must be carefully controlled as the sub-bands within the 868 - 870MHz band have differing requirements for maximum transmitted power, duty cycle and labelling.

These restrictions of use are detailed in the Radiocommunications Authority Document RA114 and CEPT/ERC Recommendation 70-03. This information is also shown in the Table under the “Sub-Band Information” heading of this document.

The SX850 is approved to EN 300 220 for use in the UK and throughout Europe.

Failure to follow the guidelines detailed in this document will invalidate the type approval of the module.

RESTRICTIONS OF USE

The SX850 is approved with the following restrictions of use:

Power Supply	5.5 - 9.0V DC Note: not approved for vehicular supply
Mode of operation	Portable and Mobile
Maximum transmitted power	refer to “Sub-Band Information” section
Channel spacing	25kHz

INSTALLATION

The SX850 is intended to fit easily and with minimum space requirements into the user's own equipment housing. The details of the enclosure/connectors of the two types are shown in Figures 1 & 2.

NOTE: The four corner tabs of the enclosure can be folded out to provide alternative mounting of the unit, with fixing centres of 93.00 x 47.5. using four M2 screws.

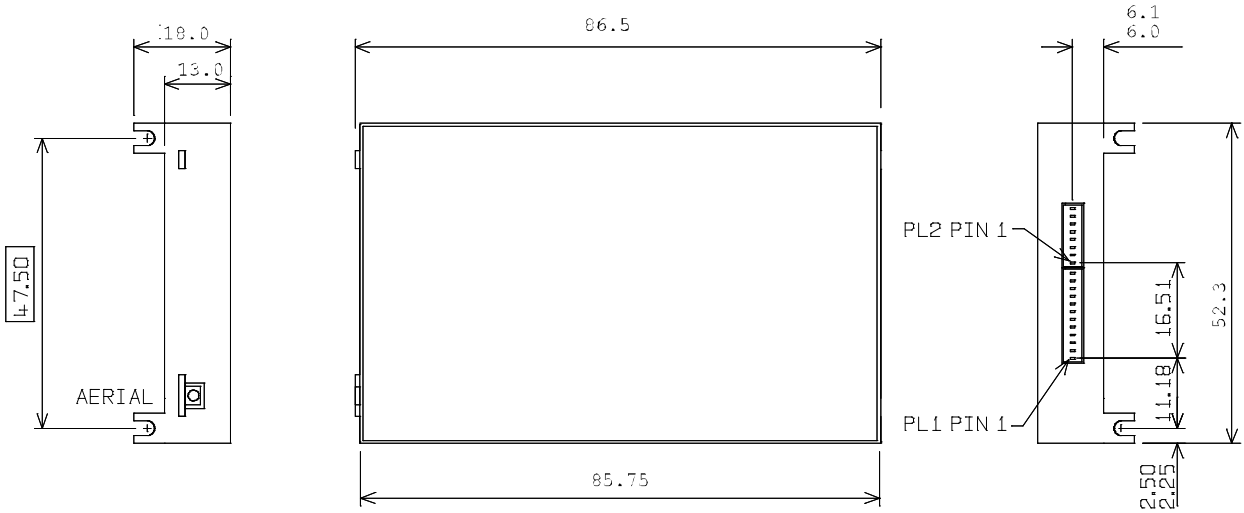


Figure 1 SX850A fixing detail

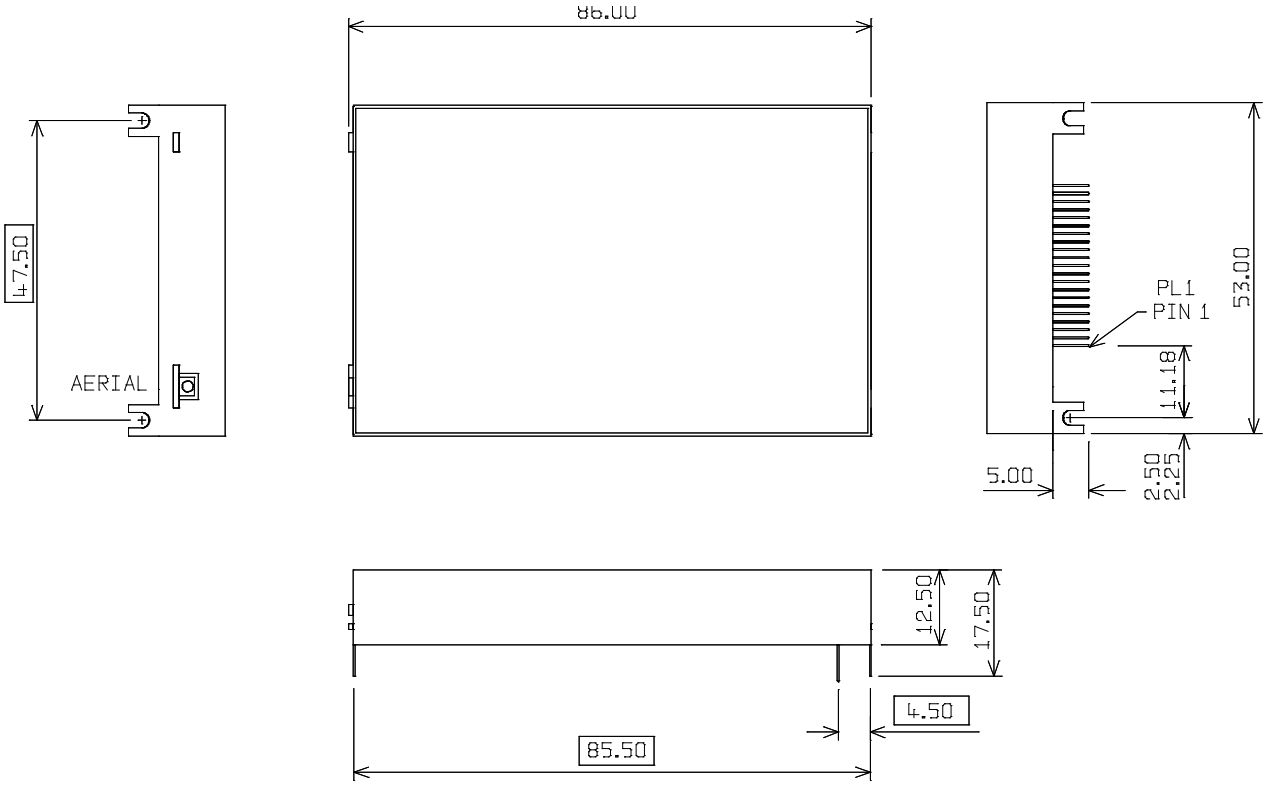


Figure 2 SX850C fixing detail

SUB-BAND INFORMATION

This transceiver is approved for use within the 868 - 870MHz band. This band is split into various sub-bands, each of which has limitations on transmitted power and duty cycle.

The following table shows these bands, the restrictions of use, and the labelling requirements. The information is taken from the Radiocommunications Authority document RA114 (Annex 3) and CEPT/ERC document Recommendation 70-03.

The restrictions of use and labelling requirements for use in other European requirements need to be checked with the relevant authorities of each country.

General Telemetry and Telecommand			
Sub-band (MHz)	**Max. Power erp (mW)**	**Duty cycle**	**Label Requirement**
868.0 - 868.6	25	<1%	CEPT SRD 1f GB
868.7 - 869.2	25	<0.1%	CEPT SRD 1g GB
869.3 - 869.4	10	<10%	CEPT SRD 1h GB
869.4 - 869.65	500	[<10%]	CEPT SRD 1i GB
869.7 - 870	5	Up to 100%	CEPT SRD 1k GB
Alarms			
868.6125, 868.6375, 868.6625, 868.6875	10	<0.1%	CEPT SRD 7a GB
869.2125, 869.2375	10	<0.1%	CEPT SRD 7b GB
869.2625, 869.2875	10	<0.1%	CEPT SRD 7c GB
869.6625, 869.2875	25	<10%	CEPT SRD 7d GB
NOTE: The channel spacing for the SX850 is 25kHz. The centre of the first channel is at a distance of *12.5kHz* from the lower frequency band edge.			

Table 1 Labelling Requirements

The maximum transmitted power is that measured at the antenna as Effective Radiated Power (ERP). This means that no antenna with any gain can be used with the SX850.

A suitable antenna for use with the unit can be obtained from R. W. Badland Ltd It is a ¼ wave flexible antenna operating over the band 868.0 - 870.0MHz. The part number is BNCUHFF 868.0 - 870.0MHz.

CONNECTIONS

On both units, the radio antenna connects via an MMCX 50Ω socket. All other connections to the SX850A transceiver are made via a 12-way connector PL1 and an 8-way connector PL2. These are single-in-line plugs for use with the free-issued connectors with flying leads.

PIN	NAME	FUNCTION	REMARKS
PL1-1	0V	0 volts	common ground
PL1-2	STBY	standby input	LOW (<+0.6V) = transceiver enabled HIGH (>+2.0V) = standby mode (internal pull-up, 100kΩ)
PL1-3	HI/LO	TX RF power select input	>+2.1V = high power <+0.8V = low power (internal pull-down, 10kΩ to 0V)
PL1-4	+Vin	positive supply input	+5.5 to +9.0 V input (-ve earth)
PL1-5	000	transmit enable input	HIGH (>+1.7V) = receiver enabled LOW (<+0.4V) = transmitter enabled (internal pull-up, 10kΩ to +5.3V)
PL1-6	TXD/MS	TXD - serial data input MS - mode select, ie channel selection by serial or parallel data input	Serial data input = single 8-bit RS232 format control word, ie logic 1 = -V, logic 0 = +V (Maximum voltage level is ±12V; inverted TTL acceptable). If not used, leave not connected, or connect to ground. Mode selected depends on the logic state at power-up: HIGH (>+3.0V) = parallel data input LOW (<+0.5V) = serial data input (internal pull-up, 10kΩ to +5.3V)
PL1-7	CS0/DT	CS0 - channel select input (LSB) DT - synthesizer serial data input*	Channel select inputs use inverted 5V logic levels; HIGH (>+1.6V) = logic 0, LOW (<+0.4V) = logic 1 CS0 to CS5 are used for channel selection by 6-bit parallel data (Internal pull-ups 20k typical to +5V) (* DT/CK/EN inputs are used for direct control of the synthesizer, this is a separate version of the SX850.)
PL1-8	CS1/CK	CS1 - channel select input CK - synthesizer programme clock *	
PL1-9	CS2/EN	CS2 - channel select input EN - synthesizer enable strobe input*	
PL1-10	CS3	channel select input	
PL1-11	CS4	channel select input	
PL1-12	CS5	channel select input (MSB)	

Table 2 PL1 Pin Connections for SX850A

PIN	NAME	FUNCTION	REMARKS
PL2-1	RF DET	TX RF present flag output	HIGH (+5V, internal 10kΩ pull-up) = TX RF present LOW (0V) = no TX RF
PL2-2	AF O/P	receiver audio output	500mV p.p. nom. into 10kΩ AC-coupled; Rout = 1kΩ. **Note:** The audio output is inverted with respect to the SX850 (or similar Wood & Douglas product) audio input.
PL2-3	SQO	squelch flag output	NPN open collector via 1kΩ ON = no signal, OFF = signal present. (NOTE: OFF when transceiver in standby mode)
PL2-4	OOL	out-of-lock output	NPN open collector via 1k; ON = out of lock (NOTE: OFF when transceiver in standby mode)
PL2-5	DMOD	digital modulation i/p **	+3V to +12V square wave, DC-coupled
PL2-6	AMOD	analogue modulation input **	750mV p-p., AC-coupled (pre-settable 200mV to 3V p-p.) ** DMOD and AMOD may not be used simultaneously. Leave unused input unconnected.
PL2-7	RSSI	'S' meter output	0V to +3V output, rising with received signal level (typ. 50dB range)
PL2-8	SQOR	squelch override input	HIGH (>+3.0V) enables AF O/P regardless of squelch state (RX only) LOW (<+0.5V or o/c) = normal operation (internal pull-down, 20k to 0V)

Table 3 PL2 Pin Connections for SX850A

The SX850C connections are via a row of 21 PCB mounting pins as shown in Tables 4 and 5.

PIN	NAME	FUNCTION	REMARKS
PL1-1	0V	0 volts	common ground
PL1-2	STBY	standby input	LOW (<+0.6V) = transceiver enabled HIGH (>+2.0V) = standby mode (internal pull-up, 40k to +4V max)
PL1-3	HI/LO	TX RF power select input	>+2.0V = high power, <+0.8V = low power (internal pull-down, 10k to 0V)
PL1-4	+Vin	positive supply input	+5.5 to +9.0 V input (-ve earth)
PL1-5	000	transmit enable input	HIGH (>+2.0V) = receiver enabled LOW (<+0.8V) = transmitter enabled (internal pull-up, 100k to +5V)
PL1-6	TXD/MS	TXD - serial data input MS - mode select, ie channel selection by serial or parallel data input	Serial data input = single 8-bit RS232 format control word, ie logic 1 = -V, logic 0 = +V (Maximum voltage level is ±12V; inverted TTL acceptable). If not used, leave not connected, or connect to ground. Mode selected depends on the logic state at power-up: HIGH (>+2.0V) = parallel data input LOW (<+0.8V) = serial data input (internal pull-up, 50k to +3V)
PL1-7	CS0/DT	CS0 - channel select input (LSB) DT - synthesizer serial data input*	Channel select inputs use inverted 5V logic levels; HIGH (>+2.0V) = logic 0, LOW (<+0.8V) = logic 1 CS0 to CS5 are used for channel selection by 6-bit parallel data (Internal pull-ups 100k to +5V) (* DT/CK/EN inputs are used for direct control of the synthesizer, this is a separate version of the SX850.)
PL1-8	CS1/CK	CS1 - channel select input CK - synthesizer programme clock *	
PL1-9	CS2/EN	CS2 - channel select input EN - synthesizer enable strobe input*	
PL1-10	CS3	channel select input	
PL1-11	CS4	channel select input	
PL1-12	CS5	channel select input (MSB)	
PL1-13	-	not connected	-

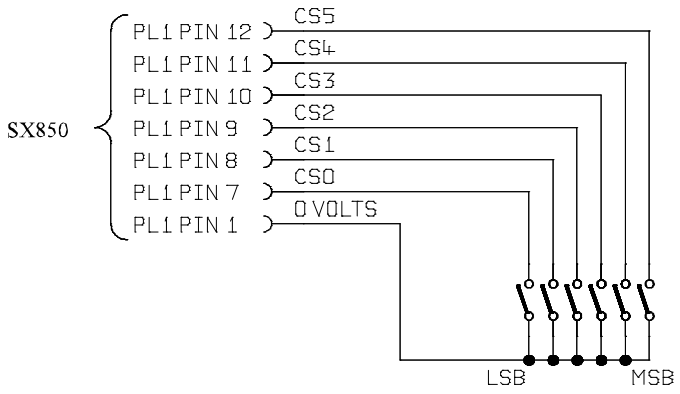
Table 4 PL1 Pin Connections for SX850C

PIN	NAME	FUNCTION	REMARKS
PL1-14	RF DET	TX RF present flag output	HIGH (+5V, internal 10k pull-up) = TX RF present LOW (0V) = no TX RF NOTE: only available when high TX RF power is selected
PL1-15	AF O/P	receiver audio output	600mV p.p. nom. into 10kΩ; AC-coupled; Rout = 2k3Ω. **Note:** The audio output is inverted with respect to the SX850 (or similar Wood & Douglas product) audio input.
PL1-16	SQO	squelch flag output	NPN open collector via 470Ω; ON = no signal, OFF = signal present. (NOTE: OFF when transceiver in standby mode)
PL1-17	OOL	out-of-lock output	NPN open collector via 470Ω; ON = out of lock (NOTE: OFF when transceiver in standby mode)
PL1-18	DMOD	digital modulation input **	+3V to +12V square wave, DC-coupled
PL1-19	AMOD	analogue modulation input **	750mV p-p., AC-coupled (pre-settable 200mV to 3V p-p.) ** DMOD and AMOD may not be used simultaneously. Leave unused input unconnected.
PL1-20	RSSI	'S' meter output	0V to +3V output, rising with received signal level (typ. 50dB range)
PL1-21	SQOR	squelch override input	HIGH (>+2.0V) enables AF O/P regardless of squelch state (RX only) LOW (+0.8V or o/c) = normal operation (internal pull-down, 70k to 0V)

Table 5 PL1 Pin Connections for SX850C

CHANNEL SELECTION

The SX850 offers one of 64 channels in parallel mode selection and one of 80 random channels, or 256 sequential, in serial mode selection. Mode selection is determined by the state of the input (MS) on PL1-6 at power-up.



When MS = HIGH (>+3.0V), the unit will look at the parallel data inputs.
When MS = LOW (<+0.5V) the unit will use the last serial channel selected.

Parallel Mode

In parallel mode one of 64 channels is selected using parallel control lines via the user interface connector (Figure 2). The six channel select inputs are a binary representation of the channel number.

Table 4 shows the switch positions for the 64 channels.

Serial Mode

In serial mode channel selection, one of 80 random channels, or 256 sequential, is programmed using a serial input word.

The data format is:

Input level RS232 or TTL level
Both levels have the same sense ie logic 1 = -V and logic 0 = +V
(Maximum voltage level is ±12V)

Baud rate 9600 baud

Data format 1 start bit, 8 data bits, 1 stop bit.
The eight data bits are a binary representation of the channel number.

Serial mode programming software is available for the SX850 transceiver, for further details contact the Wood & Douglas sales office.

Note: When using the serial frequency programming option the last selected frequency is held in memory when the unit is powered off.

Channel Number	HEX Value	Channel Switches						Channel Number	HEX Value	Channel Switches					
		5	4	3	2	1	0			5	4	3	2	1	0
0	0	O	O	O	O	O	O	32	20	1	O	O	O	O	O
1	1	O	O	O	O	O	1	33	21	1	O	O	O	O	1
2	2	O	O	O	O	1	O	34	22	1	O	O	O	1	O
3	3	O	O	O	O	1	1	35	23	1	O	O	O	1	1
4	4	O	O	O	1	O	O	36	24	1	O	O	1	O	O
5	5	O	O	O	1	O	1	37	25	1	O	O	1	O	1
6	6	O	O	O	1	1	O	38	26	1	O	O	1	1	O
7	7	O	O	O	1	1	1	39	27	1	O	O	1	1	1
8	8	O	O	1	O	O	O	40	28	1	O	1	O	O	O
9	9	O	O	1	O	O	1	41	29	1	O	1	O	O	1
10	A	O	O	1	O	1	O	42	2A	1	O	1	O	1	O
11	B	O	O	1	O	1	1	43	2B	1	O	1	O	1	1
12	C	O	O	1	1	O	O	44	2C	1	O	1	1	O	O
13	D	O	O	1	1	O	1	45	2D	1	O	1	1	O	1
14	E	O	O	1	1	1	O	46	2E	1	O	1	1	1	O
15	F	O	O	1	1	1	1	47	2F	1	O	1	1	1	1
16	10	O	1	O	O	O	O	48	30	1	1	O	O	O	O
17	11	O	1	O	O	O	1	49	31	1	1	O	O	O	1
18	12	O	1	O	O	1	O	50	32	1	1	O	O	1	O
19	13	O	1	O	O	1	1	51	33	1	1	O	O	1	1
20	14	O	1	O	1	O	O	52	34	1	1	O	1	O	O
21	15	O	1	O	1	O	1	53	35	1	1	O	1	O	1
22	16	O	1	O	1	1	O	54	36	1	1	O	1	1	O
23	17	O	1	O	1	1	1	55	37	1	1	O	1	1	1
24	18	O	1	1	O	O	O	56	38	1	1	1	O	O	O
25	19	O	1	1	O	O	1	57	39	1	1	1	O	O	1
26	1A	O	1	1	O	1	O	58	3A	1	1	1	O	1	O
27	1B	O	1	1	O	1	1	59	3B	1	1	1	O	1	1
28	1C	O	1	1	1	O	O	60	3C	1	1	1	1	O	O
29	1D	O	1	1	1	O	1	61	3D	1	1	1	1	O	1
30	1E	O	1	1	1	1	O	62	3E	1	1	1	1	1	O
31	1F	O	1	1	1	1	1	63	3F	C	C	C	C	C	C

Table 4 Switch positions for 64 Parallel Selected Channels

Note: O = switch open & 1 = switch closed

RANGE INFORMATION

The following table gives an indication of the typical ranges to be expected between a transmitter and receiver that have simple end-fed dipole antennas.

The following assumptions have been made in the calculations:

line-of-sight between antennas
0dB gain for the transmitter and receiver antennas
0dB loss for connectors and cables between the antenna and the radio connector
20dB fade and environmental margin
-100dBm received signal strength, allowing for digital and analogue signals

Range versus TX power			
Frequency (MHz)	**Power (mW)**	**Power (dBm)**	**Range (km)**
173	1mW	0	1.4
173	10mW	10	4.4
173	100mW	20	13.8
173	500mW	27	30.9
458.5	1mW	0	0.5
458.5	10mW	10	1.7
458.5	100mW	20	5.3
458.5	500mW	27	11.9
869	1mW	0	0.3
869	10mW	10	0.9
869	100mW	20	2.8
869	500mW	27	6.2

SPECIFICATIONS

General

Frequency ranges	:	868 - 870MHz
Switching bandwidth	:	2MHz
Frequency stability	:	±1.75kHz over operating temperature
Number of RF channels	:	80 random customer programmable Or up to 256 sequential channels
Channel switching delay	:	50ms maximum (over 2MHz switching bandwidth)
Channel selection	:	64 channels maximum using 6 bit parallel input. 256 channel maximum sequential, 80 random using serial data word.
Channel spacing	:	25kHz available
Modulation type	:	F1D, F3D
Spurious emissions	:	(conducted & radiated) In accordance with ETSI/CEPT
Supply voltage	:	5.5-9.0V DC -ve earth
Supply current at 7.2V	:	75mA typical (receive) 400mA typical for 500mW output (transmit)
Interface connections	:	1x8 + 1x12 way 1.27mm pitch Molex right angle plug (with mating connector + 200mm lead supplied).
RF connection	:	PC mounted socket, (200mm RG178 lead supplied).
Operating temperature	:	-25°C to +55°C
Storage temperature	:	-30°C to +70°C
Size overall	:	87 x 53 x 13 mm (3.42 x 2.08 x 0.51 inches)
Weight	:	70g
Type approvals	:	EN 300 220, ETS 300 683 (EMC) Note: tested to ETS 300 086 Test report available to any customer for submission in their own country.

Transmitter

RF output power	:	500mW (HI) (+1, -2dB)
(into 50 ohm)		10 - 25mW (LO)
TX/RX switching time	:	<20ms
Modulation input		
analogue	:	750mV p-p, AC-coupled (pre-settable 200mV to 3V p-p)
digital	:	+3 to +12V square wave DC-coupled
Frequency response	:	9Hz to 3kHz at -3dB (analogue input)
Frequency deviation		
25kHz channel spacing	:	±3.0kHz nominal (±4.0kHz max)
Adjacent channel power	:	<200nW (-37dBm)
Facilities	:	OOL detect output (+5V = TX on) (HI power only)

Receiver

Sensitivity	:	<-115dBm for 12dB SINAD (psophometrically weighted) (25kHz cs) <-107dBm for 20dB SINAD (psophometrically weighted)
Image rejection	:	>70dB
Intermodulation rejection	:	>65dB
Blocking	:	>85dB
Spurious rejection	:	>70dB
Intermediate frequencies	:	45MHz and 455kHz
Adjacent channel Selectivity		
25kHz channel spacing	:	>70dB
Recovered audio level	:	>500mV p-p typ into 10kΩ
Squelch type	:	Noise operated (2dB hysteresis typical @ 12dB SINAD point)
Squelch output	:	NPN open collector via 1kΩ ON = no signal, OFF = signal present
Facilities	:	RSSI output (0 to +3V nominal from 1kΩ source) OOL Squelch override input STBY input
Standby current	:	0.9mA typ for HI/LO input = 0V 1.6mA typ for HI/LO input = +Vin

Wood & Douglas Ltd, Lattice House
Baughurst, Tadley, Hants, RG26 5LP
Tel:+44 (0)118 981 1444 Fax: +44 (0)118 981 1567
email: sales@woodanddouglas.co.uk
website: www.woodanddouglas.co.uk