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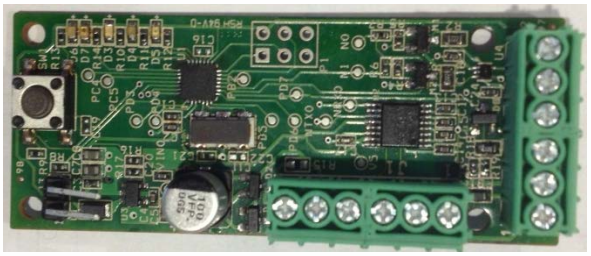
S2W001

Serial to Wiegand Converter Module

User Guide



RS232 Serial format to Wiegand format converter designed specifically for working with UHF RFID readers

Wide supply operating range 7VDC-16VDC

Fully configurable

- 10 Facility code independent translation and User code offset rules selected by EPC prefix
- 10 Facility code and User code independent position translation rules selected by EPC prefix
- 10 non-specific 6 digit code window ranging and offset translations selected by EPC prefix

Supports 9600and 115.2K baud rates

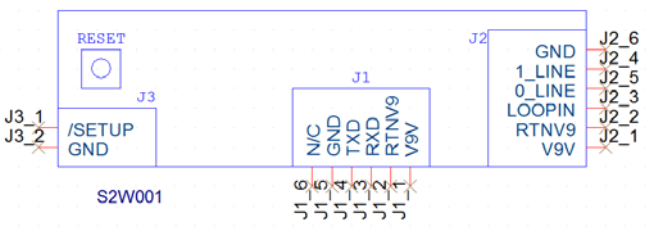
Optional loop contact input for gating read reports

Supports 255 facility codes, 65535 user codes in standard 26bit Wiegand format

LED activity indicators for Serial communications, Wiegand communication, power status and setup

Uses:

Access control installations,
Gated access points
Asset tracking



Description

The S2W001 serial to wiegand converter module is designed specifically for UHF readers that provide a 32 ASCII character output via an RS232 serial output. The converter interprets each reader report for its embedded hexadecimal 4 character EPC prefix, 2 character Facility Code (FC), and 4 character User Code (UC). Each interpreted reader report is converted to a standard 5V, 26bit Wiegand formatted output report containing the captured FC and UC. The S2W001 operates from a DC supply voltage of nominally 9V. The S2W001 is typically connected between the RFID reader and the Wiegand input device (see figure 1 for a typical connection diagram). The module provides for an optionally enabled loop contact input. When enabled, a loop contact may be employed to limit the S2W001's wiegand output to only report when the contact is closed. The Module employs 4 LEDs for indicating serial communications activity, wiegand communications activity, power status, and setup mode.

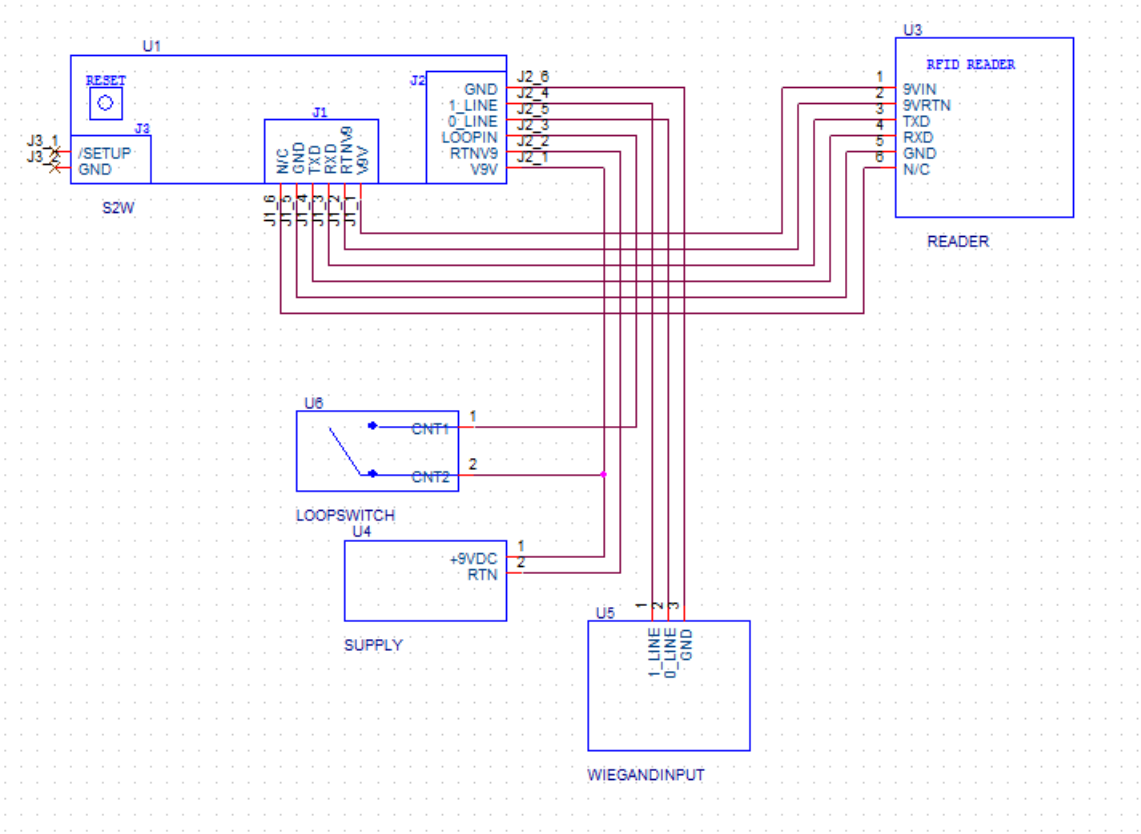


Figure 1 Typical application connections

The J3 jumper is provided to allow customization of the device setup. When a short is provided across the 1 and 2 pins of J3, the device will immediately enter a setup mode state. In setup mode, the module can be configured for baud rate, serial echo on/off, loop control enable, facility code translation, user code offset, and specifying facility and user code locations within the EPC code.

Pin Definitions

Jack	Pin #	Name	Description
J1	1	V9V	Power output connection to the RFID reader. This pin is electrically connected to J2's pin 1, and provides a second connection point to power the reader.
J1	2	RTNV9	This is the power input return connection for the reader. This pin is electrically connected to J2's pin 2 and provides a second connection point for powering the reader.
J1	3	RXD	The RS232 serial receiver input of the S2W001 module. This should be connected to the TX output of the RFID reader
J1	4	TXD	The RS232 serial transmitter output of the S2W001 module this should be connected to the RX input of the RFID reader
J1	5	GND	This is the common ground connection for all signals, serial and wiegand. It is electrically connected to J2's GND and J3's GND connections. NOTE: GND and RTN are not the same and should remain connected as described in this document.
J1	6	N/C	No internal connection
J2	1	V9V	Power input for the S2W001 module. Connect 9V nominal to this terminal. This is electrically connected to J1's pin 1.
J2	2	RTNV9	Power input return connection for the S2W001 module. This pin is electrically connected to J2's pin 2.
J2	3	1_LINE	Wiegand output '1' line. Should be connected to the wiegand reader input's 1 line input.
J2	4	0_LINE	Wiegand output '0' line. Should be connected to the wiegand reader input's 0 line input.
J2	5	LOOPIN	In default or disabled configuration setup, this pin has no effect. When enabled (via setup mode), A 'high' input on this pin allows an EPC received on the S2W's serial RX pin to be converted to wiegand format and outputted. A low on this pin blocks any received EPC from being converted and outputted. This pin is typically tied to a loop switch contact which connects the pin to the power in voltage (typically 9V) when closed.
J2	6	GND	This is the common ground connection for all signals, serial and wiegand. It is electrically connected to J1's GND and J3's GND connections. NOTE: GND and RTN are not the same and should remain connected as described in this document.
J3	1	SETUP	This pin is left open for normal conversion operation. When shorted to ground the S2W001 will immediately enter its SETUP mode where the module may be configured.
J3	2	GND	This is the common ground connection for all signals, It is electrically connected to J1's GND and J2's GND connections

LED Functions

LED Designator	Name	Color	Description
D6	Power ON	Green	Power on Indicator. Indicates the presence of 5V internal voltage
D7	SETUP	Blue	A jumper on J3 will light this LED continuously indicating that the device is in SETUP mode. When J3 is not connected, (module in normal mode) this LED may light briefly to indicate an error in the wiegand conversion or serial reception.
D3	RX active	Red	This LED lights when activity is detected on the RS232 serial input.
D4	TX active	Yellow	This LED lights when the module is transmitting on its RS232 TX output.
D5	Wiegand active	Orange	This LED lights when the module is actively transmitting a wiegand code on its outputs

Absolute Maximum Ratings

Note: absolute maximum ratings are conditions applied to the module that if exceeded, may permanently damage the module.

	MIN	MAX	Unit
V9V (relative to RTNV9)	-17	17	V
VIN, RXD (relative to GND)	-25	25	V
VOUT, TXD (relative to GND)	-13.2	13.2	V
VIN, LOOPIN (relative to GND)	-17	17	V
VOUT, 1_LINE, 0_LINE (relative to GND)	-0.3	5.5	V
Storage Temperature (non-operating)	-40	100	°C

Recommended Operating Conditions

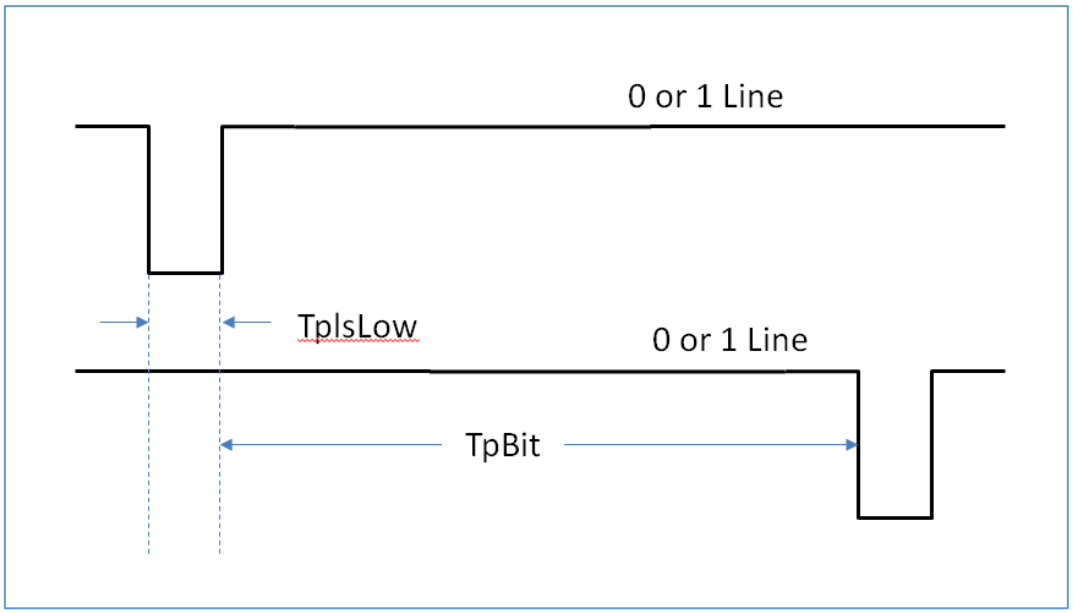
	MIN	NOM	MAX	UNIT
V9V (relative to RTNV9	7	9	16	V
VIN RXD, (relative to GND)	-25		25	V
VIN, LOOPIN	0	9	16	V
Serial input packet to packet delay (from end of previous to start of next)	85			mS
Operating temperature range	-20		80	°C

Electrical Specifications

V9V = 9VDC relative to RTNV9, ambient temperature = 25 °C unless otherwise noted

	MIN	TYP	MAX	UNIT
Iv9v, Operating supply current, no TXD,RXD, or Wiegand activity		10		mA
Vol, TXD, Rload = 3K ohms	-5.4	5		V
Voh, TXD, Rload = 3K ohms		5	5.4	V
Vol, 0_LINE or 1_LINE, no load		0		V
Voh, 0_LINE or 1_LINE, no load		5		V
Rwo, Wiegand output internal pull up resistance, 0_LINE,1_LINE		2200		Ohm
Iol, Wiegand output current low, 0_LINE, 1_LINE		0.5		A
Vih, LOOPIN	6			V
Vil, LOOPIN			2.5	V
TplsLow, 0_LINE or 1_LINE, no load		50		uS
TpBit 0_LINE or 1_LINE, no load		1		mS
SBaud, (default)		9600		baud
SBaud,(optional)		115200		baud

Wiegand output timing diagram



Functional Details

Serial input, EPC format

The S2W001 module expects to receive each serial packet in ASCII character code format. The expected packet contains the EPC and imbedded facility code (FC) and user code (UC). Each packet must be at least 32 characters long and begin with a ">" character (hex: "0x3E") contains a 'T' character and end with a carriage return symbol (hex: "0x0D") (note: the new line symbol (hex: "0x0A" is an expected part of the packet but is ignored). Figure 2 illustrates the expected input packet format:

">kTXXXXEEEEYYYYYYYYYYYYYYFFUUUUCN"

Where:

">" character marks the beginning of a packet

"k" is an nonspecific ascii character that may not necessarily be present. It is not used.

"TXXXX" are 5 characters specific to the RFID reader. The X characters are not used. The 'T' MUST be present.

"EEEE" is the 4 character EPC prefix in ASCII hexadecimal

"YYY…" represent EPC characters not immediately interpreted/used by the S2W001

"FF" are the 2 characters in ASCII hexadecimal representing the facility code (in their default position)

"UUUU" are the 4 ASCII hexadecimal characters representing the user code (in their default position)

"C" is the carriage return symbol, (0x0D)

"N" is the new line symbol, (0x0A)

The format assumes the most significant byte (MSB) for all fields is to the left.

Note that "FF" and "UUUU" can be combined to form a non FC, UC specific code, i.e "FFUUUU".

Figure 2

The Red LED D3 will light briefly when serial data is being received. The Yellow LED D4 will light briefly when serial data is being sent. The setup LED (blue, D7) also may light briefly if the S2W001 has detected an error in the serial input data. Packets that are detected as having errors are not converted and passed to the wiegand outputs.

The default serial input speed is 9600 baud, with 1 start bit, 1 stop bit, no parity. The serial speed may optionally be set to 115.2Kbaud via setup mode, also with 1 start bit, 1 stop bit, no parity.

The serial output does not echo the input serial data by default. Echo mode may be optionally enabled via setup mode.

Wiegand output format

The S2W001 transmits on its 0_LINE and 1_LINE a wiegand packet with each serial packet successfully received to a '1 for 1' relationship. The output is in a standard 26bit wiegand output with parity. Each output has an internal 2.2Kohm pull up to 5V and mosfet drain active pull down. Pulse timing for the signals is shown in the Wiegand output timing diagram. The Orange LED D5 will light briefly for each wiegand packet sent.

Loop Control

J2 pin 3 provides a contact input point for using a loop control to regulate the S2W001's output. Normally this feature is disabled and the S2W001 outputs a wiegand packet for each successfully received serial packet. When enabled (via Setup Mode), the S2W001 will only output wiegand packets when its LOOPIN input is biased to a voltage higher than its threshold of about 4.2V. The LOOPIN pin has an internal pull down so that it may be used with dry contacts that provide a voltage connection when closed.

Setup Mode

The S2W001 may be placed into its setup mode at any time when pins 1 and 2 of J3 are shorted. Removing the short will immediately revert the module back to its normal mode of operation. In setup mode, normal mode is curtailed and no wiegand processing or output will occur. The module's setup mode utilizes a fixed 9600 baud, 1 start bit, 1 stop bit, no parity serial interface with echo. In setup mode, the S2W001's advanced features can be enabled and configured via a serial terminal or other suitable interface. Setup mode uses the serial interface on J1 pins 3 and 4. Changes to any optional feature settings are immediately saved in nonvolatile memory with the successful execution of the setup command string.

Setup controlled features

Baud rate select

The S2W001 supports 2 baud rates in normal mode: 9600 and 115200 baud. 9600 baud is the default baud rate for normal mode operation. The selection of baud rate does not affect the Setup mode baud rate which is fixed at 9600 baud. The baud rate can be set to 115200 baud with the command:

">SET BAUD 1cr"

Echo mode enable

The default echo setting in normal mode is off, where serial data received is not mirrored back to the sender on TXD. Echo can be set to on via setup mode via the command:

">SET ECHO 1cr"

Loop control enable

Loop control is disabled by default and all correctly received serial packets are immediately converted and passed to the wiegand outputs. Loop control may be enabled by the setup mode command string:

">SET LOOPCNTL 1cr"

Rate control enable

In some use cases, the RFID reader and the S2W001 may pass redundant wiegand codes to the wiegand reader at a rate that is too fast for the reader to handle. This situation commonly occurs when a tag is within the RFID reader range and the reader is set to repeatedly report the tag as long

as it is in range. The S2W001's wiegand transmit rate can be limited by setting it's blocking window time out to a value suitable for reducing the effective redundant code transmit rate. When this feature is enabled, the wiegand output is disabled for the time limit set after successfully sending its unique wiegand packet. Note that any EPC code converting to a redundant wiegand code received during this black out period is not transmitted. If a different wiegand code is received during the blocking window, it will be immediately passed and will reset the blocking window. The S2W001 will now block any wiegand codes identical to this new code for the duration of the blocking window time period, or until another unique wiegand code is received or the window times out. Rate control can be enabled with the following setup command:

">SET RATECNTL 1 XXcr"

Where XX represents the blocking window period in hexadecimal. The blocking window time value is the number of 0.2 second increments that the window may be set. The minimum value is 0x01 (01) 0.2 seconds, and the maximum is 0x32 (32 or 50 in decimal) or 10 seconds.

For example to set a rate control window of 2 seconds:

2 second / 0.2 seconds/inc = 10 increments, or a value of 0x0A in hex.

The programming sequence is:

"> SET RATECNTL 1 0Acr"

Note that a leading 0 is required for values less than 0x10. Rate control is disabled by default. However, once programmed, rate control can be disabled with the SET command as below:

"> SET RATECNTL 0cr"

Translate FC with UC offset for specific EPC prefix

The S2W001 can be used to translate facility codes and add an offset to user codes for a given EPC prefix. The S2W001 supports up to 10 unique EPC prefix specific translation rules. When a serial packet containing an EPC code with a stored EPC prefix is received, the S2W001 will also check the received packet's FC (target FC) to see if it is paired with the prefix. If a match is determined, the S2W001 will replace the target FC with the stored replacement FC value in the transmitted wiegand packet. Additionally, the User Code offset value is applied. This offset is added to the received UC value. EPC prefixes are limited to values of 0x0000 to 0xFFFE (where a value of 0xFFFF is considered not set). Translated and target FC values are limited to 0x00 to 0xFE (0 to 255) (where 0xFF is considered not set) and offsets are limited to 0x0000 to 0xFFFE (0 to 65534) (where 0xFFFF is considered not set). Note that values of UC and offsets that add together and exceed 65535 will roll over. For example, a UC code of 0xFFD0 (65488) and an offset of 0x0A00 (2560) will produce a wiegand output UC of 0x09D0 (2512). An example setup string of setting a translation in the 3rd rule is shown below. Note that rules are numbered from 0 to 4:

">SET TRANSLATE_2 C12E 02 DE 00A2cr"

Here the third rule "_2" is being set (the "_" must be included). The EPC prefix is 0xC12E, the target FC is 0x02, the replacement FC is 0xDE, and the UC offset is 0x00A2. "cr" is a carriage return character.

Note that for the translate rules; each EPC prefix-target FC pair must be unique. For example, two or more translate rules can be set with common EPC prefixes as long as the target FC's are different. Similarly, multiple translate rules can have common FC's if their EPC prefixes are all different.

For a translation of the FC only where no offset is needed, the UC offset value must be set to 0x0000 (0).

FC and UC specified Code locations in EPC for specific EPC prefix

The S2W001 can also extract the FC and UC from alternate locations within a 24 ascii hex character (12 Byte) EPC for a given EPC prefix. The S2W001 supports up to 10 unique EPC prefix code location rules. The S2W001 checks the incoming serial packet for the EPC prefix. If it matches a prefix stored in one of the 10 code location rules, the S2W001 will extract the FC and UC's from the specified locations, apply any matching translation rule, covert it to wiegand format and transmit the wiegand code. Code locations for the FC and UC are specified by the location of each codes' most significant character within the 24 character EPC field. Referring to figure 1, the 24 character EPC is typically of this format:

EEEEYYYYYYYYYYYYYYFFUUUU

Where: "EEEE" is the 4 character EPC prefix in ASCII hexadecimal

"YYY…" represent EPC characters not immediately interpreted/used by the S2W001

"FF" are the 2 characters in ASCII hexadecimal representing the facility code (in their default position)

"UUUU" are the 4 ASCII hexadecimal characters representing the user code (in their default position)

The S2W001 assumes the positions within the EPC code are numbered from 1 to 24 starting from the right most character. For example EPC code:

ABCD00000000000000654321

Has '1' in its first position, '2' in its second position, '3' in its third position, and so on. For this code, the default starting position (SP) for the facility code would be position 6 for a FC of "65" and the default starting position for the user code would be 4 for a UC of "4321

FC starting positions can have values from 0x02 (2) to 0x14 (20). UC starting positions can have values from 0x04 (4) to 0x14 (20). The values for FC and UC must not overlap given their starting positions. Each set code location rule must have a unique EPC prefix from any other code location rule.

An example code location rule setup string is shown below:

">SET CODELOC_4 2345 12 06cr

Where the 5th rule ("_4") is set to check EPC prefix "2345" (0x2345). "12" (0x12) sets the FC starting position at position 18, and the '06' (0x06) sets the UC starting position at position 6.

With this example rule in place, the EPC code "234500AB0000000000EFAB00" has its FC interpreted as "AB" (0xAB) and its UC interpreted as "EFAB" (0xEFAB).

Offsetting 6 digit codes by EPC prefix using windowing

The S2W001 can also translate on more general level 6 digit non FC-UC specific codes into new code values. The S2W001 supports up to 10 unique EPC prefix code Offset rules. As with the other rules, the EPC prefix is first checked against the stored rule set. On an EPC prefix match, the received 6 digit code is checked against the assigned window. If the code falls within the window (starting and ending window values included) the rule is executed and the stored offset value is added. Summations that exceed 6 digits return only the least significant 6 digits. (I.e. a summation results in a value of 7654321, the S2W001 will return only 654321).

An example set rule is shown below:

">SET OFFSET_0 C12E 020000 020500 0BA000cr"

The above rule sets the window for EPC prefix of 0xC12E at a starting value of 0x020000 and an ending value of 0x020500. 6 digit codes received that fall within these values (starting and ending values included) will have a value of 0x0BA000 added. Thus a received 6 digit code of 0x0200C is offset to a value of 0x0DA00C

When used in conjunction with a code location rule, an OFFSET rule will combine the FC code and UC code in a manner that interprets the combined FC-UC code as a single 6 digit value. For example:

FC = "0x65; UC= "0x4321"

Combined FC-UC code: "0x654321"

Rule priority

CODE_LOCATION rules are interpreted before any TRANSLATE or OFFSET rule.

TRANSLATE and OFFSET rules can potentially overlap. The S2W001 will evaluate and execute overlapping rules in the following manner:

1. Any OFFSET rule will override any TRANSLATE rule that shares a common EPC prefix and overlaps in FC-UC (6 digit) value.

2. Lower index rules are prioritized and exclusively executed over higher index rules. Only one rule within a rule type can be executed on a received EPC code. Example: if rule T_3 is evaluated as valid and rule T_4 can be evaluated as valid, only T_3 will be executed since it is the first validated rule.

Setup Protocol

Command Message Structure

>command attribute {value_0} …{value_n}cr

Where:	Start character: ">"	Required first character on all serial input setup strings. Marks the start of a command string
	command	Required field telling the S2W001 what to do
	attribute	Optional field various (see below)
	{value_n}	Optional field various (see below) ALL VALUES are ASCII HEXADECIMAL
	end character "cr" (hex 0x0D)	cr --carriage return is required to terminal all setup messages.
	delimiters between commands, values, attributes	Only spaces or tabs may be used as message delimiters.
Note:	The first letter of any command or attribute may be used by itself without the rest of the command word as a short hand. Capital or lower case letters may be used.	

Commands

command	**Description**
SET	Tells the S2W001 that the following attribute is being written to or 'set'
GET	Retrieves the value(s) for the attribute
Erase	Erases the nonvolatile configuration memory and returns the S2W001 to its default settings
?,Help	Prints version number and command/attribute summary

Attributes

Attribute	**Description**	**command format**	**Allowed value ranges**	**Default**
BAUD	Selects serial baud rate	BAUD {baudrate}	0, (9600), 1 (115.2K)	9600
ECHO	Enables disables input echo on output	ECHO {value}	0 (off), 1 (on)	OFF
LOOPCNTL	Enables loop control filtering	LOOPCNTL {value}	0 (off), 1 (on)	OFF
RATECNTL	Limits the rate of wiegand output to 5 reports/second	RATECNTL {value] {XX}	0 (off), 1 (on); XX= 0x01-0x32	OFF

TRANSLATE_x	Allows facility(site) code and user codes to be translated and offset in value for a given 4 char prefix Key	TRANSLATE_x {prefix key} {FC original} {translated FC] { UC offset}	x is 0-9 FC: 0-0xFE (0-255) (2 ascii hex chars only) UC offset: 0-0xFFFE (0-65535) Values must be in 4 ascii hexadecimal characters	None: All 0xFF, 0xFFFF
CODELOC_x	Sets start positions for facility code and user codes in 24 char EPC code EPC code first position (1) is the right most (LSB) char	CODELOC_x {FC starting position} {UC starting position} EPC = "A12E00000000654321"	FC starting position 0x02-0x18 (2-24) UC starting position 0x04-0x18 (4-24) UC and FC positions cannot overlap. Values must be in ascii hexadecimal. x is 0-9 where the '1' is in the first (1) position Where x is 0-9.	FC SP=0x06 UC SP=0x04
OFFSET_x	Sets a window range of 6 digit codes that can be offset by a given value	OFFSET_x{window starting code} {window ending code} {offset adder}	Window starting code: 0x000000-0xFFFFFE Window ending code: 0x000000-0xFFFFFE Offset Adder: 0x000000-0xFFFFFE	none

Command Message Examples

Command String	**Returns**	**Comment**
>SET BAUD 1cr	<SET BAUD 1:115.2K	sets the normal mode baud rate to 115.2Kbaud returns current setting (entry uses short hand text)
>G Lcr	<GET LOOPCNTL OFF	3rd translate rule is set to operate on EPC's of 'C12E' and an FC of 'CD' to be translated to '12' with no offset on the user code
>SET TRANSLATE_3 C12E CD 12 0000cr	<SET TRANSLATE_3 EPC:C12E In FC:CD Out FC:12 UC Offset:0000	

>s t_0 c123 04 fd 0000cr	<SET TRANSLATE_0 EPC:C123 In FC:04 Out FC:FD UC Offset:0000	Using short hand text and lower case, sets the first translate rule
>GET CODELOC_3cr	<GET CODELOC_3 EPC:FFFF FC start pos:FF UC start pos:FF	CODE_LOC_3 is not set (all values are 0xFF or 0xFFFF)
>S O_7 E14B 030000 039999 020000	<SET OFFSET_7 EPC:E14B window start:030000 window end:039999 offset:020000	A code window between 0x02000 and 0x029999 is set where any value within this range will have a value of 0x020000 added to it

Mechanical Specifications

Length: 2.50 in.

Width: 1.00 in.

Height (highest point above base of board): 0.45 in.

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