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ID-2LA, ID-12LA, ID-20LA
Low Voltage Series
Reader Modules

Datasheet Version 1.0 Date 09/01/13





Content

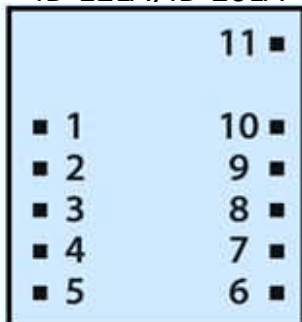
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1. Overview

ID2-LA, ID12-LA and the ID20-LA series are small footprint 2.8-5.0volt reader modules that support ASCII, Wiegand26 and Magnetic ABA Track2 data formats. The modules are pin and function compatible with the ID2/12/20 series.

2. Pin Out for ID12-LA and ID20-LA

ID-12LA, ID-20LA

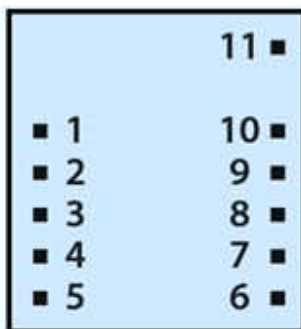


Bottom View

1. GND
2. RES (Reset Bar)
3. NC
4. NC
5. CP
6. Tag in Range
7. Format Selector
8. D1 (Data Pin 1)
9. D0 (Data Pin 0)
10. Read (LED / Beeper)
11. +2.8V thru +5.0V



ID-2LA



Bottom View

1. GND
2. RES (Reset Bar)
3. ANT (Antenna)
4. ANT (Antenna)
5. CP
6. Tag in Range
7. Format Selector
8. D1 (Data Pin 1)
9. D0 (Data Pin 0)
10. Read (LED / Beeper)
11. +2.8V thru +5.0V





3. Device Operational Characteristics

| Parameter | ID-2LA, ID-12LA, ID-20LA |
|-----------------------|---|
| Frequency | 125 kHz nominal |
| Card Format | EM 4001 or compatible |
| Read Range ID3 | Up to 30 using suitable antenna using ID-Innovations clamshell card @5v |
| Read Range ID13 | Up to 12cm using ISO card, up to 18cm using ID-Innovations clamshell card @5v |
| Read Range ID23 | Up to 18cm using ISO card, up to 25cm using ID-Innovations clamshell card @5v |
| Encoding | Manchester 64-bit, modulus 64 |
| Power Requirement | +2.8 VDC thru +5 VDC @ 35mA ID-13, 45mA ID-23 |
| RF I/O Output Current | +/- 200mA PKPK |

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) |
|-----------|-----------------|---------------------|----|----|-----------|

Example for Calculation of Checksum for ASCII

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) | | | | | | | | | | | | | |

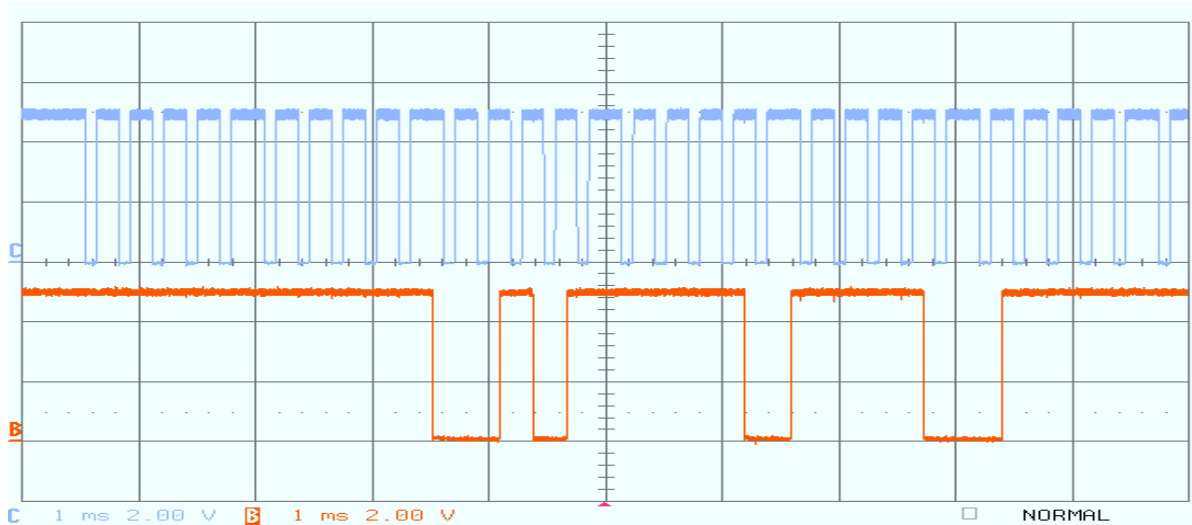
P = Parity start bit and stop bit

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

| | | | | | |
|------------------|----|------|----|-----|-----------------|
| 10 Leading Zeros | SS | Data | ES | LCR | 10 Ending Zeros |
|------------------|----|------|----|-----|-----------------|

[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

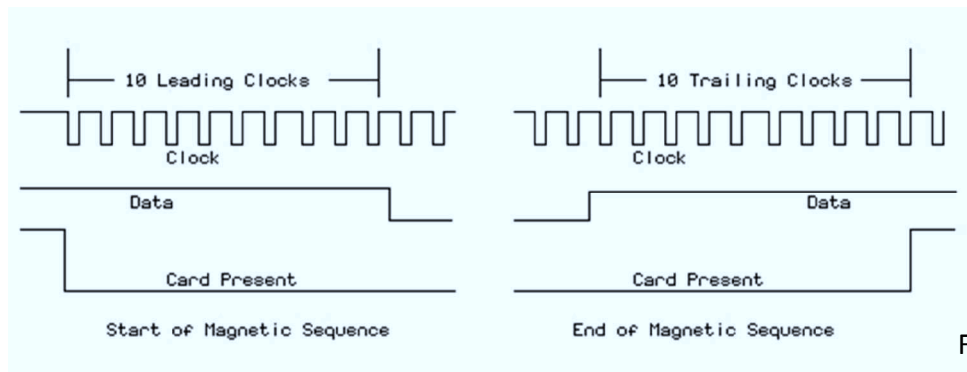


Fig. 4

Data Timings for Magnetic Emulation

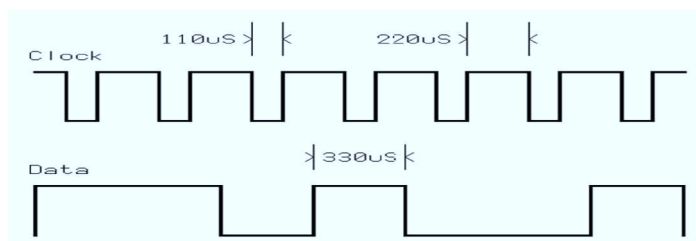


Fig. 5

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 330µs. The approximate clock duration is 110µs. 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 | GND 0V | GND 0V | GND 0V |
| Pin 2 | Strap to Pin11 | Reset Bar | Reset Bar | Reset Bar |
| Pin 3 | To External Antenna ID-2LA only | Antenna | Antenna | Antenna |
| Pin 4 | To External Antenna ID-2LA only | 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

Pin1 is the zero volts supply pin and the communications common ground.

Pin2 is used in manufacture and should be strapped to pin11 at all times.

Pin3 is only connected on the ID-2LA and it should be connected to an external antenna of 1.337mH. On the ID-12LA and ID-20LA modules pin3 should be left blank.

Pin4 is only connected in the ID-3. It should be connected to an external antenna. It should be left blank on the ID13 and ID23 modules.

Pin5 is only used as a 'Card Present' output when the output format is set to Magnetic Emulation. For timings see the 'Magnetic Emulation Waveforms in section 5.

Pin6 is used as a 'Tag in Range' indicator. When a tag is in range the pin is set to VDD voltage else it is at 0v. Pin6 output has an internal 3K3 resistor and may be used to drive an LED directly.

Pin7 is the format selector. The format selector selects the format depending where it is connected. See table above. Note that the output format is decided at switch on and cannot be changed later.

Pin8 has alternate functions. When the output format is set to Magnetic Emulation pin8 is used as the 'Clock' output. For timings see the 'Magnetic Emulation Waveforms in section 5. The alternate mode is active when the output format is set to ASCII and pin8 then outputs the ASCII data. Pin 8 may be used to connect to a computer RS232 input. See section on connecting to a computer.

Pin9 is active when the output format is set to ASCII and it outputs complementary (inverted) ASCII data output. Pin 9 is also suitable for connection to a UART.

Pin10 is the beeper out pin. When the beeper is active pin10 delivers an output square wave of approximately 3.3KHz. The pin is not buffered and cannot be used to drive a beeper directly.



Pin11 is the DC supply pin. The supply voltage must be free from noise and preferably from a linear regulator with less than 3mV PKPK noise. Many modern regulators have noise below 100uV RMS and these are ideal. See the section on choice of power supply.

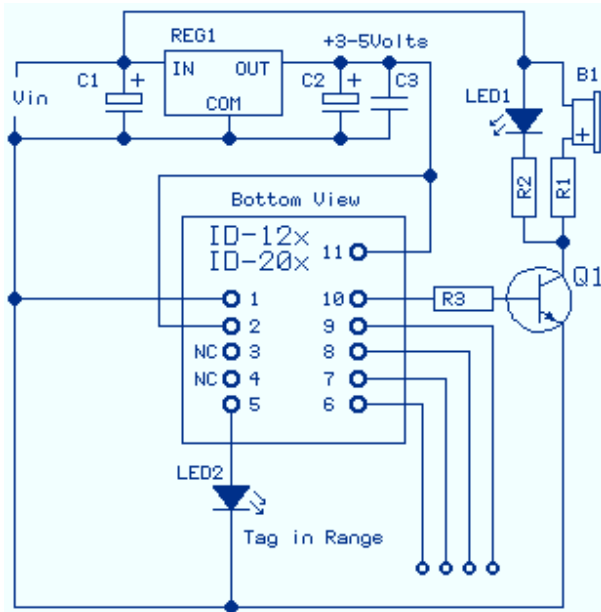
7. Absolute Maximum Ratings

| | | |
|--|-------------------|-------------------|
| Maximum voltage applied to Pin 2 | (Vcc) | 5.5volt |
| 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.

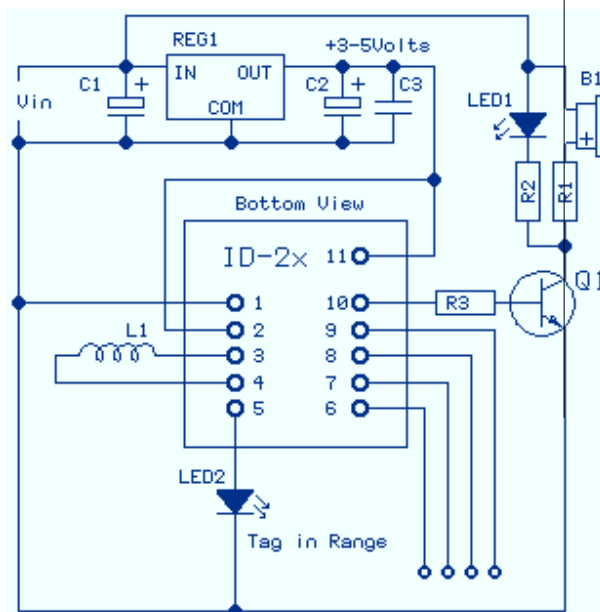
8. Circuit Diagram

8.1 Circuit Diagram for ID-12LA, ID-20LA



| Parts List | |
|------------|--------------------------|
| Part # | Value |
| R1 | 100R |
| R2 | 4K7 |
| R3 | 2K2 |
| C1 | 10uF 25v electrolytic |
| C2 | 1000uF 10v electrolytic |
| C3 | 100nF |
| Q1 | BC457 or similar |
| LED1 | Read LED |
| LED2 | Tag In Range LED |
| B1 | 2.7kHz – 3kHz 5v PKPK AC |

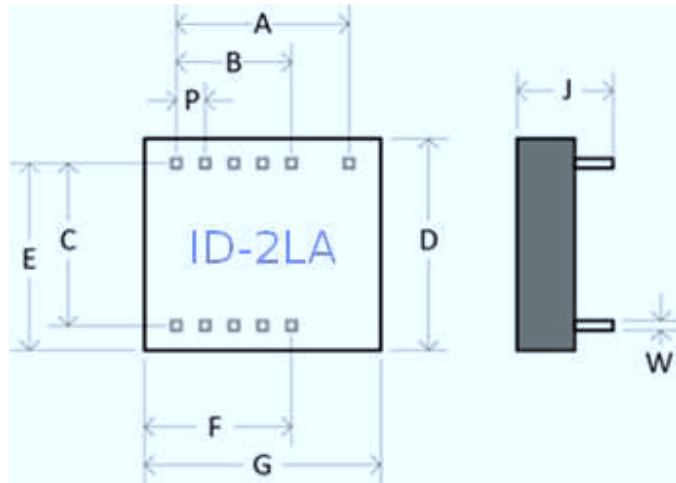
8.2 Circuit Diagram for ID-2LA



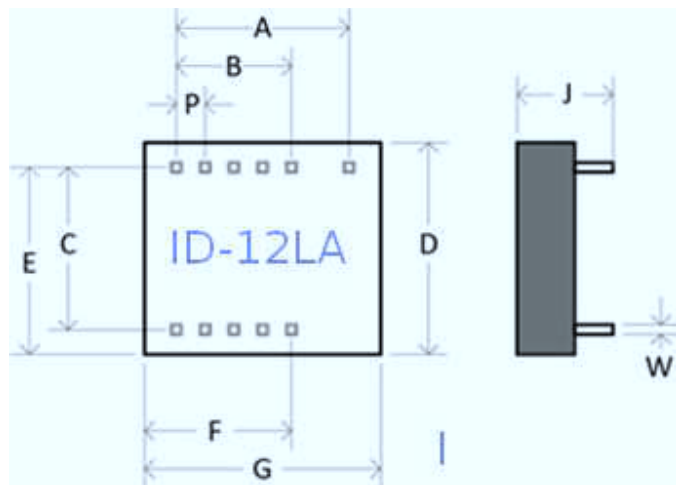
| Parts List | |
|------------|--------------------------|
| Part # | Value |
| R1 | 100R |
| R2 | 4K7 |
| R3 | 2K2 |
| C1 | 10uF 25v electrolytic |
| C2 | 1000uF 10v electrolytic |
| C3 | 100nF |
| L1 | 1.337mH |
| Q1 | BC457 or similar |
| LED1 | Read LED |
| LED2 | Tag In Range LED |
| B1 | 2.7kHz – 3kHz 5v PKPK AC |

9. Dimensions (mm)

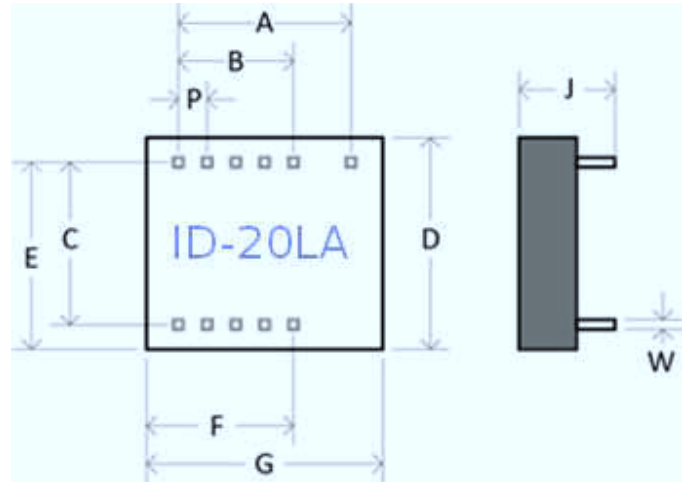
| ID-2LA | | | |
|----------|------|------|------|
| | Nom. | Min. | Max. |
| A | 12.0 | 11.6 | 12.4 |
| B | 8.0 | 7.6 | 8.4 |
| C | 15.0 | 14.6 | 15.4 |
| D | 20.5 | 20.0 | 21.5 |
| E | 18.5 | 18.0 | 19.2 |
| F | 14.0 | 13.0 | 14.8 |
| G | 22.0 | 21.6 | 22.4 |
| P | 2.0 | 1.8 | 2.2 |
| H | 5.92 | 5.85 | 6.6 |
| J | 9.85 | 9.0 | 10.5 |
| W | 0.66 | 0.62 | 0.67 |



| ID-12LA | | | |
|----------|------|------|------|
| | 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 | 25.3 | 24.9 | 25.9 |
| E | 20.3 | 19.8 | 20.9 |
| F | 16.3 | 15.8 | 16.9 |
| G | 26.4 | 26.1 | 27.1 |
| P | 2.0 | 1.8 | 2.2 |
| H | 6.0 | 5.8 | 6.6 |
| J | 9.9 | 9.40 | 10.5 |
| W | 0.66 | 0.62 | 0.67 |



| ID-20LA | | | |
|----------|------|------|------|
| | 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 | 40.3 | 40.0 | 41.0 |
| E | 27.8 | 27.5 | 28.5 |
| F | 22.2 | 21.9 | 23.1 |
| G | 38.5 | 38.2 | 39.2 |
| P | 2.0 | 1.8 | 2.2 |
| H | 6.8 | 6.7 | 7.0 |
| J | 9.85 | 9.4 | 10.6 |
| 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 module Pin8 via the series 1k to pin2 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 UART is made by connecting Pin9 to the UART Rx in pin

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:

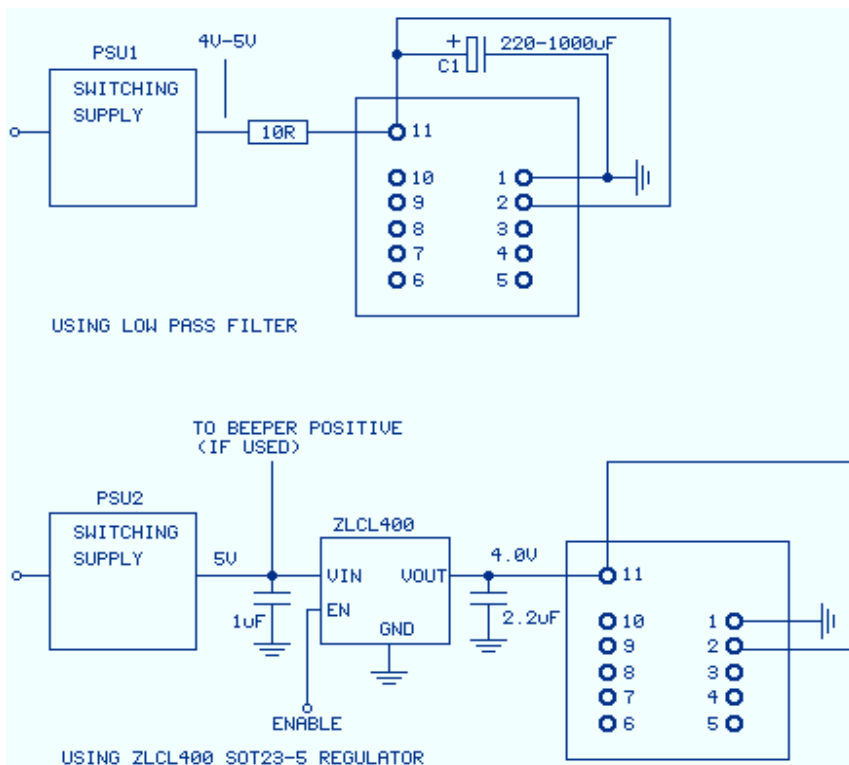
<http://braypp.googlepages.com/terminal> - Truly an excellent piece of software, the best terminal we have ever seen.

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

12. Choice of Power Supply

The choice of power supply is very important. The ideal power supply will be a linear type such as an LM7805 or a 3.3 volt equivalent. Batteries may also be used without a regulator, a suitable arrangement can consist of a 3volt lithium cell or 3x 1.5v cells to give 4.5 volts. Note that ID-Innovations will be introducing a low-range series of micro-power reader modules (current <1mA) with the same pin out.

Switching power supplies are gaining increasing popularity, however switching supplies can present several problems for 125 KHz readers. The switching frequency must not be close to a multiple of 125 KHz or severe interference can result which will reduce the read range. Another issue with switching supplies is output voltage ripple. For good range the output ripple should be less than 3mV PKPK. This is very demanding on switching power supplies. Some recommended solutions are shown below for use with working with switching power supplies.



The upper diagram shows a low pass filter which may help increase range if the output ripple from the switching power supply is less than 10mV PKPK. The best solution, and the one which takes up less space, uses an SOT23 linear LDO regulator. The circuit employs a Zetex device which may also be powered down. Alternatively a Microchip MCP1702 could be considered, however the maximum current is limited to 50mA and may not be suitable for the ID-2LA in some circumstances.



13. Designing Coils for ID-2LA

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-2LA 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-2LA 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 ID2-LA has an internal capacitor of 1N2, which perfectly tunes the recommended inductance of 1.337mH.

Warning. Do not exceed the stated maximum voltages and currents for the ID2-LA 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>



14. Fine Tuning the ID-2LA

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 more inductance is required. If the voltage decreases as the ferrite is brought up to the antenna then the inductance is too great. If no ferrite is available 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 means that the module is near optimum tuning. When using ferrite for test then it implies that the coil is a little under value and when using aluminium sheet it implies the coil is a little over value.



15. ID-2LA Compatibility Issues with the ID-2

With the exception of pin6, which should be left unconnected in the ID-2, and which now serves as a 'Tag in range Pin', the ID2-LA 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 ID2-LA employs an internal 1n2(0.0012uF) capacitor and an external 1.337mH search coil.

The ID2-LA 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 COG capacitor is added across pins 1 and 4. As with the ID-2, the ID2-LA 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. The ID2-LA RF output drive is greater than the ID-2 RF drive. Users wishing to migrate to the ID2-LA should ensure that the RF voltage and current limits are not exceeded.

16. ID-12LA, ID-20LA Compatibility Issues with ID-12, ID-20

With the exception of pin6, which should be left unconnected in the ID-12 and ID-20, and which now serves as a 'Tag in range Pin', the ID12-LA and ID20-LA is 100% pin compatible and supply voltage compatible with the ID-12 and ID-20 and its read and output data functionality is also 100% compatible.

17. Layout Precautions for ID-12LA and ID-20LA

The layout of the mother board is important. Below is a short list of steps to ensure good read range.

- 1) Never put a copper ground plane under an ID-12LA or an ID-20LA. The antenna in the module will couple with the copper and the copper will act as a shorted turn. A shorted turn acts much like a negative inductance and will detune the antenna in the module.
- 2) Never run a noisy supply track under the module. The track will couple with the antenna and the noise will reduce the read range.
- 3) Never run the tracking of decoupling capacitors for other circuitry, processor etc., under the module.
- 4) Track the module supply decoupling capacitor as close to pin1 and pin11 as possible.



- 5) Use a linear regulator for the supply if possible. If a switching power must be used then see the section on choice of power supply.
- 6) If a switching supply is present on the same mother board, and uses an inductor, consider rotating the inductor to obtain the least coupling with the module antenna.
- 7) Preferably power the beeper from another supply. Beepers can draw large current that can cause the module supply voltage to dip momentarily causing a module brown out reset or other erratic malfunction.

Note. Low power regulators are less expensive, easier to configure, take up less room and noise is easier to control. If long read-range is not critical to your application, consider the ID-Innovations micro power range of pin compatible modules; these typically draw less than 100 micro amperes at 3v.

18. Contact Information

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