

## ID-3LA Reader Module

### Advanced RFID Reader Technology



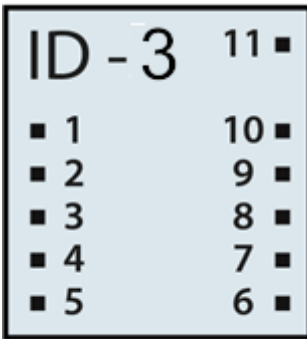
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## 1. Overview

ID-3LA is a small footprint reader module that uses an external antenna and has read ranges up to 30cm using Innovations Clamshell cards. The reader supports ASCII, Wiegand26 and Magnetic ABA Track2 data formats.

## 2. Pin Out ID-3LA (standard)



**Bottom View**

Fig. 1

1. GND
2. RES (Reset Bar)
3. ANT (Antenna)
4. ANT (Antenna)
5. CP
6. Tag in Range (Future)
7. +/- (Format Selector)
8. D1 (Data Pin 1)
9. D0 (Data Pin 0)
10. Read (LED / Beeper)
11. +2.8V thru +5V



## 3. Devices Operational and Physical Characteristics

Parameter	ID-3LA
Approx. Case Dimensions	20.5 mm x 22 mm x 6.2 mm
Frequency	125 kHz
Card Format	EM 4001 or compatible
Encoding	Manchester 64-bit, modulus 64
Power Requirement	+2.8 thru +5 VDC
I/O Output Current	+/- 200mA PK

## 4. Data Formats

Output Data Structure - ASCII - 9600 Baud, No Parity, 1 stop bit.

Output = CMOS (Push Pull) 0-Vdd

STX (02h)	DATA (10 ASCII)	CHECK SUM (2 ASCII)	CR	LF	ETX (03h)
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Example for Calculation of Checksum for Output type '1'

Suppose the output Data is 0C000621A58E

Here the actual data is 0C,00,00,06,21,A5 and the checksum is 6E

Using binary we Exclusive OR the bit columns

```

0C   =   00001100
00   =   00000000
06   =   00000110
21   =   00100001
A5   =   10100101
    
```

CHECKSUM = 10001110 = 8E

**Output Data Structure - Wiegand26 – 1mS repeat, 50uS pulse. Open Drain**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
P	E	E	E	E	E	E	E	E	E	E	E	E	O	O	O	O	O	O	O	O	O	O	O	O	O	P
Even parity (E)													Odd parity (O)													

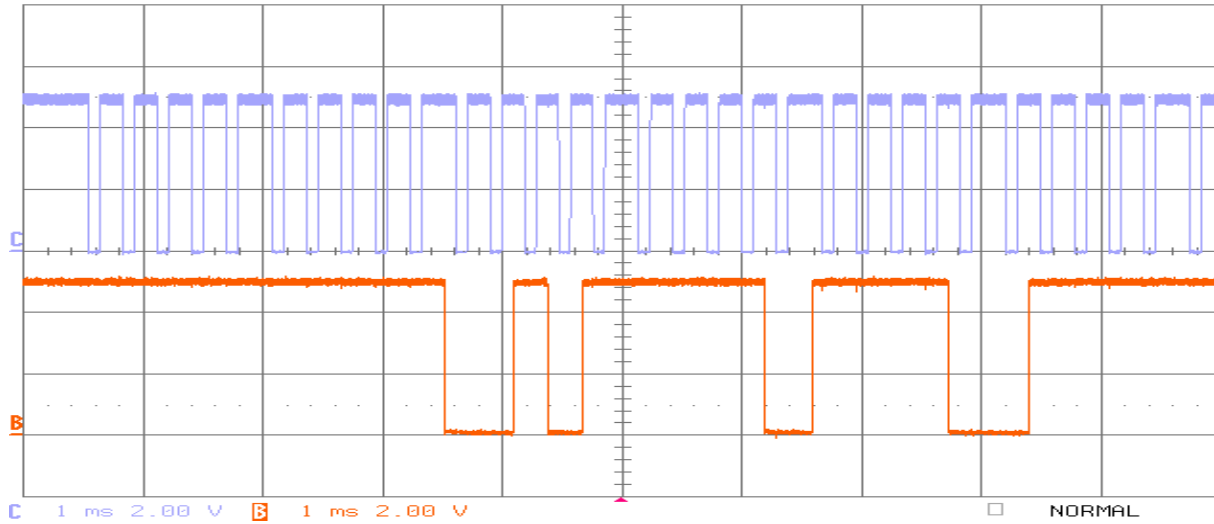
P = Parity start bit and stop bit

**Output Data Magnetic ABA Track2 – At Approx. 80cm/sec. Open Drain**

10 Leading Zeros	SS	Data	ES	LCR	10 Ending Zeros
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[SS is the Start Character of 11010, ES is the end character of 11111, and LRC is the Longitudinal Redundancy Check.]

## 5. Magnetic Emulation Waveforms



Blue = Clock, Brown = Data

Fig. 3

### Start and End Sequences for Magnetic Timing

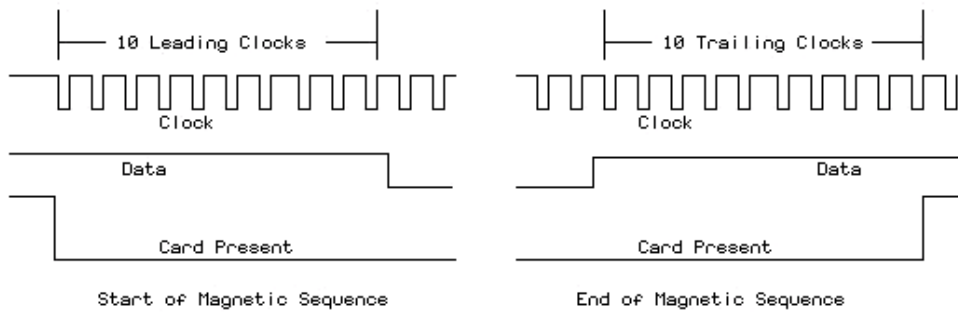


Fig. 4

### Data Timings for Magnetic Emulation

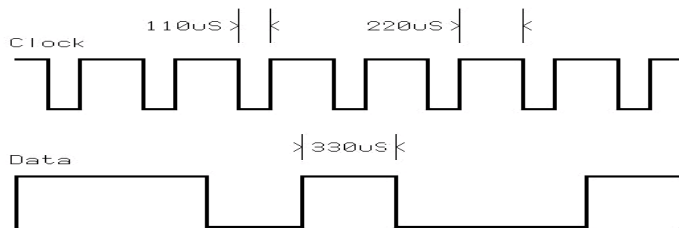


Fig. 5

The magnetic Emulation Sequence starts with the Card Present Line going active (down). There next follows 10 clocks with Zero '0' data. At the end of the 10 leading clocks the start character (11010) is sent and this is followed by the data. At the end of the data the end character is sent followed by the LCR. Finally 10 trailing clocks are sent and the card present line is raised.

The data bit duration is approximately 330uS. The approximate clock duration is 110uS. Because of the symmetry data can be clocked off either the rising or falling edge of the clock.

## 6. Pin Description & Output Data Formats

Pin #	Description	ASCII	Magnet Emulation	Wiegand26
Pin 1	Zero Volts and Tuning Capacitor Ground	GND 0V	GND 0V	GND 0V
Pin 2	Strap to Pin11	Reset Bar	Reset Bar	Reset Bar
Pin 3	To External Antenna and Tuning Capacitor	Antenna	Antenna	Antenna
Pin 4	To External Antenna	Antenna	Antenna	Antenna
Pin 5	Card Present	No function	Card Present*	No function
Pin 6	Tag in Range (Future)	Tag in Range	Tag in Range	Tag in Range
Pin 7	Format Selector (+/-)	Strap to GND	Strap to Pin 10	Strap to +5V
Pin 8	Data 1	CMOS	Clock*	One Output*
Pin 9	Data 0	TTL Data (inverted)	Data*	Zero Output*
Pin 10	3.1 kHz Logic	Beeper / LED	Beeper / LED	Beeper / LED
Pin 11	DC Voltage Supply	+2.8 thru 5V	+2.8V thru 5V	+2.8V thru 5V

\* Requires 4K7 Pull-up resistor to +5V

## 7. Absolute Maximum Ratings

Maximum voltage applied to Pin 2	(Vcc)	5.4volt
Maximum voltage applied to Pin 2	(Reset)	Vcc + 0.7v, -0.7v
Maximum current drawn from Pin 3 (	Antenna)	+/- 75mA
Maximum 125 KHz RF Voltage at Pin 4	(Antenna)	+/- 80volt Peak
Maximum current drawn from Pin 5	(Card Present)	+/- 5mA
Maximum current drawn from Pin 6	(Tag in Range)	+/- 5mA
Maximum Voltage at Pin 7	(Format Selector)	Vcc + 0.7v, -0.7v
Maximum current drawn from Pin 8	(Data1)	+/- 5mA
Maximum current drawn from Pin 9	(Data0)	+/- 5mA
Maximum current drawn from Pin 10	(Beeper)	+/- 10mA
Additionally, Pins 5, 6, 7, 8, 9 & 10 may not have a voltage exceeding		Vcc + 0.7v, -0.7v

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

## 8. Circuit Diagram for the ID-3LA

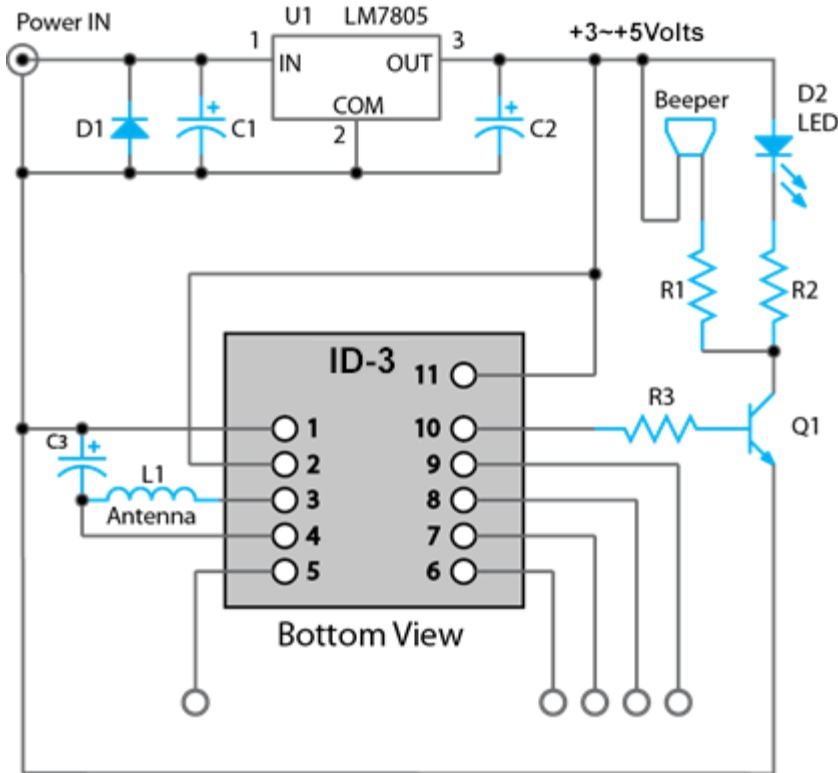


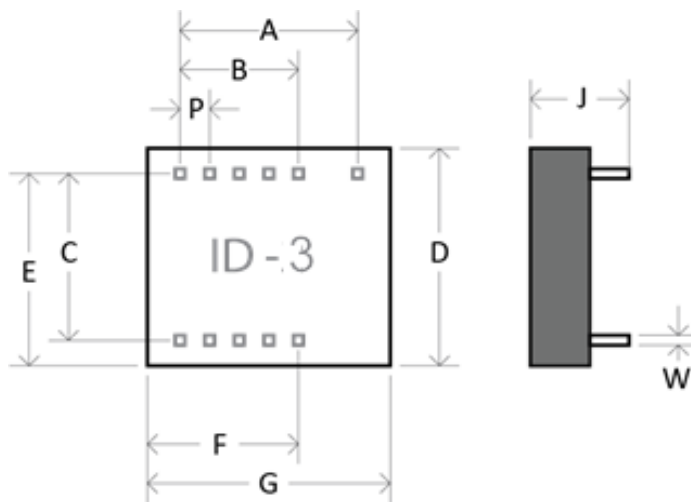
Fig. 6

Parts List	
Part #	Value Max.
R1	100R
R2	4K7
R3	2K2
C1	10uF 25v electrolytic
C2	1000uF 10v electrolytic
C3	Only used if L1 is less than 1.337mH*
Q1	BC457 or similar
D1	1N4001
D2	Red or Green LED
L1	1.337mH
Beeper	2.7khz – 3kHz 5v PKPK AC

\* See Sections 12 & 13

## 9. Dimensions (mm)

ID-3LA			
	Nom.	Min.	Max.
A	12.0	11.6	12.4
B	8.0	7.6	8.4
C	15.0	14.6	15.4
D	20.5	20.0	21.5
E	18.5	18.0	19.2
F	14.0	13.0	14.8
G	22.0	21.6	22.4
P	2.0	1.8	2.2
H	5.92	5.85	6.6
J	9.85	9.0	10.5
W	0.66	0.62	0.67



## 10. Connection direct to a computer

Direct connection to a computer RS232 can be made by connecting Pin8 to a 1k series resistor and connecting the other end of the resistor to the computer RS232 input. The mode is called pseudo RS232. On a standard D9 socket, connect the output of the ID-3LA via the series 1k to pin 2 of the D-type. Connect the ground to Pin5 on the D-type. Leave the TX pin3 open. See “Useful Information” below for free terminal download information.

Note that a +2.8v rail will result in the data outputs having a lower swing and may not be suitable for all computers.

### 10.1 Connection to a Processor UART

Direct connection to a computer RS232 can be made by connecting Pin8 via a 1k series resistor to the computer RS232 input. The mode is called pseudo RS232. On a standard D9 socket, connect the output of the ID-3LA via the series 1k to pin 2 of the D-type. Connect the ground to Pin5 on the D-type. Leave the TX pin3 open. See “Useful Information” below for free terminal download information.

### 10.2 Connecting a Read LED

Sometimes the user may not want to drive a beeper but may still need to drive an LED. In this case a driver transistor may not be necessary because the Beeper Output Pin can supply 5mA continuously. Connect a 1k5 resistor to the Beeper Pin. This will limit the current. Connect the other end of the resistor to the LED anode and connect the cathode to ground.

## 11. Useful information

For general testing we suggest the user downloads a terminal program free from the internet. Here is one particularly good one to consider:

<http://braypp.googlepages.com/terminal> - Truly an excellent piece of software, the best terminal we have ever seen.

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)



## 12. Designing Coils for ID-3LA

The recommended Inductance is 1.337mH to be used with the internal tuning capacitor of 1n2. In general the bigger the antenna the better, provided the reader is generating enough field strength to excite the tag. The ID-3LA is relatively 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.

Long read ranges, up to 30cm and more, can be achieved with Innovations Long Range Clamshell Cards using 10x10cm Antennas. 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 after which a degree of 'Try it and see' is unavoidable. If the reader is located in a position where there is a lot of heavy interference then less range cannot be avoided. In this situation the coil should be made smaller to increase the field strength and coupling. 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 71 turns on a 120mm diameter former gave an inductance of 1.33mH.

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-2 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 the experimenter has an inductance meter that works at 100 KHz then he can adjust the inductance back to 1.337mH by winding extra turns. Failing this an external capacitance, C3, 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 has an internal capacitor of 1N2, which perfectly tunes the recommended inductance of 1.337mH, but if the inductance is less than this a compensating capacitor 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.

**Warning.** Do not exceed the stated maximum voltages and currents for the ID-3LA RF output.

Anybody who wishes 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 to suck it and see. <http://ww1.microchip.com/downloads/en/AppNotes/00831b.pdf>

### 13. The Tuning Capacitor

*Note. Tuning capacitors are only required for the ID-3LA module if a 1.337mH antenna is not used. It is recommended that the internal 1n2 capacitor is used for tuning, however a capacitor may be also be added externally if an external antenna of less than 1.337mH is used. The combined capacitance should not exceed 2n7. Do not forget that the choice of tuning capacitor can also substantially affect the quality of your system.*

The loss in the series antenna is required to be fairly high to limit the series current. A low Q will hide a lot of the shortcomings of the capacitor, but for quality and reliability and repeatability the following capacitors are recommend.

Polypropylene	***	Good.	Readily available. Ensure AC voltage at 125kHz is sufficient.
COG/NPO	*****	Excellent.	Easily best Choice. Ideal for SMD mass production.
Silver Mica	**	Very Good.	Very expensive, large, difficult to procure.
Polycarbonate	**	Good.	Readily available. Ensure AC voltage at 125kHz is sufficient.

### 14. Capacitor Working Voltage

A capacitor capable of withstanding the RMS voltage at 125kHz MUST be chosen. The working voltage will depend on the coil design. I suggest the designer start with rugged 1n5 Polypropylene 630v capacitor to do his experiments and the come down to a suitable size/value. The capacitor manufacturer will supply information on their capacitors. Do not simply go by the DC voltage, this means little. A tolerance of 5% is acceptable. COG capacitors are getting less expensive and are excellent. Normally with COG capacitors the permitted AC is 2x the DC rating.

### 15. Fine Tuning

We recommend using an oscilloscope for fine-tuning. 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 you need more inductance (or more capacitance). If the voltage decreases as you bring the ferrite up to the antenna then the inductance is too great. If you have no ferrite then a piece of aluminium sheet may be used for testing in a slightly different way. Opposing currents will flow in the aluminium and it will act as a negative inductance. If the 125kHz AC voltage increases as the aluminium 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 you are near optimum tuning. If you are using ferrite then the coil is a little under value and if you are using an aluminium sheet then the coil is a little over value.

## 16. ID-3LA Compatibility Issues with the ID-2

The ID-3LA is 100% pin compatible and supply voltage compatible with the ID-2 and its read and output data functionality is also 100% compatible, the only difference is the RF drive power and tuning.

The original ID-2 employed an internal 1n5 (0.0015uF) capacitor and an external 1.07mH search coil, the ID-3LA employs an internal 1n2(0.0012uF) capacitor and an external 1.337mH search coil.

The ID-3LA has a greater RF drive than the ID-2 and the internal tuning capacitor (1n2) requires an external antenna inductance of 1.337mH. If this value inductance is used an external tuning capacitor is not required.

Note that the original ID-2 search coil (value 1.07mH) may still be used if a 180pF or a 220pF external capacitor is added across pins 1 and 4. As with the ID-2, the ID-3LA internal tuning capacitor can be accessed on pins 1 and 4. If an external capacitor is added it should be a 100v 180pF COG or a 100v 220pF COG. Note that COG dielectric is considered near perfect capacitor and a 100v DC rating is sufficient.

The ID-3LA RF output drive is greater than the ID-2 RF drive. Users wishing to migrate to the ID-3LA should ensure that the RF voltage and current limits are not exceeded.

## 17. Contact Information

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