



**Enhanced Reader Modules**  
**ID-3LA-SA, ID-12LA-SA, ID-20LA-SA**  
**Stand Alone Series**

**Datasheet**

*Advanced RFID Reader Technology*



Rev1.1—28/02/2015

## Table of Contents

Section	Title	Page
<hr/>		
1.	ID-xxLA-SA Features .....	5
2.	Device Overview .....	5
3.	Pin Out.....	6
3.1	Pin Out ID-3LA-SA .....	6
3.2	Pin Out ID-12LA-SA & ID-20LA-SA.....	6
4.	Pin Description Summary.....	6
5.	Pin Description Detail .....	7
6.	Recommended Test Circuit for the ID-3LA-SA, ID-12LA-SA, ID-20LA-SA .....	9
	Bill of Materials .....	9
7.	Design Considerations .....	10
8.	Device Specifications .....	11
9.	Absolute Maximum Ratings .....	11
10.	Normal Operation (Autonomous Mode) .....	12
11.	Normal Mode Output Data Format.....	12
	Output Data String .....	12
12.	Quick Start – Using the TEST command set. ....	13
12.1	Connecting to the Host Computer. ....	13
12.2	Logging In.....	14
12.3	Adding a Card .....	14
12.4	Removing a Card .....	14
12.5	Using TEST commands with a Parameter .....	14
13.	EEROM Description .....	14
13.1	EEROM – Summary.....	15
14.	EEROM Byte4 - General Purpose Flags.....	15
15.	The Command Sets.....	16
16.	The TEST Command Set Introduction.....	16
16.1	General Format for TEST Command set .....	17
16.2	Test Command Set Summary .....	17

---

---

16.3 Test Command Set Descriptions.....	<b>18</b>
16.3.1 Login .....	<b>18</b>
16.3.2 Logout.....	<b>18</b>
16.3.3 Add Card .....	<b>18</b>
16.3.4 Remove Card .....	<b>18</b>
16.3.5 Send EEROM Contents .....	<b>19</b>
16.3.6 Change Password.....	<b>19</b>
16.3.7 Set Strike Period.....	<b>19</b>
16.3.8 Set Channel1.....	<b>20</b>
16.3.9 Set Channel2.....	<b>20</b>
16.3.10 Assign Channel1 .....	<b>20</b>
16.3.11 Assign Strike Mode.....	<b>21</b>
16.3.12 Perform Beep Cycle.....	<b>21</b>
16.3.13 Perform Strike Cycle.....	<b>21</b>
16.3.14 Configure Channel2 I/O.....	<b>22</b>
16.3.15 Read Channel B Input [STX] [7E] [ETX] .....	<b>22</b>
16.4 TEST Command Reader Response Description.....	<b>23</b>
17. Polled Commands Introduction .....	<b>24</b>
17.1 General Formats for Series 2x and 4x Command Sets .....	<b>25</b>
17.2 Polled Command Sets Summary.....	<b>26</b>
17.3 Polled Commands Description.....	<b>27</b>
17.3.1 Send Card or Data .....	<b>27</b>
17.3.2 Output Control .....	<b>28</b>
17.3.3 Assign Strike .....	<b>29</b>
17.3.4 System Response .....	<b>29</b>
17.3.5 Set Strike Period .....	<b>29</b>
17.3.6 Read EEROM.....	<b>30</b>
17.3.7 Write New Address .....	<b>30</b>
17.3.8 Add Card .....	<b>30</b>
17.3.9 Remove Card .....	<b>30</b>
17.3.10 Change password .....	<b>31</b>
17.3.11 Confirm Password .....	<b>31</b>
17.3.12 Safe EEROM.....	<b>31</b>

---

---

17.3.13 Unsafe EEROM.....	<b>31</b>
18. Reader Responses to Polled Commands .....	<b>32</b>
19. USB Oriented Command Set .....	<b>32</b>
19.1 SEND MODULE NAME .....	<b>32</b>
19.2 SEND VERSION.....	<b>32</b>
20. Factory Reset .....	<b>33</b>
21. Security Issues.....	<b>33</b>
22. Choice of the Strike (Latch) .....	<b>34</b>
23. Setting up Pin2 of the Module – External Connections .....	<b>34</b>
23.1 Connection to a MAX232.....	<b>34</b>
23.2 Connection to a MAX485.....	<b>34</b>
23.3 Connection to a UART .....	<b>34</b>
23.4 Connection Direct to a Computer .....	<b>34</b>
23.5. Connecting to an LED direct - Pin2 is not affected.....	<b>34</b>
23.6 Connections to DB9 Socket.....	<b>34</b>
24. Designing Coils for the ID-3LA-SA .....	<b>35</b>
25. Tuning the ID-3LA-SA.....	<b>36</b>
26. Error Codes .....	<b>36</b>
27. PIC16xx Assembly Code for CRC Calculation.....	<b>37</b>
28. Calculated Values of CRC for Testing.....	<b>39</b>
29. Useful information .....	<b>40</b>
30. Case Dimensions for ID-xxSA .....	<b>41</b>
31. Contact Information .....	<b>42</b>
32. Important Safety Notice.....	<b>42</b>
Disclaimer.....	<b>43</b>
Appendix A .....	<b>44</b>
PCB Component Layer for Test Board.....	<b>44</b>
PCB Top Copper Layer for Test Board .....	<b>44</b>
PCB Bottom Copper Layer for Test Board .....	<b>45</b>
PCB Top and Bottom Layers of Test Board .....	<b>45</b>
Index .....	<b>46</b>

---

## 1.ID-xxLA-SA Features

- **Built in 47 Card Memory**
- **Autonomous mode**
- **Poling Mode**
- **Choice of CCITT 16bit CRC Error Checking**
- **Internet Control Software Available**
- **10 Character Password**
- **2 Remote Controlled Auxiliary Channels**
- **Remote 'Door Closed' Sensing**
- **More than 1 Billion Alpha Numeric Polled Addresses**
- **Adjustable Strike (Latch) Period**
- **4 Command Interfaces**
- **Comprehensive Error Reporting for Rapid Development.**
- **Long Range 12cm and 18cm**
- **Remote Card Memory Management**
- **Selectable RX/TX Polarity**
- **Low Power, 3v to 5volt Supply**

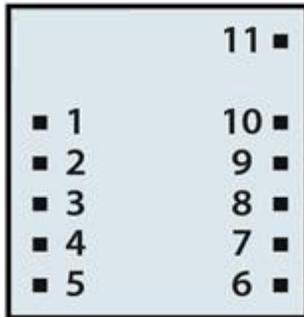
## 2. Device Overview

The ID-XXSA series low cost reader modules have advanced features and are designed to be used in stand-alone or remote controlled applications. They have the same footprint as existing Innovations reader modules The ID-12LA-SA and ID-20LA-SA incorporate internal antennas, and have read ranges of 12cm and 18cm, respectively with ISO cards and up to 25cm with Innovations long-range clam shell cards. The modules are usually supplied with a set of pre authorized cards which may be adequate some stand-alone installations. Extra cards may be added up to a total of 47 for larger installations, using the 'Test Interface'. The 'Test Interface is easy to use and responds in English. A computer with a simple down-loadable terminal program is all that is required to start interacting with the reader to add or subtract cards and set system parameters. There are two remotely controlled channels that can be used to operate other user peripherals. For complex multiple reader installations, two polling interfaces are provided, one is intended for rapid test and commissioning while the other is intended to be the final working interface and features a CCITT 16bit CRC communications error check, essential for polled networks in electrically noisy environments. A ten character hexadecimal password is required for sensitive transactions such as adding and subtracting cards and changing system parameters.

A final command set is included to keep compatibility with Innovations USB reader modules and this in conjunction with Innovations free PC software facilitates Internet control.

### 3. Pin Out

#### 3.1 Pin Out ID-3LA-SA

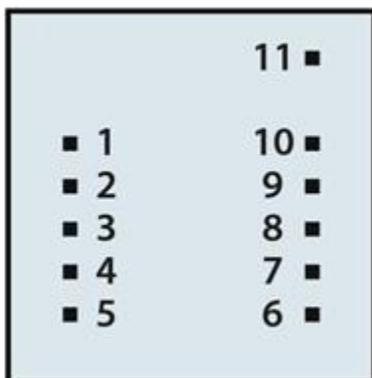


Bottom View

1. GND
2. Set UART/Serial
3. ANT (Antenna)
4. ANT (Antenna)
5. Strike Driver
6. Channel1 (Aux)
7. RX in
8. Tx Out
9. Channel2 (Aux)
10. Read (Beeper)
11. +3 to 5v



#### 3.2 Pin Out ID-12LA-SA & ID-20LA-SA



Bottom View

1. GND
2. Set UART/Serial
3. Do not Connect
4. Do not Connect
5. Strike Driver Logic
6. Channel1 (Aux). Rx In
8. Tx Out
9. Channel2 (Aux)
10. Read (Beeper)
11. +3 to 5V



### 4. Pin Description Summary

Pin #	Description	Notes
Pin 1	Zero Volts and Ground	
Pin 2	Select Communications Polarity	
Pin 3	To External Antenna	Ant (ID-3LA-SA only)
Pin 4	To External Antenna	Ant (ID-3LA-SA only)
Pin 5	Strike Driver Logic	-
Pin 6	Channel1 (Auxiliary Out)	Remote Controlled I/O
Pin 7	Communications RX	Data In
Pin 8	Communications TX	Data Out
Pin 9	Channel2 (Auxiliary In/Out)	Remote Controlled I/O
Pin 10	Beeper Logic out	As a DC pulse
Pin 11	DC Voltage Supply	+3v thru +5V

## 5. Pin Description Detail

**Pin1** is zero volts and communications ground. The copper connections to the pin should be robust, however using a ground plain that extends under the module antenna is not advisable as it will become an RF shorted turn causing detuning and loss of range. Care must be taken to route this line away from any regulator smoothing capacitors which can crowbar a lot of noise current and cause noise pickup in adjacent antenna leads. Ideally the Ground and the Supply leads should be placed opposite each other on each side of the board up to the point of meeting the Module.

**Pin2** is used to set the polarity of the communications. In effect it can perform an inversion of the output & input communications, so that the designer can use a mix of peripherals without resorting to glue logic. See the section on communications and connections.

**Pin3, Pin4** are only used on the ID-xxSA to connect to an external antenna and should be left unconnected on all other module types. The antenna connections should not pass under or near power chokes or regulator smoothing capacitors which can crowbar a lot of noise current and induce this noise pickup into adjacent antenna leads. For less pickup, try to place the copper tracks on opposite sides of the PCM so that they are positioned dead on top of each other.

**Pin5** is the Strike Driver logic. It is suggested that the output is used to drive an FET that in turns powers the strike. The module logic output will be between 3v and 5v depending on the VDD. A logic level FET will be required. Alternatively an NPN bipolar super alpha pair may be employed. It is suggested that a 10k series protection resistor is used to protect against unintended shorts from damaging the ID-xxSA module.

**Pin6** is Auxiliary Channel1 (Pin6) which can be remotely controlled. See Test Interface commands 77 and polled Interface commands. It shares control with the internal logic and is used as a strike indicator and normally goes to an LED. The Internal logic can be inhibited so that the Channel is remote controlled only. See command 79 'Assign Channel1' for the simple Test Interface and command 23 \$ 43 'System Response' commands for polled test interfaces.

**Pin7** is the RX serial input pin. The input polarity of this pin can be inverted by setting pin10, and this may prevent the need for glue logic when interfacing with different sources. See the section on *communications and connections*.

**Pin8** is the TX serial input pin. The input polarity of this pin can be inverted by setting pin10, and this may prevent the need for glue logic when interfacing with different sources. See the section on *communications and connections*

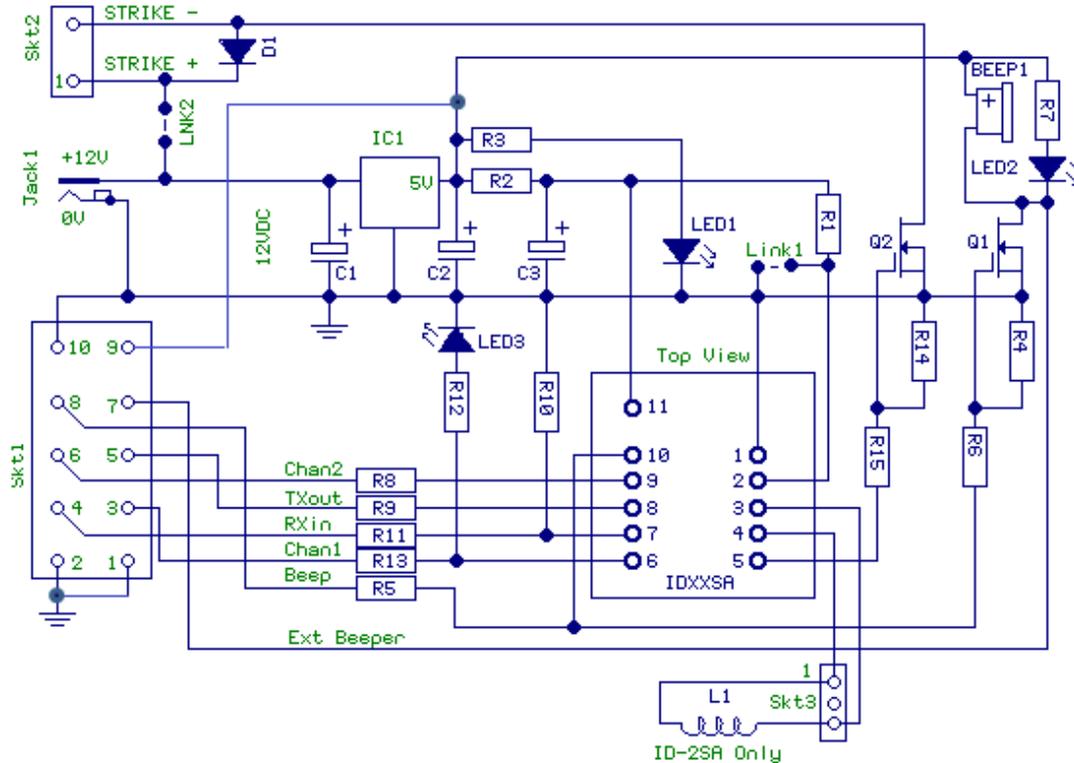
**Pin9** is Auxiliary Channel2 which can be remotely controlled. See command 78 'Set Channel2' for the simple Test Interface and polled 'Output Control' commands 24 & 44.

This pin can also be assigned as an input channel for remote 'Door Closed' sensing. See commands 20 for determining Channel2 input status, and 23 for Channel2 assignment to Input or Output.

**Pin10** is the beeper out logic. The beeper requires an NPN driver transistor and should be DC working rated at the supply voltage. Generally DC beepers are protected against inductive spikes and are either push pull or have an internal diode protection. If spikes are observed an external diode may be wired across the beeper terminals to prevent damage to the driver transistor. The current rating of the diode must be at least equal to the beeper current.

**Pin11** is the VDD positive supply pin. The module is rated at +3v thru +5v. Care must be taken to route this line away from any regulator smoothing capacitors which can crowbar a lot of noise current and cause noise pickup in adjacent antenna leads. Ideally the Ground and the Supply leads should be placed opposite each other on each side of the board up to the point of meeting the Module. A 1uF ceramic X7R capacitor across pins 1 & 11 is recommend, in addition to any other smoothing circuitry. *In line with previous recommendations, ensure that the major portion of the smoothing is not performed by this capacitor or it will actually detract from the reader performance – and the bigger the capacitor is made, the worse the effect will be!*

## 6. Recommended Test Circuit for the ID-3LA-SA, ID-12LA-SA, ID-20LA-SA



For PCB details of the Test Board see Appendix A

### Bill of Materials

R1, R4, R10, R14	33k	250mW
R2	4R7	250mW
R3, R7, R11, R12	22k	250mW
R6, R15	1k	250mW
R5, R8, R13, R9	3k3	
C1	10uF, 25v	BIPOLAR
C2	10uF, 25v	
C3	470uF, 10v	
Q1, Q2	IRLU120NPBF	
D1	1N4002	
LED1, LED2, LED3	High Brightness	
IC1	LM7805	
ID-Innovations Module	ID-3LA-SA/ID-12LA-SA/ID-20LA-SA	
L1 (ID-3LA-SA Only)	1.34mH	
Beeper1	12VDC	Beeper

## 7. Design Considerations

The Circuit shown in section 6.1 is primarily designed for robust operation but is nevertheless inexpensive. The output transistors were chosen because they will probably withstand a short (or two) during experimentation and they can be downsized considerably. The LEDs have simply been specified as 'High Brightness' because almost anything will do. The LM7805 is a TO220 device, chosen because it too can withstand experimental abuse and it too can be downsized considerably. The antenna is only used with the ID-3LA-SA module, the ID-12LA-SA and the ID-20LA-SA already have internal antennas. Using innovations clamshell cards read ranges in excess of 25cms can be had with the ID-20LA-SA module, however ranges up to 35cm can be achieved by using the ID-3LA-SA with a larger coil. See the section on coil winding.

Care should be taken when placing copper tracking under the modules that feature internal antennas. Do not run the supply tracks under the module and do not use an earthed plane. Earthed planes are fine for HF circuits but not good near antennas as they act as a shorted turn and have the effect of reducing the coil inductance and detuning the module antenna. R1, C3 form a LF filter. C3 may be increased in value up to 2200uF to affect a small increase in read range however it is pointless increasing C2 which is connected to the regulator output as this terminal is voltage controlled by the regulator. If the regulator is noisy, the negative feedback in the regulator itself will try to *maintain* the noise on the output and all that will happen is the more capacitance that is added the more the crowbar current will increase, what is worse, the tracking will carry the crowbar current and will induce it into any nearby antenna.

The perfect power source is a 1A 12VDC regulated adapter. They have high mains insulation and are ideal for most door strikes. Do not site the adapter next to the reader because almost all modern adapters use HF switching regulators and the inductors will couple noise into the antenna.

Pin 2 is used to set the polarity of the TX and RX signals. In effect the internal signals are inverted by grounding this pin so designers will not need interface glue logic. See the section on Communications and Connections. Designers who want to interface the reader using a MAX232 device, should note that this and similar ICs use capacitor switching and it and its associated components should be situated as far from the antenna as possible. The low frequency types using 1uF switching capacitors are more suitable. For polled applications a MAX485 type chip is suitable and this will not have these interference problems. There are arguments for taking the beeper to the 12vDC input supply, but it was decided to place use the output from the 5v regulator which has a current limit and more suitable for experimentation.

## 8. Device Specifications

Parameter	ID-3LA-SA, ID-12LA-SA & ID-20LA-SA
Frequency	125 kHz
Card Format	EM 4001 or compatible
Encoding	Manchester 64-bit, modulus 64
Current Requirement @ 5v	30mA nominal
Voltage Supply Range	+3v through +5.4v
I/O Output Current	+/- 5mA
Communications RX/TX	9600 Baud, 8Bit, No Parity
Read Range using ISO Card	ID-12LA-SA = 12cm, ID-20LA-SA = 18cm
Read Range using Clamshell Card	ID-12LA-SA = 18cm, ID-20LA-SA = 25cm
Card Memory Capacity	47 + 1 Used for Password
Maximum Polled Addresses	> 1 Billion
Certification	EC, C-TICK, ROHS FCC

## 9. Absolute Maximum Ratings

Maximum voltage applied to Pin 1	Vcc	+5.5v
Maximum voltage applied to Pin 2	Set Uart/Serial	Vcc +0.5v
Maximum current drawn from Pin 3	Antenna	± 100mA Peak
Maximum 125 KHz RF Voltage at Pin 4	Antenna	± 70v Peak
Maximum current drawn from Pin 5	Strike	± 5mA
Maximum current drawn from Pin 6	Aux Channel1	± 5mA
Maximum Voltage at Pin 7	Rx In	Vcc ± 0.7v`
Maximum current drawn from Pin 8	Tx Out	± 5mA
Maximum current drawn from Pin 9	Aux Channel2	± 5mA
Maximum current drawn from Pin 10	Beeper	± 5mA
Pins 5, 6, 7, 8, 9 & 10 may not exceed	Vcc ± 0.5v	

These ratings are absolute maximums. Operation at or near the maximums may cause stress and eventual damage or unpredictable behavior.

## 10. Normal Operation (Autonomous Mode)

The ID-12LA-SA simply requires a 3-5v DC power source, a strike driver transistor, a few resistors and the strike and it can be operational.

In normal mode, when a card is presented to the reader, it looks up the card in the EEROM memory and if the card is in the present it sends a pulse to pin 5 to operate the lock strike circuit. The read LED output and the Strike LED output will both turn on. The beeper will also sound for approximately one second. When a card is presented to the reader that is not stored in memory the read LED will flash but a strike pulse will not be sent, nor will the strike LED flash. The module also sends the ID data to the Tx Out pin for monitoring.

At a later stage, should the installation require more cards, they can be easily added using the TEST interface which is simple to use, responds in English and presents no major difficulty. The TEST interface is reasonably comprehensive; for example, it can add and subtract cards and be used to change system parameters like the strike period. Advanced users may also like the high end features such as two remotely controlled ports for auxiliary control of peripherals, channel1 (Pin6) and channel2 (Pin 9). The latter may be configured as an input to sense 'Door Closed'.

## 11. Normal Mode Output Data Format

In 'normal' mode the reader sends the data ID of every card that it reads. Note that the output data format differs from the ID-3LA/ID-12LA/ID-20LA modules which send a checksum. The normal mode automatically ceases to operate if the reader module detects a valid polled command.

Data Settings 9600 Baud, 8 Data Bits, 1 Stop Bits, No Parity Bit

[Output Data String](#)

**[10 ASCII DATA-ID CHARACTERS] [CR] [LF]**

Where CR = Carriage return Character 0x0D, LF = Line feed Character 0x0A

Example - Card Data in Hexadecimal = 123456789A

ASCII String = 31,32,33,34,35,36,37,38,39,41 ,0D,0A

## 12. Quick Start – Using the TEST command set.

The user must first set up the link to the computer. Any computer with an RS232 interface will do. Most table top PCs have an RS232 port. For computers that only have USB connection, a USB/RS232 converter can be purchased from the local computer store. The TEST interface was designed to be used with a terminal program by 'normal' people and for most installations it is all they will ever need. There is no time-out, so the user can type in at his own speed and the reader responses are in standard English. Error messages and other responses do not need to be looked up, they are quite clear, for Example 'Card Already Exists!', 'Unrecognised CMD', 'Login Success', 'Login Failure', 'Access Denied' and so on. Note, the polled interfaces use different error messages.

### 12.1 Connecting to the Host Computer.

- 1) Choose a terminal program. We strongly recommend the Bray++ terminal V1.9b 201000620B which performs excellently. It is free and can be found at <http://sites.google.com/site/terminalbpp/>  
The steps following will be explained with reference to this terminal program.
- 2) Select the correct communications polarity for the computer interface by linking pin10. See the 'Communications and Connections' section and the Standard Connections to a DB9 Socket.
- 3) Ensure that when direct communicating without a MAX232 chip, protection resistors are in place, before connecting the cables to the host computer – see recommended circuit.
- 4) Run the terminal program on the host computer.
- 5) Set the terminal to 9600 baud rate, no parity bit and 1 stop bit.
- 6) Set the terminal to display 'ASCII'.
- 7) Activate the terminal by hitting the 'Connect' button at the top left.
- 8) Set the host keyboard to capital letters.
- 9) Check that the terminal is displaying cards as they are being read by the reader, if not repeat steps 1 thru 8 and check carefully.
- 10) The user types commands at the very bottom of the screen.

Note that the Macros near the bottom of the screen can be used to send message strings to test the system. Hit 'Set Macros' and type in your commands. The Macros can even be made to repeat by themselves. We recommend the user do a little exploring as the terminal is easy to use and satisfying. If the user cannot download the Bray terminal from the link above it can still be obtained from other locations. Do a search for 'Bray Terminal'.

## 12.2 Logging In

Logging in is required for all TEST commands that write to the reader module EEROM. The password supplied with the reader module will be required. All commands are preceded with an STX (02h) control code and end with ETX (03h) control code. STX is sent by performing a control/B and an ETX is sent by performing a Control/C. To send these control codes, first depress the control key and then press the B or C key, then release the B or C key, followed by the control key. The login command is **[STX] [70] [Password] [ETX]**. Password consists of 10 hexadecimal characters such as '12345ABCDE'. The terminal will show **'LOGIN SUCCESS'**

## 12.3 Adding a Card

The TEST interface command for adding a card is **[STX] [72] [CARD ID] [ETX]**. The card ID should first be visually confirmed by presenting the card to the reader to display it on the terminal. Adding a card is the same procedure as for logging in except the command code is 72 and CARD ID will be the card data as displayed on the terminal. The terminal will reply with **'WRITE SUCCESS'**

## 12.4 Removing a Card

The TEST command for removing a card is **[STX] [73] [CARD ID] [ETX]**. The card to be removed should first be entered in the CARD ID position. The terminal will reply with **'CARD REMOVED'**

## 12.5 Using TEST commands with a Parameter

The Set Channel1 (Pin6) command **STX] [77] [Parameter] [ETX]** uses a single byte hexadecimal parameter to control the channel output. The parameter is entered as 00 to clear the channel and 01 to set the channel. Remember that a single hexadecimal byte needs to be entered as 2 ASCII characters. These are entered as ASCII '0' and ASCII '0' for 00 or ASCII '0' and ASCII '1' for 01.

The TEST command interface is comprehensive and adequate for single reader installations. Remember to keep the password in a safe place. The password can be changed to a more memorable one at any time. If password is lost, see "Factory Reset".

## 13. EEROM Description

The EEROM area stores the Password and the reader Polling address as well as timing and other values. The EEROM has been made available for viewing to aid commissioning. The EEROM can be accessed in total by either the Test 74 command or by polled commands 28 and 48. The EE general purpose flags byte4 can also be accessed individually by Polled commands 20 and 40 by setting the command parameter bit2. EEROM Byte4 can also be sent individually using command 20 with the appropriate parameter and this allows a rapid system check if large numbers of readers are to be serviced.

### 13.1 EEROM – Summary

Byte#	Byte Description
00	House Keeping only
01	House Keeping only
02	House Keeping only
03	Strike Period. FF approximates to 16 seconds
04	EEROM General Purpose Flags – See below
05	House Keeping only
06	Shadow Password Byte1. Used for security when changing passwords
07	Shadow Password Byte1. Used for security when changing passwords
08	Shadow Password Byte1. Used for security when changing passwords
09	Shadow Password Byte1. Used for security when changing passwords
10	Shadow Password Byte1. Used for security when changing passwords
11	Polled Address1
12	Polled Address1
13	Polled Address1
14	Polled Address1
15	House Keeping only
10 -14	Password
15-255	Storage for Authorized Cards

### 14.EEROM Byte4 - General Purpose Flags

Bit#	Bit = 0 Description	Bit = 1 Description
Bit0	Polled Commands with and without CRC accepted	Only Polled commands with CRC accepted.
Bit1	Series 7x (Test Interface) commands accepted	Inhibit the Test Interface. All 7x series commands ignored.
Bit2	Data stored at EEROM shadow Password area is not designated for future password.	Data stored at EEROM shadow password is designated for future Password.
Bit3	Normal mode is operating.	Normal mode is inhibited
Bit4	Strike power is normally Off	Strike Power is normally On
Bit5	Channel1 (pin6) control is shared with Strike LED indicator logic.	Channel1 (Pin6) control is not shared and responds to remote commands only
Bit6	Poll is not active	Poll is active
Bit7	EEROM is not safe. All writes allowed	EEROM is safe. No writes allowed

## 15. The Command Sets

For speed of development and ease of use four command sets have been included. A first simple 'TEST' command set allows the user to interface with a terminal for rapid evaluation. It responds in English and is user friendly. For single reader installations the Test command set is probably adequate. The TEST interface allows the user to change the password, perform a strike cycle, perform a beep cycle, sense door open/closed and add and subtract cards from the valid list. Several commands are for Internet functionality for use with ID-Innovations free demonstration software and enables remote control and identification of the module. A total of 47 cards plus password card can be included. A polled command set and a polled command set with CRC are also included.

## 16. The TEST Command Set Introduction

The TEST Command Set interface sends most responses as text, for example 'Login Failure', 'Login Success', 'All Zeroes Failure' and so on. All control message strings sent to reader must start with **STX** and end with **ETX**. These are ASCII control codes for **Start of Text** and **End of Text** respectively and have ASCII values of 02 and 03. If a terminal program is being used then these will correspond to CONTROL B and CONTROL C on the keyboard. To get the terminal to send these characters first depress the control key, then the B or the C keys, then release the B or C key followed by the control key.

The Alpha portion of Alpha-numeric characters must be entered in upper case. For example 'ABCDEF1234'. The parameter field is not sensitive to length. If a parameter is not entered at all a zero parameter will be entered.

## 16.1 General Format for TEST Command set

**[STX][Command Code Field][Parameter Field][ETX]**

Where :-

**STX** STX is the Start of Text ASCII control Character that consists of a \$2, sent as a single binary character.

**Command Code Field** There are four sets of command codes that each consist of two hexadecimal numbers. The TEST commands range from 70 thru 7A.

**Parameter Field** The parameter field can be either 1 or 5 hexadecimal bytes depending on the command. These characters are converted and sent as either 2 or 10 ASCII characters. Single bytes (2 ASCII) are used to send timing periods for beeper and strike and range from 00 to FF. Single bytes are also used to send control bits for the remote control of Channels 'A' and 'B' and also to define the reader response type in commands 20 and 40. Five byte fields (10 ASCII characters) are used to send card IDs or passwords.

**ETX** ETX is the End of Text ASCII control Character that consists of a \$3, sent as a single binary character.

## 16.2 Test Command Set Summary

Command#	Title
70	Login
71	Logout
72	Add Card
73	Subtract Card
74	Send EEROM Contents
75	Change Password
76	Set Strike Period
77	Set Channel1 (Pin6)
78	Set Channel2 (pin9)
79	Assign Channel1 (Pin6)
7A	Assign Strike NO/NOFF
7B	Perform Beep Cycle
7C	Perform Strike Cycle
7D	Configure Channel2 I/O
7E	Read Channel2 Input

## 16.3 Test Command Set Descriptions

### 16.3.1 Login

[STX] [70] [Password] [ETX]

#### Example

[STX] [70] [1234567890] [ETX]

Reader Response Transmission

- |                                   |                 |
|-----------------------------------|-----------------|
| 1) If password is correct sends   | 'LOGIN SUCCESS' |
| 2) If password is incorrect sends | 'LOGIN FAILURE' |

Explanation : Some commands such as add or remove cards require that the user be logged in. Logging in and out prevents mistakes and adds a little security to the transactions.

### 16.3.2 Logout

[STX] [71] [ETX]

#### Example

[STX] [71] [ETX]

Reader Response Transmission 'LOGOUT SUCCESS'

Explanation : Logging out may help prevent errors because it restricts access.

### 16.3.3 Add Card

[STX] [72] [CARD ID] [ETX]

#### Example

[STX] [72] [1234567890] [ETX]

Reader Response Transmission

- |                                     |                        |
|-------------------------------------|------------------------|
| 1) If card is written to memory     | 'WRITE SUCCESS'        |
| 2) If the card is already in memory | 'CARD ALREADY EXISTS!' |
| 3) If Card ID is all zeroes         | 'ALL ZERO ERROR'       |
| 4) If the memory is full            | 'MEM FULL'             |
| 5) If the user has not logged in    | 'ACCESS DENIED'        |

Explanation : The user can add cards as required. Up to 47 cards can be stored in EEROM. Card ID must be written in hexadecimal. Login is required.

### 16.3.4 Remove Card

[STX] [73] [CARD ID] [ETX]

#### Example

[STX] [73] [1234567890] [ETX]

Reader Response Transmission

- |                                  |                  |
|----------------------------------|------------------|
| 1) If card is erased from memory | 'CARD REMOVED'   |
| 2) If the card is not found      | 'CARD NOT FOUND' |
| 3) If the user has not logged in | 'ACCESS DENIED'  |

Explanation : The user can remove cards as required. The Card ID must be written in hexadecimal.

### 16.3.5 Send EEROM Contents [STX] [74] [ETX]

**Example** [STX] [74] [ETX]

Reader Response Transmission

- |                                  |                 |
|----------------------------------|-----------------|
| 1) Reader sends EEROM contents   | EEROM Contents  |
| 2) If the user has not logged in | 'ACCESS DENIED' |

Explanation : The contents of the EEROM including the cards, timings and housekeeping will be sent. Login is required.

### 16.3.6 Change Password [STX] [75] [NEW Password] [ETX]

**Example** [STX] [75] [1234567890] [ETX]

Reader Response Transmission

- |                             |                       |
|-----------------------------|-----------------------|
| 1) Reader Sends             | 'NOW RE-SEND COMMAND' |
| 2) Upon repeat reader sends | 'SUCCESS'             |

Explanation : The password change is performed in three stages. The user is first required to log in using the old password. The user must then send the required password and the reader will ask for the command to be repeated. When the command is repeated the new password takes effect. Login is required.

### 16.3.7 Set Strike Period [STX] [76] [Strike Period] [ETX]

**Example** [STX] [76] [80] [ETX]

Strike Period            80 = Approx 8 seconds

Reader Response Transmission

- |                                  |                 |
|----------------------------------|-----------------|
| 1) Reader Sends                  | 'WRITE SUCCESS' |
| 2) If the user has not logged in | 'ACCESS DENIED' |

Explanation : The Strike time is sent in hexadecimal. The maximum time allowed is 0xFF which equates to around 16 seconds. Login is required.

### 16.3.8 Set Channel1

[STX] [77] [Parameter] [ETX]

#### Example

[STX] [77] [01] [ETX]

Parameter	BIT 0 =	0	Channel1	Low
	BIT 0 =	1	Channel1	High
	BITS 1-7	Future – leave as 0		

Reader Response Transmission 'OK'

Explanation : The status of Channel 1 and Channel 2 outputs are determined by bits 0 and 1 of the Parameter byte. It should be noted that control of Channel 1 is shared locally with an LED that indicates the strike status. The local action can be inhibited using [STX] [79] [1] [ETX] and enabled using [STX] [79] [0] [ETX]. Login is required.

### 16.3.9 Set Channel2

[STX] [78] [Parameter] [ETX]

[STX] [78] [01] [ETX]

Parameter	BIT 0 =	0	Channel2	Low
	BIT 0 =	1	Channel2	High
	BITS 1-7	Future – leave as 0		

Reader Response Transmission 'OK'

Explanation : The status of Channel 1 and Channel 2 outputs are determined by bits 0 and 1 of the Parameter byte. Login is required.

### 16.3.10 Assign Channel1

[STX] [79] [Parameter] [ETX]

#### Example

[STX] [79] [00] [ETX]

[STX] [79] [01] [ETX]

Parameter	BIT 0 = 0	Strike indication allowed
	BIT 0 = 1	Strike indication inhibited
	BITS 1-7	Future – leave as 0

Reader Response Transmission 'OK'

Explanation : Channel 1 is a digital output that can be controlled remotely. This channel also has a LED indicator and is also assigned to the strike to indicate the strike cycle. This command enables or disables the strike indication function so that it is 100% under remote control. Login is required.

### 16.3.11 Assign Strike Mode [STX] [7A] [Parameter] [ETX]

**Example** [STX] [7A] [NO] [ETX]

[STX] [7A] [NC] [ETX]

Parameter NO = Strike Power Normally Off (Fail secure)

NC = Strike Power Normally On (Fail safe)

Reader Response Transmission 'WRITE SUCCESS'

Explanation : Most strikes are only powered to open the strike but some strikes are designated normally energized meaning that the power must be applied all the time *except* when the strike is opened. This command changes the strike output driver to suit normally energized strikes. Log in is required.

**WARNING.** Strikes that are normally energized are specially made for high heat dissipation. Care must be taken to ensure that a strike that is normally not energized is not permanently powered or it may overheat. Setting the wrong strike mode can result in the door being open when it should be closed and vice-versa.

### 16.3.12 Perform Beep Cycle [STX] [7B] [ETX]

**Example** [STX] [7B] [ETX]

Reader Response Transmission 'OK'

Explanation: The Reader performs a Beep cycle.

### 16.3.13 Perform Strike Cycle [STX] [7C] [ETX]

**Example** [STX] [7C] [ETX]

Reader Response Transmission 'OK'

Explanation: The Reader performs a Strike cycle.

### 16.3.14 Configure Channel2 I/O

[STX] [7D] [Parameter] [ETX]

**Example**

[STX] [7D][00] [ETX]

**Example**

[STX] [7D][08] [ETX]

Parameter            00 = Set Channel2 as an Output  
                           08 = Set Channel2 as an Input

Reader Response Transmission 'OK'

Explanation : This command is used to determine if Channel2 is an input or an output. As an output it can be used to send data remotely to a peripheral such as a beeper of a 2nd strike. As an input it can be used to send data from the reader to a remote location for use such as a door closed indication.

### 16.3.15 Read Channel B Input [STX] [7E] [ETX]

**Example**

[STX] [7E] [ETX]

Reader Response Transmission '0' or '1'

Explanation : Reader sends the input status of Channel 2, module Pin9'. If channel2 is programmed as an output then it will return false data. A typical use would be a door closed indication.

## 16.4 TEST Command Reader Response Description.

All responses are sent in **ASCII** code. When the response is not obvious, as in 'Send EEROM Contents', a response is sent in English. The responses are:-

<b>LOGIN SUCCESS</b>	The User has entered the correct password and can change system parameters and issue commands.
<b>LOGIN FAILURE</b>	The user has entered an incorrect password.
<b>LOGOUT SUCCESS</b>	The user has successfully logged out and the system will not respond to other TEST commands.
<b>WRITE SUCCESS</b>	The reader has successfully written to the EEROM contents.
<b>CARD ALREADY EXISTS</b>	The reader is warning that the user has attempted to authorize a card that is already authorized and stored in the EEROM.
<b>ALL ZERO ERROR</b>	An attempt has been made to authorize a card or change the password with a number that contains all zeroes. This is not allowed. It is also not allowed to enter the strike time as zero.
<b>MEM FULL</b>	The EEROM is full. No more cards can be added. The EEROM can store 47 cards in addition to the password card.
<b>ACCESS DENIED</b>	The user is denied access because the Login Command has not been successfully completed or - The EEROM has been 'SAFED' to prevent EEROM writes. The EEROM can only be 'SAFED' and 'UNSAFED' by using polled series commands.
<b>CARD REMOVED</b>	A card has been removed from the EEROM memory at the user request.
<b>CARD NOT FOUND</b>	The user has asked for a card to be removed but that card cannot be found in the EEROM memory.
<b>NOW RE-SEND COMMAND</b>	The change password command must be repeated to ensure that the new password has not been corrupted. The user must repeat the new change command again.
<b>SUCCESS</b>	Generalized response similar to OK. Means the user command was successfully performed.
<b>OK.</b>	The user command has been performed successfully.

## 17. Polled Commands Introduction

The 2x command polled interface uses 4 character alpha numeric addressing capable of addressing more than 1 billion reader locations. The long address field allows meaningful names such as Site1, Site2, Rm10 etc., to be used so that look up tables are not required. All ASCII characters can be used except control characters such as CR, LF, STX, ETX etc. The readers store 47 cards and are autonomous, so large numbers of readers may be accommodated providing they only require the occasional memory updates. Critical commands such as erase and add cards require the use of a 10 digit password. The password can be changed remotely and the system response modified.

When total remote control of all reader locations is required, the speed of the polled interface will be a limiting factor. A delay of around a second is generally no problem and this will correspond to about 100 locations. Communications are run at 9600 baud which is popular because it is a good compromise between speed and cable length. It will be noted that the communications are half duplex. For polled applications a separate RS485 chip must be employed so that multiple readers can be hung on the same line.

The 4x series polled commands feature a 16bit CRC. The functions are similar to the 2x series command interface without the CRC, the only difference is command 23, which is prevented from inhibiting non CRC commands. Interference can be a serious problem for polled systems because commands and addresses may get corrupted and if undetected can result in unpredictable behavior. Commercial polled systems generally employ error checking. To this extent, the non-CRC interface is only included to allow fast development. Accordingly, it is strongly recommended that the user sets up the 4X command interface with the CRC. The 16bit CRC is far better at detecting errors than its size would suggest. For example, if the message length is 90bits and there is an average error rate of 1 in 100k bits, the chance of an error not being detected is less than 1 in  $10^{-24}$ , and this is serious protection. The CCITT CRC was chosen not because it is the very best, but because it performs well and many engineers have worked examples of Assembler and 'C' code to hand. Note that a Microchip PIC Assembly listing for the CRC is available at section 27.

Meaningful error messages always contribute to rapid system development and commissioning. The SA reader features comprehensive error reporting. An error message consists of an ASCII NAK control code followed by the error number. If an error is detected, and the address is valid, the reader addressed will respond with an appropriate error message. Error messages include, Message Length Error, Data Format Error, Password Fail, CRC Fail, Card Not Present, Card Already Exists, Unknown Command, Buffer Overflow, Access Denied and Memory Full.

When a reader receives ANY valid polled command, it will leave 'NORMAL' mode and switch to polled mode, and will cease automatic transmitting of card IDs after every read. This state will be permanent. To return to 'NORMAL' mode see command 29/49. The Alpha portion of Alpha-numeric characters must be entered in upper case. For example 'ABCDEF1234'

## 17.1 General Formats for Series 2x and 4x Command Sets

**2x Series**            [STX] [Command Code] [Address] [Parameter] [ETX]  
**4x Series**            [STX] [Command Code] [Address] [Parameter] [CRC] [ETX]

Where :-

**STX**    STX is the Start of Transmission Character, an 02h, **Control Character** sent as a single ASCII character.

**Command Code Field** The command code consists of two **Hexadecimal** numbers ranging from 20 to 2F for strings that do not include a CRC check and 40 thru 4F for strings that do include a CRC check. These characters are converted and sent as 4 ASCII characters. The '2' tells the reader to not expect a CRC, while the '4' tells the reader to prepare for a CRC.

**Address Field** The address field uses 4 ASCII characters which may be **Alphanumeric**. Addresses can be meaningful, for example 'BLD1', 'FL12', 'CAT1', PAD1, FRED and so on. The only limitation is the address must not include an ASCII control code such as ETX, STX, CR and LF. The reader itself *can* accept all ASCII characters except ETX and STX however many communications programs will respond to control codes and cause issues.

**Parameter Field** The parameter field should be either 1 or 5 **Hexadecimal** bytes depending on the command. These characters are converted and sent as either 2 or 10 ASCII characters. Single bytes (2 ASCII) are used to send timing periods for beeper and strike and range from 00 to FF. Single bytes are also used to send control bits for the remote control of Channels 'A' and 'B' and also to define the reader response type to commands 20 and 40. Five byte fields (10 ASCII characters) are used to send card IDs or passwords.

**CRC**    The CRC is a standard 16bit CCITT cyclic redundancy check forming two **Hexadecimal** bytes is converted and sent as 4 ASCII characters. Sample code for the PIC16Fxxx series is given in section 27. Note that the **starting value** for the CRC calculation is '**FFFF**', not '0000'

**ETX**    The ETX is the End of Transmission Character, an 03h **Control Character** sent as a single ASCII character

## 17.2 Polled Command Sets Summary

<b>Command #</b>	<b>Title</b>
20/40	Send Card or Data
21/41	Output Control
22/42	Assign Strike
23/43	System Response
24/44	Set Strike Period
25/45	Not Implemented In this Version
26/46	Not Implemented In this Version
27/47	Not Implemented In this Version
28/48	Read EEPROM
29/49	Write New Address
2A/4A	Add Card
2B/4B	Remove Card
2C/4C	Change Password
2D/4D	Confirm Password
2E/4E	Safe EEROM
2F/4F	Unsafe EEROM

## 17.3 Polled Commands Description

**17.3.1 Send Card or Data** [STX] [20]<sup>1</sup> [Address] [Parameter] [ETX]

[STX] [40]<sup>1</sup> [Address] [Parameter] [CRC] [ETX]

**Reader Response Transmission for Parameter = x0, where x = Do Not Care**

If reader buffer contains a card ID that has not been sent, reader sends

[N] [Card ID] example 'N1234567890' (New Card)

If reader buffer contains a card that has already been sent, reader

sends [P] [Card ID] example 'P1234567890' (Previous Card)

If reader buffer contains a card that has not been validated<sup>2</sup>, reader

sends [U] [Card ID] example 'U1234567890' (Unchecked Card)

**Reader Response Transmission for Parameter = x1**

If reader buffer contains a card that has not been sent, reader sends

[N] [Card ID] example 'N1234567890'

else sends<sup>2</sup> ACK

**Reader Response Transmission for Parameter = x2**

Reader sends the EE Flags general Purpose Flags

[E<sup>H</sup>, E<sup>LO</sup>] example '7A'

**Reader Response Transmission for Parameter = x4**

Reader sends the input status of Channel 2, module Pin9

[0] or [1] example '0' or '1'

- (1) This command halts the target reader during the response TX, so any particular reader address should not be targeted more than 10x per second.
- (2) The reader validates a card data by reading it three times. If the card has not been verified by 3 reads then the card data is sent preceded by a 'U' (un-validated)

**17.3.2 Output Control**      **[STX] [21] [Address] [Parameter] [ETX]**  
    **[STX] [41] [Address] [Parameter] [CRC] [ETX]**

Explanation : The addressed reader sets the outputs of channels 1 & 2 according to Bit0 and Bit1 and initiates a Strike Cycle or a Beeper cycle according to Bits2 and Bit3. Note that control of Channel 1 is shared locally with an LED that indicates the strike status, the local action can be inhibited using [23] [Address] [04] [ETX] or [43] [Address] [04] [CRC] [ETX].

Parameter	BIT 0 = 0	Channel1 Low
	BIT 0 = 1	Channel1 High
	BIT 1 = 0	Channel2 Low
	BIT 1 = 1	Channel2 High
	BIT 2 = 1	Start Beeper Cycle
	BIT 3 = 1	Start Strike Cycle
	BITS 4-7	Future – leave as 0

**Reader Response Transmission = ACK**

### 17.3.3 Assign Strike

[STX] [22] [Address] [Parameter] [ETX]

[STX] [42] [Address] [Parameter] [CRC] [ETX]

Parameter	BIT 0 = 0	Strike Drive Normally Off
	BIT 0 = 1	Strike Drive Normally On
	BITS 1-7	Future – leave as 0

Explanation : Most strikes are powered to open the strike but some strikes are designated normally energized meaning that the power must be applied all the time *except* when the strike is opened. This command changes the strike output driver to suit normally energized strikes. Log in is required.

**Reader Response Transmission = ACK**

### 17.3.4 System Response

[STX] [23] [Address] [Parameter] [ETX]

[STX] [43] [Address] [Parameter] [CRC] [ETX]

Parameter	BIT 0 = 0	Test Interface Allowed
	BIT 0 = 1	Test Interface NOT Allowed
	BIT 1 = 0	2X and 4x Commands Allowed
	BIT 1 = 1	Only 4X Commands Allowed
	BIT 2 = 0	Channel1 Not Assigned to Remote
	BIT 2 = 1	Channel1 Assigned to Remote
	BIT 3 = 0	Channel2 Pin9, set as an Input
	BIT 3 = 1	Channel2 Pin9, set as an Output
	BITS 3-7	Future – leave as 00000

Explanation : Bit0 inhibits the TEST interface for polled applications.

Bit1 inhibits the 2x series interface.

Bit2 inhibits the Strike indication. Channel1 only responds to remote commands.

Bit3 sets channel1 as an output or an input. As an input it can be used to send door open/closed status to remote location.

**Reader Response Transmission = ACK**

### 17.3.5 Set Strike Period

[STX] [27] [Address] [Parameter] [ETX]

[STX] [47] [Address] [Parameter] [CRC] [ETX]

Parameter consists of two hexadecimal characters, ranging from 00 to FF.

Explanation : The maximum time allowed is 16 seconds.

**Reader Response Transmission = ACK**

**17.3.6 Read EEROM**                    **[STX] [28] [Address] [Password] [ETX]**  
    **[STX] [48] [Address] [Password] [CRC] [ETX]**

Explanation : The Reader sends the contents of the EE memory including flags, timings and list of authorized cards. Login is required for this command.

**Reader Response Transmission = Reader sends contents of EEROM**

**17.3.7 Write New Address**            **[STX] [29] <sup>1</sup> [New Address] <sup>2</sup> [Password] [ETX]**  
    **[STX] [49] <sup>1</sup> [New Address] <sup>2</sup> [Password] [CRC] [ETX]**

Explanation : Reader changes its address to 'NEW Address'. Login is required for this command. Meaningful addresses are allowed, for example 'BLD1', RM1, FL12 and so on.

**Reader Response Transmission = ACK**

- (1) This command targets all readers and requires them to check their passwords. During the checking period the readers temporarily halt reading activity. To ensure that reading activity can continue unimpeded the command should not be sent more than 10x a second.
- (2) Programming a reader Address to 'FFFF' will make the reader revert to normal non polled mode which can be useful for testing. The reader must be taken out of the polled network, because any subsequent valid polled command will make the reader resume polled mode, using 'FFFF' as its address.

**17.3.8 Add Card**                        **[2A] [Address] [CARD-ID] [ETX]**  
    **[STX] [4A] [Address] [CARD-ID] [CRC] [ETX]**

Explanation : The data in CARD-ID is added to the list of authorized cards in reader EE ROM. CARD ID must be a valid 5byte Hexadecimal number, sent as 10 ASCII characters.

**Reader Response Transmission = ACK**

**17.3.9 Remove Card**                    **[STX] [2B] [Address] [CARD-ID] [ETX]**  
    **[STX] [4B] [Address] [CARD-ID] [CRC] [ETX]**

Explanation: The data in CARD-ID is added to the list of authorized cards in reader EE ROM. CARD ID must be a valid 5byte Hexadecimal number, sent as 10 ASCII characters.

**Reader Response Transmission = ACK**

**17.3.10 Change password** [STX] [2C] [Address] [NEW Password] [ETX]  
[STX] [4C] [Address] [NEW Password] [CRC] [ETX]

Explanation: The data in NEW Password must be a valid 5byte Hexadecimal number, sent as 10 ASCII characters. NEW Password will be stored in the reader Shadow Password area until confirmed with the 'CONFIRM Password' password command. This method ensures that should there be an unexpected power failure while the reader is writing the password to EEROM, either the old password or the new password is still operable.

**Reader Response Transmission = ACK**

**17.3.11 Confirm Password** [STX] [2D] [Address] [OLD Password] [ETX]  
[STX] [4D] [Address] [OLD Password] [CRC] [ETX]

Explanation : The existing password is sent as confirmation to change to the new password. The data held in the EEROM Shadow Password area is written to the password location. Even if the power fails repeatedly during the change password process, upon switch on, the reader will continue the process once this command has been received, ensuring continuity of a valid password.

**Reader Response Transmission = ACK**

**17.3.12 Safe EEROM** [STX] [2E] [Address] [Password] [ETX]  
[STX] [4E] [Address] [Password] [CRC] [ETX]

Explanation : This command disables all writes to EEROM and should be used to prevent extraneous writes in the event of power spikes, low voltage or other processor malfunctions.

**Reader Response Transmission = ACK**

**17.3.13 Unsafe EEROM** [STX] [2F] [Address] [Password] [ETX]  
[STX] [4F] [Address] [Password] [CRC] [ETX]

Explanation: Enables writes to EEROM. This command should be used before a command that writes to EEROM. After the command that requires an EEROM write has executed the system should be made safe again with command 14.

**Reader Response Transmission = ACK**

## 18. Reader Responses to Polled Commands

All responses are sent in ASCII. Where it is not clear from the reader response that a command has received and processed, the reader sends an ACK (ASCII = 06) or in the case of the reader not being able to comply the reader sends a NAK (ASCII = 15) + an Error Code. The Error Code is a single hexadecimal number. See Error Codes

## 19. USB Oriented Command Set

The following commands allow compatibility with Innovations USB oriented enhanced modules.

### 19.1 SEND MODULE NAME [STX] [00] [ETX]

#### Reader Response Transmission

The reader sends the module type **IDXXSA**

Where XX is model type, IE. 02, 12, 20

Explanation : This enables Innovations PC software to identify the module type.

### 19.2 SEND VERSION [STX] [01] [ETX]

#### Reader Response Transmission

The reader sends the software version **XXSS**

Where XX is the Version and SS is the Sub Version

Explanation : This data is used by Innovations to link to the appropriate software.

### 19.3 SEND DATE [STX] [02] [ETX]

#### Reader Response Transmission

The reader sends the manufacturing date. **YYMMDD**

Where YY is the Year, MM is the Month and DD is the Day

Explanation : This data is used by Innovations for traceability and quality control.

## 20. Factory Reset

It happens! Passwords get lost but it is not a disaster, the user can reset the Module to the Factory condition. After a factory reset, a first card must be presented to the reader and this becomes the reader password. The card will also be authorized to activate the strike. After this, the module will authorize any additional cards brought up to the reader up to the specified amount supplied with the module. Before performing a factory reset it is a good idea to be in possession of the same number of cards that came with the module, because if the user has just 2 cards left and 10 are specified, the next 8 people who present cards to the reader automatically become instant authorized users!

Alternatively, after a first card has been presented to the reader to create the password any command Interface can used to create a second or subsequent card up to the maximum of 47 cards. It should be noted that for security, the automatic factory authorization process is inhibited after a command interface has been used to add a card. That means that after a first card has been presented to a reader and one of the command interfaces has been used to add a subsequent card, that from that moment on, presenting a card to the reader will not lead to it being authorized.

To initiate a factory reset perform the following steps

- 1) Switch Off
- 2) Remove connections to Pin7 on the module.
- 3) Link pin4 and Pin8 together
- 4) Switch on for 5 seconds. The beeper may make a noise.
- 6) Remove the link from Pin 6 to Pin8
- 7) Switch off
- 8) Replace any previous connects to Pin6
- 9) Present the number of cards specified to the module to be authorized OR use a command interface as described above to enter at least one card.

It may be argued that having a factory reset function reduces security, however, anybody who can get access to the reader PCB also has the perfect opportunity to link the strike leads and gain entry regardless, or even add their own parallel entry system. For sensitive applications it is suggested the reader is placed in a secure container or alarmed and the wires to the strike are made inaccessible

## 21. Security Issues

***A lot of effort has been made to increase the device security; however the reader module is not sold as a high security device. No claims as to the suitability of the reader in security applications are made and it is up to the user to assess the reader's suitability for any specific purpose. We do say the reader requires password authorization for system changes and addition or removal of cards. The EEROM can be made safe and can only be restored with the password.***

## 22. Choice of the Strike (Latch)

The most popular strike is rated at 12VDC and is normally powered off. They are affordable and powered by inexpensive power 12VDC mains adapters. Innovations market a stand-alone kit (ID-XXSA Evaluation Kit Mk1) to kick-start applications using the ID-XXSA modules. It incorporates the ID-XXSA module and all that is required is a strike. The strike driver uses a FET and is suitable for DC strikes requiring up to 2A and 24volt max. The strike period is 5 seconds. Most strikes use 12VDC and the board has a DC 12V link for the strike supply, alternatively the strike may be externally powered for higher voltages. See 'Important Safety Warning Notice'.

## 23. Setting up Pin2 of the Module – External Connections

The correct communications polarity for the computer interface must be set using pin2. Pin2 is used to set the correct polarity enabling connections to UARTS, RS232 drivers and to computers.

**23.1 Connection to a MAX232 - Link Pin2 of the module to Ground.** Connecting the RX and TX lines via resistors is permissible and may help PCB drafting as well as reducing RFI. In this mode the module is connected to a MAX232 type chip to interface with the computer RS232 line. Using a MAX232 generic chip enables a degree of noise immunity and depending on the cable, medium distances.

**23.2 Connection to a MAX485 - Link Pin2 of the module to Ground.** Connecting via resistors is permissible and may help PCB drafting as well as reducing RFI. In this mode the module is connected to a MAX85 type chip before connecting to the computer RS232 line. Using a MAX485 generic chip enables a high degree of noise immunity and depending on the cable, long distances.

**23.3 Connection to a UART - Link Pin2 of the module to VDD.** Connecting via resistors is permissible and may help PCB drafting as well as reducing RFI. In this mode the module is connected to a microprocessor UART.

**23.4 Connection Direct to a Computer - Link Pin2 of the module to VDD.** This mode is sometimes referred to as pseudo RS232 and it suitable only for short distances.

**23.5. Connecting to an LED direct - Pin2 is not affected.** Sometimes a beeper is not required but an LED is. In this case a driver transistor is not necessary and the LED can be connected to pin10 via a series10k resistor, cathode to ground.

### 23.6 Connections to DB9 Socket.

The ground pin is pin5. Pin 3 of the computer DB9 socket is the RS232 TX and should be connected to ID-xxSA module pin7 (RXin), via the interface chosen above. Pin2 of the computer DB9 socket is the RS232 RX and should be connected to ID-xxSA module pin8 (TXout), via the interface chosen above.

## 24. Designing Coils for the ID-3LA-SA

(Note the ID-12LA-SA and the ID-20LA-SA must not be used with an external antenna.) The antenna Inductance for the ID-3LA-SA is 1.07mH. When this value is used the external tuning capacitor (C3) is not required because the ID-3LA-SA already has an internal tuning capacitor of 1n5. In general the bigger the antenna the better, provided the reader is generating enough field strength to excite the tag. The ID-3LA-SA is low power so a maximum coil size of 15x15cm is recommended if it is intended to read ISO cards. If the reader is intended to read glass tags the maximum coil size should be smaller, say 10x10cm.

There is a science to determine the exact size of an antenna but there are so many variables that in general it is best to get a general idea and then 'Suck it and See'. If the reader is located in a position where there is a lot of heavy interference then less range may be unavoidable. In this situation the coil should be made smaller to increase the field strength and reduce the interference pickup. It is difficult to give actual examples of coils for hand winding because the closeness and tightness of the winding will significantly change the inductance. A professionally wound coil will have much more inductance than a similar hand wound coil.

For those who want a starting point into practical antenna winding it was found that 63 turns on a 120mm diameter former gave an inductance of 1.07mH. As far as the inductance is concerned, the wire diameter is not important, although thicker wire often means higher Q and more read range. Do not be worried about using high Q coils, the ID-3LA-SA can handle Q factors up to 50, but be careful not to exceed the maximum RF output current and voltage.

Sometimes the antenna coil is necessarily surrounded by a metallic enclosure or has an adjacent copper PCB plane. Both these can behave like a shorted turn. A shorted turn has the effect of setting up a current in opposition to the ID-3LA-SA antenna coil current and is analogous to adding a negative inductance. Some range can be clawed back by either increasing the inductance or increasing the capacitance. If an inductance meter that works at 100 KHz or greater is available then the inductance can be adjusted back to 1.07mH by winding extra turns. Failing this the capacitance can be increased to offset the lower inductance and bring the antenna back to tune.

Remember, that normally there is no need for external capacitance because the ID-3LA -SA has an internal 1n5 capacitor, which perfectly tunes the recommended inductance of 1.07mH, however, if the inductance is less than this a compensating capacitor, (C3), must be added externally to bring the antenna back to tune. If the user monitors the coil voltage with an oscilloscope, this will tell all. As a tip, if ferrite is brought near a coil with too low inductance, the RF output voltage will rise and if aluminum foil is brought near a coil which has too high inductance, the RF voltage will similarly rise. This will indicate which side of the tuning the coil is.

**Warning: Do not exceed the stated maximum voltages and currents for the ID-2 RF output.**

For those who wish to be more theoretical we recommend a trip to the Microchip Website where we found an application sheet for Loop Antennas. All the same, once the user has got some theoretical knowledge, the advice of most experts is still 'Suck it and see'. <http://ww1.microchip.com/downloads/en/AppNotes/00831b.pdf>

## 25. Tuning the ID-3LA-SA

For development we recommend using an oscilloscope for tuning. Use a high impedance probe on 10x for Isolation, and to protect the oscilloscope input amplifiers. Connect the oscilloscope to observe the 125kHz AC voltage across the coil. Get a sizeable piece of ferrite and bring it up to the antenna loop. If the voltage increases then more inductance is required (or more capacitance). If the voltage decreases as the ferrite is brought up to the antenna then the inductance is too great. If no ferrite is to hand then a piece of aluminum sheet may be used for testing in a slightly different way. Opposing currents will flow in the aluminum and it will act as a negative inductance. If the 125kHz AC voltage increases as the aluminum sheet approaches the antenna then the inductance is too high. Note it may be possible that the voltage will first maximize then decrease. This simply means that the antenna is near optimum tuning. If ferrite is used then the coil is a little under value and if aluminum sheet is used then the coil is a little over value. The RF driver includes protection resistors which protect the module against momentary RF shorts. The resistors also make the tuning much less critical and this is deliberate. For production a go/no-go range test is all that is required. Note that the module RF output may be shorted momentarily to ground without damage but heat dissipation may damage the internal drivers if a short is sustained. Be careful to keep the RF pins from shorting to other module pins.

## 26. Error Codes

- '1' **Card Already exists.** The reader is not complying because it has been asked to add a card that is already in the list of authorized cards.
- '2' **Card Does Not Exist.** The reader cannot comply because it has been asked to erase a card from memory a card that does not exist.
- '3' **Memory is Full.** The reader cannot add a card because the memory is full.
- '4' **Nothing to Write.** The reader cannot change the password because nothing has been written to the EEROM temporary password memory. A password must first be stored in EEROM using command 2A.
- '5' **Password Fail.** The password given does not match the reader password.
- '6' **Access Denied.** A command requiring an entry in the EEROM has been received, but the EEROM has been put in the 'Safe' state by command 2E/2F. To enable writes a 2F/4F command must be received.
- '7' **Buffer Overflow.** The command string is too long.
- '8' **Message Length Error.** The command received has too many or too few characters
- '9' **Unknown Command.** An unrecognised command has been received.
- 'A' **CRC Fail.** A valid 4x series command has been received but the CRC is incorrect.

## 27. PIC16xx Assembly Code for CRC Calculation

The following PIC code, adapted from Microchip Application files is suitable for most PIC16Fxx devices. The routine is byte driven, which suits the 4X command structure.

The CRC is applied to the whole command, excluding the STX and ETX control characters. Hexadecimal values, NOT the ASCII values are used. An example is shown below.

Test for CRC for 40123401 = 1E2F, Where:- 40 = Command, 1234 = Address, 01 = Parameter

```

;-----EQUATES-----
        CBLOCK 0X20
                DATA1
                DATA2
                DATA3
                DATA4
                DATA5
                CRC16_LO
                CRC16_HI
                COUNT
                INDEX
        ENDC
;-----CODE-----
LOAD_TEST_DATA  MOVLW          0X40
                MOVWF          DATA1
                MOVLW          0X12
                MOVWF          DATA2
                MOVLW          0X34
                MOVWF          DATA3
                MOVLW          0X01
                MOVWF          DATA4

                ;CCITT STARTING WITH VALUES $FFFF
PERF_CRC1      MOVLW          0XFF
                MOVWF          CRC16_HI
                MOVWF          CRC16_LO

                ;Set UP DATA REFERENCE
                MOVLW          DATA1
                MOVWF          FSR0L          ; FSR on some devices

                ;DATA LENGTH
                MOVLW          4
                MOVWF          COUNT
LOOP          MOVF          INDF0,0          ; or use MOVF  INDIRECT,0  on some devices
                INCF          FSR0L,1        ; or use INCF  FSR,1 on some devices
                CALL          CRC_UPDATE
  
```

	DECFSZ	COUNT,1
	GOTO	LOOP
	RETLW 0	
CRC_UPDATE	XORWF	CRC16_HI,0
	MOVWF	INDEXX
	ANDLW	0XF0
	SWAPF	INDEX,1
	XORWF	INDEX,1
DO_HIGH_BYTE	MOVF	INDEX,0
	ANDLW	0XF0
	XORWF	CRC16_LO,0
	MOVWF	CRC16_HI
	RLF	INDEX,0
	RLF	INDEX,0
	XORWF	CRC16_HI,1
	ANDLW	0XE0
	XORWF	CRC16_HI,1
	SWAPF	INDEX,1
	XORWF	INDEX,0
	MOVWF	CRC16_LO
	RETLW 0	

Note. The code shown is for the enhanced PIC16Fxxx series. The only changes for the old series are:-

INDF0,0 becomes Indirect,0

FSROL becomes FSR

## 28. Calculated Values of CRC for Testing

The following tables for series 4x commands are included to aid rapid system testing and development. The reader address is taken as 1234 in most examples.

CMD	CRC
<b>40</b> Send Card	STX 40 1234 00 <b>0E0E</b> ETX
<b>40</b> Send only New Card	STX 40 1234 01 <b>1E2F</b> ETX
<b>41</b> Perform a Strike Cycle	STX 41 1234 04 <b>383E</b> ETX
<b>42</b> Perform a Beeper Cycle	STX 42 1234 08 <b>626E</b> ETX
<b>43</b> All Interfaces Allowed	STX 43 1234 00 <b>95D2</b> ETX
<b>43</b> CRC Interface Only	STX 43 1234 03 <b>A5B1</b> ETX
<b>44</b> Set Channel1 High	STX 44 1234 01 <b>D4DE</b> ETX
<b>44</b> Set Channel1 Low	STX 44 1234 00 <b>C4FF</b> ETX
<b>45</b> Set Channel2 High	STX 45 1234 00 <b>B24B</b> ETX
<b>45</b> Set Channel2 Low	STX 45 1234 01 <b>A26A</b> ETX
<b>46</b> Allow Local Control of Channel1	STX 46 1234 00 <b>2997</b> ETX
<b>46</b> Inhibit Local Control of Channel1	STX 46 1234 01 <b>39B6</b> ETX
<b>47</b> Set Strike Time 0.5 Sec	STX 47 1234 08 <b>DE2B</b> ETX
<b>47</b> Set Strike Time 2.0 Sec	STX 47 1234 F0 <b>B03C</b> ETX
<b>48</b> Read EEROM	STX 48 1234 5050FFA002 <b>35D7</b> ETX
<b>49</b> Write Poll Address 0001	STX 49 0001 5050FFA002 <b>4911</b> ETX
<b>49</b> Write Poll Address 1234	STX 49 1234 5050FFA002 <b>7204</b> ETX
<b>4A</b> Add a Card	STX 4A 1234 9876543210 <b>9AA4</b> ETX
<b>4B</b> Subtract a Card	STX 4B 1234 9876543210 <b>DD77</b> ETX
<b>4C</b> Change Password to 3333333333	STX 4C 1234 3333333333 <b>37E6</b> ETX
<b>4D</b> Confirm Old Password 5050FFA002	STX 4D 1234 5050FFA002 <b>7D69</b> ETX
<b>4C</b> Change Password to 5050FFA002	STX 4C 1234 5050FFA002 <b>3ABA</b> ETX
<b>4D</b> Confirm Old Password 3333333333	STX 4D 1234 3333333333 <b>7035</b> ETX
<b>4E</b> Put EEROM in Safe State	STX 4E 1234 5050FFA002 <b>B51C</b> ETX
<b>4F</b> Unsafe EEROM State	STX 4F 1234 5050FFA002 <b>F2CF</b> ETX

## 29. Useful information

### The Bray++ Terminal

For general testing we suggest the user downloads a terminal program free from the internet. Here is one particularly good one to consider: <http://sites.google.com/site/terminalbpp/> Truly an excellent piece of software. If this is hard to get try a search for Bray 1.9b 20100630. This version is good but any version will be also acceptable.

### Technical Queries

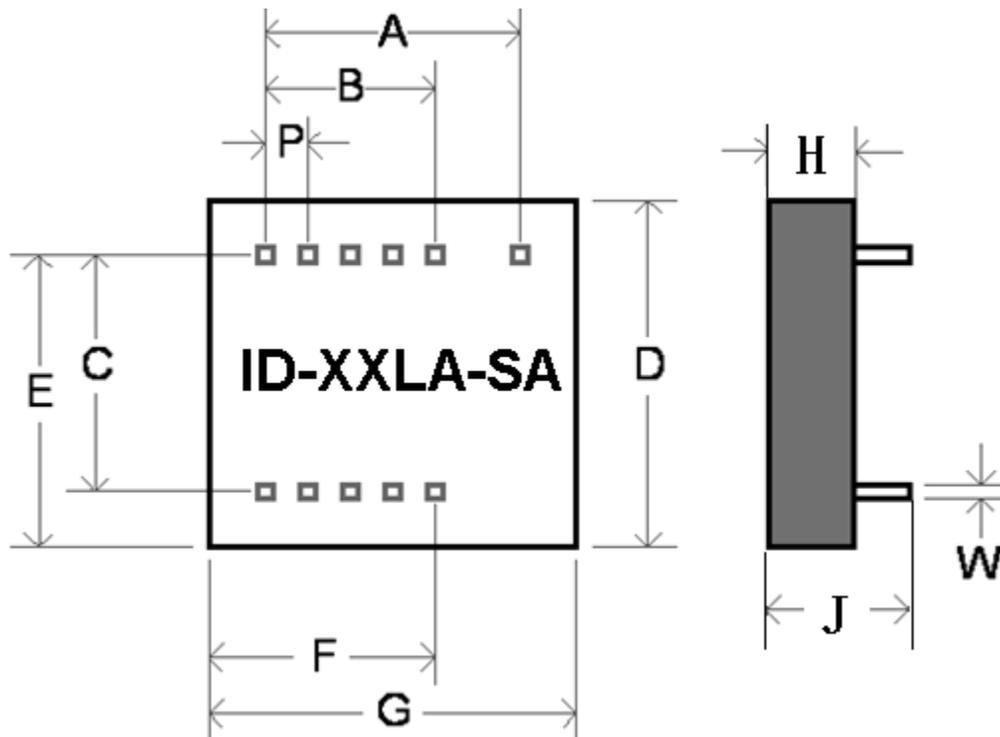
If you have any technical queries please contact your local distributor, they have all the technical resources to help you and support you. Where no local distributor exists, our technical helpline may be contacted by writing to [help@ID-Innovations.com](mailto:help@ID-Innovations.com)

Please state your geographic region, the module serial number and where you obtained it.

### Q & A

Questions and answers to technical problems are available on line at [ID-Innovations.Com](http://ID-Innovations.Com). Customer feedback is *always* appreciated.

### 30. Case Dimensions for ID-xxSA



	ID-3LA-SA			ID-12LA-SA			ID-20LA-SA		
	Nom	Min	Max	Nom	Min	Max	Nom	Min	Max
<b>A</b>	12.0	11.6	12.4	12.0	11.6	12.4	12.0	11.6	12.4
<b>B</b>	8.0	7.6	8.4	8.0	7.6	8.4	8.0	7.6	8.4
<b>C</b>	15.0	14.6	15.4	15.0	14.6	15.4	15.0	14.6	15.4
<b>D</b>	20.5	20.0	21.5	25.3	24.9	25.9	40.3	40.0	41.0
<b>E</b>	18.5	18.0	19.2	20.3	19.8	20.9	27.8	27.5	28.5
<b>F</b>	14.0	13.0	14.8	16.3	15.8	16.9	22.2	21.9	23.1
<b>G</b>	22.0	21.6	22.4	26.4	26.1	27.1	38.5	38.2	39.2
<b>P</b>	2.0	1.8	2.2	2.0	1.8	2.2	2.0	1.8	2.2
<b>H</b>	5.92	5.85	6.6	6.0	5.8	6.6	6.8	6.7	7.0
<b>J</b>	9.85	9.0	10.5	9.9	9.40	10.5	9.85	9.4	10.6
<b>W</b>	0.66	0.62	0.67	0.66	0.62	0.67	0.66	0.62	0.67

All Dimensions in mm

## 31. Contact Information

### Head Office—Australia

ID Innovations

21 Sedges Grove

Canning Vale, W.A. 6155

Telephone: +61 8 94554615

Fax: +61 8 94553615

## 32. Important Safety Notice

*Never use this reader in applications of sustaining life, for locks on medical cabinets or any application where power failure or reader failure can cause bodily harm, damage, injury or loss.*

*It is ESSENTIAL that there is always an alternative method of readily opening the lock such as a key in case of a power failure, or a reader failure. Never rely wholly on the card reader to operate a lock.*

*Most strikes on sale offer the user a choice of fail safe and fail open and it is up to the user to choose the correct strike for the application.*

## Disclaimer

The information in this document is provided solely for the use of ID Innovations' products. There are no express or implied copyright licenses or intellectual property rights granted to design or fabricate any of ID Innovations' products based on the information provided in this document.

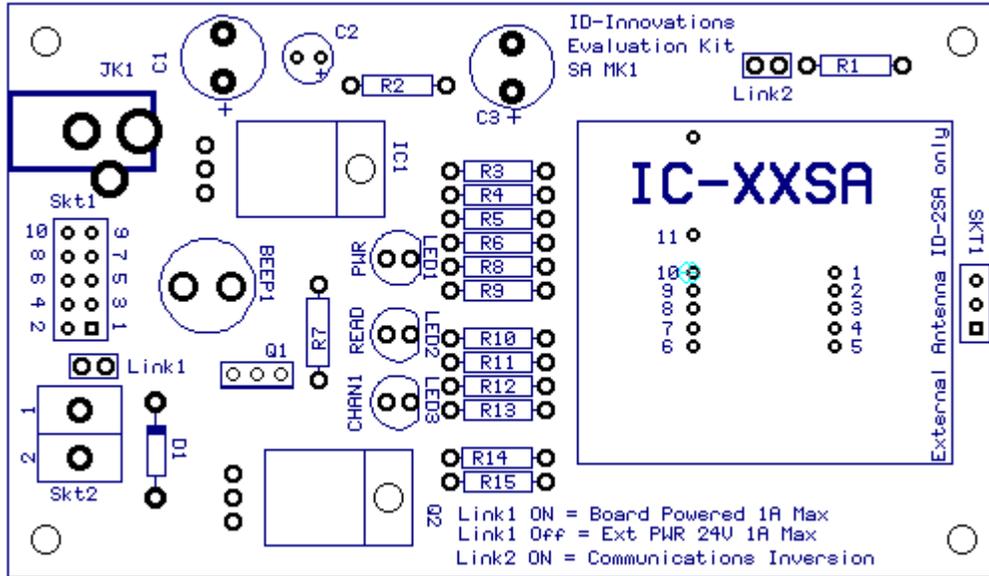
ID Innovations reserves the right to make changes to specifications and product descriptions at any time without notice. The specifications provided in ID Innovations' datasheets can and do vary in different applications and actual performance may vary over time.

ID Innovations' products are not intended for and will not be used in life support systems, human implantation, nuclear facilities or systems or any other application where product failure could lead to loss of life or catastrophic property damage.

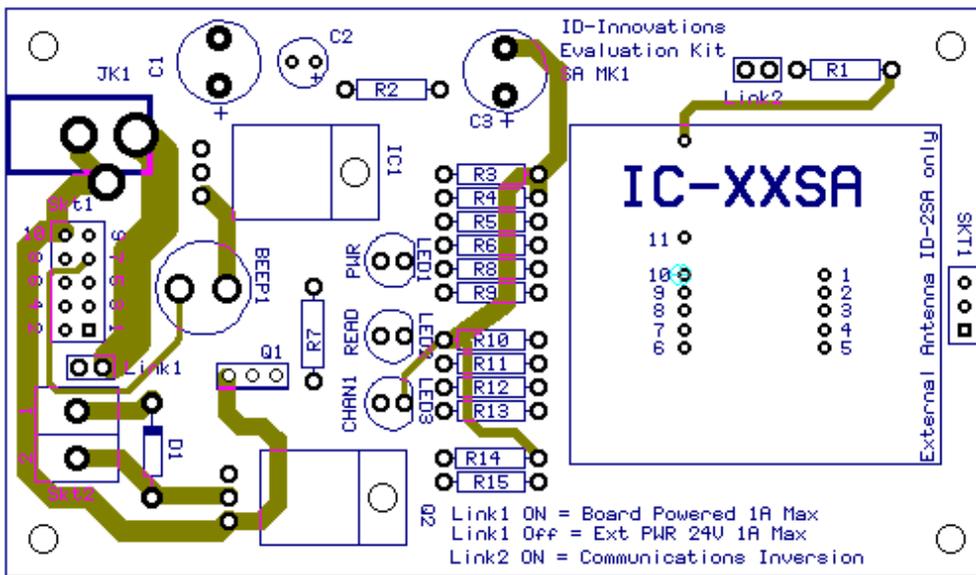
ID Innovations makes no warranty, representation or guarantee regarding the suitability of its products for any purpose, and it assumes no liability, whether claim, loss, damage or expense of any kind caused in whole or in part, directly or indirectly by the inadequacy of any products for any purpose, any infringement, deficiency or defect in any products whether or not covered by any manufacturer's warranty, the use or performance of any products, any interruption or loss of service, or any special, direct, indirect, incidental or consequential damage, including, without limitation, personal injury or loss of business or profit, or other damage, whether or not ID Innovations has been informed of the possibility or likelihood of such or any other damages, arising out of the application or use of any product and information provided.

## Appendix A

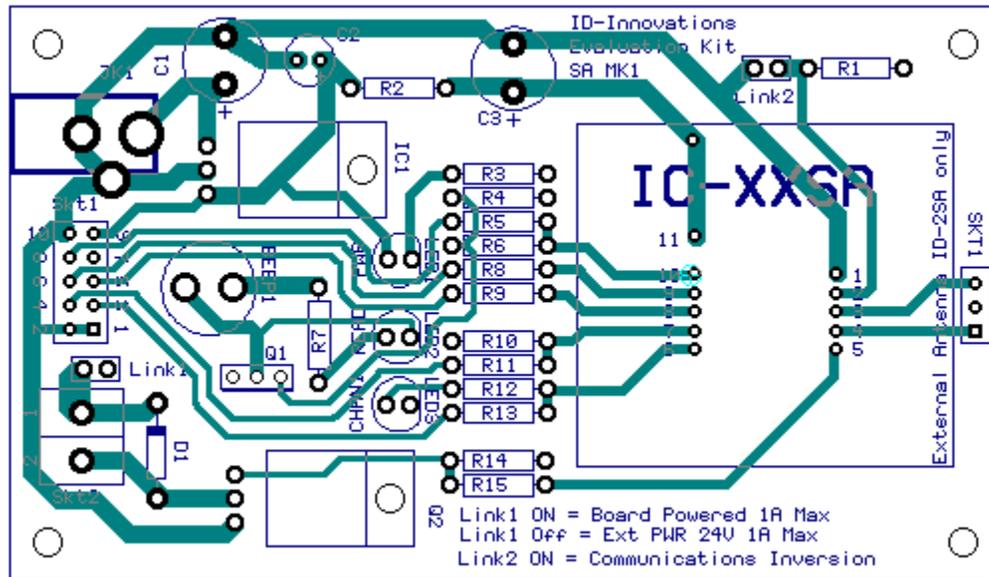
### PCB Component Layer for Test Board



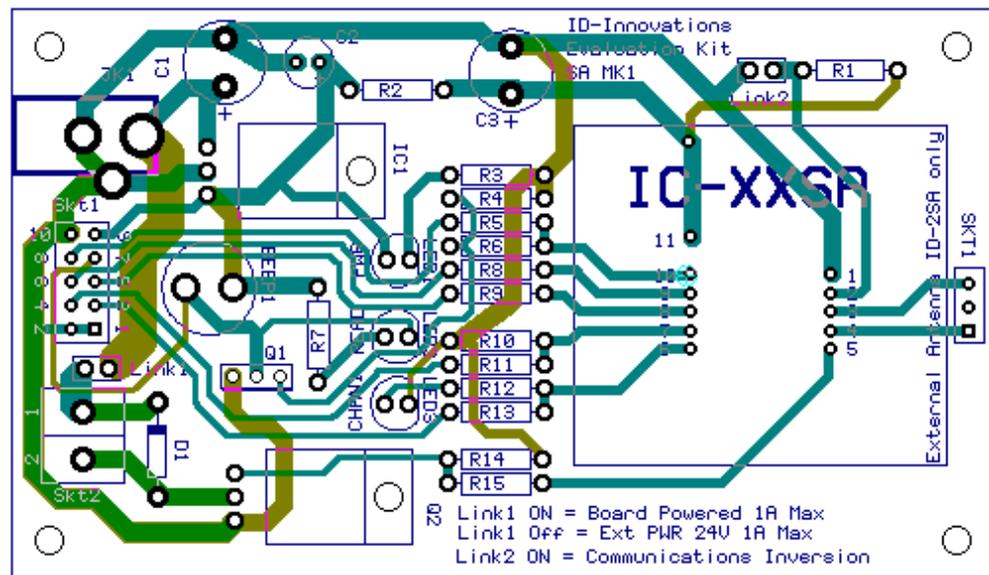
### PCB Top Copper Layer for Test Board



### PCB Bottom Copper Layer for Test Board



### PCB Top and Bottom Layers of Test Board



## Index

Index ( A-B )		Section
A		
Add Card		
	Test Command Set Summary	16.2
	Add Card [STX][70][Password][ETX]	16.3.1
	Add Card [STX][Address][CARDID][ETX]	17.3.8
	Add Card [STX][Address][CARDID][CRC][ETX]	17.3.8
Aluminum Foil	Designing Coils for ID-3LA-SA	24
Antenna	Designing Coils for ID-3LA-SA.	24
Assembler	PIC16xx Assembly Code for CRC Calculation.	27
Assign		
Assign Channel1 [STX] [79] [Parameter] [ETX]		16.3.10
Assign Strike Mode [STX] [7A] [Parameter] [ETX]		16.3.11
Assign Strike [STX][22][Address][Parameter][ETX]		17.3.3
Assign Strike [STX][ [22][Address][Parameter][CRC][ETX]		17.3.3
ASCII	(American Standard for Information Interchange)	
	The TEST Command Set Introduction	16
	Reader Responses to Polled Commands	18
	TEST Command Reader Responses Description	16.4
Autonomous	Normal operation (Autonomous Mode).	10
Auxiliary	Pin Description Summary	4
Auxiliary Channel1		6

Auxiliary Channel2		6
B		Sections
Baud Rate		
Device Specification,		
Baud Rate = 9600, 8 Data, No Parity		8
	Normal Mode Output Data Format	10
	Connecting to a Host Computer.	12.1
Beeper		
	Device Overview	2
	Pin Out ID-3LA-SA	3.1
	Pin Out ID-12LA-SA, ID-20LA-SA	3.2
	Pin Description Summary	4
	Pin Description detail	5
	Absolute Maximum Ratings	9
	Recommended Circuit Diagram for the ID-3LA-SA, ID-12LA-SA, ID-20LA-SA	6.1
Bray Terminal Connecting to Host Computer		12.1.
<b>Index (C-N)</b>		
C		
Change Password	Test Command Set Summary	16.2
CHANGE Password	[STX] [75] [NEW Password] [ETX]	16.3.6
	Polled Commands Sets Summary	17.3.1
CHANGE Password	[STX][ [2C] [Address] [NEW Password] [ETX]	17.3.11
	[STX][ [4C] [Address] [NEW Password] [CRC] [ETX]	17.3.11
Calculated Values of CRC for Testing		28
Command Strings		17.3
Command Strings		17.13.1
Command Code Field	STX][Command Code FIELD][Parameter FIELD][ETX]	17.1
Confirm Password	Polled Command Sets Summary	17.2

	[STX][ 2C] [Address] [NEW Password] [ETX]	17.3.10
	[STX][ 4C] [Address] [NEW Password] [CRC] [ETX]	17.3.10
	[STX][ 2D] [Address] [OLD Password] [ETX]	17.3.11
	[STX][ 4D] [Address] [OLD Password] [CRC] [ETX]	17.3.11
CRC	PIC16xx Assembly Code for CRC Calculation	27
D		
Data Format	Normal Mode Output Data Format	11
Data Settings		11
DB9 Socket Standard Connections To a DB9 Socket	9600 Baud, 8 Data Bits, 1 Stop Bits, No Parity	23.6
Designing Coils for the ID-3LA-SA		24
Device Specifications		8
E		
EEROM		
	Description	13
	Summary	13.1
	Byte4 – General Purpose Flag	14
Error Codes 26.		
F		
Factory Reset		20
I		
Interference	Design Considerations	7
L		
Logging In		12.2
Logging Out		12.2
Login [STX] [70] [Password] [ETX]		16.3.1
Logout [STX] [71] [ETX]		16.3.2
Logging in		12.2
<b>Index (M–U )</b>		

M		Sections
MAX232 Connections to a MAX232		23.1
MAX485 Connections to a MAX485		23.2
MAX232 Design Considerations		7
N		
Normal Mode Operation		11.
O		
Overview	Device Overview	2
P		
PCB Test Board		See Appendix A
PIC16Fxx Assembly Code for 16 bit CCITT CRC Calculation		27
Pin Description Detail		5
Pin Description Summary		4
Polled Commands Introduction		17
Polled Command Set Summary		17.2
	General Format for 2x and 4x Series Polled Commands	17.3
R		
TEST Command Reader Responses Description.		16.4
S		
Safe EEROM		17.3.12
Send Card or Data [STX] [20]1 [Address] [Parameter] [ETX]		17.3.1
Set Strike Period [STX] [76] [Strike Period] [ETX]		16.3.5
System Response [STX][23] [Address] [Parameter] [ETX]		17.3.4
Security Issues		21
Standard Connections To a DB9 Socket		23.6

T		Sections
Tuning The ID-3LA-SA		25
U		
Unsafe EEROM		17.3.13