IralukCeta 2012 Field Identification Tag Reader

Operations Manual for the IralukCeta 2012 Reader and Antenna

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FCC Statement of Qualifications

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This device is also registered with Industry Canada as follows:

The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

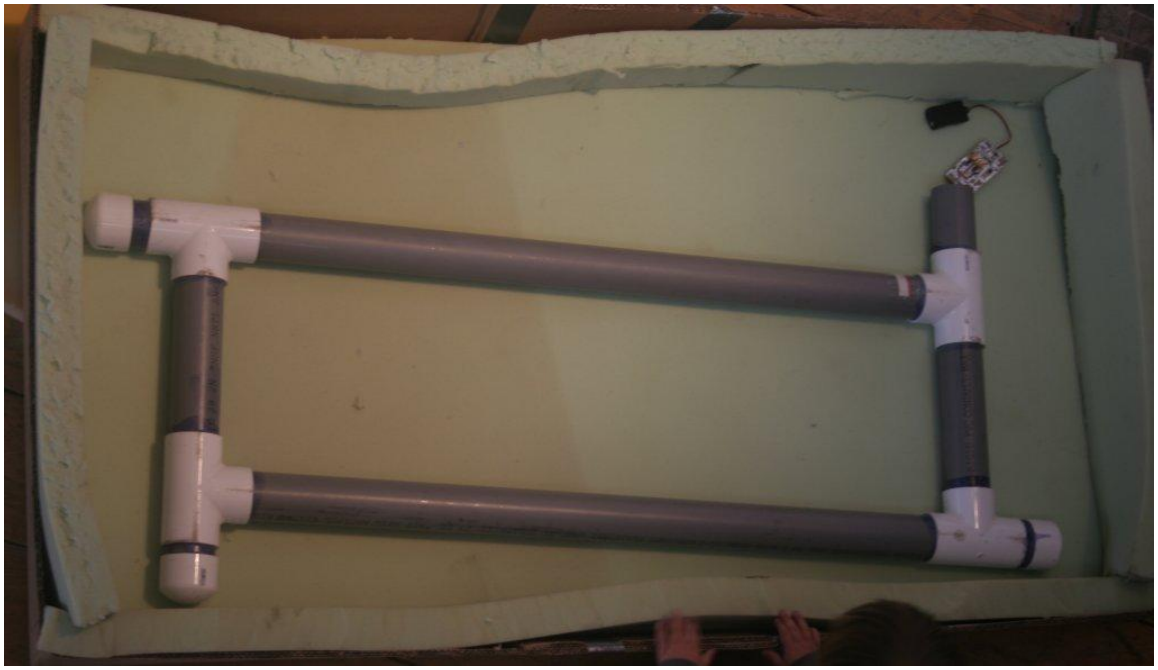
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Model: IralukCeta
FCC ID: AYS-IRALUKCETA

FCC Device Labeling

The labeling of each device will be on the outside of the rectangular PVC enclosure for the antennae on the corner for input power and communications access.

Antenna Hardware



Antenna without wiring harness

The main part of the reader is the antenna housing, a waterproof rectangular PVC pipe assembly with the antenna coil inside. The electronic 'tag reader' circuit board at its lower end is permanently attached to the antenna coil leads. The reader has an attached battery holder that requires two "AA" size batteries. The reader will not function without these batteries.

There are two connectors on the upper end of the circuit board. A four-pin non-polarized connector is for ground, external power supply (+12V typ.) and two RS-232 interface (TX, RX) wires. A wire harness is supplied but the installer can extend or make up an equivalent harness to suit their installation site requirements. A second 5-pin connector is included for the sole purpose of a debugging and programming interface, and as such it is not to be used by the installer or user.

The wire harness/weatherproof assembly is made up of commercially available Schedule 40 PVC conduit and fittings. The supplied 2" flexible coupling is to be slid over the antenna's housing and clamps are to be tightened to assure waterproof connection if underwater installation is to be accomplished for fish detection.

At the option of the installer the flexible coupling can be replaced with 2" PVC coupling and solvent welded to the antenna's housing. Observe all precautions in this manual as it will be impossible to disassemble the solvent welded unit without destroying the antenna's housing.

The upper end of the flexible coupling is slid over a 2"-3/4" bushing and a supplied 3/4" PVC conduit continues to a weatherproof U-turn. The 3/4" conduit can be replaced with a longer piece if necessary.

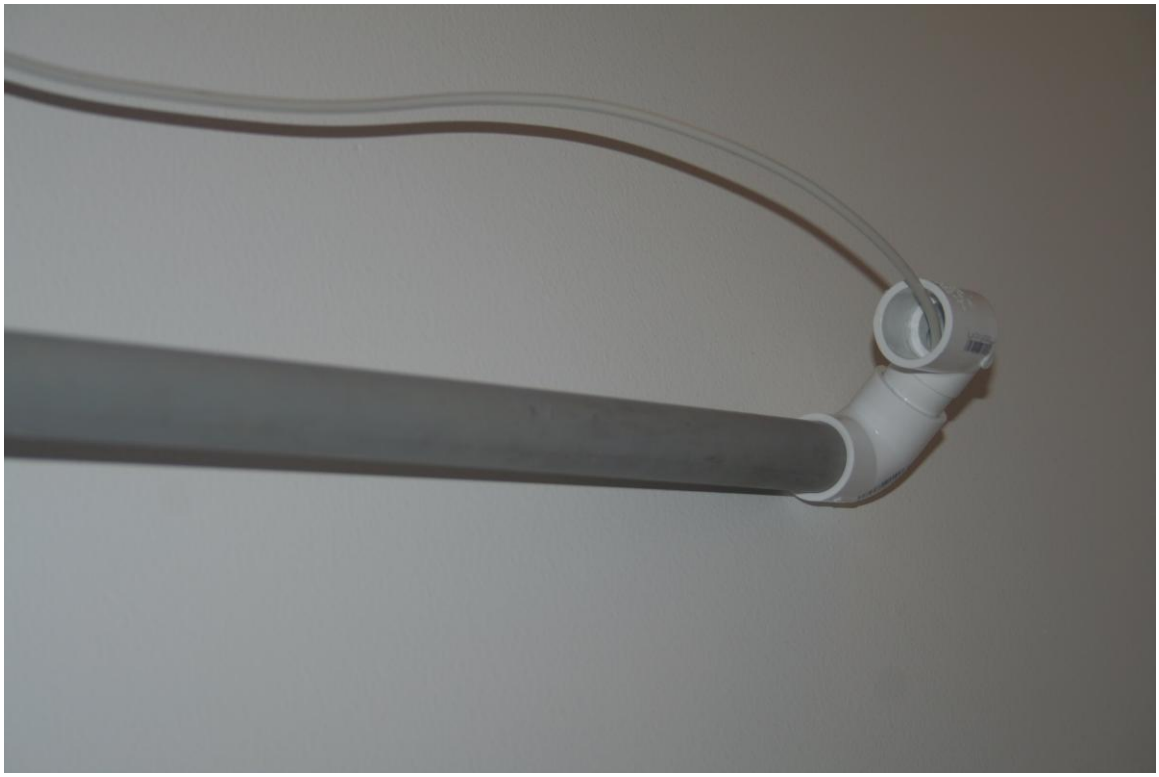


Photo of Power/Communications Cable 'Wire Harness' and protective PVC conduit with 'U-turn' to be filled with Silicone

If the installation environment is tidal, the top of the conduit must extend significantly above the highest tide expected. Once the site's requirements are met with the length of conduit and wire harness, all PVC joints with power/communications wire inside (two pieces of weatherproof U-turn, the 3/4" conduit to the bushing) must be solvent welded to waterproof the installation. The wired weatherproof U-turn is to be filled with silicone sealant and allowed to dry (keep the U-turn upside down so the antenna assembly is to be connected as the last step, typically at the installation site and the clamps on the flexible coupling are to be tightened.

The wire harness has two alligator clips (red = +12V; and black = ground) and an RS-232 cable ending in a DB-9 female connector for configuring the reader and access to reader's data.

A sample PIT tag is found in the shipping box as well for testing the reader. It is embedded in a small piece of black anti-static foam. PIT tags are fragile and are made of glass and ferrite; once the glass is cracked the functionality of the tag is compromised. Other foam in the black plastic can is to protect the tag during shipment. Ends of the tag are visible in the black foam to be aligned with the axis of the reader for better coupling; see industry publications on limitations of PIT tag technology and detection rates.

Final Assembly Instructions

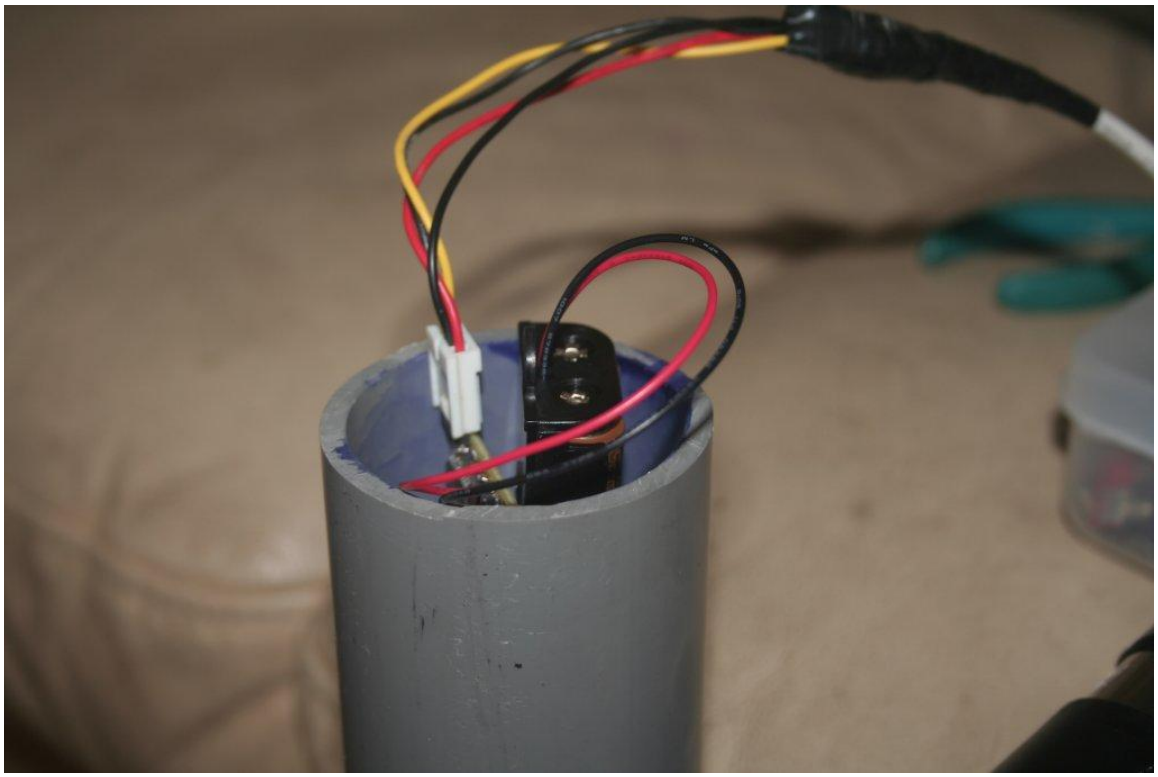
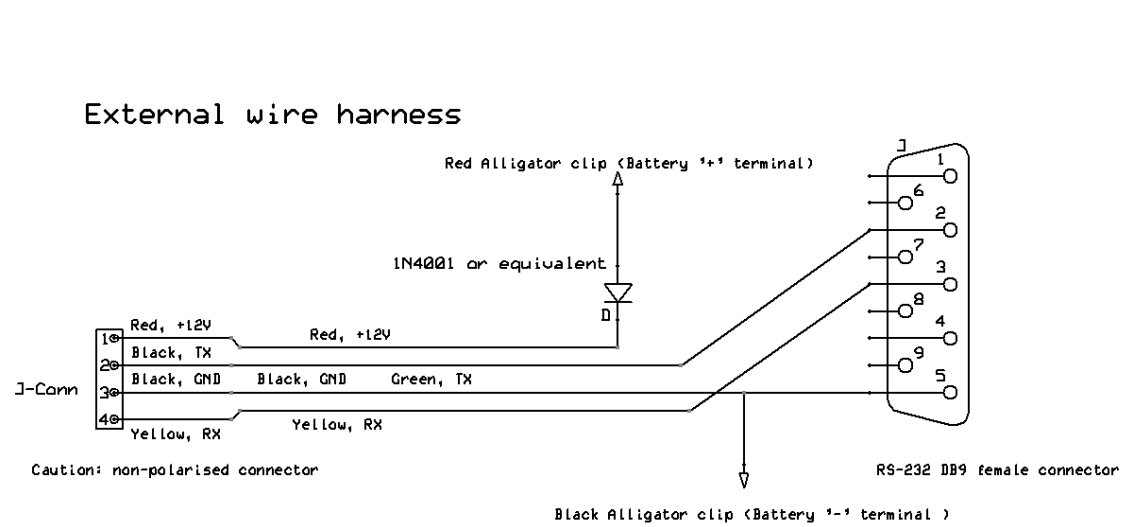


Photo of 4-pin connector

The 4-pin female connector at the end of the wire harness is to be connected to the circuit board. As the connector is not polarized, pay attention to the orientation of the connection. Red wire is the +12V power supply is to be connected to the pin towards the center of the board and the yellow wire is to be near the edge of the board. Reversing the polarity or offsetting the connector may damage the circuitry. The four wires from the connector are Red (+12V), Black (RS-232 TX), Black (Ground), Yellow (RS-232 RX). The harness can be extended or made up for longer conduit to allow for site's requirements such as distance from the reader's antenna to the main battery and site for data access. Be sure to disconnect the main battery before charging it.



Pin-out of External Wire Harness

The wire harness provided has a built in polarity protection diode. Although it reduces voltage available to the reader, 10 volts is more than enough for most environments. Internal limitations of the reader (antenna peak voltages) can be typically reached with a 5-7 volt power supply.

Operation Instructions: PIT Tag Reader

The IralukCeta RFID reader operates at principal frequency of FDX-B standard of 134.2 KHz. It generates the magnetic field with the coil antenna providing power to the passive RFID PIT tags and processes the signature returned by the tag. It is intended for installation at remote sites with no utility power available; typical power consumption of 100mA at 12V is consistent with capability of a typical lead-acid automotive, marine or scientific battery (wet cell, gell cell or AGM variety). The battery can be supplemented with a solar battery charger that would be able to recharge the battery depending on the local weather conditions. For example, a 1-AMP solar panel would be able to provide 24-hour power requirements of the reader in 3-4 hours of sunshine. Installation in any industrial environments with significant amount of electrical noise will reduce reader's sensitivity to the tag's response. SMPS (Switch Mode Power Supplies) are the most common noise generators so for testing purposes laptop computers should be powered by batteries which would be the case in field environments. Typical residential or office/industrial environment usually has a lot of offending electrical noise due to light dimmers, CFLs, SMPS which all degrade reader's sensitivity, sometimes rendering the reader incapable of detecting the tags.

Reader setup, control and data retrieval can be established using a laptop computer (recommended for field work) equipped with a standard RS-232 9-pin male port or an

appropriate USB to Serial converter. At power up the communication settings are 9600 baud, 8 bits, no parity, 1 stop bit, no flow control. Baud rate can be switched and will be maintained by the reader until power is lost.

At power up the reader prints out its identification and some diagnostic messages:

IralukCeta FDX-B tag reader
MCP79410 Oscillator was OFF
MCP79410 Oscillator started in 0x066A
EEPROM Memory scan
06:0000(0000)

The reader starts its operation at minimum antenna power and ramps up the driving voltage to achieve 800 volt peak-to-peak voltage on the antenna and resonant capacitors. Depending on environmental conditions (most notable are water level and salinity) the driving voltage is constantly adjusted to avoid exceeding the reader's limitations. Reader arrives with tuning capacitors installed and adjusted; on the lower end of the circuit board a 5-pair jumper pins are provided to allow adjustments in case of antenna de-tuning. See reader 'R' command for assistance in this task.

Most commands are command-line based, entered and executed with the ‘Enter’ key. A few are special single key press commands (Ctrl-T shown as ^T etc). Most commands are described briefly in a help screen invoked using the '?' command.

Typically, a command with no parameters will display the options for the command or current settings controlled by said command.

?	This help screen
U	List supported baud rates
Uxxxx	Set baud rate by BRGVAL
?Mbaaaallll	Print Memory b=bank [0,1,2,5,6,7] a=address[0000..F000] llll=length
?V	Print Voltages (Batt, DRV, p-Front End, n-Front End)
!M	Init Memory
!T	Print Time
!Tmm/dd/yy hh:mm:ss	Set Time
!TB[+/-]	RTC Battery ON/OFF - off for prolonged storage
!TO[+/-]	RTC oscillator ON/OFF

Antenna drivers/field control/monitoring commands:

Ddd[L/R/B]ss	Drive level control (dd: 00=min, FF=max) L-end R(rc-end) Both
+x –x	Main frequency adjustment x=[0..9,A..F]
Rddr	Frequency-Voltage Resonance test dd=drive level, see above r=range (134.2 +- range in 0.8% steps)
TxxxxSSSSbbbb	Timing/Duty cycle control: xxxx=Schedule (0400=128 per second FFFF=twice per second) SSSS=Start wave count bbbb=Sampled waves before FDXB TagID bit 0 to be detected (SSSS+bbbb)*7.45<
^T	Enter Idle mode (antenna field off)
^R	Return to Active mode (antenna field on)

Signal processing controls:

Pppnn	Set Front End PDC pp=P-channel nn=N-channel
S[PNn]	Channel use for Sampling P=P-channel, N=N-channel, PN=add, Pn=subtract
Gxx	Signal conditioner Virtual Ground xx=level, default=80
^B	Sample Buffer display on/off
B	Sample Buffer Comp/ADC toggle
^N	Toggle print of running parameters
^O	Toggle print of Sample range

Additional Commands

'U' command will display the list of available baud rates. Uxxxx will switch to corresponding rate. For example,

'U006C' switches to 19200 baud.

Series of commands beginning with question mark are typically for read-only parameters like battery voltage. '?' by itself gives the list of available commands. '?V' will print the Battery Voltage, Temperature, Antenna driving voltage and Resonant voltage.

Series of commands beginning with exclamation point are typically initialization commands for user configured parameters that are persistent - their results are persistent main battery power being shut off.

'!T' displays current time (two different times may mismatch by up to one second)
'!Tmm/dd/yy hh:mm:ss' sets the time.
'!TB' displays the current status of backup battery. Disabled backup battery will
'!TB-' turns off backup battery. This might be done for prolonged storage just prior to turning off the main battery
'!TB+' turns on backup battery.
'!TO' provides similar RTC oscillator control

'!M' initializes non-volatile memory to factory initialized blank state.

'D' prints the current controls of final antenna drivers. Two-digit hex number is the control for the voltage of the final driver, enabling the unit to drive the antenna with variable voltage from under 2 V to nearly full main battery supply voltage minus nominal dropout voltage of the voltage regulator circuit. However, driving the antenna at full power will damage the reader's circuitry so firmware limits the peak voltage to 400V, for 800V peak to peak voltage.

Antenna is driven in H-bridge configuration - L driver is connected to the coil, R driver to the resonant capacitors. Capital L signifies that the L driver is active, lower case l means that the driver is inactive. Same for R driver. Single digits following these letters signify starting state of the driver.

'Dxx[L/R/B/N]ss' controls the current settings for the antenna driver; xx is the control for the antenna driver voltage. L would enable Left (coil) driver only; R would enable Right (capacitor) driver only; B means that both drivers will be active, N=none. Starting state must be 01 or 10 for Both drivers enabled, None option is provided for debugging purposes only. Altering the starting states of the drivers may improve unit's sensitivity.

For a check of antenna tuning, a resonant test should be initiated using the 'Rddr' command. The Reader will drive the antenna with a range of frequencies in about 0.8% steps and print out the resulting resonant voltages. There is no automatic protection for overvoltage; these tests should be done at lower power settings to verify tuning of the antenna. dd is the Drive level as described in 'D' command. 'R10' is a good starting point. A list of frequencies and resonant voltages will appear along with measurement of actual voltage driving the antenna measurement at the end of each resonant test. Full range of frequencies is 119.717 to 152.667 KHz with 30 steps in between (total of 31 frequencies). If the tuning capacitors are picked correctly, a maximum resonant voltage will appear at 134.2 KHz point with voltages for neighboring frequencies dropping off symmetrically. A maximum voltage at frequency higher than 134.2 signifies need for greater capacitance and at lower frequency and vice versa. Adjustments to tuning capacitors can be made on a 5-position jumper block on the circuit board's bottom edge, next to the coil antenna's connection. Starting at the side edge of the board, each consecutive capacitor is roughly twice the value of previous one. 'r' parameter of the 'Rddr' command controls the range of the resonant test, with default value being 0xF (15 decimal). Thus the test can be conducted with a smaller frequency range, Rdd5 providing five frequencies to each side of 134.2 in a range of 128.998-139.839 KHz.

'T' command prints current state of the Timing/Duty cycle controls. 'TxxxxSSSSbbbb' is the full command format. xxxx parameter (4-digit hex number) provides the schedule of antenna being energized; maximum value of FFFF corresponds to the lowest rate of antenna activation of about twice per second. The lowest value of this parameter is 0400 corresponding to about 128 duty cycles per second. Default value is 1000, about 32 cycles per second. This is the main control for Reader's power consumption. While antenna is energized, current of about 250-300mA is consumed; when it is not, a lower standby current is drawn.

The second parameter is the number of waves to be ejected while disregarding the incoming data. Some number of waves will be required to bring the resonant circuitry to full operating voltage; after that a PIT tag takes a few milliseconds to begin sending tag's ID number. First 10 bits of the Tag's response are header bits. The bbbb parameter if 'T' command is the number of 134.2 KHz waves the Reader will generate before encountering the full header of FDX-B tag. If the header is not encountered, antenna's field is shut off until the next powering of the antenna is due according to the xxxx parameter. If the header bits are encountered during those bbbb waves, the antenna is kept powered up until completion of tag's ID transmission. Environmental electrical noise may trick the reader into thinking that a tag is in antenna's field, however, CRC algorithms of FDX-B protocol will verify that a true tag was encountered instead of random noise which may look like tag's response. Entire sequence of FDX-B tag response is 4096 waves of the magnetic field (128 bits at 32 waves per bit), currently the extra data following CRC bits is never read from a tag. Different tags may have different delays from encountering reader's field to starting the response.