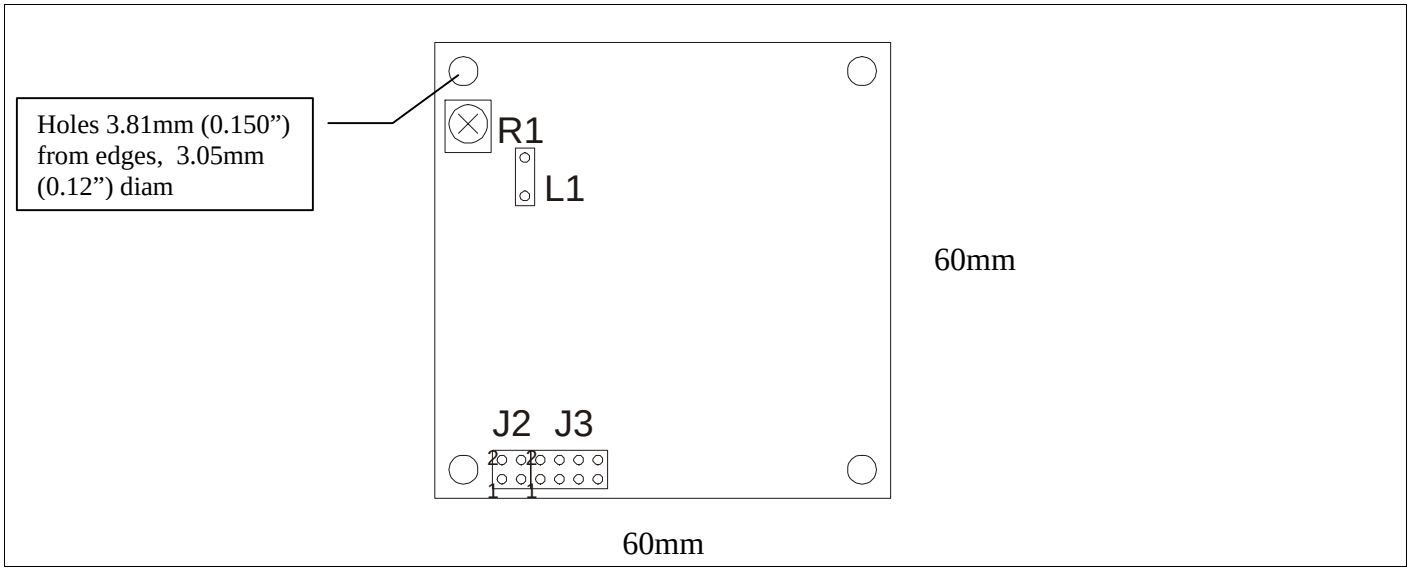
RW01OEM

The RW01OEM is a small, inexpensive and easy to use reader/writer/decoder board for passive RF identification tags. It is intended for OEM applications. A power source and an antenna is all that is required to use the reader. It can read and write to Manchester encoded ASK type transponders such as the EPD30RW150. It's low-power requirements permits battery operation and can be integrated into hand held devices.

It has an identical form factor and similar power and other requirements to Intersoft's TRR01OEM board. To facilitate the two-way connection required for interactions with the read/write tag, it employs a dual mode operation with a small command set.



Specifications

Function	Reader/writer/decoder for 125 kHz ASK Manchester 1024 bit RF identification tags, (EM4450 or similar)
Interface	RS232 or TTL, 9600,4800,2400,1200 baud, 8 data bits, no parity, 1 stop bit, optional flow control
Antenna type	1.62 mH coil (calculated, see note)
Read range	Antenna and tag dependent
Power requirements	9 - 12 VDC regulated
Dimensions	60 mm x 60 mm x 16 mm (2.375 inches x 2.375 inches x 0.625 inches)
Operating temperature	0 to +50 C
Humidity	non-condensing
Connections	Standard: 8-pin (RS232) .12-pin (TTL), 20-pin edge connector .1 header (L1) *see ordering info.* Optional power connector

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General Description

The RW01OEM board performs all functions necessary for a RFID read/write station. It continuously powers, reads and decodes transponders that are within its reading range. When a transponder tag passes within range of the reader antenna, the RF magnetic field generated by the reader powers the tag. The tag then transmits its data. The reader board will then demodulate and decode the data. The data is then sent as a packet using a RS232 (or TTL) interface. While the tag remains within reading range it will be continuously powered and the reader will continuously transmit its data.

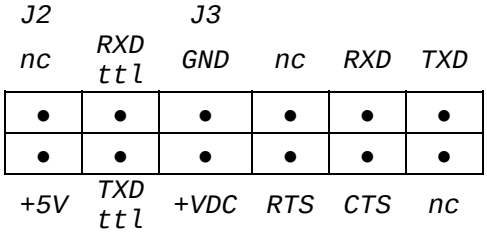
Connection options

The RW01OEM board is available with several connection options, both as standard and with extended features. The standard mode of connection is via an 8-way header via which power is supplied and the RS232 data signals are attached. The power and RS232 connections are also available via the 20-way edge connector. An optional addition of a four way header (and removal of the RS232 chip) allows access to the RS232 signals at TTL level while the addition of an optional power connector and a minor modification to the board (to disconnect the power pin on the 8-way header) allows a ribbon connector RS232 cable to be connected directly to the 8-way header

RS232

The information is sent using a RS232 (or TTL) interface. It operates at a user configurable baud rate (default is 9600, set in the onboard EEPROM). The data format is 8 data bit, No parity, 1 stop bit.
The RS232 port can be set to use the CTS and RTS hardware handshaking protocol. This is disabled by default.

Connections



J3 is the standard connector; an 8-pin 0.100-inch spacing double row male header.

+VDC	(J3.1)	Connect to positive side of power supply. (red) A 9 to 12 VDC regulated supply is required. A 9-volt battery can also be used (positive + terminal). Although the board offers some protection; please check for proper polarity.
GND	(J3.2)	Connect to negative side (ground) of power supply. (blk) This is also the common ground for the RS232 (PC DB9.5) (wht)
RTS	(J3.3)	Connect to CTS (PC DB9.8) of RS232 terminal.
nc	(J3.4)	no connection
CTS	(J3.5)	Connect to RTS (PC DB9.7) of RS232 terminal.
RXD	(J3.6)	Connect to TXD (PC DB9.3) of RS232 terminal (grn)
nc	(J3.7)	no connection
TXD	(J3.8)	Connect to RXD (PC DB9.2) of RS232 terminal (orn)

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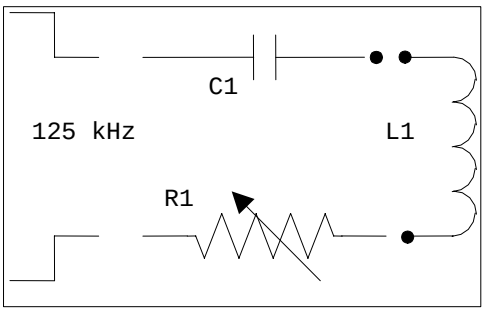
J2 provides TTL level signals on a 4-pin 0.100-inch spacing double row male header adjacent to J3

+5V	(J2.1)	Provides regulated 5VDC for powering external devices (50 mA maximum)
nc	(J2.2)	reserved (do not connect)
TXD	(J2.3)	TTL-TXD. Connect to TTL level RXD of a UART/microcontroller.
RXD	(J2.4)	TTL- RXD. Connect to TTL level TXD of a UART/microcontroller.

L1 is a 2-pin 0.200-inch spacing single row male header. It is used to connect the antenna.

Antenna Design



A single antenna is required for powering and reading the transponders. The antenna is used in a series resonant circuit, formed by C1, L1, and R1. The board requires, based on calculation with the on-board 1nF capacitor, an antenna with an inductance of 1.62 milliHenries. Proper value and shape of the antenna are installation dependent and must be determined by the user. The nominal resonant frequency is 125 kHz. To improve the reading range, the board will automatically adjust the driver's frequency to the resonance of the antenna circuit. The antenna can be a simple air wound coil. As an example, the demo kit antenna is a square antenna 9 cm x 9 cm with 83 turns (about 30 meters of 0.254 mm diameter (30 AWG)) wire; its inductance is 1.58mH with 10 ohm DC resistance. The reading range is spherical with the antenna located at the equator. Minimum and maximum read range is determined, in great part by the size of both the reader and tag antennas

Read Range Adjustments

The read range can be adjusted using the trimmer potentiometer, R1. This changes the Quality factor of the series resonant circuit. Although increasing the Q factor (turning clockwise) of the circuit increases the read range, it also increases the amount of spurious signal received. Therefore the boards should be individually adjusted with each attached antenna in their final environment.

Data Transmission *(firmware version 1.0.0 and greater)*

The data packet is comprised of 1 start byte; a variable number of data bits depending on how the tag has been programmed, 2 checksum bytes, and one stop byte.

The start byte is always a '**:**' (58d, 3Ah). The data bytes are an ASCII representation of the hexadecimal digits stored in the tag that the tag has been programmed to send. The checksum is two bytes long. It is an ASCII representation of the 8-bit sum of the data bytes sent. The stop byte is always an ASCII 'carriage return' (13d, 0Dh) and is followed by a 'line feed' (10d, 0Ah).

An example of a received packet follows:

:	2D E4 BE 00	D6	<CR>
3A	32 44 45 34 42 45 30 30	44 36	0D
start byte	*ASCII codes of the data (4 numbers - 8 digits)*	*checksum*	*stop byte*

The data packet is sent every time a tag is detected. If a tag remains in the reading field, its data will be sent continuously.

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Controlling the board

Upon power up, the board enters read mode. If the coil has been configured to power-on at power up (factory default), it will commence to read data from any tag within range and send the relevant data packet. Between each read, the board monitors the serial connection for incoming data. Any character received on the serial port will immediately put the device into command mode [note that an <ESC> character will result in the device then immediately returning to read mode]. If the character is a command then it will be stored and acted upon. There are two types of command character: immediate and processed. Immediate commands are acted upon as soon as the character is received. Processed commands are acted upon after reception of address, data and carriage return.

Immediate commands

<ESC>	(1Bh)	Escape returns reader to tag read mode at any point in command processing
<CR>	(13h)	Return ends a command or returns "OK" if used by itself and places the tag in command mode.
<SP>	(20h)	Space repeats the last command
<BK>	(08h)	Backspace can be used to delete command or data in processed command mode.

Processed command

C	(43h)	Turns the coil (i.e. energizing field) on and off
E	(45h)	Dumps the contents of the eeprom in hex
L	(4Ch)	Tag login
P	(50h)	Change a tag password
R	(52h)	Resets tag
S	(53h)	Selective read. Reads one or more word from tag.
V	(56h)	Returns the version of the software
W	(57h)	Writes to tag
X	(58h)	Programs a byte of eeprom code

Note: command are all upper case letters.

Commands Description

Note: To exit command mode and return to read mode, send the <ESC> (27h) character. The <ESC> character can be sent when the board is waiting for any character.

Tag commands

These are concerned with operations upon the R/W tag

L (Login)	L is followed by 4 bytes (8 characters) of login data (password). Password is by factory default initially: 00000000. Example: L00000000<CR>
R (Reset tag)	Resets the tag. Necessary for certain changes to take effect. No data. Example: R<CR>

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S (Selective Read) Requests the tag to output a different range of data from the default.
S is followed by start address location and end address location.
Due to interface speed and memory limitation, this command may not display more than about 10 word correctly. We recommend reading 8 words at a time.
The following will request that memory location 06 through 08 be transmitted.
Example: S0608<CR>

W (Write tag) Writes data to a tag. W is followed by one byte (two characters) of address data and 4 bytes (8 characters) of data. You must first Login before Writing to the tag. The following will write FEFE0101 at location 05.
Example: W05FEFE0101<CR>

P (Change password) Changes password. P is followed by the old tag password and then the new password (4 bytes) with no spaces. Factory default is 00000000.
Caution: the password is write-only and cannot be retrieved if lost. Without the correct password the tag cannot be written to or modified!
The following will change the existing password (00000000) to this new password (FE10FE10)
Example: P00000000FE10FE10<CR>

Board Commands

These are commands related to the RW01OEM board.

C (Coil on/off) C is followed by a single byte.
Use 81h for the byte to turn the coil on and 80h for the byte to turn the coil off.
Please note that this change is not preserved over resets of the board. To have the state of the coil set after a reset you must program the onboard EEPROM.
Example: C81<CR>

E (List board settings) List contents of onboard EEPROM in hex.
Example: E<CR>

X (Write EEPROM) Writes a byte to EEPROM. Programs board settings.
X is followed by 1 byte for the address and one byte for the data.
Example to write a 03h at onboard EEPROM location 0
Example: X0003<CR>

V (Version) Returns the version of the boards software and any special configuration options.
Example: V<CR>

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EEPROM Settings

The onboard EEPROM stores board setting.
Use the board command 'X' to write information to the EEPROM.
The board must be reset (power up) for any changes to take effect.

Coil State After Reset (EEPROM address: 00 bit 0)
The coil may be set to not power up automatically at boot. This is set by bit 0 in byte 00 of the EEPROM. If the bit is set, the coil is turned on at boot. If it is cleared, then it is turned off.
The coil may be turned on or off using the C command without affecting this setting.
It should be noted that even with the coil turned off at boot, the board will still enter read mode though no data will be received from any tag or be transmitted over the RS232 connection.
Example: X0001<CR>
Writes a 01h to address 00 of EEPROM.
The bit is set; the coil will be on after reset.
(Caution side effect: see Hardware Flow Control).

Hardware Flow Control (EEPROM address: 00 bit 1)
The CTS and RTS RS232 lines are disabled by default and no flow control is used.
Hardware flow control is enabled on reset by setting bit 1 of byte 00 in the EEPROM.
Example: X0002<CR>
Writes a 02h to address 00 of EEPROM.
The bit is set; hardware flow control will be on after reset.
(Caution side effect: see Coil State After Reset).

Baud rate (EEPROM address: 01)
The baud rate of the RS232 connection may be selected by setting byte 1 of the board settings. The following values are used:

0 = 9600
1 = 4800
2 = 2400
3 = 1200

Example: X0102<CR>
Writes a 02h to address 01 of EEPROM.
Baud rate will be 2400 after reset.

By default and on any other value the baud rate is set to 9600.

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Errors

The board will transmit the following error codes when it encounters a problem.

ALN	An odd number of characters were received in the command buffer data.
BUF	An incorrect number of characters were received in the command buffer data.
LER	Board was expecting to receive a login window from the tag but none was received.
RER	Board was expecting to receive either an ACK or a NAK pattern from the board but neither was received.
RXX	An RS232 error was generated by the RS232 port (either a framing error or a buffer overrun error. If you receive this error often; you should consider using hardware flow control.

Ordering information

RW01OEM-STD

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