

The Easy-Radio ER400TRS intelligent radio transceiver incorporates Easy-Radio technology to provide a high performance, simple to use radio device that can bi-directionally transfer serial data over a range of up to 250 meters Line Of Sight (LOS).



The transceiver operates on the Pan-European 433MHz frequency band from a 3.6V supply and is housed in a space saving Single-In-Line (SIL) package. Serial input and output simplify interface to host systems and the embedded software reduces design and development time significantly.

This data sheet describes the electrical and physical characteristics of the device. Operation of the software is described in the 'Easy-Radio Software Guide', which should be read in conjunction with this data sheet.

### Features

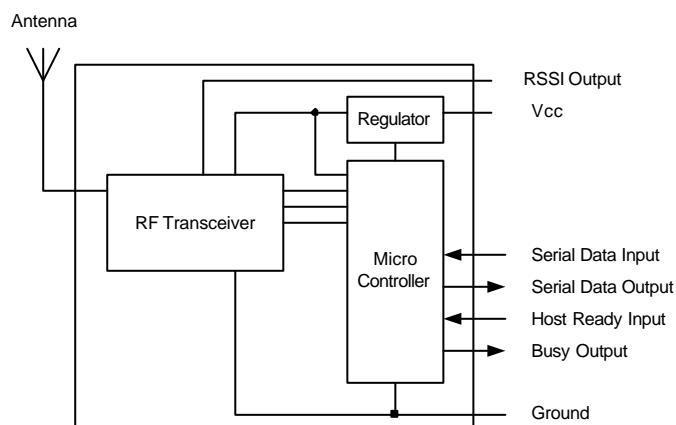
Crystal controlled synthesiser for frequency accuracy  
 Highly selective front-end, 175KHz improves range  
 10mW Transmit RF power output, -105dBm sensitivity  
 Serial Input & Output for transparent data transmission  
 Low operating voltage - 3.6 Volts – Single Lithium Cell  
 Low power consumption: <23mA in Transmit mode  
 17.0mA in Receive mode  
 User programmable: Frequency of operation  
 Data Rate  
 Output Power

### Applications

Handheld Terminals  
 Environmental Sense & Control  
 Vehicle to Base Station Data Transfer  
 Remote Data Acquisition  
 Electronic Point of Sale equipment

### Description

The Easy-Radio 400 Transceiver is a complete sub-system that combines a high performance very low power RF transceiver, a microcontroller and a voltage regulator. (Figure 1) The microcontroller programmes the functions of the RF transceiver and provides the interface to the host system via a serial input/output. It also contains programmable EEPROM memory that holds configuration data for the various transceiver-operating modes. The microcontroller also relieves the host from the intensive demands of searching for signals within the noise, recovering the received data and transmitting data in a suitable format. A Received Signal Strength Indicator output can be optionally used to measure received signal levels. The module connects to a 50-Ohm antenna such as a whip, helical or PCB loop.



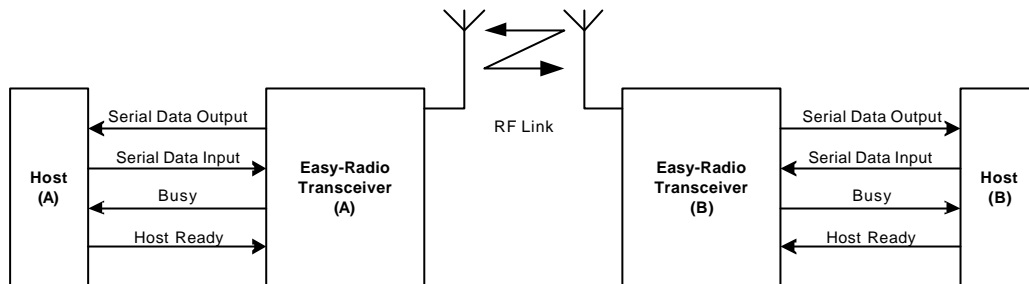
**Figure 1 Easy-Radio Transceiver Block Diagram**

The Serial Data Input and Serial Data Output operate at the standard 19,200 Baud and the two handshake lines provide optional flow control to and from the host. The Easy-Radio Transceiver can accept and transmit up to 192 bytes of data, which it buffers internally before transmitting in an efficient over-air code format.

Any other Easy-Radio Transceiver within range that 'hears' the transmission will decode the message and place the recovered data within a receive buffer that can then be unloaded to the receiving host for processing and interpretation. Transmission and reception are bi-directional half duplex i.e. transmit OR receive but not simultaneously.

## Application & Operation

Figure 2 shows a typical system block diagram comprising hosts (user's application) connected to Easy-Radio Transceivers. The hosts (A & B) will be monitoring (collecting data) and/or controlling (sending data) to some real world application.

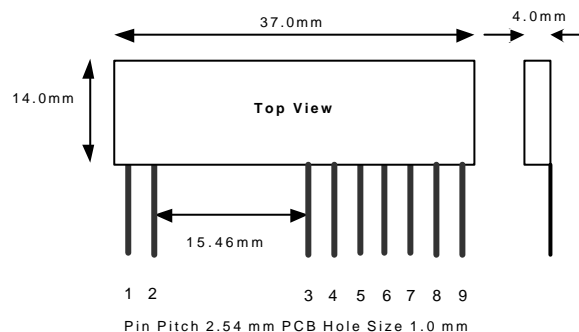


**Figure 2 Typical System Block Diagram**

The hosts provide serial data input and output lines and two 'handshaking' lines that control the flow of data to and from the Easy-Radio Transceivers. The 'Busy' output line, when active, indicates that the transceiver is undertaking an internal task and is not ready to receive serial data. The 'Host Ready' input is used to indicate that the host is ready to receive the data held in the buffer of the Easy-Radio Transceiver.

The host should check before sending data that the 'Busy' line is not high, as this would indicate that the transceiver is either transmitting or receiving data over the radio link. It should also pull the 'Host Ready' line low and check that no data appears on the Serial Data Output line.

Detailed operation of interfacing, handshaking (including timing) is described in the 'Easy-Radio Software Guide'.



## Pin Out

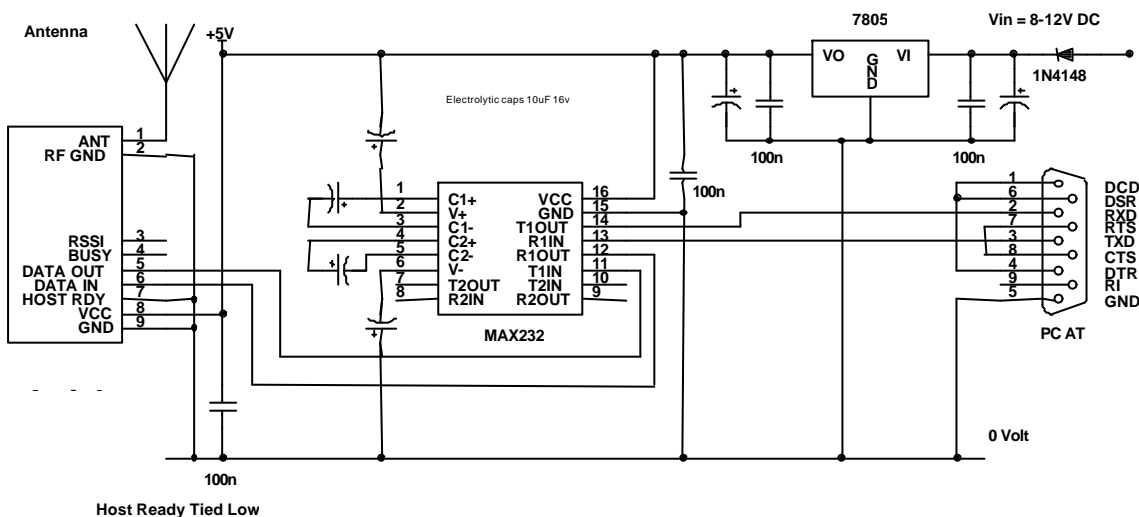
### Pin Description

Pin No	Name	Description	Notes
1	Antenna	50 Ohm RF input/output. Connect to suitable antenna.	See Note
2	RF Ground	RF ground. Connect to antenna ground (coaxial cable screen braid) and local ground plane. Internally connected to other Ground pins.	
3	RSSI	Received Signal Strength Indication	See Note
4	Busy Output	Digital Output to indicate that transceiver is ready to receive serial data from host.	CTS function
5	Serial Data Out	Digital output for received data to host	
6	Serial Data In	Digital input for serial data to be transmitted	

7	Host Ready Input	Digital Input to indicate that Host is Ready to receive serial data from transceiver	RTS function
8	Vcc	Positive supply pin. +3.6 to +5.5 Volts. This should be a 'clean' noise free supply with less than 25mV of ripple.	
9	Ground	Connect to supply 0 Volt and ground plane	

### Checklist

1. The module operates internally from an on board 3.3 Volt low drop regulator. The logic levels of the input/output pins are therefore between 0 Volt and 3.3 Volts. (See specifications).
2. The serial inputs and outputs are intended for connection to a UART or similar low voltage logic device. Do not connect any of the inputs or outputs directly to an RS232 port. The transceiver module may be permanently damaged by the voltages (+/- 12V) present on RS232 signal lines. See Application Circuit (Figure 4) for typical connection to an RS232 port via MAX232 interface IC.
3. The 'Host Ready Input' should be tied to 0 Volt (Ground) if not used.
4. The 'Serial Data In' should be tied to Vcc if not used. (Receive mode only).
5. Outputs will drive logic operating at 5 Volts and inputs will be correctly driven by logic operating at 5 Volts (CMOS & TTL logic levels).



**Figure 3 Application Circuit**

Figure 3 shows the connection of the Easy-Radio ER400TRS Transceiver to a PC AT RS232 port. A MAX232 provides the necessary voltage level shifting required to send and receive serial data at the typical +/- 12V RS232 signal levels. This IC also inverts the RS232 signal to match those required by the Easy-Radio Transceiver.

### Notes

1. Do NOT connect the Easy-Radio Transceiver directly to an RS232 port as it may cause permanent damage to the transceiver.
2. The 'Host Ready Input' handshake line is shown tied to 0 Volt (Ground) thus allowing any data received to be immediately sent to the RS232 port. PCs have sufficient internal buffering to accept and process this data without the need for flow control.
3. The 'Busy Output' handshake line is not connected. If data is sent whilst the transceiver is busy (e.g. transmitting), it will be lost.
4. The PC handshake lines (CTS, RTS) are hard wired to defeat any software that may test the state of these lines.
5. Windows 'HyperTerminal' software built into the Windows operating system provides a useful method of sending and receiving data to and from a PC during testing. Set the data format

Properties to '19200 8-N-1' and use 'Direct Connection' to the chosen Com port. Use a 1:1 cable (not 'crossover') to connect to the PC Com port.

6. The addition of LEDs to the handshake lines provides a useful diagnostic tool.

### Absolute Maximum Ratings

Operating Temperature Range	-20° C to +65° C (Commercial)
Storage Temperature Range	-20° C to +75° C
Vcc (Pin 8)	- 0.3 to + 6.0 Volts
All Other Pins	- 0.3 to 3.3 Volts
Antenna	50V p-p @ < 10MHz

**Performance Data** Supply +5.0 Volt  $\pm$  5%, Temperature 20° C

DC Parameters	Pin	Min	Typical	Max	Units	Notes
Supply Voltage (Vcc)	8	3.6	5.0	5.5	Volts	
Transmit supply current	8		23		mA	
Receive supply current	8		17.0		mA	
Quiescent supply current	8		2		mA	1
<b>Interface Levels</b>						
Data Output Logic 1			3.1		Volts	10k load to +Vcc supply
Data Output Logic 0			0.1		Volts	10k load to +Vcc supply
Logic Output Current				10	mA	
Data Input Logic 1		2.0			Volts	
Data Input Logic 0				0.2	Volts	
Input Pull-ups			100		K Ohm	2
RF Parameters	Pin	Min	Typical	Max	Units	Notes
Antenna Impedance	1		50		Ohms	
RF Frequency			433-4		MHz	See software guide for specific frequencies
<b>Transmitter</b>						
RF Power Output	1		+10		dBm	50 Ohm load
Frequency accuracy			$\pm$ 50		ppm	Overall
FM deviation			-30		kHz	
Harmonics			-25		dBc	
Over Air Data rate			19200		bps	Manchester Encoded
<b>Receiver</b>						
Receive Sensitivity			-107		dBm	BER = $10^{-3}$
LO leakage			-60		dBm	Meets EN 300 220-3
RSSI Output	3	0		1.2	Volt	See Figure 6
Logic Timing	Pin	Min	Typical	Max	Units	Notes
Initial Power Up Time			7.5		mS	3,4
Standby Power Up Time			TBA			5
Serial Data Rate			19,200		bps	Host interface. 6
<b>Mechanical</b>						
Size		37 x 14 x 4		mm		
Pin Pitch			2.54		mm	Standard 0.1 Inches
Weight			5		gms	

### Notes

1. Processor running at full speed. Contact the Sales Office for details of special low power variants.
2. The 'Host Ready Input' and the 'Serial Data Input' have 'weak' internal pull-ups enabled. These inputs should not however be left 'floating' but should be tied to either Vcc or Ground 0 Volts.
3. When power is first applied to the module the processor retrieves 'calibration' data for the RF section that compensates for temperature and power supply voltage variations. The transceiver will then be

ready to receive (default) or transmit. It would normally be left in this powered state ready to receive data.

4. During power up the Busy Output line goes high.
5. Contact the Sales Office for special 'fast' versions that can incorporate internal 'duty cycling' to further reduce quiescent power consumption for battery powered applications.
6. Serial data rate up to 38.4k standard but 76.8k available on request.

## Notes

### RSSI Output

The transceiver has a built in RSSI (Received Signal Strength Indicator) that provides an analogue output voltage that is inversely proportional to the RF energy present within the pass band of the receiver. It ranges from 0 Volt (maximum signal,  $-50\text{dBm}$ ) to 1.2 Volts (minimum signal,  $-105\text{dBm}$ ) and has a slope of approximately  $50\text{dB/Volt}$ . This analogue output signal should only be connected to a high impedance load ( $>100\text{k Ohms}$ ) and can be used to provide a measure of the signal strength and any interfering signals (noise) within band during the installation and operation of systems.

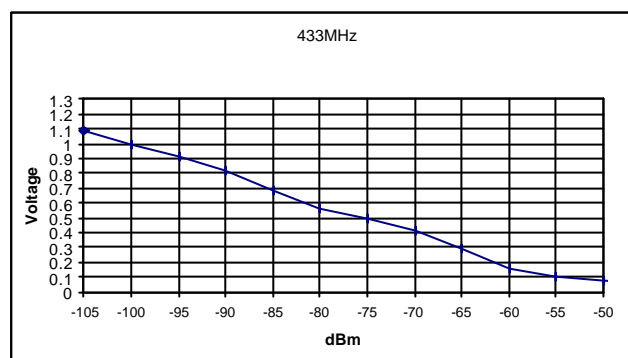


Figure 4 RSSI Output

### PCB Layout

The Ground (0 Volt) pins of the transceiver should be connected to a substantial ground plane (large area of PCB copper) connected to 0 Volt. It is suggested that a double-sided PCB be used with one layer being the ground plane.

### Power Supply

The supply used to power the transceiver should be 'clean' and free from ripple and noise ( $<20\text{mV p-p}$  total). It is suggested that  $100\text{nF}$  ceramic capacitors be used to de-couple the supply close to the power pins of the transceiver. The use of 'switch mode' power supplies should be avoided as they can generate both conducted and radiated high frequency noise that can be very difficult to eliminate. This noise may considerably reduce the performance of any radio device that is connected or adjacent to the supply.

### Antennas

The transceiver can be used with the various common types of antenna that match the  $50\text{ Ohm}$  RF Input/Output such as a monopole (whip), helical or PCB/Wire loop antennas.

Monopole antennas are resonant with a length corresponding to one quarter of the electrical wavelength ( $\lambda/4$ ). They are very easy to implement and can simply be a 'piece of wire' or PCB track which at  $434\text{MHz}$  should be  $16.4\text{ cms}$  in length. This should be straight, in 'free space' (kept well away from all other circuitry) and should be connected directly to the Antenna pin of the transceiver. If the antenna is remote it should be connected via a  $50\text{ Ohm}$  coaxial feeder cable or transmission line. A  $50\text{ Ohm}$  transmission line can be constructed on FR4 board material by using a  $3\text{mm}$  wide PCB track over a ground plane. This should be kept as short as possible.

Helical antennas are also resonant and generally chosen for their more compact dimensions. They are more difficult to optimise than monopole antennas and are critical with regard to surrounding objects that can

easily 'de-tune' them. They operate most efficiently when there is a substantial ground plane for them to radiate against.

Wire or PCB Loop antennas are the most compact antennas but are less effective than the other types. They are also more difficult to design and must be carefully 'tuned' for best performance.

The Internet can provide much useful information on the design of Short Range Device (SRD) Antennas.

**Product Order Codes**

Name	Description	Order Code
Easy-Radio 400 Transceiver (Single-In-Line)	UK/European Transceiver Module on 433 MHz	ER400TRS

Please contact the sales office for availability and other variants of the standard product. The software interface can be customised to specific requirements for high volume applications.

**Document History**

Issue	Date	Revision
1-0	October 2002	Preliminary
1-1	October 2002	Additions to specifications
1-2	March 2003	Amendments to specification, sensitivity & power consumption
1-3	Sept 2003	Amendments to minimum supply volts

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