![tres - transponder and reader engineered systems logo]

# tres900s
# Operations Manual

# Table of Contents

# Product Description

## Scope

This document describes the functional requirements and software features contained in the newly designed **tres900 Enhanced GEN2 Reader** hereon known as **tres900s**. This document lists the product specifications, as well as performance, and operational criteria.

## Summary

The **tres900** is the brand name for a new line of 902~928 MHz RFID Readers and Tags. We are a U.S. based company comprised of seasoned RFID professionals, including engineers, marketing, and distribution specialists. We have designed a product line that is ideally suited to the parking, supply chain, document tracking, and many other markets. We will be selling our products through Systems Integrators, Distribution and OEM channels. The **tres900s** is designed and manufactured in the USA to be an enhance version of the present **tres900** GEN2 UHF Reader.

The **tres900s** is designed to reduce the number of electronic components needed for a traditional Product. This is accomplished by using a custom integrated RF IC in place of many individual components. The product will offer the following features:

- Wiegand Output Format, multiple and custom formats, 3-wire
- EMI protected I/O lines, i.e. 2 each for Wiegand Output, 1 each for Trigger Input, 2 each for RS232, 2 each for RS485, etc.
- Reverse Polarity and Over Voltage protection on the input voltage
- Serial RS232 + RS485 Bi-directional, used for configuration and data output
- Buffer (100 mS to 60 sec), read tag + output tag + buffer tag, read and output after buffered time
- Timer read (10 mS to 1 sec), time between read and output data
- Multiple tag reads, single tag process the strongest RSSI read from tags
- LED flashing and Audio (Piezo) tone for power on and for a tag read
- Ethernet TCP/IP Output, daughter board (optional)
- Controller functionality w/relay, Site Code and ID range configurable
- SPI Flash IC to restore the program and store valuable settings

## Product Identity

The **tres900s** will be given an engineering part number.  This part number prefix will start with the prefix number '900S'.  The firmware version will be '900S.0.0.xx'. Designated as:

| Model # | Board rev | Hardware rev | Serial Number |
|---------|-----------|--------------|---------------|
| 900S | x | xx | xxxxx |

## Reference Documents

- TBD

## Revision History

- Rev 01 04/13/19 - first draft by Rick L
- Rev 02 05/31/19 - changes made after evaluating prototype units
- Rev A 06/21/19 - first release after hardware updates and pre-production units

# Product Operations

## Hardware Description

The **tres900s** Reader comes with many rich features like multi-protocol and multi-tag reading, integrated and environmentally protected packaging and long-distance reading.

The **tres900s** Reader is a fully integrated reader with a RF module IC, power conditioning, built-in circular polarized antenna and packaged in a weather-tight and UV protected housing. The circular polarized antenna allows it to work in AVI and asset management applications and its programmable triggering modes enable the reader to work in either self-triggering (timing) or trigger mode. Versatile I/O interfaces enable the **tres900s** to work with multiple serial devices and with standard Wiegand controllers.

The **tres900s** Reader is a multi-protocol UHF reader, which supports ISO18000-6B and EPC protocols. It can read UCODE, TI, Alien and many other labels. The reader's firmware is field upgradable, enabling it to support protocol expansion and feature upgrades, giving it the ability to grow with the maturing RFID technologies.

The integrated high-gain circular polarized antenna allows the reader to achieve a respectable read range, and the internal DSP module enables the reader to manage multi-tag arbitration at high speed, thus making it suitable for AVI and material management applications.

## Reader

The RFID Reader is a device that captures and processes tag data. These devices are called readers or interrogators. Readers are connected to the antenna and are connected to the RFID network infrastructure. The Reader provides the energy of which a fraction is used to energize and wake up the tag. The reach of the reader is determined by the design of the antenna (both Tag and Reader) and the power and configuration of the reader. The Reader detects and filters data bits emitted from compatible RF Tags then converts the bits into the associated computer format of serial RS232/485, Ethernet (optional) and/or Wiegand communications protocols. Advanced error detection algorithms provide error-free operation.

The **tres900s** Reader operate on a fixed power source of 5vDC. Connection to the Reader is best made by using shielded twisted pair cables (22 AWG up to 22 feet, over 22 feet see recommended wire chart at end of this document).

## Tags

An RFID-tag is a device which is attached to objects and/or assets to be identified. When radio signals are received, information is transmitted back to the RFID reader. RFID tags consist of the following components: the microchip (or IC), the antenna, the connection between IC and antenna and the substrate on which the tag is produced. The microchips are the brains of the tag. The antenna handles the communication from either the Tag to the Reader or from the Reader to the Tag.

Passive tags reflect the RF signal transmitted to them from a reader or transceiver and add information by modulating the reflected signal. A passive tag does not use a battery to boost the energy of the reflected signal.

## Wiegand interface

The Wiegand interface uses three wires, one of which is a common ground and two of which are data transmission wires usually called DATA0 and DATA1, alternately labeled "D0" and "D1" or "Data Low" and "Data High". When no data is being sent, both DATA0 and DATA1 are pulled up to the "high" voltage level — usually +5 VDC. When a 0 is sent the DATA0 wire is pulled to a low voltage while the DATA1 wire stays at a high voltage. When a 1 is sent the DATA1 wire is pulled to a low voltage while DATA0 stays at a high voltage.

The high signaling level of 5 VDC is used to accommodate long cable runs from card readers to the associated access control panel, typically located in a secure closet. Most card reader manufacturers publish a maximum cable run of 500 feet. An advantage of the Wiegand signaling format is that it allows very long cable runs, far longer than other interface standards of its day allowed.

## Serial RS232/RS485

The Reader will output standard RS232/485 outputted via standard ASCII format or HID serial format and can be viewed on any ASCII terminal viewer like Hyper Term. The RS232 will be a bi-directional device because it also needs to communicate to a PC the setup parameters described later in this document.

## Trigger Mode

When the Installer puts the reader in trigger mode, the reader will be put into IDLE mode, this means the reader will not read and power consumption will be only 20mA. Once the trigger is activated (Trigger wire to ground); it will take 6mS to start reading and outputting tag data again. There are two external terminals on the connector, software configurable.

## Power Requirements

The **tres900s** is powered from the TRES supplied regulated power supply with a voltage range of +5vDC @ 2A minimum.

## Relay Description

The CPC1018N is a miniature single-pole, normally open (1-Form-A) solid state relay that employs optically coupled MOSFET technology to provide $1500V_{rms}$ of input to output isolation with up to 600mA Load Current and 60Vp Blocking Voltage.  The super-efficient MOSFET switches and photovoltaic die use IXYS Integrated Circuits Division's patented OptoMOS architecture while the optically coupled output is controlled by a highly efficient infrared LED.

## Software Description

In this section, we will try to describe options that can be configured in the field. TRES developed a GUI that will be self-contained (.exe) so it can be run easily in the field and not have to install it on the user's device. Below are some of the features that need to be incorporated in this program.

## Option Feature

These below options should be incorporated into the new setup program that would be used in-house and in the field by installers to configure the reader for their installation site they are presently at. Features that should be included are:

- RF Power settings, 10 dBm minimum; to 30 dBm max (pull down menu)
- Wiegand Output, pulse width, and pulse period (see range below in Table and References)
- Read tag output, read buffer to delay tag after first read and output, 100 mS minimum to 60 seconds maximum, works on both Wiegand and RS232/485 (configurable)
- Timing Read, timing read interval 100 mS minimum to 5 seconds maximum
- Trigger Read Delay, length reader powered after Trigger let go, 0 to 100 seconds
- Single tag read mode (strongest tag RSSI read) or multiple tags; selectable
- Switch between Wiegand + Serial or Serial Only modes
- Serial output configured for Raw ASCII or HID serial simulation
- RS485 configurability, Baud rate, Protocol (CR/LF or OSDP), and Address
- Incoming Tag ID, output certain Facility Code 1 to 255 (26-bit only range), tag IDs'
- Relay: not Enabled, Hold Time 100 mS to 3 seconds
- Indicators control, LED + Audio, On /Off, software configurable
- Log window, to monitor tags being read
- Update Firmware, a feature to field flash the firmware
- Large Tag display window to read tag data at a long distance

## Default tres900s settings

- Radio Power: 30 dBm
- Reader: Timed Mode, Multiple Tags, 500mS timed interval, and trigger read delay 0 sec.
- Serial Comm: RS232 baud rate 115200, ASCII mode
- Wiegand: Wiegand + serial, output buffer 500mS, Pulse Width 80uS, Pulse Period 1200uS
- Ids: Facility Code is not selected
- Relay should not be selected
- Output Wiegand + Serial
- Output Buffer set to 0.1 sec
- Received Timing selected
- LED selected

## Connecting to tres900s

In this section we will detail the incoming wires to the **tres900s** reader. Please refer to the label and diagram that follows this text and note the terminal markings.

## Wiring Diagram

The top label designates the signal to the main PCBA, described later in this document, and the bottom color labels denote the color cable codes used on the present tres900 Reader.

Tres900s
Wiring Diagram
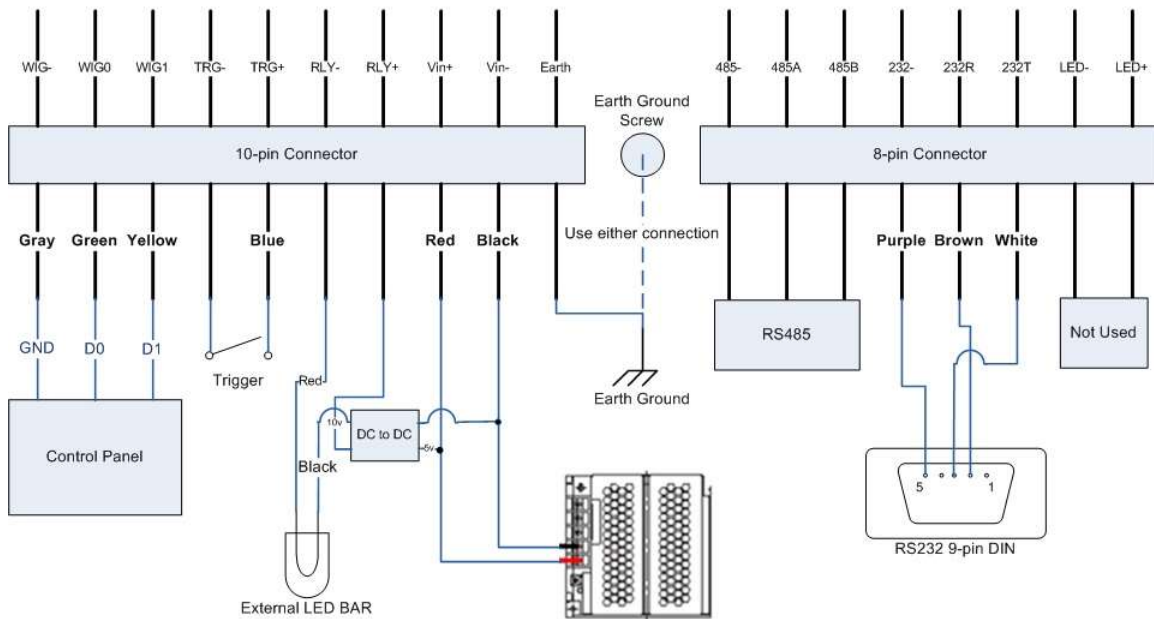
## LED Control

This is an LED control output; it will power an LED with 3.3v DC. The LED+ goes to the Anode of the LED while the LED- goes to the Cathode of the LED.

## RS232 Control

This input / output lines are used to control or be controlled by and RS232 device. Line description, 232T goes to pin 3 of a 9-pin DIN (RX), 232R goes to pin 2 of a 9-pin DIN (TX) and 232- goes to pin 5 of a 9-pin DIN (ground).

## RS485 Control

This input / output lines are used to control or be controlled by and RS485 device. Line description, 485B normally goes to the T/R- or 485B line, 485A normally goes to the T/R+ or 485A line and the 485- is the Ground line.

## Earth

Here you would connect an Earth ground to the reader instead of or still to the back panel of the reader.

## Power Connect

This is where you get power to the reader from TRES supplied regulated power supply. Remember to use the TRES regulated DC supply +5vDC @ 2A. The reader has a built-in linear regulator with EMI, reverse polarity and overvoltage protection.

## Relay Control

You can use this relay to control a power relay or an external LED that needs more power than supplied. You could put 12vDC on one side of the relay and an LED to ground on the other. The relay is a form C NO relay.

## Trigger Control

Here is where you would connect your relay output from a detection device or anything you would want to control the reader. When you select trigger mode, you need to short-out the RLY+ line with the RLY- line, usually thru a dry contact.

## Wiegand Control

This is your typical open collector Wiegand output terminals. The WIG1 line goes to your DATA 1 (D1) terminal on your controller, the WIG0 line goes to your DATA 0 (D0) terminal and the WIG- is the Wiegand ground line.

# tres900s Interface Setup Program

In this portion of the document you will learn how to communicate and configure the **tres900s** Reader. Hook up your **tres900s** and stated in the previous section, connect to a serial port, and power up everything. When you run the TRES_SETUP.EXE program (Downloadable from our website) you will see the following screenshot:
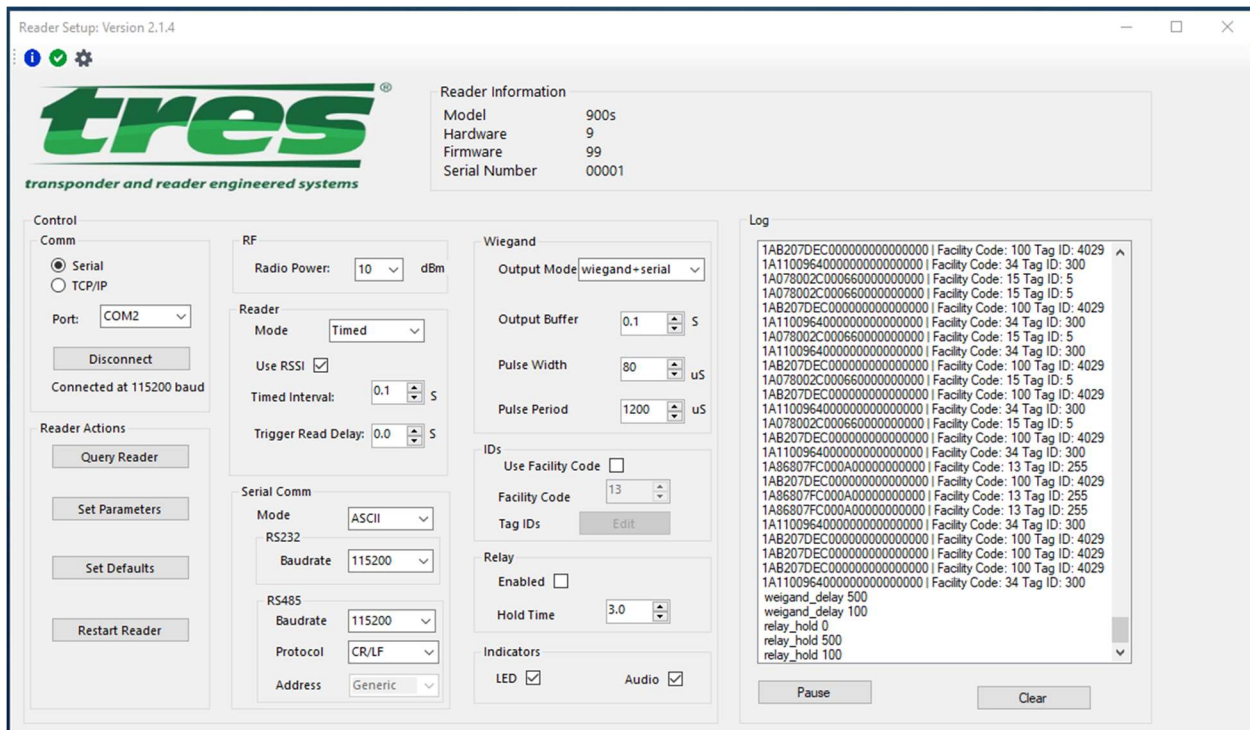


As you can see from the image above, you have many features that allow you to modify the **tres900s** reader, so you can have a more successful install. These features were described above in this document and below.

## Upper Left Tools

In the upper left section of the **tres900s** Setup utility you will see three (3) icon buttons, the one that looks like a gear (next to check mark) has the following four (4) options:

1. **Open Tag Display**, this is a feature that will display a large window in the upper portion of the computer screen that will display any valid 26-bit Wiegand that is read by the iModule. This is a usefull tool to easily read the decyphered Wiegand tags.
2. **Reader IP Address List**, allows you to modify the IP settings if you have the TCP/IP option.
3. **Set IP Address**, after you modified the IP address, this will upload it to the reader.
4. **Update Firmware,** this allows you to update the firmware in the field. This is useful if there are changes to the product or if you have custom firmware.
5. **Reader ID,** this is where you can get the serial number on the reader, can only be modified at the factory.
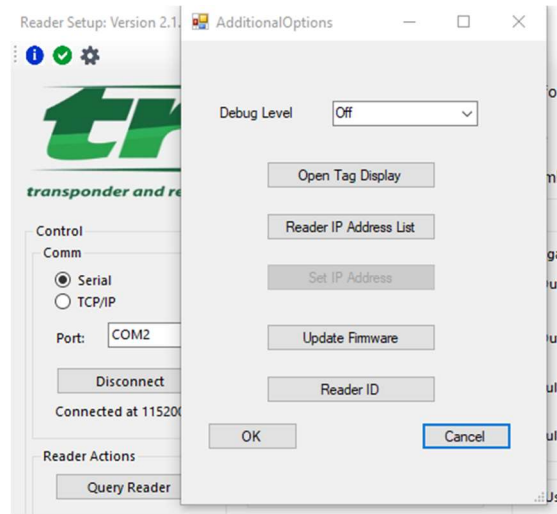
## Control Section

This is the first section you will use to connect to the **tres900s**, here is where you will connect and communicate between your computer and to the **tres900s**. You may first want to do a Device Manager lookup on your computer to see what COM PORT you are using to connect to the reader with.

### Comm

Upon power up, the **tres900s** will search for available communication devices. Select the appropriate **Comm Port** device from the drop-down menu to connect to your computer to the reader, then press the **Connect** button, if you have the TCP/IP option, you can also select it here. When connected, you will get the screen that states that you are connected, a **Query** is done during the connection process. When finished using the setup program, just press the **Disconnect** button. If you plug in your serial device after starting this software, that device will not be recognized, you will have to shut down the setup program, then restart the setup program in order to recognize your communications port.

### Reader Interface Actions

**Query Reader**, this should always be done if you made changes to the reader and wanted to get the stored data from the **tres900s**. A Query is done automatically when you first connect to the **tres900s** and run the setup program.
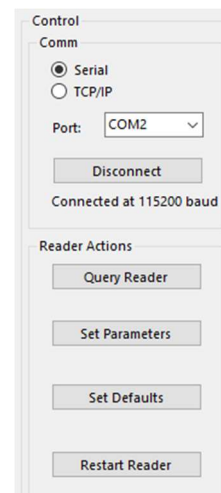
**Set Parameters**, this is the icon button you press to update the Reader settings with your changes you make. After you make your changes to the reader, you will have to press this icon button in order to send your changes to the flash memory.

**Set Defaults**, in case you get lost and want to reset all setting to factory default, you would press this icon button to restore all your setting to the factory default mode.

**Restart Reader,** this just restarts the reader instead of having to remove power.

### RF Section

This is where you would change the RF output power from 10dBm to 30 dBm. The higher the number, the more power the unit puts out. Remember, if you push too much power out, it will act just like a stereo where when you crank it too loud, the signal gets distorted.
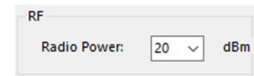
### Reader section

This section allows you to modify how you read a tag. The explanation will follow along with describing each section.

**Mode,** this is where you would select Timing or Trigger mode. Timing mode is where you are constantly reading tags. Trigger mode is where the reader is not reading tags until the trigger line is triggered (shorted to ground).
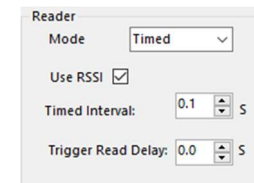
**Use RSSI,** this allows you to power a tag at maximum distance and only read if at a distance set. This function is not fully working yet.

**Timed Interval,** this is where you set the frequency of when you read tags, minimum is 100mS and maximum read interval is 5 seconds.

**Trigger Read Delay,** this is the setting to leave the reader on after the trigger is released, minimum setting is 0 seconds and maximum is 10 seconds.

### Serial Comm Section

**Mode**, this portion allows you to select between standard **ASCII** (2 HEX character F/C and 4 characters ID) or **HID** Serial PROX reader output from a converted Wiegand Input. An example of the HID format is the top line to the right and the ASCII equivalent is the second line, where the first two HEX characters is the Facility Code (0F hex = 15 decimal) and the second four charcaters is the ID number (0005 hex = 05 decimal).
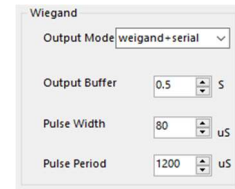
`0100041E000B6D`
`0F0005`
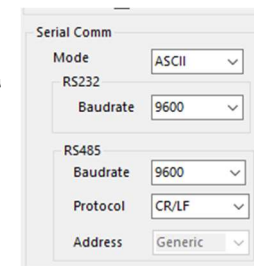
**RS232,** here you will select your baud rate you want to communicate thru the serial port. Selections are 9600, 19200, 57600, 115200 (default). This is usually set to the 115200 baud and most devices are automatic baud selection, this is mainly for use with your dumb terminal program like HyperTerm or CoolTerm.

**RS485,** in this section you can also modify the baud rate of the RS485, just as you did with the RS232, 9600, 19200, 57600, 115200. The Protocol option allows you to select either the standard CR/LF output, or the secure OSDP option.

## Wiegand Section

This is where you can modify your Wiegand settings. You normally would not need to modify the Wiegand settings, but if you are running longer cable, then you may have to. To modify the Wiegand timing, go to the Wiegand Setting section of the Setup Software, then select the desired timing parameters.

**Output Mode,** you have the options of select to output both Wiegand and Serial or just the serial data.
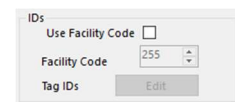
**Output Buffer,** this allows you to select a Wiegand buffer from 100 mS…60 seconds. That means, when the **tres900s** reads the first tag, this tag will be outputted thru either or both Wiegand and serial, then store this tag into the buffer for time selected or until another valid tag is read. If another tag is read before the timer times out, this tag data will be outputted, the buffer will be reset, and this tag will be the new stored tag.

**Pulse Width**, this allows you to modify the Wiegand Pulse Width, the specification is 20 µSec to 100 µSec

**Pulse Period**, this allows you to modify the Wiegand Pulse Period, the specification is 200 µSec to 20000 µSec
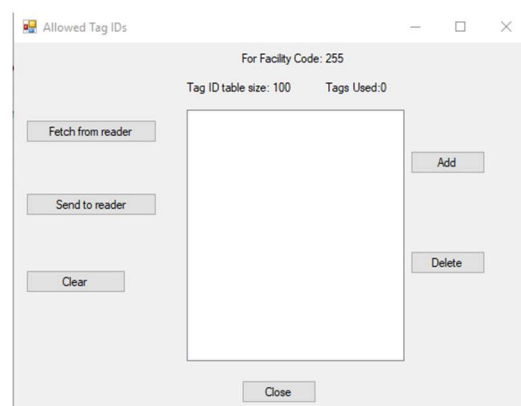
## IDs Section

In this section of the software, you will have the ability to select then add a Facility Code and/or ID number(s). This is where you select and set a facility code and all other facility codes read will be ignored. If no facility code is selected, all valid IDs will be outputted per user configuration. If one Facility Code is selected, only this Facility Code will be outputted per user configuration.

**Use Facility Code**, when this box is selected, a facility code will be used to output only the facility code selected. This means that you can read other tags with a different facility code and they will not be outputted to your device. If you select the relay option, later in this document, then only when this facility code is read, the relay will engage.

**Facility Code**, here you will select the facility code you want to output only. When you select between 0...255, only a tag read with this site code will be outputted thru the Wiegand port. You can use the up down scroll option or you can just enter the facility code you want. Remember to send your changes to the reader by using the 'Send to reader' option.

**Tag IDs**, this is where you add, modify and delete ID numbers. See larger picture on the right. First you select the **Add** button on the right of the popup box and another popup box will be displayed.

You can enter a single number or a range of numbers. The single number can be entered by just entering a number in the highlighted box

You can also select the **Enter range of data** box and enter the starting ID then the ending ID. You have up to 100 different IDs. Once completed, just press the **OK** to save or **Cancel** to not save them. You now need to press the **Send to Reader** button to update your changes into the readers flash memory.
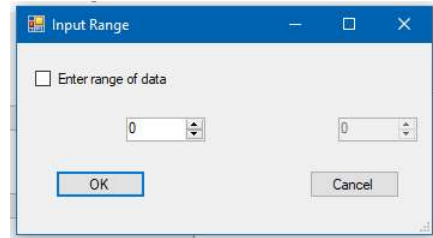
You can send this data to the Reader, Fetch numbers already stored in the Reader or you can Clear and start over. Remember to always send your changes to the memory by using the '**Set parameters**' option mentioned earlier after you '**Close**' from this option. This is just a precaution; I also will query the memory to see if my changes were saved properly.

### Relay

**Enabled**, when this box is selected, you enable the use of the relay. It works off the Facility Code, if no Facility Code selected, then it closes contact on any valid Wiegand input read. If the Facility Code and/or ID range selected, the relay will close only when a valid tag with that Facility Code and ID range is received from the reader.
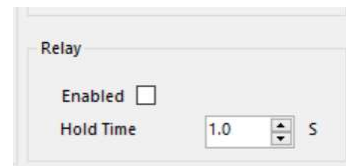
**Hold Time**, this is the relay hold time, you select between 100 mS…3 seconds. When the relay is selected, and a valid tag is read, this time selection will keep the relay closed for that period of time. This is handy when you want to control a device for a longer or shorter period of time after the valid tag is read and manipulated per user configuration.

## Indicators

Here is the section where you turn the LED and the Audible Beeper ON/OFF for a valid read. The factory default is on but if you do not need to see an LED flashing or hear the Beeper beeping for a valid Wiegand read, then you can turn either of them off here.
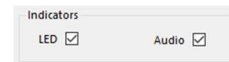
## Log Window

This is a very useful section, every valid tag read will be converted and displayed here. Even if you set facility code, every valid tag read will be displayed. This is a very useful tool for troubleshooting your tag data and a good way to check the tags programming.

**Pause**, this icon button just stops displaying the inputted tag data. Like anything else, if you tired of seeing data displayed, then you pause the data being displayed.

**Clear**, this icon button is useful for clearing out the log window. Sometimes you get too much data and want to clear it out and start over.
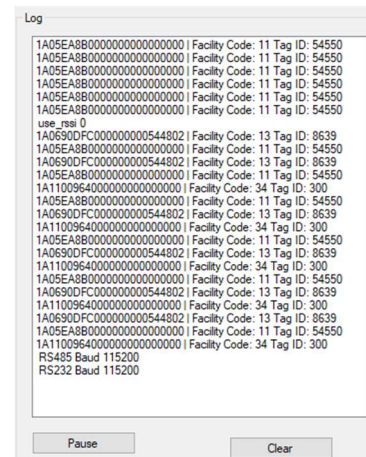
## Specifications

| Item Details | tres900s |
|---|---|
| Operating Frequency | 902.75MHz～927.25MHz @ 500KHz hop (50 total hops) |
| RF Protocol | ISO18000-6B, EPC Class 1, EPC Class 1 GEN 2 |
| Operating Method | Frequency Hopping Spread Spectrum (FHSS) |
| Antenna | Internal 7dBi circular polarized |
| Max RF Power | 30 dBm (1 Watt) |
| RF Power Range | 10~30 dBm, Software Adjustable |
| Tag ID Modes | Timed Mode - automatically reads at fixed time |
| | Trigger Mode - external trigger control to read |
| Wiegand Timing Parameters | Pulse Width 80μS, Pulse Period 1200μS (adjustable) |
| Identify Tag Time | <8ms - Identify single tag |
| Reading Tag Time | Reads every 8 bytes in less than 5ms |
| Reading Tag Distance | 18' to 25', depends on variables defined later |
| Communication Interface | RS-232, RS-485. TCP/IP, OSDP, Multiple Wiegand Formats |
| Input | One-way trigger input |
| Power Supply (suggested) | 5VDC @ 2Amp (supplied) |
| Power Consumption (peak) | 1.5 A max. @ 5VDC (7.5 Watts) |
| Size | 10.075" diameter (273.05mm) x 3.85" thick (97.79mm) |
| Work / Storage Temperature | -4°F to 158°F (-20°C to +70°C) / -40°F to 185°F (-40°C to +85°C) |
| Certifications | FCC Part 15 Subpart C and Canada RSS-210 |
| Working Status Indication | Audible Beeper, external LED option |
| Extra Features/Options | Relay, External LED, Multiple Wiegand Formats, OSDP, scrambled tag data to reader, TCP/IP, RS485 |

## Reader Installation Guide

This section contains information for configuring the Reader's power and signal cabling. Power and communications are provided through supplied two phoenix plugs (one 8-pin and one 10-pin) that you can remove from the PCBA, attach your wires, then reinsert the plugs to the connectors.

## Mounting

The mounting bracket is designed specifically for mounting the **tres900s** Reader. The Reader could be installed on a pole or on wood, concrete, or brick structures and aim the antenna toward zone of coverage. Figure 7 below shows how the bracket looks assembled on a pole. The tool of choice would be a 3/8" (10 cm) wrench.

Figure 7

# Installation Overview

The Reader is supplied in a weatherproof enclosure for direct outdoor installation or can be placed indoors, such as in a guardhouse, or close to other electronic equipment. The Reader outputs the decoded ASCII data to an access control unit via standard data cabling. The system outputs data in both the standard Wiegand and serial RS232 outputted simultaneously.

## Trigger Function

If the Reader is configured for triggering mode, the reader will only read a tag when the **BLUE** trigger wire (T1) is tied to ground. Normal ways to accomplish this is by using Loop Detectors to detect the presence of a vehicle to open a gate, or as a safety device to prevent the gate from closing on a vehicle in its path.

## Vertical Plane

Vertical orientation is adjusted so as to aim the antenna at a spot about twenty feet (6.5 M) on the road from the vehicle. From this spot forward, the detection area will increase as you get closer to the gate.

## Tag Vehicle Installation

A vertical orientation is the optimal orientation of the Tag in order of signal response performance. If not a windshield tag, then install the Tag using double-sided tape or Velcro™. Ensure the label-end of the Transponder is mounted in a vertical position for optimum read range. Prior to installation, make certain the desired location complies with all state and local vehicle code laws.

## Parallel Surfaces Rule

Passive RF tag actually gets its power from the reader. That is to say that, the reader is emitting RF and the tag must be able to absorb that RF, accelerate the signal and to reflect it back to the reader. Therefore, if the surface of the reader and tag are close to parallel, this principal will result in better tag reads.

# Wiegand Panel Wiring

# Serial Port RS232 Wiring

# Troubleshooting Guide

Q: To confirm that the unit is operating properly
- ➢ Confirm the beeper is audible when a good tag is presented or when power is first applied. If it is not, remove power.
- ➢ Check that the **RED** and **BLACK** wires are installed correctly
- ➢ Check the voltage at the Reader pigtail cable (see wire chart below), if you under cabled the voltage drop would be too much to power up the Reader. Verify the voltage supplied to the Reader is 5 VDC

Q: Reader just beeps and keeps beeping, about 3 x per second
- ➢ Not enough power from the power supplier, Insufficient power,
- ➢ Check the voltage at the Reader pigtail cable (see wire chart below), if you under cabled the voltage drop would be too much to power up the Reader. Verify the voltage supplied to the Reader is 5 VDC

Q: Reader does not recognize a tag (no beep, no outputted tag data)
- ➢ If no beep, check to see if another tag works, maybe damaged tag. Verify Reader operations by connecting to a computer through the RS232 port and running a Terminal program.

Q: How can I verify that the tres900 Reader I have is Wiegand or serial or TCP/IP?
- ➢ Both Reader products have RS232 and one model has Wiegand and one has TCP/IP. The TCP/IP model has a cat 5 cable with an 8-pin connector attached.

Q: Tag data to panel is scrambled or Reader beeping and host not responding
- ➢ One or more of the Reader's wiring connections are incorrect. Power down the receiver/panel and verify the wiring connections are correct. Check that Data 0 (**GREEN** wire), Data 1 (**YELLOW** wire) and ground (**GRAY**) are properly attached between the tres900 to the host panel.
- ➢ Earth Ground should terminate at the back of the Reader through the mounting brackets or through the Readers Power Supply Ground wire (negative feed).
- ➢ Cable between Reader and panel is too long, check Wiegand specifications
- ➢ Check to insure the tres900 tag number and site code are properly programmed in the host panel.
- ➢ Check the Wiegand timing that your host is looking for and ensure their timing scheme is within the SIA standard parameters.

Q: Read Range too short
- ➢ Ground loop could be an issue here, see if earth ground terminates at the reader. Check by powering reader without reader ground wire connected. Earth ground should terminate at the Reader, check your panel or power supply.
- ➢ Tag orientation should be in a vertical position for the Readers Antenna maximum performance and distance.

## Wiring Guide

Selecting the correct size and type of wire will enhance the performance and reliability of your system. The size of the wire must be large enough to carry the maximum current expected without undue voltage losses. All wire has a certain amount of resistance to the flow of current. This resistance causes a drop in the voltage from the source to the load. Voltage drops cause inefficiencies. The wire sizing guide below provides the minimum wire size needed to limit voltage drops to 10% at a given distance in a 5vDC system.

| POWER | WIRE GUAGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| W(VA)/Amps | 12 AWG | 14 AWG | 16 AWG | 18 AWG | 20 AWG | 22 AWG | 24 AWG | 26 AWG |
| 20W/1.67A | 147' | 95' | 62' | 39' | 25' | 15' | 10' | 6' |

# LIMITED WARRANTY

*Transponder and Reader Engineered Systems, Inc.* (hereafter TRES) warranties its tres900s tag readers, cards and tags to the original purchasers to be free from defects in material and workmanship for a period of one (1) year from the date of shipment, subject to exclusions below. The Reader warranty is contingent upon the use of the TRES provided power supply.

**Return Material Authorization:** TRES liability under this warranty is limited to the repair or replacement of the defective product (at the discretion of TRES). Product will be returned to TRES only after the issuance of a Return Merchandise Authorization (RMA) by TRES Technical Support Dept. TRES will provide advance replacement of tres900s readers submitted for warranty claim provided that the customer requests advance replacement with the issuance of a Purchase Order at the time an RMA is issued, at which time an invoice will be generated for the Advance Replacement product(s). If the product to be returned under RMA is not received by TRES within 30 days of RMA issuance, or the warranty is determined to be void under the conditions of this warranty statement, the customer will be responsible for payment of the invoice issued at the time of the Advance Replacement, subject to normal credit terms and conditions. Customer will be responsible for shipping the RMA products to TRES at address listed on the RMA form and clearly marking the outside of the box with the RMA number. If the reader(s) are covered under this warranty, then a credit will be issued against the Advanced Replacement invoice.

**Repairs:** TRES liability under this warranty is limited to the repair or replacement of the defective product (at the discretion of TRES). If the returned product is tested and deemed to be fully functional, it will be returned to the customer and a $ 50.00 evaluation fee will be assessed. If the returned product can be repaired, and the product is deemed to be covered by warranty per this warranty statement, it will be repaired free of charge. If the returned product is not covered under this warranty, then it will be repaired at a cost of $ 75.00 per hour labor plus cost of parts. In the event of a required repair that is not covered by warranty, the customer will be contacted prior to the start of repairs and provided an estimate of said repairs.

**Warranty Exclusions:**

a. Defects or damage resulting from use of the product in manners other than normal and customary.
b. Defects or damage from misuse, accident, vandalism, neglect or attempted modification.
c. Defects from improper installation, testing, operation, maintenance
d. Damage due to improper wiring of devices not in accordance with published installation instructions.
e. Attempted disassembly or repair without written authorization from TRES.
f. Power surges due to malfunctioning power supply regulation, surge suppression or lightning.
g. No returns/refunds on custom tags
h. Tags that have been de-faced, mishandled, improperly mounted and/or removed and re-mounted

**This warranty is extended by TRES to the original purchaser and may not be assigned or transferred to any other party. This is the complete and exclusive warranty for tres900s readers and tags sold by TRES, and this warranty may not be enlarged by any other statements that are not a part of this warranty statement without TRES' express written consent.**