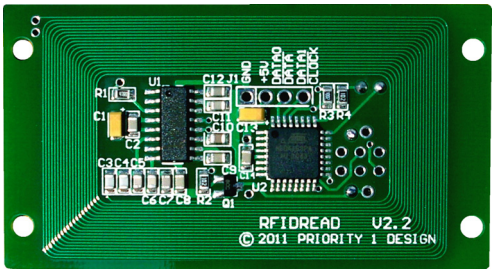
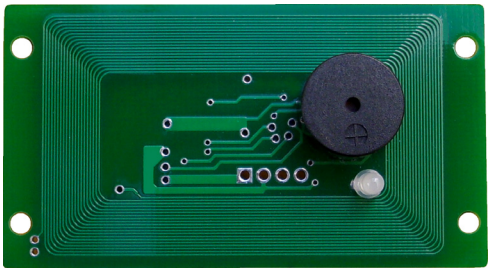
RFIDREAD-RW
RFID reader writer module

Designed for embedding into products manufactured by third-parties, the RFIDREAD-RW Module is a 125Khz RFID Card reader writer in a printed circuit board form factor.





- **Reads EM4100 compatible transponders.**
  64bit Read Only, Manchester Encoded at 64cyc/bit.
  Reads and Writes T5557 compatible transponders.
  Manchester Encoding 32 cyc/bit.
- **Read Distance: 6cm for cards, and 4cm for keytags.**
- **Small Form factor, unit size: 66mm x 34mm**
- **On board duel color LED (Red/Green) for Pass indication.**
- **On board Buzzer for Pass indication.**
- **Integrated RFID Coil Antenna.**
- **Serial TTL Uart**

Description.
The RFIDREAD-RW is designed to read and write the popular range of EM4100 and T5557 compatible proximity cards and transponders available on the general market. EM4100 compatible transponders contain 64 bits of Read Only memory, while T5557 transponders carry 224 bits of Read/Write memory.

The RFID reader writer module is interfaced via 4 lines carrying supply and data outputs. In addition an on board duel color led, and buzzer give audio and visual PASS indications when a transponder comes within reading range. The LED and buzzer can be controlled by setting various options.

In operation the reader will continually scan for either EM4100 or T5557 transponders depending on which type has been selected. The transponder type can be selected by way of pre-defined commands via the Uart Receive line. When the selected transponder is in range it is read and its associated data is transmitted on the Uart Tx line in serial ASCII format.

The command set for the RFIDREAD-RW describe such functions as:

- Set LED color and function.
- Set Buzzer Function.
- Set Default Transponder type.
- Locate Tag
- Read Block
- Read Password Protected Block
- Write Block
- Write Password Protected Block
- Enable/Disable password Protection
- Set Maximum Block
- Setup Transponder Configuration
- Emulate EM4100 with T5557 tag.

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ABSOLUTE MAXIMUM RATINGS (1)

V+ to GND	-0.3V to 6.0V
Digital Inputs to GND	–0.3V to 5.3V
Operating Current	85mA **(2)**
Operating Temperature Range	0° C to 85°C
Storage Temperature Range	0° C to 85°C

NOTE: (1) Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum conditions for extended periods may affect unit reliability.
NOTE: (2) May vary due to component variations.

Connector Pin Description

Interface is via 4 line connection. Table 1. describes the pin connections to the unit.

Pin.	Label.	Description.
1	GND	System ground. Connect to power supply's ground (GND) terminal.
2	+5V	System power, +5V DC input. **(2)**
3	DATA0/DATA	Uart Tx (TTL levels only) **(1)**
4	DATA1/CLOCK	Uart Rx (TTL levels only) **(1)**

Table 1. 4 line interface.

NOTE: (1) The uart outputs have voltage ranges at standard TTL level. Care must be taken to ensure that voltages outside the range of –0.3V to 5.3V are not applied to these lines. If a RS232 interface is required then the use of an appropriate level translation circuit should be used.
NOTE: (2) A clean and stable +5V supply is required in order to insure proper operation of the Reader module. Any additional noise introduced into the supply line will reduce the reading range of the module.

Principle of Operation:

The RFIDREAD-RW reader generates a magnetic field through its integrated antenna at 125kHz. Passive RFID transponders also have an integrated antenna that are tuned to the same frequency. When they are within range of the reader unit they are able to draw sufficient power from the electromagnetic field to power their own internal electronics. Once powered they are able to modulate the incident magnetic field which is detected by the reader. In this way the Transponders are able to transmit their data to the reader.

There are many different types of transponders designed to operate at various frequencies, and their functions and the amount of information they carry can also vary. The RFIDREAD-RW is able to read Transponders optimized for 125kHz. It will read EM4100 compatible transponders carrying 64 bits of read only data, as well as read and write T5557 compatible transponders carrying 224 bits of Read/Write memory using Manchester Encoding.

As the protocol for EM4100 transponders differs from that of the T5557, the transponder required to be scanned is first selected, or made the default tag. (See RFIDREAD-RW command description further). Once selected the reader will continually scan for this transponder type. When the reader detects the selected RFID tag its data is read for processing and the decoded data sent via ASCII coded serial Output.

Serial Output Format description:
When a successful read of a transponder takes place the unit will transmit a string of information. This string of information will vary in length depending on the type of transponder being scanned, and the configuration of the transponder.

EM4100 transponder Output
The output format for a read of an EM4100 transponder is a simple string of 10 ASCII coded Hexidecimal characters followed by the ASCII code $0D (carriage return) as a string end marker.
For example, when reading a EM4100 compatible card with the Version Number of $06, and a card data of $001259E3 the following string is transmitted:

06001259E3<crn> where <crn> is serial ASCII code $0D

The card information is transmitted once and a new string will not be sent until the transponder moves outside of the scanning range, and it, or another transponder enters scanning range again.
NOTE: Although EM4100 compatible transponders contain 64bits of information not all the bits are defined for user data. Some data bits are allocated as parity check bits and for other functions. To see an overview of the EM4100 protocol see http://www.priority1design.com.au/em4100_protocol.html

T5557 transponder Output.
The output format for a read of a T5557 transponder is slightly more complicated than an EM4100 as it has more data and various options that alter its behavior. The memory structure of the T5557 rfid tags is as shown in Fig 1. T5557 memory structure.

Block memory description.	**Example data**
Page 0,Block 0, 32 bit Configuration data.	Manchester, max block = 4
Page 0,Block 1, 32 bit R/W Data	12665577
Page 0,Block 2, 32 bit R/W Data	99A0FF56
Page 0,Block 3, 32 bit R/W Data	226390AA
Page 0,Block 4, 32 bit R/W Data	56129800
Page 0,Block 5, 32 bit R/W Data	FFFF0000
Page 0,Block 6, 32 bit R/W Data	99880011
Page 0,Block 7, 32 bit R/W Data, or Password	12345678
Page 1, Block 1, 32bit Trace data	-
Page 1, Block 2, 32bit Trace data	-

Fig 1. T5557 memory structure.

When the tag enters the RF field and powers up it loads the information stored in the configuration block. This tells it what bit rate and encoding scheme to transmit in. It then enters into Regular Read Mode.
In Regular Read Mode the tag will start to transmit its data starting from Block 1, and ending in the block number selected by a parameter known as the Max Block value stored in the configuration data (block 0).

The RFIDREAD-RW will decode the information coming from the tag and output the data in an ASCII coded string. This is of the form of 8 ASCII hex characters per 32bit block, with each block separated by an ASCII space character $20. The full string is terminated with a carriage return character $0D.
For example, when reading a T5557 compatible card with the example data shown above and a Max Block set to 4 the following string is transmitted:

12665577 99A0FF56 226390AA 56129800<crn> ,where <crn> is serial ASCII code $0D

The card information is transmitted once and a new string will not be sent until the transponder moves outside of the scanning range, and it, or another transponder enters scanning range again. However various block access read and write commands are available for the T5557 as described further. For a more detailed description of the T5557 transponder see http://www.priority1design.com.au/t5557_rfid_transponder.html

RFIDREAD-RW command description.

Various commands and parameter data are sent to the RFIDREAD-RW via the Uart Rx line on the interface connector (pin 4. DATA1/CLOCK.). Commands sent to the reader consist of simple ASCII strings terminated with a carriage return. The reader will then process the command and respond by transmitting data or status information on the Uart Tx line (pin3. DATA0/DATA)

The reader has various selectable power up options. These options are written to non-volatile memory within the unit and will be retained even after the unit is turned off. These options are:

- Set LED color and function.
- Set Buzzer Function.
- Set Default Transponder type.

LED and Buzzer functions activate for a short period after a successive read of a transponder. The behavior of which can be controlled by the appropriate command. Setting the default transponder controls which transponder type the reader first starts to look for once it is turned on. See Table 2. Setting power up options.

LED Color While Scanning.	LED color Transponder Read.	Serial Command Code.
RED (default)	GREEN (default)	SL0 <crn>
GREEN	RED	SL1 <crn>
LED OFF	GREEN	SL2 <crn>
LED OFF	RED	SL3 <crn>
LED OFF	LED OFF	SL4 <crn>
RED	RED	SL5 <crn>
GREEN	GREEN	SL6 <crn>

BUZZER FUNCTION.	Serial Command Code.
BEEP ON READ(default)	SB0<crn>
BUZZER DISABLED	SB1<crn>

DEFAULT TRANSPONDER.	Serial Command Code.
EM4100(default) Read Only	SD0<crn>
T5557 Read/Write Tag	SD1<crn>

Table 2. Setting power up options. <crn>= ASCII carriage return code $0D

When a command is processed successfully the reader will respond with the standard response of :

OK<crn>

If the command is misunderstood, a status code is sent back. See **Error Codes and Status Description**.

Additionally the RFIDREAD-RW features the following commands as summarized in Table 3. Active Tag Commands summary.

Command Description	Serial Command Code.
LOCATE TRANSPONDER	LTG<crn>
SELECT TAG TYPE	STx<crn>
READ BLOCK (T5557)	RBx<crn>
WRITE BLOCK (T5557)	WBx<32bit Data><crn>
READ PASSWORDED BLOCK (T5557)	RPx<32bit Password><crn>
WRITE PASSWORDED BLOCK (T5557)	WPx<32bit Password><32bit Data><crn>
SET MAXIMUM BLOCK (T5557)	SMx<crn>
ENABLE PASSWORD PROTECTION (T5557)	PWE<crn>
DISABLE PASSWORD PROTECTION (T5557)	PWD<32bit Password><crn>
READ CONFIGURATION BLOCK (T5557)	RCB<crn>
SETUP CONFIGURATION BLOCK (T5557)	SCB<crn>
WRITE EM4100 PROTOCOL (T5557)	WEP<40bit Data>
READ TRACE DATA (T5557)	RTD<crn>
READ STANDARD DATA	RSD<crn>

x denotes block address : 0-7
(T5557) denotes T5557 tag commands only

Table 3. Active Tag Commands Summary.

Locate Transponder Command.
When a transponder enters the scanning field of the reader its data is decoded and transmitted on the Uart Tx line; however once data is sent there is no indication that the tag is still within scanning range. At some point it may have been removed. The Locate Transponder commander is useful in determining if a tag is still present. The command protocol for which is shown here, along with the available responses.

Protocol: **LTG<crn>** ,where <crn> is $0D carriage return.

Command Protocol Example	Response.	Description.
LTG<crn>	**?1<crn>**	**Tag not present**
	OK<crn>	**Tag present**

Select Tag Type Command.
This command is almost identical to the Set Default Transponder command, except that the parameters are not stored to non volatile memory. On power up the selected tag will always revert back to that set using the Set Default Transponder command.
This command is used for alternating between scanning for one type of transponder and another. A user may elect to scan for an EM4100 tag during, for example, a 1 second period and a T5557 tag the next, in alternating fashion.
Special Note: The Select Tag command also introduces a 5 second lockout of the reader's normal Pass indication and serial output. If a tag enters the field within 5 seconds of issuing this command it will not transmit the card data, or issue LED and buzzer indications. This is to prevent contradictory data being sent to any scanning program accessing the reader while a tag enters the scanning field.

Protocol: **STx<crn>** ,where x = tag type code 0 to 1, <crn> is $0D carriage return.

Command Protocol Example	Response.	Description.
ST0<crn>	**?1<crn>**	**Tag not present**
	OK<crn>	**EM4100 Tag selected**
ST1<crn>	**?1<crn>**	**Tag not present**
	OK<crn>	**T5557 Tag selected**

Read Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
T5557 Transponders have 7 blocks of 32bits of read/write memory. The blocks are addressed in the range of block 1 to block 7. It is used to read the 32bits of data of a selected block.

Protocol: **RBx<crn>** ,where x is the block address 1 to 7, <crn> is $0D carriage return.

Command Protocol Example	Response.	Description.
RB1<crn>	**?1<crn>**	**Tag not present**
.	**aabbccdd<crn>**	**8 ASCII hex bytes representing**
.		**1 block of 32bit data is returned**
RB7<crn>		

If this command is sent while the tag is in password mode, the command will be ignored by the transponder and it will revert to standard read mode. In this case the returned information will be one or more blocks of 32bit data depending on the Max Block setting stored within the transponder configuration block.
If an EM4100 tag is selected instead then the reader will output the standard data format which is 10 ASCII hex characters and a carriage return.

Standard read response for an EM4100 transponder.

Command Protocol Example	Response.	Description.
RB1<crn>	**?1<crn>**	**Tag not present**
.	**06001259E3<crn>**	**10 ASCII hex bytes for**
.		**EM4100 data.**
RB7<crn>		

Write Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
T5557 Transponders have 7 blocks of 32bits of read/write memory. The blocks are addressed in the range of block 1 to block 7. It is used to write 32bits of data to a selected block.

Protocol: **WBx<32bit Data><crn>** ,where x is the block address 1 to 7, <crn> is $0D carriage return.

Command Protocol Example	Response.	Description.
WB1aabbccdd<crn>	**?1<crn>**	**Tag not present**
.	**?2<crn>**	**Tag failed to Write**
.	**OK<crn>**	**Data written. (aabbccdd)**
WB7aabbccdd<crn>		

If this command is sent while the tag is in password mode, the command will be ignored by the transponder

Read Passworded Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is in password mode.
T5557 Transponders have 7 blocks of 32bits of read/write memory. The blocks are addressed in the range of block 1 to block 7. It is used to read the 32bits of data of a selected block with password protection.

Protocol: **RPx<32bit Password><crn>** ,where x is the block address 1 to 7, <crn> is $0D carriage return and 32bit password is expressed as 8 ASCII hex bytes.

Command Protocol Example	Response.	Description.
RP1FFAACC00<crn>	**?1<crn>**	**Tag not present**
.	**aabbccdd<crn>**	**8 ASCII hex bytes representing**
.		**1 block of 32bit data is returned**
RP7FFAACC00<crn>		

If this command is sent while the tag is not in password mode, the command will be ignored by the transponder and it will revert to standard read mode. In this case the returned information will be one or more blocks of 32bit data depending on the Max Block setting stored within the transponder configuration block.
If an EM4100 tag is selected instead then the reader will output the standard data format which is 10 ASCII hex characters and a carriage return.

Write Passworded Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is in password mode.
T5557 Transponders have 7 blocks of 32bits of read/write memory. The blocks are addressed in the range of block 1 to block 7. It is used to write 32bits of data to a selected block with password protection.

Protocol: **WPx<32bit Password><32bit Data><crn>** ,where x is the block address 1 to 7, <crn> is $0D carriage return, and 32bit password is expressed as 8 ASCII hex bytes.

CAUTION. Only issue this command if the Tag is in Password protection mode otherwise data corruption may occur. A transponder that is not in password mode will misinterpret the password for data and an incorrect write will occur.

Command Protocol Example	Response.	Description.
WP112345678aabbccdd<crn>	**?1<crn>**	**Tag not present**
.	**?2<crn>**	**Tag failed to Write**
.	**OK<crn>**	**Data written. (aabbccdd)**
WP712345678aabbccdd<crn>		

In this example the password is $12345678 stored in block 7

Set Maximum Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
As discussed earlier in this document the T5557 transponders enter Standard Read mode when they first enter the RF field of the reader. In this mode they will start transmitting data from block 1 to a block address defined in the configuration block. This value is the Max Block value and can be any value from 0 to 7.
If the password mode is to be used for the tag then the maximum block should not be set to 7 as this will cause the password that is stored in block 7 to be transmitted. Note also that if the maximum block is set to 0 this will cause the configuration block to be transmitted only.
This command is useful when an application requires that part of the data stored on the tag be automatically transmitted, in other words "public data", while the upper blocks remain private, readable only though a direct block read command.

Protocol: **SMx<crn>** ,where x is the Max Block value required (0 to 7), <crn> is $0D carriage return.

Command Protocol	Response.	Description.
SM0<crn>	**?1<crn>**	**Tag not present**
.	**?2<crn>**	**Tag failed to Write**
.	**OK<crn>**	**Max value Set ok.**
SM7<crn>		

Enable Password Protection.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
This command does a write to the configuration block (block 0) of the tag and sets the Password control bit. Following this command all direct block access commands require a password to be sent.
Note that when a tag first enters scanning range it will start transmitting from block 1 to the value set by the Max Block parameter. If there are locations that are required to be kept private a Max Block value below that required to be private should be set.

Protocol: **PWE<crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
PWE<crn>	**?1<crn>**	**Tag not present**
	?2<crn>	**Tag failed to Write**
	OK<crn>	**Password mode enabled.**

Disable Password Protection.
This command is only valid if the T5557 transponder is selected, and the tag is in password mode.
This command does a write to the configuration block (block 0) of the tag and clears the Password control bit. Following this command all direct block access commands do not require a password to be sent.

Protocol: **PWD<32bit Password><crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
PWD<12345678><crn>	**?1<crn>**	**Tag not present**
	?2<crn>	**Tag failed to Write**
	OK<crn>	**Password mode disabled.**

In this example the password is $12345678 stored in block 7

CAUTION. Only issue this command if the Tag is in Password protection mode otherwise data corruption may occur. A transponder that is not in password mode will misinterpret the password for data and an incorrect write will occur. As this command accesses the configuration block writing incorrect data to this block may render the tag unreadable. This can occur if the tag is set to operate with encoding other than Manchester, or at rates that the RFIDREAD-RW is not designed to operate with.

Read Configuration Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
This command is used to read the configuration block (block 0).

Protocol: **RCB<crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
RCB<crn>	**?1<crn>**	**Tag not present**
	aabbccdd<crn>	**8 ASCII hex bytes representing the 32bit configuration block.**

Setup Configuration Block Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode.
The RFIDREAD-RW currently only reads T5557 tags setup for Manchester Encoding, 32cyc/bit, with Sequence terminator active. T5557 transponders sold by Priority 1 Design are all setup as such by default however the user may encounter transponders setup otherwise. If the configuration block has not been locked, or password protected the use of this command will set the transponder to the appropriate mode.

Protocol: **SCB<crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
SCB<crn>	**?2<crn>**	**Tag failed to Read/Write**
	OK<crn>	**Tag setup successfully.**

Note: The Tag type selected will be set to T5557 after using this command.

Write EM4100 Protocol Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode. EM4100 protocol tags are Read Only and their data is factory set. This presents a problem when a duplicate tag, or a tag with predefined data is required. This command solves this problem by writing the data and configuration block of a T5557 Read/Write tag so that it appears to function as a EM4100 tag to a standard reader.

Protocol: **WEP<40 bit data><crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
WEP1200071239<crn>	**?1<crn>**	**Tag not present**
	OK<crn>	**T5557 Tag will now function as a EM4100 tag.**

In this example the T5557 Tag will now behave as an EM4100 protocol Tag with a Version Number of $12, and a data of $00071239. The RFIDREAD-RW will still be selected for T5557 tags after this command. To read the Tag with the new protocol a Set Tag Type command (STx), or Set Default Tag (SDx) will need to be sent in order to read EM4100 protocol tags. In order to return the T5557 tag to its normal function a Setup Configuration Block (SCB) command can be used.

Read Trace Data Command.
This command is only valid if the T5557 transponder is selected, and the tag is not in password mode. This command is used to read the two blocks of Trace information stored in page 1 of the T5557 transponders. These are Read Only blocks and carry manufacturer codes, lot numbers, and other such data for tracing the source of the transponder.

Protocol: **RTD<crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
RTD<crn>	**?1<crn>**	**Tag not present**
	E0150156 1411081C<crn>	**2 x 8 ASCII hex bytes representing 2 blocks of Trace data.**

Read Standard Data
This command is valid for all transponder types. It is used to tell the reader to output the tag's standard data that it normally transmits when it first enters the RF field of the reader. This command is generally used in conjunction with the Set Tag command for continuous polling purposes. The Set Tag command is first issued, which creates a 5 second lockout of the normal serial communications. During this 5 second window the Read Standard Data command is issued to read the data of any tag currently within scanning range.

Protocol: **RSD<crn>** ,where <crn> is $0D carriage return.

Command Protocol	Response.	Description.
RSD<crn>	**?1<crn>**	**Tag not present**
	E0150156 1411081C<crn>	**Standard data for Tag.**

Error Codes and Status Description.

The RFIDREAD-RW unit will respond to every command with either the requested data, or one of these status strings summarized here.

ERROR AND STATUS CODES.	DESCRIPTION.
?0<crn>	Command not understood.
?1<crn>	Tag not present.
?2<crn>	Tag failure to Read/Write.
?3<crn>	Access to Block 0 not allowed
OK<crn>	Function Performed Successfully.

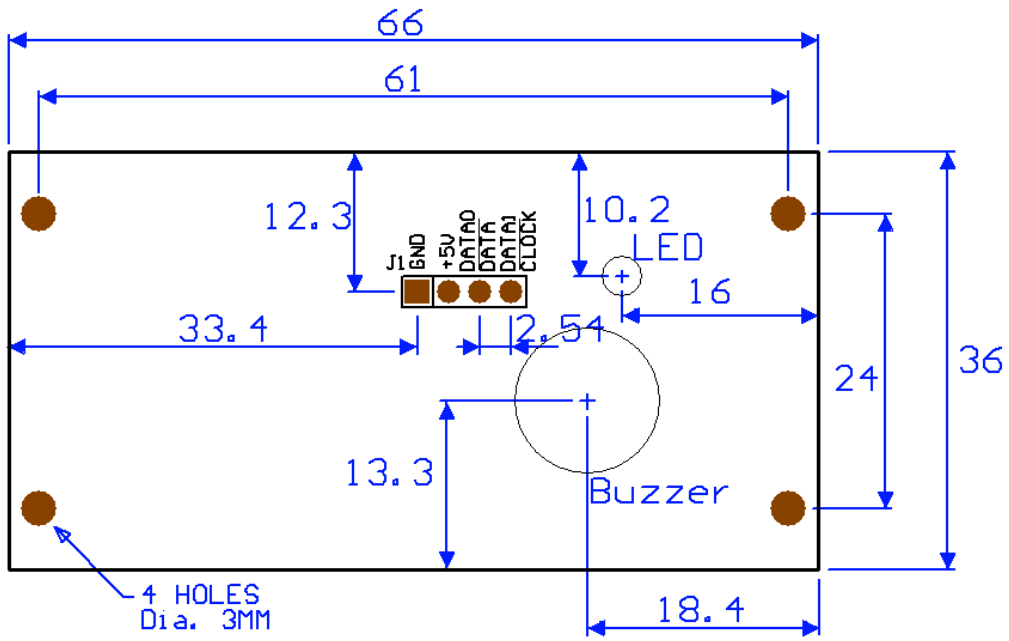
Table 4. Error Codes and Status Description summary.

Serial protocol description:
The protocol for the Serial Input and Output lines is 9600 Baud, 8 data bits, 1 stop bit, no parity.
These lines are TTL level only. If a RS232 interface is required then an appropriate level translation circuit should be used.

Limitations of the RFIDREAD-RW.
The T5557 transponders are capable of being set up with various encoding schemes and bit rates. However the RFIDREAD-RW currently only reads transponders using Manchester Encoding schemes at a bit rate of 32 cycles per bit, with the Sequence terminator pattern active. For this reason limitations have been placed on Write executions to the configuration block in order to prevent accidentally placing the transponders into an unreadable mode of operation.

For applications regarding other encoding schemes, bit rates, and transponder types please contact our technical department via our web site at http://www.priority1design.com.au/

Dimensions:



All Dimensions in mm.
LED and Buzzer located on bottom side.

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