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Data Sheet

Magswipe.pdf
8 Pages
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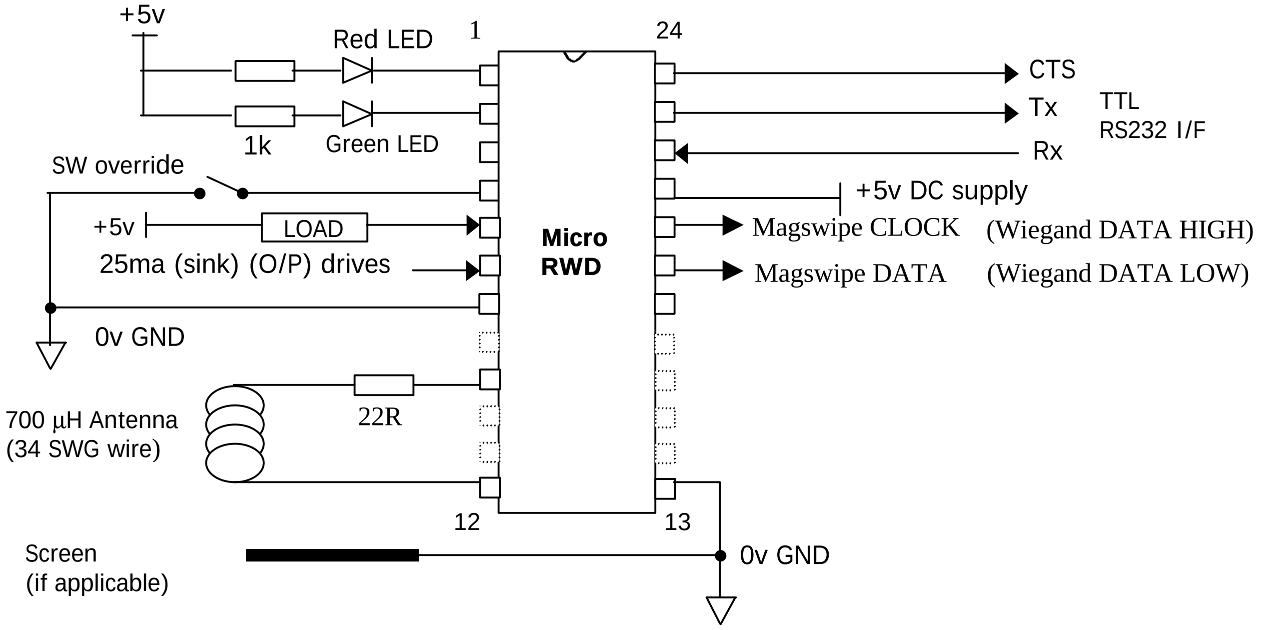
Micro RWD EM4001 "Mag swipe" Decimal Output Version

This version of the Micro RWD product behaves in the same manner as the standard Micro RWD EM4001 reader with the additional features of having "Mag swipe" ISO track 2 standard Clock and Data output (75 bpi, 5-bit BCD, 40 characters) or "Wiegand" 26/36 bit data HIGH, data LOW outputs. In addition the MicroRWD converts the 40 bits of data from the EM4001 card to a decimal format so the "Mag swipe" or "Wiegand" output is a decimal representation. The usual TTL serial interface is supported along with the simple commands to read the tag data and programme the RWD's internal parameters, these commands do not use the decimal conversion, so the Read command returns the raw card data in hex format as before.
The diagram below shows the pinout configuration for the Micro RWD Hybrid chip version where two pins are used to output the clock and data information according to the "Mag swipe" protocol or the data HIGH, data LOW signals for the Wiegand protocol. The Micro RWD "Mag swipe" and Wiegand version can replace existing Magnetic strip readers and Wiegand door entry systems with a fully compatible contactless smart card solution.

"Mag swipe" or Wiegand output is selected by an RWD EEPROM parameter. EEPROM byte 4 selects Wiegand or Mag swipe output (default) and byte 5 further selects 26 bit or 36 bit (default) output if Wiegand is selected.

Micro RWD Hybrid chip connections



Mag swipe Mode

The Micro RWD "Mag swipe" decimal version operates by converting the 40 bits (5 bytes) of EM400X transponder data to a 14 digit BCD (Binary Coded Decimal) representation. The header and trailer information is then added to complete the data frame before it is transmitted as data/clock signals according to the specification over page. The complete 40 bit hex data is still available to the user using the host READ command. Note that the Mag swipe option uses the full 14 bit BCD sequence as the base data for the output protocol whereas the Wiegand option uses a truncated 10 digit BCD sequence as described on page 4.

EM4001 tag data (Hex): 0xFF FF FF FF FF (Maximum value)
Internal BCD conversion: 01099511627775 (14 digit decimal)

Example 1:
EM4001 tag data (Hex): 0x01 02 0B EE 31
Internal BCD conversion: 00004329303601 (14 digit decimal)

Card swipe format: SS 0000 4329 3 03601 ES LRC

Where SS = Start Sentinel code (0B hex)
0000 = leading digits
4329 = 4 digit site code
3 = Issue number
03601 = Card Number
ES = End Sentinel code (0F hex)
LRC = Longitudinal Redundancy Checksum (EX-OR of all preceding nibbles + odd parity bit)

Example 2:
EM4001 tag data (Hex): 0x00 00 98 96 81
Internal BCD conversion: 00000010000001 (14 digit decimal)

Card swipe format: SS 0010 0 00001 ES LRC

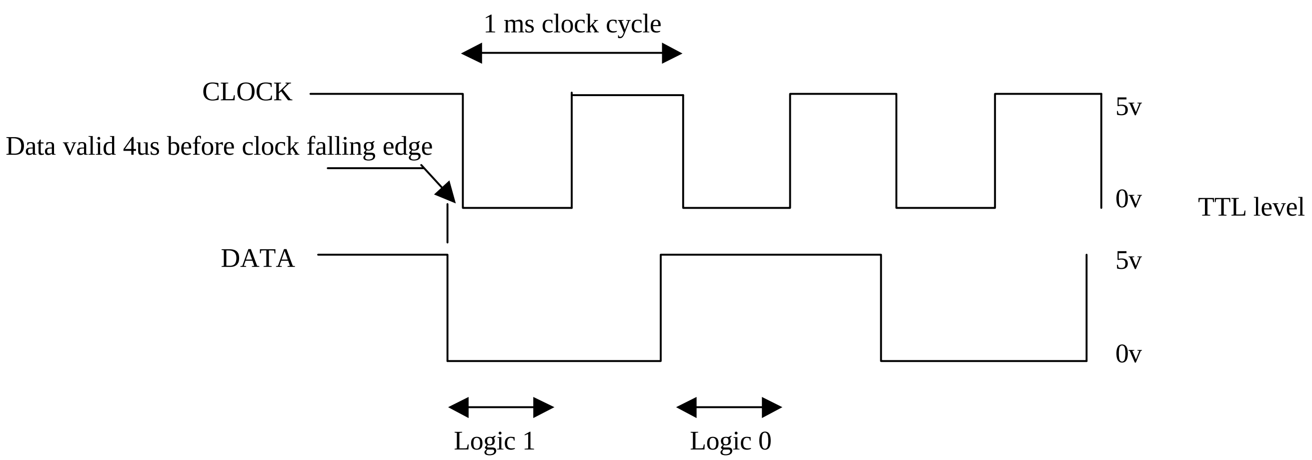
Where SS = Start Sentinel code (0B hex)
0000 = leading digits
0010 = 4 digit site code
0 = Issue number
00001 = Card Number
ES = End Sentinel code (0F hex)
LRC = Longitudinal Redundancy Checksum

The EM4001 tags to be used with this system should therefore be encoded with the 40 bits of data to correspond with the required Site, Issue and Card number digits. The EM4001 programming station or encoder must ensure that the required decimal number is converted and stored on the EM4001 card as hex data.
The clock and data protocol is output a single time whenever the tag is within the RWD's antenna field and the tag has been validated. This output is independent of the normal TTL serial interface that responds to received commands and replies with the raw 40 bits of EM4001 tag data.

The clock and data protocol can be basically described as a sequence of 5 bit digits (4 bits with odd parity, LSB transmitted first) framed by Start Sentinel and End Sentinel digits with the sequence terminated by an LRC digit.

The clock timing is 1ms per cycle and the 17 digit sequence is preceded by 25 null clocks (Data line high) and is concluded by 30 trailing null clocks. The logic sense is data high = logic 0 and data low = logic 1.

Mag swipe Protocol Timing Diagram



Data stable before clock falling edge and while clock low

Mag swipe Output Data Format

Example converted BCD data: 00 00 04 60 22 12 75 (14 digit decimal)
Card swipe format: SS 0000 0460 2 21275 ES LRC

Displaying card data in column form:

	(b0 - b4)	
SS(B)	1101 0	(4 bit data, LS bit first + odd parity bit)
0	0000 1	14 digits
0	0000 1	
0	0000 1	
0	0000 1	
0	0000 1	
4	0010 0	
6	0110 1	
0	0000 1	
2	0100 0	
2	0100 0	
1	1000 0	
2	0100 0	
7	1110 0	
5	1010 1	
ES(F)	1111 1	
LRC	1110 0	(Even parity bits for each b0-b3 column + odd parity bit)

Displaying card data as binary sequence:

11010	00001	00001	00001	00001	00001	00100	01101	00001	01000	01000	10000	01000	11100	10101	11111	11100
B	0	0	0	0	0	4	6	0	2	2	1	2	7	5	F	LRC

Wiegand Mode

As with the “Mag swipe” option, the Wiegand output option operates by converting the 40 bits (5 bytes) of EM400X transponder data to a 14 digit BCD (Binary Coded Decimal) representation. However this BCD sequence is then truncated to the least significant 10 digits to comply with the maximum data size for Wiegand protocol. The required data length is selected by an EEPROM parameter; byte 5 = 00 selects 26 bit and byte 5 = 01 (default) selects 36 bit output. The RWD operates by converting the BCD number to the Wiegand 26/36 bit data frame, which is then output as data HIGH and data LOW signals. The complete 40 bit hex data is still available to the user using the host READ command.

Wiegand Output Protocol

The Wiegand protocol (26 bit mode) itself is made up of a leading even parity bit (for b0 - b11), 24 bits of data (from transponder data) and a trailing odd parity bit (for b12- b23). The 36 bit mode has the same format except 34 bits are used to form the data sequence.

For example:-

Converted BCD data: 00 00 04 60 22 12 75 (14 digits)
Truncated BCD data: 04 60 22 12 75 (10 digits)

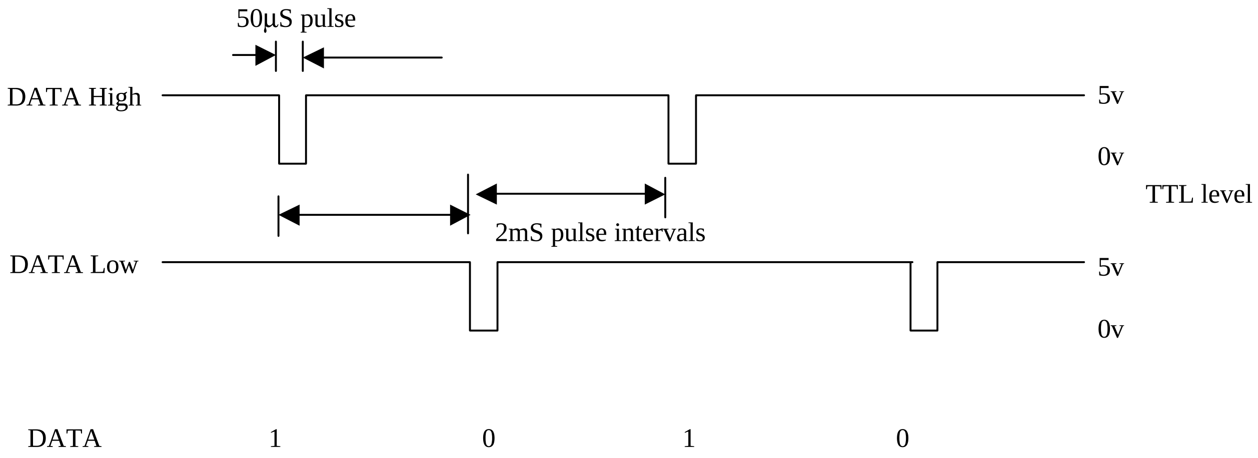
Wiegand 26 bit sequence:-	E	(b0 --------- b11)	(b12 -------- b23)	O
	E	(0 4 6	0 2 2)	O
	1	0000 0100 0110	0000 0010 0010	1

Where E is EVEN parity bit for bit 0 to 11 and O is ODD parity bit for bits 12 to 23

The EM4001 tags to be used with this system should therefore be encoded with the 40 bits of data to correspond with the required Wiegand data. The EM4001 programming station or encoder must ensure that the required decimal number is converted and stored on the EM4001 card as hex data.

The Wiegand protocol is output a single time whenever the tag is within the RWD’s antenna field and the tag has been validated. This output is independent of the normal TTL serial interface that responds to received commands and replies with the raw 40 bits of EM4001 tag data. The physical Wiegand protocol is asynchronously transmitted as low going 50 µS pulses on the appropriate data HIGH or data LOW pins. These pulses are separated by 2mS periods.

Wiegand Protocol Timing Diagram



Micro RWD EM400x serial protocol specification

The Micro RWD EM400X is designed to communicate with EM Marin EM400X RF transponders (EM4001, EM4102 etc) configured for 64 cycles/bit Manchester coded data.
The Micro RWD has two basic modes of operation:-

1) Remote mode connected to a host serial interface. This is where the stored list of authorised identification codes can be empty, effectively authorising all transponders for authentication. A simple serial protocol allows a host system to communicate with the Micro RWD in order to program new authorised identification codes, change configuration and perform read operations from the tag itself.

2) Standalone mode where the tag identification codes are checked against the stored list of authorised codes. If an identification code matches, the output drive and Green LED are enabled. Effectively standalone mode occurs when there is no host system communicating with the Micro RWD.

The identification codes described in this text are regarded as the first four bytes (most significant 32 bits) of the tag memory array.

Serial Interface

This is a basic implementation of RS232. The Micro RWD does not support buffered interrupt driven input so it must control a BUSY (CTS) line to inhibit communications from the host when it is fully occupied with tag communication. It is assumed that the host (such as a PC) can buffer received data.
Tx, Rx and RTS signals from the Micro RWD are all TTL level and are converted to +/-12v levels using an inverting charge pump driver device such as the MAX232 (note the inversion of the TTL levels).

Serial Protocol

The following commands are supported. The corresponding acknowledge code should be read back by the host and decoded to confirm that the command was received and actioned correctly.
The serial bit protocol is 9600 baud, 8 bits, 1 stop, no parity (lsb transmitted first).
The status flags returned in the Acknowledge byte are as follows:

```
b7  b6  b5  b4  b3 b2 b1 b0
1   1   1   1   1  1  1  1
        |   |   |  |  |  EEPROM error (Internal EEPROM write error)
        |   |   |  |  Tag OK (Tag identification code matched to list)
        |   |   |  Rx OK  (Tag  communications and acknowledgement OK)
        |   |  RS232  error (Host serial communications error)
        |   RELAY Enabled flag
        HTRC (or Antenna fault) error flag
```

Note that bits 6 and 7 are fixed 1's so that an acknowledge code of D6 (Hex) would generally indicate no errors with a matched (and authenticated) Tag present.
Note also that only the relevant flags are set after each command as indicated in the following specification.

Read EM400X Tag

Command to read 5 bytes of data from EM400X (40 bit) memory array. If the read was successful, indicated by acknowledge status flags then five bytes of tag data follow.

	B7 B0	
Command:	0 1 0 1 0 0 1 0	(0x52)
Argument1:	x x x x x x x x	(Dummy Page number e.g 00)
Acknowledge:	1 1 F F F F F X	(F = Status flags)

Data only follows if read was successful

Reply1:	D D D D D D D D	(D = msb data read from EM400X)
Reply2:	D D D D D D D D	
Reply3:	D D D D D D D D	
Reply4:	D D D D D D D D	
Reply5:	D D D D D D D D	(D = lsb data read from EM400X)

Note that for the Read Tag command, if an error flag has been set in the Acknowledge code then there will be NO following data.

Tag STATUS

Command to return Tag status.
The acknowledge byte flags indicate general Tag status.

	B7 B0	
Command:	0 1 0 1 0 0 1 1	(0x53)
Acknowledge:	1 1 F F F F F X	(F = Status flags)

Message

Command to return product and firmware identifier string to host.

	B7 B0	
Command:	0 1 1 1 1 0 1 0	(0x7A)
Reply:	"IDE RD MC200/EM400X (SECM200 V1.xx) DD/MM/YY" 0x00	

Returned string identifies author, product descriptor, project name, firmware version no. and date of last software change. Note that the string is always NULL terminated.

Note also that the serial communication uses hardware handshaking to inhibit the host from sending the Micro RWD commands while Tag interrogation is in progress. This serial communication protocol allows for a 10ms 'window' every Tag polling cycle indicated by the BUSY line being low. During this 'window' the host must assert the first start bit and start transmitting data. The BUSY goes high again 10ms after the last stop bit is received.

NOTE that only one command sequence is handled at a time.

Program EEPROM

The Micro RWD has some internal EEPROM for storing system parameters such as configuration and authorised ident codes. This command sequence allows individual bytes of the EEPROM to be programmed with new data. Note that due to the fundamental nature of these system parameters, incorrect data may render the system temporarily inoperable.

	B7 B0	
Command:	0 1 0 1 0 0 0 0	(0x50)
Argument1:	N N N N N N N N	(N = EEPROM memory location 0 - 255)
Argument2:	D D D D D D D D	(D = data to write to EEPROM)
Acknowledge:	1 1 X F X X X F	(F = Status flags)

Internal EEPROM memory map

Byte 0: Tag Polling Rate (x 2.5ms)
Byte 1: RF ON/OFF lock byte (0x55 = RF ON, anything else = OFF, normally set to 0x55)
Byte 2: Reserved (Checksum)
Byte 3: RWD type option byte: (00 = MC200, 01 = EM400X- default)

Byte 4: RWD data output option byte: (00 =Wiegand, 01 = Mag swipe Track 2 Clock/Data - default)
Byte 5: Wiegand option byte: (00 = 26 bit mode, 01 = 36 bit mode - default)
Byte 6: Reserved
Byte 7: Reserved

Byte 8: Reserved
Byte 9: Reserved
Byte 10: Reserved
Byte 11: Reserved

Start of authorised tag codes. List is terminated with FF FF FF FF sequence.
List is regarded as empty (all ident codes valid) if first code sequence in list is (FF FF FF FF).
The tag identity code is taken as the least significant four bytes of the EM400X five byte sequence.
List can hold up to 60 identity codes.

Byte 12: 0xFF Empty list
Byte 13: 0xFF
Byte 14: 0xFF
Byte 15: 0xFF

Byte 16: (MSB) Tag ident code
Byte 17:
Byte 18:
Byte 19: (LSB)

Byte 20: (MSB) Tag ident code
Byte 21:
Byte 22:
Byte 23: (LSB)
-
-
Byte 255: Last Internal EEPROM location

Method of Operation

The Micro RWD reader only allows full communication with EM4001 transponders if an initial level of security has been passed. The system works by reading the tag memory, stripping off the various parity bits to give the user memory and taking the least significant four bytes as a serial number (identity code), the first (most significant) byte is ignored. The Micro RWD internal EEPROM is then checked to see if this serial number is stored in the authorisation list located from byte 12 onwards. If the tag serial number is matched to a serial number stored in the Micro RWD or the list is empty then the tag has passed the validation test. If the Micro RWD has FF FF FF FF (hex) stored at EEPROM locations 12 to 15 then the list is treated as empty and all EM4001 tags are accepted through the validation test.

Full communication and Mag stripe/Wiegand data output is only allowed if this initial security check has been passed (or the Micro RWD authorisation list is empty).

More information on the Micro RWD and other products can be found at the Internet web site:

http://www.ibtechnology.co.uk

Or alternatively contact IB Technology by email at:

sales@ibtechnology.co.uk