iGR

35-Watt UHF Transceiver / Repeater User Manual

This manual is for use with iGR radios supplied by iGage Mapping Corporation. Similar radios purchased from other sources cannot be programmed with the described programming tool, will have different menu structures, modes of operation and firmware.

Copyright

Radio Safety Warning

The iGR radio has not been designed for use with life critical applications such as autonomous driving applications. Any such use voids the radio warranty and iGage assumes no liability or fault for any issue whatsoever.

Be careful when setting an antenna near powerlines or other high obstacles.

Use lightning protection for lightning prone areas. Do not setup or take down an antenna during a storm.

Installation of antenna on buildings or other structures must be done respecting local ordinances.

Batteries are dangerous. Follow the instructions and safety warnings that are included with your battery.

Stay at least 2-meters distant from the repeater antenna. The emitted field strength is high enough to damage your brain tissue!

Do not touch the antenna when the radio is energized.

Do not energize the radio unless the RF connector is connected to an antenna and the antenna is at least 2-meters from your body.

If you have a pacemaker, do not stand closer than 20-meters to the antenna.

Do not use the radio near blasting caps or explosives or in explosive environments.

Even after you turn off the radio, there is a chance that the heatsink will be hot. Use the handle to transport if it has been running.

Service and Support

Your radio includes support, service and repairs from iGage Mapping Corporation. If you have any questions, please contact us for assistance.

Your purchase of a radio does not include training or specific instructions or assistance with applications for GNSS equipment purchased elsewhere.

Please contact the supplier of your GNSS equipment for assistance with non-iGage supplied equipment.

> iGage Mapping Corporation
> Salt Lake City UT 84105

> Voice: +1-801-412-0011
> eMail: support@igage.com
> web: www.iGage.com

Warranty

Before you get hung-up with radio hardware or software programming problems, please give us (iGage Mapping Corporation) a call:

> +1-801-412-0011

Our goal is to take great care of our customers and be reasonable with everyone. Our response to issues may exceed your expectations and this written warranty.

IMC is "iGage Mapping Corporation" of Salt Lake City Utah USA.

IMC warrants the iGR radio, which we sell directly, to be free of defects in material and workmanship and will conform to our published specifications for these periods:

> Radio / Repeater: 1-year
> Cables and accessories: 30-days
> Any supplied battery has: NO WARRANTY

This warranty applies only to the original purchaser of the product.

Hardware: Purchaser's exclusive remedy under this warranty shall be limited to the repair or replacement, at IMC's option, of any defective part of the receiver or accessories which are covered by this warranty. Repairs under this warranty shall only be made by IMC at an IMC service center. Any repairs by a service center not authorized by IMC will void this warranty.

In the event of a defect, IMC will at its option, repair or replace the hardware product with no charge to the purchaser for parts or labor. The repaired or replaced product will be warranted for 30-days from the date of return shipment, or for the balance of the original warranty, whichever is longer.

Software: IMC warrants that software products included with hardware products will be free from media defects for a period of 30-days from the date of shipment and will substantially conform to the then-current user documentation provided with the software. IMC's sole obligation shall be the correction or replacement of the media so that it will substantially conform to the then-current user documentation. IMC does not warrant the software will meet purchaser's requirements or that its operation will be uninterrupted, error-free, or virus-free. Purchaser assumes the entire risk of using the software.

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Warranty Exclusions

The following are excluded from the warranty coverage:

- Periodic maintenance and repair or replacement of parts due to normal wear and tear.
- Product Finishes.
- Batteries exposed to heat, cold; or batteries opened or physically damaged. As iGage does not supply or warrant batteries, you must purchase them elsewhere.
- Installations or defects resulting from installation.
- Any damage caused by: shipping, misuse, abuse, negligence, tampering, or improper use; disasters such as fire, flood, wind, and lightning; unauthorized attachments or modification.
- The warranty does not cover damage due to welding current loops. If the radio or antenna are permanently attached to metal structures, you must disconnect the radio from power and antenna connections before welding on the structure.
- Inverted Power Supply connection. Connecting the radio with reversed power immediately voids the warranty.
- Service performed or attempted by anyone other than an authorized IMC service center.
- That the radio will be free from any claim for infringement of any patent, trademark, copyright, or other proprietary right, including trade secrets.
- The iGR radio warranty is voided if you operate it outside of the United States.
- Any defect caused by operation of the radio without an antenna attached or with a damaged antenna cable.

Except as set forth in this limited warranty, all other expressed or implied fitness for any particular purpose, merchantability, or non-infringement, are hereby disclaimed.

IMC shall not be liable to the purchaser or any other person for any incidental or consequential damages whatsoever, including but not limited to lost profits, damages resulting from delay or loss of use, loss of or damages arising out of breach of this warranty or any implied warranty even though caused by negligence or other fault of IMC or negligent usage of the product.

In no event will IMC be responsible for such damages, even if IMC has been advised of the possibility of such damages.

This written warranty is the complete, final, and exclusive agreement between IMC and the Purchaser.

RMA

To obtain warranty service from iGage Mapping Corporation the purchaser must obtain a return materials authorization (RMA) number prior to shipping by calling

> +1-801-412-0011

Or by email:

> info@igage.com

Purchaser's return address and the RMA number must be clearly printed on the outside of the package. IMC reserves the right to refuse to provide free-of-charge service if the date of sale cannot be determined or if the serial number is altered or removed. IMC will not

provide any service or support for similar radios not purchased through the IMC supply chain. IMC will not be responsible for any losses or damage to the product incurred while the product is in transit or is being shipped for repair. Insurance is recommended. IMC suggests using a traceable shipping method such as UPS, FedEx or USPS with signature tracking when returning a product for service.

Do NOT send batteries with equipment for repair. If you send batteries you will need to pick them up in person at our facility as we are unable to ship used batteries.

The Purchaser shall always pay shipping to IMC, **IMC will return warranty repairs by UPS ground or USPS Priority Mail**, unless the Purchaser agrees to prepay expedited service costs.

If the purchaser requires a commitment to expedited service, we highly recommend purchasing a second radio to use as a hot-spare.

IMC will not pay for warranty returns to destination outside of United States. The purchaser shall always pay any associated duty associated with warranty repairs. The iGR radio's warranty is voided by use or transport outside of the USA.

FCC Statements

FCC Caution § 15.19 Labeling requirements

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.

§ 15.105 Information to the user

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

§ 15.21 Information to the user

Any Changes or modifications not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

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This equipment should be installed and operated with a minimum distance of 2-meters between the radiator & your body. If you have a pacemaker you should maintain a 20-meter distance from an operating radio.

FCC Information

Model Name:	iGR
Model/Part Number:	HX-DU8616D
FCC ID:	2ACRAHX-DU8616D
Manufacturer Code:	2ACRAHX (Harxon)

The iGR radio has a wide operating frequency range. Operation is allowed only on licensed frequencies.

Frequencies can only be configured using the approved iGage supplied iGR programming tool. Frequencies cannot be programed from the front panel. A supervisor / technician key is required for radio programming.

The iGR programming tool will not allow programming within these reserved frequency ranges:

399.8875 through 410.0125

433.4875 through 434.5125

These ranges will NEVER be available for legal operation and the user is cautioned to not attempt to circumvent these hard exemptions by using other programming tools.

FCC Licensing Information

The iGR UHF radio (PN HXDU8616D) requires FCC licensure for transmit operation in the United States. It is illegal to operate the device in Transmit mode (as a UHF Base or repeater) without a valid FCC license at any output power, in any area, under any non-emergency condition.

The following article describes the pitfalls of broadcasting without a license:
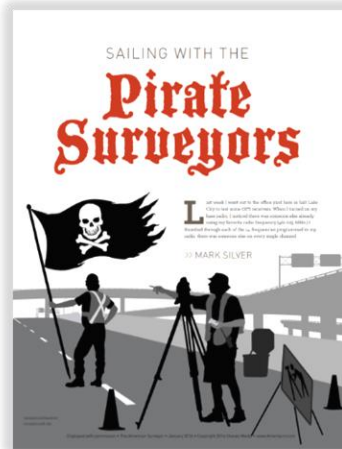
http://www.amerisurv.com/PDF/TheAmericanSurveyor_Silver-PirateSurveyors_Jan2014.pdf

If you did not have an FCC license when your radio was shipped, no channel table will be installed on the radio.

You may not legally use the radio in a transmit application without:

- o Obtaining a valid FCC License.
- o Verifying that the radio's frequency tables match your license.
- o Adding your FCC Call Sign to the internal radio so that the radio can properly broadcast your Call Sign in Morse Code every 15 minutes.
- o Putting a label on the device with your FCC Call Sign.
- o Keeping a copy of your FCC License with the radio when it is in use as a transmitter.

> In January 2020, the 'Preventing Illegal Radio Abuse Through Enforcement Act, or "PIRATE" Act (S.1228)' was signed raising the penalty for non-compliance to $100,000 per day with a $2,000,000 maximum!

If you choose to operate this equipment without obtaining an FCC license, you do so at your own risk and by opening the Supervisor / Technician Key Card envelope you implicitly agree to indemnify iGage Mapping Corporation against any FCC action as a result of your programming.

Obtaining a New FCC License

If you don't have an existing FCC license to transmit UHF corrections you will likely use a 'Radio Licensing Company' to obtain frequency coordination and submit an application to the FCC.

The entire FCC application process typically costs around $600, which will include a Frequency Coordination fee and the FCC filling fee.

You may be asked these questions when applying for a license:

Question	Answer
Frequency Requested	"Standard RTK GPS Pool", Monitor: NO
Band	451-469, no splits
System	Conventional
Type	Base and Mobile Simplex FB. MO
Wattage	35 Watts Mobile; 35 Watts Base
Bandwidth	12.5 kHz
Interconnection	None
Emission Type	Digital Data
Location	The States where you might work or 'USA'
Antenna Mounted On	Survey Tripod, not to exceed 20 feet
Emission Designator	9K75F1D

It can take as long as 3-months to obtain an FCC license and Call Sign after the initial filing. You may be eligible to operate after the application is submitted and prior to an FCC Call Sign being issued.

FCC ID Broadcast

You must have an FCC License to operation this radio. You must program your FCC ID into the radio and configure the radio to automatically broadcast the station identification ID with a 15-minute or less interval.

CSMA

This radio has a Carrier Sense Multiple Avoidance function that listens for other users on the transmit frequency prior to broadcasting. This function is controlled on the display interface, see Top Level Menus page 21.

For operation on shared frequencies in the United States you must enable CSMA. If you have a fixed-point operation license it may be permissible to disable CSMA.

If CSMA is preventing the radio from operating, consider moving to a different licensed frequency.

Base Radio Setup Notes

Your Base receiver and control software may have the ability to change radio channels and operation modes from the data collector with other radios.

This configuration method will not work with the iGR radio as it has a proprietary software interface. You can modify some settings from the front panel; however, a few settings (Channel Bandwidth, FEC) can only be set by the computer connection.

Repeater Quick Setup Guide

Choose an optimum location for the repeater placement.

Typically, the repeater will receive a full correction message from the Base and immediately retransmit the corrections at a higher power on the same radio frequency as received.

It is also possible to receive corrections on one frequency and transmit on another licensed channel.

The repeater does not need to be located near the Base; it only needs to be able to dependably listen to the Base's signal. This is great for applications where it is convenient to place the Base on a convenient control point, and then place the repeater on a nearby hill that has excellent radio coverage.
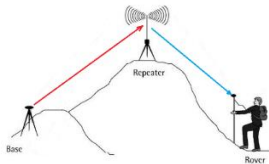
Elevating the repeater antenna, either by setting it up on hill or providing a high mast will always be more effective than raising the output power.

In some terrain environments where you are working in a series of canyons, placing the repeater a long distance away from the canyon bottoms (across a valley) may provide excellent coverage. Look for a repeater location that is visible from all work areas,

1. Hang the radio on a Tripod using the bale hook on the back of the radio:

   If you choose to lay the radio on a flat surface, the heat sinks may not be as effective and may melt or damage the supporting surface.

2. Inspect the UHF antenna cable for broken ends. Make sure the antenna is well connected to the mount and that all of the antenna connections are clean and solid. Check the antenna cable to make sure that it has not been pinched in the hinge of a hard-shell carry case:
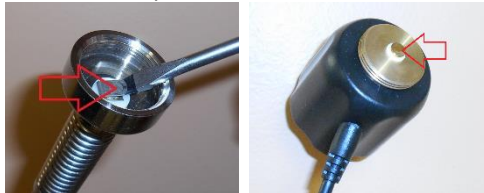
3. Attach the UHF antenna cable and antenna to the radio prior to connecting power to the radio.

4. Before plugging in the UHF radio, always ensure that the UHF antenna has been connected to the radio. Double check that the polarity (**RED** = **+**; **BLACK** = **-**) is correct before attaching the power connector to the radio.

5. Plug the round power connector into the radio first, then connect the flat 2-PIN SAE connector. Since the radio may begin transmitting immediately after you connect power, do not stand next to the antenna, provide a 2-meter separation between the antenna and radio for RF-exposure reduction.

Repeater Radio Battery

Follow all battery manufacture safety suggestions, all the time! High-capacity batteries are extremely dangerous.

The duty cycle of the radio in normal operation is about 50% and the radio draws about 7-amps at full output power. So, a 9-hour day requires 32-amp hours. The less the battery is discharged as a function of its maximum capacity, the more charge cycles the battery will accept.

A best case would be to charge the battery to 80% and to run it down to 50%. Thus only 30% of the available charge would be used in a 9-hour day, this would help maximize the life of the battery.

The full capacity of the battery at normal temperatures would need to be 107-amp hours. Derating the battery 50% for cold temperature operation will increase the reasonable capacity to over 200-amp hours.

For these reasons, when purchasing a battery for the Base:

<div align="center">

*big-is-certainly-**better**!*

</div>

Large deep cycle wet cell (flooded), AGM or gel batteries are available at reasonable cost from many sources.

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Batteries are complicated and there is a debate whether it is better to purchase an inexpensive battery and replace it often (every year) or to purchase an expensive battery and try to get two- or three-years life.

This decision probably depends on your ability to not misuse the battery as described in the 'Battery Death' section below. If you are going to entrust the battery to a field crew, or work in extreme hot or cold environments; then this decision might be obvious.

Remember:

- Old or damaged/neglected batteries are the #1 source of repeater issues.
- A battery with high internal resistance will result in substantially lower output power and range.

The #1 Radio / Repeater Problem

If your radio / repeater used to work and now it does not, the NUMBER ONE cause is a bad or failing battery. Use the voltmeter displayed on the front panel of the radio to check the non-transmitting battery voltage.

The battery that you use for the repeater MUST be relatively new with low internal resistance. When the repeater broadcasts a correction the current (AMPS) draw is very high. If the terminal voltage of the battery drops below 10.5 volts during this draw, the repeater will not work.

If you set the power to Low Power (5-Watts) and the repeater 'sounds good' and the LED's flash repeatedly, but when you turn the output power to High Power (35-Watts) and the repeater fails then you probably need to replace the battery.

The #2 Radio / Repeater Problem

Bad cables and damaged antennas.

Check that your antenna has all of the parts attached, don't operate without the silver tip if it has one. Verify that the connection on the top of the NMO connector is not oxidized and is making good contact.

Don't pinch the antenna cable in the hinge of the transport case.

Don't free-hang the antenna cable down mast extension. Wrap the cable around the mast to prevent it from flexing in the wind.

The #3 Radio / Repeater Problem

Other users on the same frequency will dramatically reduce the range possibility for your radio/repeater.

Purchase and learn how to use a handheld radio to listen for other users prior to setting up your base. Choose a radio channel that has no competition from other users.

Battery Death

Read the recommendations from the battery manufacturer for your battery. The battery manufacture's recommendations supersede any information presented in this User Manual.

Batteries are VERY complicated electro-mechanical machines. You can purchase a brand new 100% functional high-capacity battery and then immediately kill the battery and it will NEVER be the same and there will be no hope of reconditioning.

Overcharging

Charging a battery past 100% will quickly destroy your battery. Overcharging or continuously charging can:

- Cause corrosion of the positive battery plates
- Increase battery water consumption
- Increase the internal temperatures, which will lead to heat damage that is beyond repair

Different types of batteries are more sensitive too overcharging and experience different forms of damage.

Sealed lead-acid (SLA) and gel batteries, for example, are particularly susceptible to overcharging damage because any lost water cannot be replaced.

Typically running a battery between 50 and 80% of charge (never charging to 100%) would greatly extend battery life; however, this will leave only 30% of the rated capacity for use.

Overcharging a lead-acid wet-cell battery causes the electrolyte water to break into oxygen and hydrogen gas which depletes electrolyte levels in the batteries. This causes a high concentration of sulfuric acid in the electrolyte which then damages (cell sulfation) the battery plates.

Undercharging

Undercharging a battery will result in the battery running down further in the field during the day.

You want your AGM, SLA or Flooded Cell battery to stay at 50% charge or higher. So, the battery needs to be fully charged to provide sufficient power for a day's use.

Forgetting to charge your repeater battery might force you to deplete it fully on a subsequent field day which will permanently damage the battery.

Battery Cell Sulfation

Once white sulfuric crystals appear on the lead plates (the positive plates will be light brown and the negative plates will be dull, off white) your battery will no longer hold a dependable charge.

There are special 'pulse' chargers, there are electrolyte exchange regimens, there are special additives. They are all bunk. And most of the reconditioning solutions are very dangerous to implement.

Reversing the effects of sulfation is highly unlikely and the battery should just be replaced.

Extreme Discharge

You should never discharge a wet cell, AGM or Gel battery below 50% charge. Not even for a very short period of time.

At normal temperatures a 12-Volt nominal, wet-cell battery will have an open circuit (no load) terminal voltage of 12.73 volts at 100% charge; at 50% charge the open circuit terminal voltage will drop to 12.10 volts.

It is especially important to not store a **depleted** battery for long and if you are not going to use the battery for more than a few months you need to charge it periodically to replace lost charge while sitting.

The iGR radio has a cut off voltage (user adjustable) where it will cease to transmit, however standby current will continue to deplete your battery.

Allowing a battery to deplete to less than 30% charge, just once, will damage a battery. It will never be the same. There will be NO recovery.

Shorting a Battery

High discharge current, typically caused by accidently shorting the terminals of a battery may cause the plates to overheat and weld. This will cause permanent sulfation.

However, the real danger is the very high probability of battery explosion which typically blows caustic sulfuric acid everywhere. This is an imminent threat to life. (Your life, not the battery's!) Don't allow battery terminals to short.

Extreme Temperatures

For each 18°F rise in temperature, the life of a lead-acid batter is cut in half. So, if a battery should last for 4 years at 72°F, keeping it at 92°F degrees will reduce its life to 2-years.

DO NOT charge wet cell (flooded), sealed or gel batteries at temperatures less than 50°F.

You should only charge lead-acid batteries (AGM, Sealed, Wet Cell) at moderate temperatures between 50°F and 120°F.

Specialty extreme / severe temperature batteries may survive low and high charging better.

"Jump Starting" a depleted battery

Depleted batteries should NOT be 'jump started'. They should be charged slowly with a fractional C charge current. (C is the battery charge capacity.) Don't charge a 20-AmpHour capacity battery with a 25-AmpHour charge setting.

Watering

Add distilled water often, never acid, to keep the liquid within 0.15" of the bottom of the cell fill indicator. If the battery plates are exposed to air, even during transport, it will damage the cells.

Only add water if the battery is fully charged. However, if the plates are exposed to air, first add enough water to cover the top of the plates. Then charge the battery fully and finally fill to the fill indicator at the bottom of the filling well.

Multiple Users on Same Radio Frequency

If there is someone or something else on the same frequency, it will greatly reduce the distance you can move from your Base.

Use a Handheld UHF radio (like the 'BaoFeng UV-5R Dual Band Two Way Radio' available on Amazon) to check if the frequency is unused before you start:

Carry the Handheld radio with you all day so that you can check if someone sets up on your frequency after your session begins.

Become familiar with what it sounds like if you are the only user on a frequency and what it sounds like if there is more than one user on the same frequency.

Sources of interference include:

- other surveyors and engineers
- voice users (truckers, businesses, railroads, schools, service companies)
- wireless microphones
- SCADA equipment (like water or oil pipeline infrastructure)
- control backhauls on com links
- nearby AM or FM radio transmitters
- nearby radar systems

The radio frequencies that are generally assigned (by the FCC in conjunction with frequency coordination) are not exclusive and are assigned to multiple users in the same area.

Radio and Repeater Operation

GNSS Base receivers typically transmit one correction every second. When used in simplex mode connected to a Base with a data cable, the radio protocol must only be fast enough to transmit all of the data within one second.

When used as a repeater, all of the data must be transmitted in less than ½ second so that each message can transmitted twice.

Protocol Carrying Capacity

The carrying capacity (raw data rate) of common radio protocols that meet 12.5 KHz narrow-banding requirements are:

```
Satel, 9600, FEC OFF           1,100 bytes per second
Satel, 9600, FEC ON              830 bytes per second   << Best
TT450S, 4800, FEC OFF            400 bytes per second
TT450S, 4800, FEC ON             360 bytes per second
```

If you have a 'Special 25-KHz FCC' license you could also use these protocols:

```
TT450S, 9600, FEC ON           1,100 bytes per second
Transparent EOT, 9600, FEC ON; also called 'PacCrest-GMSK'
                                 650 bytes per second
```

The Satel Protocol at 9,600 baud with FEC (Forward Error Correction) enabled is the best protocol for users with standard USA licenses. Enabling FEC can extend the range over four times the range available with FEC OFF. The 830 bytes per second data rate provides sufficient carry capacity for operation.

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For repeater applications, because each correction message must be transmitted twice with a short end of transmission timeout, the message length is limited to ~410 bytes per second.

The iGR radio also supports several additional protocols, however they are so uncommon and have such wide channel bandwidth that they are both unsuitable and illegal for use in the United States and have no real value for most RTK receiver use.

FEC: Forward Error Correction

Even though enabling FEC reduces the carrying capacity by 25%, adding FEC for noisy channels greatly increases the chance that a valid RTK correction packet will be decoded by the rover. Turning on FEC can quadruple the usable distance.

For short distances and clean electrical environments, the increased carrying capacity of FEC=OFF may be valuable for some applications.

Correction Packet Length

For a base receiver tracking and broadcasting corrections with 29 or more satellites:

RTCM3.X	~310 bytes per second	< Good Choice
RTCM3.2	~580 bytes per second	
RTCM3.2 MSM1	~320 bytes per second	< Good Choice
RTCM3.2 MSM2	~410 bytes per second	< Okay Choice
RTCM3.2 MSM3	~580 bytes per second	
RTCM3.2 MSM4	~630 bytes per second	
RTCM3.2 MSM5	~860 bytes per second	
RTCM3.2 MSM6	~860 bytes per second	
RTCM3.2 MSM7	~1010 bytes per second	
sCMR (sCMRx)	~315 bytes per second	< Good Choice
CMRx	~315 bytes per second	< Good Choice
ATOM-COMPACT	~250	< Good Choice
CMR+ (CMR Plus)	~361 bytes per second (GPS+GLONASS only)	

You can mitigate these high correction data rates somewhat by raising the tracking angle on the base to 15-degrees.

For a receiver tracking 29 SVs:

RTCM3.2 **0 deg tracking mask**	~550 bytes per second
RTCM3.2 **15 deg tracking mask**	~480 bytes per second, saves 110 bps

You might also consider disabling unused signals at the base. For example, disabling tracking for BeiDou, QZSS and IRNS:

RTCM3.2 **0 deg mask full track**	~550 bytes per second
RTCM3.2 **0 deg mask remove: BDS, QZSS, IRNS**	
	~410 bytes per second, saves 140 bps

What is the disadvantage of CMR+?
Only GPS + GLONASS are encoded in CMR+. Corrections for L5, L2C, GLONASS L3 and Galileo may not be available.

What is the disadvantage of sCMRx / CMRx?
Only Trimble **OEM** receivers can decode sCMRx. True Trimble receivers (like the R8, R10, R12) are purposely prevented from using sCMRx and instead rely on the CMRx protocol.

What is the disadvantage of RTCM3.2 MSM4 through 7?

RTCM3.2 MSM3 and higher cannot be used with a repeater if the satellite count is high.

When used with a repeater, each correction message must be transmitted twice plus a 20-millisecond repeater delay. The total transmissions in one second cannot exceed 1-second in length without skipping the next message.

For this reason, sCMRx or CMRx pushed over a Satel 9600 baud, FEC ON channel is usually the best choice for users in the USA with 12.5 KHz narrow-banded FCC licenses.

Recommended Configurations

The most reliable and easiest configuration is to rebroadcast corrections on the same frequency that corrections are received. Use a handheld radio initially choose a licensed frequency with no other traffic.

Try to avoid these frequencies:

> 454.500 MHz   454.550 MHz

as they are in common use for voice traffic.

These are the recommended settings for an iGR repeater, any licensed frequency will be equivalent:

Radio Configuration	Log				

Device Information

Radio Model	eRadio Pro
Serial Number	
Firmware Version	
Hardware Version	V01
Frequency Range	410 to 470 MHz

Radio Settings

Radio Mode	3 - Repeater
Current Radio Channel	13
Over-the-Air Protocol	9 - Satel
FEC (Forward Error Correction)	☑
Output Power	1 - Medium (20-wa
Over-the-Air Link Rate	9600 bps
UART (Cable) Baud Rate	115200 Baud
Call Sign (CW Morse Code)	
Call Sign Interval (default 15)	15 minutes
Low Voltage Warning	11.0 Volts
Low Voltage Tx Disable	10.5 Volts

Channel Table

Verify Frequencies   Force 12.5 KHz BW

Channel	TX Frequency	RX Frequency	Bandwidth
CH 000	461.025,000	461.025,000	12.5 KHz
CH 001	461.050,000	461.050,000	12.5 KHz
CH 002	461.100,000	461.100,000	12.5 KHz
CH 003	462.125,000	462.125,000	12.5 KHz
CH 004	462.375,000	462.375,000	12.5 KHz
CH 005	462.400,000	462.400,000	12.5 KHz
CH 006	464.500,000	464.500,000	12.5 KHz
CH 007	464.550,000	464.550,000	12.5 KHz
CH 008	464.600,000	464.600,000	12.5 KHz
CH 009	464.625,000	464.625,000	12.5 KHz
CH 010	464.650,000	464.650,000	12.5 KHz
CH 011	464.700,000	464.700,000	12.5 KHz
CH 012	464.725,000	464.725,000	12.5 KHz
CH 013	464.750,000	464.750,000	12.5 KHz
CH 014	464.750,000	461.025,000	12.5 KHz
CH 015			
CH 016			

Setup screens for common receivers are shown below.

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SP80 Base: Satel 9600, FEC ON

SP80 Web Interface

SP80 SurvPC Radio Configuration

iGage iG8: Satel 9600, FEC ON
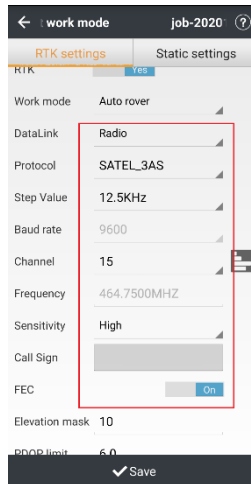

iG8: PC Web Interface
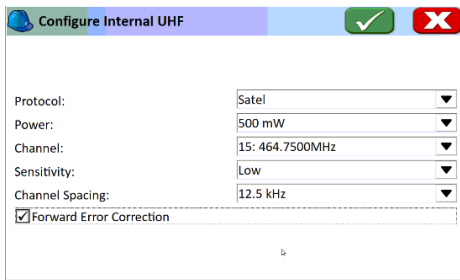
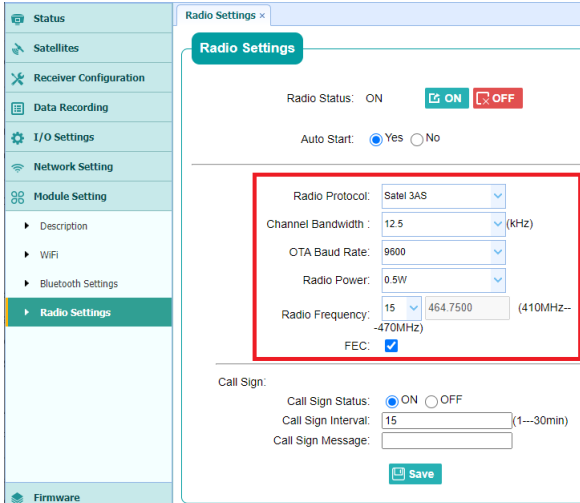*iG8: SurvPC Interface*
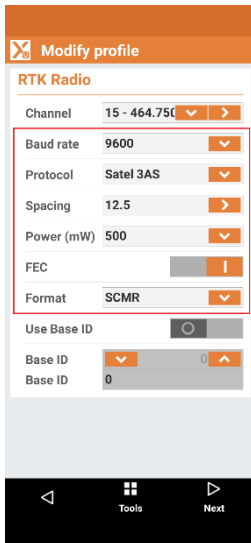
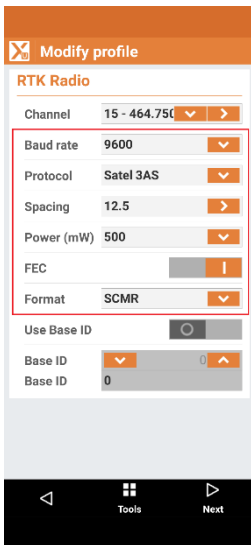*iG8: X-PAD RTK Radio profile*

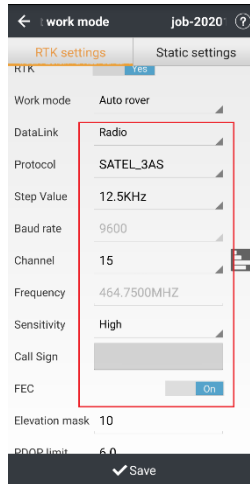*iG8: LandStar 7 'work mode' profile*
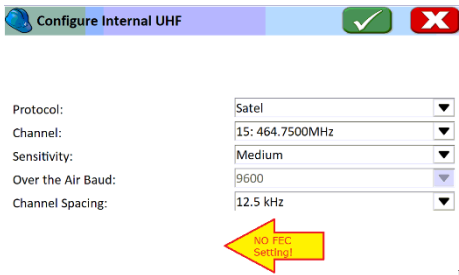
iGage iG9: Satel 9600, FEC ON
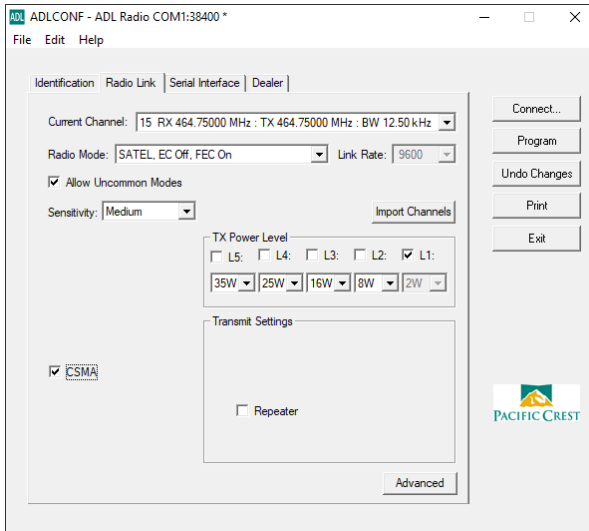

iG9 PC Web Interface

iG9 X-PAD RTK Radio profile

iG9 LandStar7 work mode profile


SurvPC does not support FEC ON for the iG9

Note: SurvCE/SurvPC does NOT support changing the FEC toggle to ON for the iG9/I90. SurvCE/SurvPC always turns FEC OFF. If you use the iG9 with SurvCE/SurvPC you MUST disable FEC on the repeater.

ADL Vantage / Trimble® TDL 450L, 450H: Satel 9600 FEC ON

ADL Vantage (35 or Pro) and Trimble® TDL 450L / 450H: Satel 9600 FEC OFF compatible configuration. The radio mode 'SATEL, EC Off, FEC On' with Link Rate = 9600.

Front Panel Operation

iGage
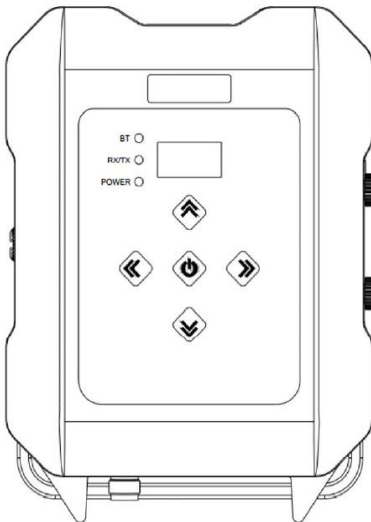
LEDs

BT   Bluetooth Connection. **Red** when connected to a Bluetooth device.

RX/TX   **GREEN** - Receiving, **RED** - Transmitting, OFF Idle

Power   **GREEN** - Valid supply voltage, **RED** – Under voltage (programmable)

If the iGR radio is working as a repeater you should see the RX/TX LED blink **GREEN** then **RED** once per second. **GREEN** indicates that a message was received, **RED** indicates that it was transmitted.

Buttons

Power / Enter
Push and hold for 1-second when the radio is OFF to turn ON power.
Push and hold for 3-seconds when the radio is ON to turn OFF power.
Tap to confirm menu selections.
Tap to turn display on if it dims.

Left and Right
Move through menu items.

Up and Down
Change menu item selections or options.

Power Applied Notes

If the radio was last turned off with the power button, you must turn it on again with the button after applying power.

If the radio was turned off by disconnecting power or a power loss, it will automatically turn on again when power is applied. This feature makes the iGR suitable for remote site use.

If the supply voltage is less than the 'Low Voltage Warning' setting (11.8 volts default), the power LED will flash red twice per second.

If the supply voltage is greater than the 'Low Voltage Warning' setting (11.8 volts default) the power LED will be green steady.

If the supply voltage is less than the 'Low Voltage Tx Disable' setting (11.5 volts default) the power LED will blink red once per second and the radio will not transmit. The radio will still continue to consume power at the Standby rate.

Front Panel Controls

When the radio powers up, the display will be on the main '**Device Info**' menu. You can click the right and left arrows:

to move through the top-level menus

Top Level Menus

`12.7V[|||]`
`  Device Info`
`   Channel`
`    CH 016`
	Displays the battery voltage and the currently selected channel.
	
	A signal strength indication will appear when the radio receives data on the Rx frequency.

>>	Click the right arrow to move to the next top level menu 'Rx/Tx Freq' ->

`12.7V[|||]`
` Ch Tx/Rx Freq`
` *016`
`464.75000`
 	
`461.10000`
	Display and change the current *Channel Number* which sets the transmit (top) and receive (bottom) frequencies. Use the Up and Down buttons to cycle through the choices, press *Enter* to select a new channel.

>>	

`12.7V[|||]`
`   Data`
`Protocol`
`>*SATEL`
`  ETALK`
	Display and change the *Data Protocol*:
	      TRANSEOT, TRIMTALK, TRIMMK3, SATEL, ETALK
	Click *Enter* to save selection

>>	

`12.7V[|||]`
` Radio Link`
`Rate`
` *9600`
	Display the 'Over-the-Air' Radio Link Rate. Read only, the programming tool must be used to change this value because it is tied to the *Channel Bandwidth* which is regulated by the FCC license.

>>	

`12.7V[|||]`
`   Radio Mode`
`>*Radio`
`Repeater`
	Display and change the radio operation mode:
	      DUPLEX, TX ONLY, RX ONLY, Radio Repeater
	The most common modes are DUPLEX (for cable connection to radio) and Radio Repeater.

>>	

`12.7V[|||]`
` Transmit`
`Power`
	Display and change the *Transmit Power* of the radio. Low, Medium and High. Press *Enter* to save selection. The '*' will be displayed next to the current selection.

iGage

M >*L	
12.7V[||] Serial Baud >*115200	Display and change the *Serial Baud Rate* used to communicate over the programming cable. Click *Enter* to save selection. The '*' will be displayed next to the current selection. 115,200 is the default value.
12.7V[||] Auto Adapt SBaud > OFF Adapt Start:ON	When using a cable connected to a Base receiver, if you don't know the baud rate of the Base, move the cursor to 'Adapt Start:ON' and click Enter. The radio will attempt to figure out the correct '*Serial Baud Rate'* when the base begins to transmit. This function is rarely used.
12.7V[||] OLED Sleep Mode > ON Time: 5min	To extend the life of the Organic LED display (OLED) and to save power the display is programed to turn off after 5 minutes. You can change the delay-to-off time from this menu.
12.7V[||] Transmit Power M >*L	Display and change the radio output power. The '*' is displayed next to the current selection. Use the up and down arrows to select, then press *Enter* to save changes. Use the lowest power that will cover your working area.
12.7V[||] Disturb Check >Channel: 0 State: Press OK	Perform a 'Disturbance Check' on a single radio channel. Set the 'Channel: ?' to the channel you want to check, then move the cursor to the 'State: Press OK' line and click Enter. The radio will listen for another user on the same channel and display the channel status. Either 'Worst', 'Bad' or 'Good' will be returned depending on the channel's activity. Selecting a channel with 'Good' is best.

iGage **Gage**   iGR Radio User Manual

`12.7V[||]`
 	
`    Bluetooth`
`> OFF`
	Toggle the Bluetooth ON and OFF by clicking the *Enter* button.
	
	Bluetooth operation is not supported by the iGR.

`12.7V[||]`
 	
`      CSMA`
`> ON`
	Toggle the CSMA check ON and OFF by clicking the *Enter* button.
	
	CSMA = ON is required for operation in the USA unless you have a 'clear channel' license.

`12.7V[||]`
 	
`    Language`
`> Chinese`
`* English`
	Choose the display language. Only English and Chinese are available. If you accidently get the radio into the Chinese language mode: 1) cycle the power,
	
	1) click the right arrow until you see 语言 (language) on the top display line, 3) Use the up and down buttons to select 英语 (English language) on the second line, 4) click *Enter*.

Device Info Menu

From the main top-level 'Device Info' menu, you can press the down and up arrows

to move through the 'Device Info' status screens:

`        12.7V[||]`
`  Device Info`
`   Channel`
`    CH 016`
	This is the main top-level menu. Click on the up-arrow and down-arrow buttons to move through the 'Device Info' menu items.
	
	All of the 'Device Info' menu items are read/only status. You can not change settings in these menus.

	Click the down arrow button to move down to the next Device Info screen

`        12.7V[||]`
`  Device Info`
` Rx Frequency`
`  461.10000`
	The transmit frequency. Read-only. The channel selection on the top-level menu will change this value based on the channel table.

`        12.7V[||]` `  Device Info`	The receive frequency. Read-only.

Rx Frequency 461.10000	
12.7V[||] Device Info Protocol SATEL	The currently selected radio protocol. Can be changed from a top-level menu.
12.7V[||] Device Info Transmit Power L	The currently selected 'Output Power'. Can be changed from top level menu.
12.7V[||] Device Info Call Sign ON	Displays if the Call Sign is ON or OFF.
12.7V[||] Device Info Model:eRadio Pro FWver:D025.03.01	Model name and Firmware Version.
12.7V[||] Device Info HW Ver: V01 S/N:D18900658	Device Hardware Version and Serial Number.
12.7V[||] Device Info Factory Setup	Factory Setup: Click the 'Enter' button, then select Y, then enter again to return the radio to the factory default settings. Select N then enter to return to the main Status Menu

Data Power Cable
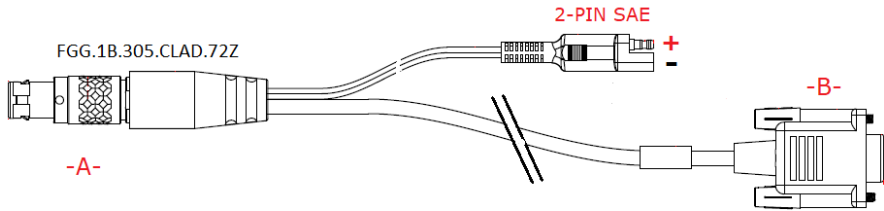
LEMO #1 shell, 5 pin circular plug. P/N FGG.1B.305.CLAD52Z is available from mouser.com:

https://www.mouser.com/ProductDetail/LEMO/FGG1B305CLAD52Z/?qs=ZAjGDd5n2aFPMI%2FpWzEQPA%3D%3D

The pin numbering shown below is for the socket and the back (solder-side) of the connector. The pin side of the connector is opposite.
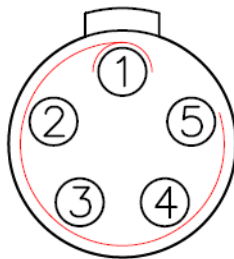
Pin Number 5-Pin LEMO -A-	Pin Number DB 9F -B-	2-Pin SAE	Description
1		**+**	**+12 V Power Input**
2		**-**	**-12V Power Ground**
3	2		Tx Data Output, connects to computer Rx
4	5		Data Ground
5	3		Rx Data Input, Connects to computer Tx
	1,4,6,7,8,9		-no connection-

Power Cable
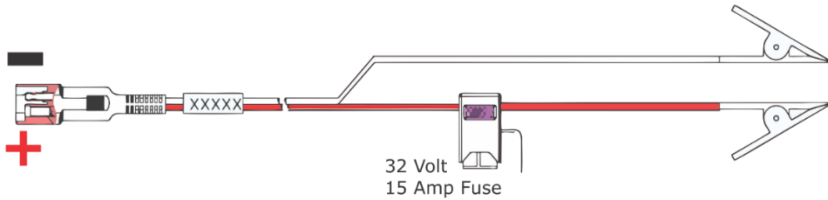
Be very careful when building custom or using manufactured SAE 2-PIN connectors. The positive and negative pins interchange when connected to the load or supply. It is very easy to confuse + and – pins. Refer to the image above, remembering that the socket and pin designation of + and – interchange for the load and supply cables.

Third party cables may be marked backwards as they may be intended to be load cables!

Connecting power backwards voids the radio warranty.

RF Output Connector

50-ohm TNC Female

For RF58 and LMR195 cables we recommend the Amphenol PN 122108 TNC Male connector.

If the radio is operated in wet locations, you can coat the outside and inside of the TNC connector with clear 'Silicone Dielectric Grease' or a commercial contact preservative to help eliminate corrosion.

RF Cable Suggestions

Many coaxial cables are in successful use for UHF radio operation.

The most common types of coax with insertion loss at 461.2 MHz (excluding connector loss) are shown in this table:

	18 feet	50 feet	100 feet
RG58	2.0 dB	5.6 dB	11.2 dB
LMR195	1.6 dB	4.4 dB	8.7 dB
RG8	0.9 dB	2.5 dB	5.0 dB
LMR400	0.7 dB	1.8 dB	3.6 dB

Both LMR400 and RG8 are very difficult to deploy daily in field use at low temperatures and may not coil tightly for storage. We recommend selecting coax to keep the loss less than 6 db.

As an example: using an 18' long LMR195 coax, assuming 1db connector/connection loss, at high power (35-watts) with a 3 dB gain antenna results in an estimated 36 watts of ERP (Effective Radiated Power) and a 4-mile real world range in canopy or a 53-mile open path range. NOTE: this probably exceeds the ERP level licensed to most surveyors.

Using a 50' long LMR195 coax, assuming 1db connector/connection loss, at high power (35-watts) with a 3 dB gain antenna results in an estimated 23 watts of ERP (Effective Radiated Power) and a 3.2-mile real world range in canopy or a 41-mile open path range.

Elevating the Antenna

The most important thing that you can do to increase radio range:

> Elevate the antenna.

For example, let's compare two repeater-use scenarios in high canopy on flat ground with no hills or mountains. *This comparison is an estimate based on real world conditions and your results may be better or worse. These results are not guaranteed and no implication of true performance is made.*

Repeater Transmitter: For both cases we will use an 18' LMR195 cable with a 5 dB gain, end-fed dipole (like the iGage iGA antenna) on the iGR repeater. We will compare the range with Low and High output power and the antenna at 6' AGL (Above Ground Level) and 20' AGL.

Rover: Assume the rover has -108 dBm receive sensitivity with an iGA 5 dB end fed dipole mounted on the bottom of a smart GNSS antenna with its midpoint at 5 feet above the ground.

Output Power	Height AGL	ERP	Real World Canopy Range	Free Air Path Range	Amp Hours per 9-hour Day @ 50% Duty
5 watts	6'	10-watts	2.5 miles	32 miles	14
28-watts	6'	57-watts*	4.0 miles	80 miles	32
5-watts	20'	10-watts	6.5 miles	32 miles	14
28-watts	20'	57-watts*	7.6 miles	80 miles	32

* May exceed most FCC licenses allowable ERP

Raising the output power 560% is not as effective as raising the antenna higher in the air.

With an elevated antenna, raising the output power from Low to High only increases the range 14%.

Clearly a higher antenna is better than higher power.

Caution: before raising an antenna 20 feet into the air, ensure that it will not touch or fall into power lines. Don't use a high antenna if there is a chance it will be hit by lightning. Don't setup or takedown an antenna when the possibility of lightning exists.

Effective Radiated Power (ERP) Considerations

Most iGR kits supplied by iGage include an antenna cable and 5-dBi End-Fed-Dipole antenna. This combination will result in superior long-range coverage; however, the effective radiated power may exceed the maximum Effective Radiated Power (ERP) allowed by your license if the radio is set to High output power.

The estimated ERP (Effective Radiated Power) of the supplied antenna cable, connections and antenna included in the kit; assuming 0.75 dB connector loss, 1.4 dB cable loss and 1.8 VSWR match; is:

Power	Effective Radiated Power
Low – 5-Watts	9-Watts ERP
Medium – 20 Watts	35-Watts ERP
High – 35 Watts	**61-Watts ERP**

Many FCC licenses are limited to 35-watt ERP so the medium power setting is appropriate with the supplied accessories. Additional cable lengths, damaged connectors, crimped coax or changing the antenna element will change the ERP significantly.

Using the iGR_Programmer Tool

Installation

iGR_Programmer is a single file executable. It is compatible with Windows XP, Windows 7, Windows 8 and Windows 10.

The tool is distributed on a thumb drive with the radio, however it is usually best to download the latest version from the iGage website.

You can place the executable anywhere on a Windows PC and start the tool by clicking on it.

Placing the tool on your desktop makes it easy to find and easy to start:
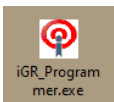
Reboot after Programming

Important Note: You must reboot the radio after programming for changes to be implemented.

Hint: Set to Low Power when Programming

If you plan on programming the radio on your office desk be sure to attach an antenna.

Before programming, use the front panel keys to set the TX power to low. This will reduce your personal exposure to RF and it will prevent your computer monitor from blanking when the radio transmits while programming.

Operation

When the tool is run, it will initially be blank:
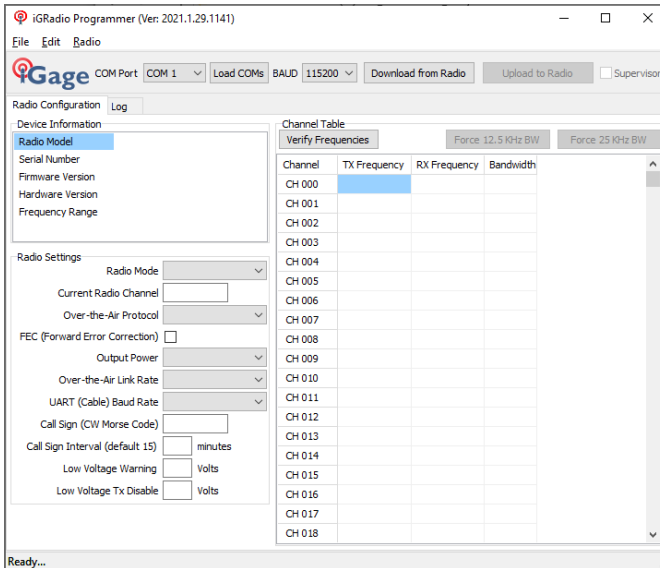
Begin by connecting a UHF antenna to the radio, then attach the radio to a serial port and finally powering the radio on either by connecting the battery or using the ON/OFF switch after connecting the battery. Set the TX power to Low, this will prevent the radio from transmitting at full power while reading and writing which typically will blank your computer monitor.

After the radio boots, make sure the selected 'COM Port' matches the COM port the radio is connected to:

You can click the Load COMs button to limit the drop down COM port list to values that actually exist on the computer. By default, the list includes COM1 through COM256.

Set the Baud Rate to match the interface rate selected on the front panel of the radio:

The default rate is 115,200 as shown above.

Click the 'Download from Radio' button to recall the radio current settings from the connected device:
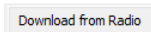
Once you download the current radio settings, you can modify the settings as required for your application.

iGage
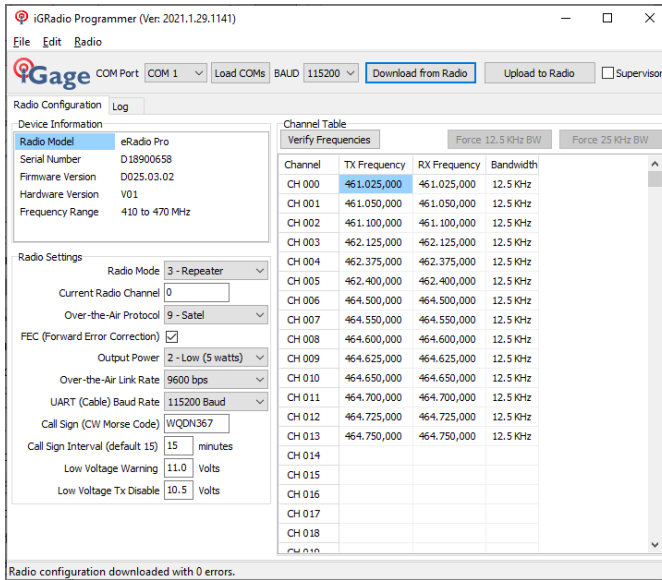
Some items will require a supervisor key to change. This key can be found in a sealed envelop with your radio.

When modifications are complete, click the 'Upload to Radio' button to send the new configuration to the radio:
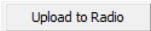
Use the 'File: Save' option to save your configuration to a file.

Use the 'File: Export' option to write and optionally print a human readable configuration file.

Advanced Information

Load COMs

When you start the iGR_Programmer tool, the COM Number dropdown box will allow selection of any COM port in the range 1 through 256.

Clicking 'Load COMs' searches for valid COM ports and populates the drop-down list with only valid COM ports that currently exist on the computer. This function can take 30-seconds or more to complete.

Download from Radio
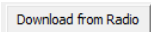
Attempts to connect to the radio using the currently selected COM port at the currently programmed Baud Rate. If successful all of the radio's current settings will be loaded into the programming tool.

Upload to Radio
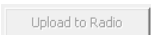
Verifies all settings then if no issues are found, transfers all of the settings from the computer to the radio.

> **After the settings are uploaded, the radio must be restarted to make the new settings active!**

Verify Frequencies

Verify Frequencies

All of the frequencies, channel bandwidths, call sign and call sign interval value are checked for FCC compliance. In addition, frequencies are verified to be even multipliers of the channel bandwidth.

Low Voltage Warning and Disable

Low Voltage Warning [   ] Volts
Low Voltage Tx Disable [   ] Volts

When the supply voltage drops below the warning value, the power LED will flash twice per second.

If the supply voltage drops below the disable value, the radio will not transmit.

The default Low Voltage Warning setting is **11.8** volts.

The default Low Voltage Tx Disable setting is **11.5** volts.

Radio Mode

Radio Mode [∨]
0 - Transceiver (Tx & R
1 - Tx Only
2 - Rx Only
3 - Repeater
4 - Network Bridge / Re
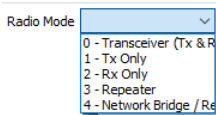
The radio mode can be:

0. **Transceiver**: Transmits and Receives data to the serial cable
1. **Transmit Only**: data on the serial port is transmitted, received data is tossed.
2. **Receive Only**: data on the serial port is tossed, data received over the air is passed to the serial cable.
3. **Repeater**: received data is stored until the transmission stops, the stored message is then retransmitted.

Repeater mode is the most common mode. You can configure the radio to retransmit on the same frequency or a different frequency depending on your application and the channel setting.

Note that repeater operation does not pass data to the serial cable.

Current Radio Channel

Current Radio Channel [   ]

This selects which of the programmed channels is active. The current channel can also be selected from the front panel. The channel should be in the range of programmed channels and the tool will set the channel to the highest programmed channel if you set it to a non-available channel.

Remember that the lowest channel number is 0 (zero) not 1 (one).

Over the Air Protocol
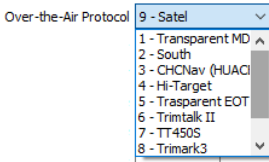
The following protocols are supported in the USA:

- Transparent EOT
- Trimtalk II
- TT450S
- TrimMark 3
- **Satel**

The most efficient protocol is Satel FEC OFF however Satel FEC ON will have double (or more) the range if there path is electrically noisy.

The 'TrimMark 3' is common, however it has been depreciated by most manufacturers.

Transparent EOT, TrimtalkII, TT450S are limited to 4,800 baud with 12.5 KHz Channel Bandwidth. 4800 baud does not have sufficient carrying capacity for repeater operation with GNSS signals.

For repeater operation, **Satel FEC ON** is highly recommend!

Additional information can be found in the Radio and Repeater Operation section on page 13.

FEC (Forward Error Correction)

When FEC is enabled the radio adds error correction bits to the original data. The receiving radio then removes these bits when decoding the transmission. Error correction will greatly improve the reliability of received data and double the usable range, however it adds ~25% additional overhead.

Both sides (the Transmitter and the Receiver) must have matching FEC settings.

The default FEC value is **ON** (unchecked).

Output Power
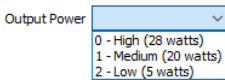
Select between output power settings:

- High   35-watts
- Medium   20 watts
- Low   5 watts

Use the lowest power sufficient to complete your work.

Note: Actual output power is dependent on the supply voltage. Effective output power is dependent on the antenna gain and the loss of the UHF cable and connectors. Remember that elevating the antenna higher above the ground will always be more effective than an increase of power. You can offset lower power by using an antenna with higher gain.

Lower power will substantially lengthen battery life. Lower power will allow an older battery to operate without triggering under voltage cutouts.

Over-the-Air Link Rate

Over-the-Air Link Rate

4800 bps
8000 bps
9600 bps
16000 bps
19200 bps

The over the air link rate is the rate of data transmitted by the UHF radio. The Over-the-Air rate need not match the Cable baud rate.

The Over-the-Air rate is limited by the Channel Bandwidth and the Protocol. Not all rates are possible for combinations of protocol and channel bandwidth. Consult the mode chart in this User Manual.

UART (Cable) Baud Rate

UART (Cable) Baud Rate

9600 Baud
19200 Baud
38400 Baud
57600 Baud
115200 Baud

The UART rate controls the speed of data over the cable, not the air link. You should use the highest baud rate that is compatible with the connected device to minimize the delay of transmission and reception.

The data format is always 8-data bits, no parity, 1-stop bit. The interface level of the cable is RS-232.

Call Sign (CW Morse Code), Call Sign Interval

Call Sign (CW Morse Code) [   ]

Call Sign Interval (default 15) [   ] minutes

You must have an FCC License to use the iGR radio. The license will include a unique alpha-numeric Call Sign that must be broadcast at least every 15-minute in Morse Code.

While the Call Sign is broadcasting the radio cannot transmit data so incoming data is stored until the Call Sign transmission is complete. For this reason, it is best to broadcast the Call Sign as infrequently as possible, thus 15-minutes is the default interval.

Low Voltage Warning

Low Voltage Warning [   ] Volts

If the supply voltage is less than the 'Low Voltage Warning' setting (11.8 volts default), the power LED will flash red twice per second.

If the supply voltage is greater than the 'Low Voltage Warning' setting (11.8 volts default) the power LED will be green steady.

Low Voltage Tx Disable

Low Voltage Tx Disable [   ] Volts

If the supply voltage is less than the 'Low Voltage Tx Disable' setting (11.5 volts default) the power LED will blink red once per second and the radio will not transmit.

iGage

Supervisory Mode

 Supervisor

The radio frequency channel assignments and the Bandwidth cannot be modified without checking the 'Supervisor' checkbox. When first checked you will be prompted to enter the 5 or 6 character 'iG Key' for your specific radio:

When the proper key is properly entered, the 'OK' button will be enabled and the status box will change to green.

Every radio has a unique supervisor key.

Checking the 'Save iG Key on this machine' will remember the iG Key so that you won't need to type the supervisor key in again on this computer. If the computer is a shared device, you should not remember the key as you are responsible for unlicensed programming. You can remove a remembered key by selecting: 'Radio: Force Device SN: OK' and then unchecking the box.

The 'iG Key' is contained on a card that is distributed by iGage with the radio. If you lose the keycard you will need to call the iGage factory to obtain the code.

By entering the Supervisor key-code you agree that:

1. To indemnify iGage Mapping Corporation against all claims of unlicensed and unauthorized use.
2. The radio will be programmed only with transmit frequencies that you are legally entitled to use.
3. The channel bandwidths are set appropriately (typically 12.5 KHz).
4. You have a 'FCC Call Sign' and the FCC Call Sign will be entered into the radio and broadcast

5. The 'FCC ID' is labeled on the radio exterior.
6. A valid copy of the 'FCC License' will be kept at the radio's location.

Note that operating the radio outside of these regulations will result in a $100,000 per day fine if you are caught! The FCC is VERY SERIOUS about non-licensed and improper use.

The 'iG Key' should only be shared with responsible parties.

Compliance Checks

When you click on the 'Upload to Radio' button:

 Upload to Radio

The programming tool will automatically check to make sure that the channel frequencies and channel bandwidths are not specifically forbidden for use in the USA.

Because the same radio is used for a variety of applications, by private and government agencies it is not possible to make extensive range checks other than:

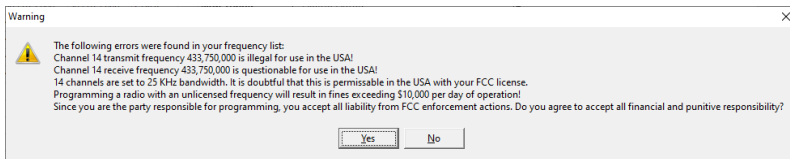399.8875 MHz >= f >= 410.0125 MHz   § 15.205 Restricted bands of operation

432.9875 MHz >= f >= 434.0125 MHz   § 15.240 Operation in the band 433.5-
434.5 MHz

Any errant frequency or channel bandwidth will trigger this warning:

If you click on 'Yes' you will be allowed to proceed. Please note that doing so is probably an invitation for FCC enforcement action.

Entering Frequencies

USA Standard Frequencies

80% of all Survey Users in the USA are licensed for the same / similar frequencies. The menu option 'Edit: USA Standard' (available only when in Supervisor mode):
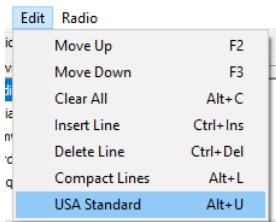
will enter this frequency table:

Channel	TX Frequency	RX Frequency	Bandwidth
CH 000	461.025,000	461.025,000	12.5 KHz
CH 001	461.050,000	461.050,000	12.5 KHz
CH 002	461.100,000	461.100,000	12.5 KHz
CH 003	462.125,000	462.125,000	12.5 KHz
CH 004	462.375,000	462.375,000	12.5 KHz
CH 005	462.400,000	462.400,000	12.5 KHz
CH 006	464.500,000	464.500,000	12.5 KHz
CH 007	464.550,000	464.550,000	12.5 KHz
CH 008	464.600,000	464.600,000	12.5 KHz
CH 009	464.625,000	464.625,000	12.5 KHz
CH 010	464.650,000	464.650,000	12.5 KHz
CH 011	464.700,000	464.700,000	12.5 KHz
CH 012	464.725,000	464.725,000	12.5 KHz
CH 013	464.750,000	464.750,000	12.5 KHz

Typically, only one or two lines will need to be modified. You can use the 'Edit' menu functions to add and delete lines as necessary. After making changes, use the 'File: Save' function to save your unique frequency / channel set.

Auto RX Frequency Entry

When entering a TX frequency, the RX frequency is always modified to match the TX frequency. If you want to have a different RX frequency, enter the TX frequency first, then edit the RX frequency.

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Table Editing Functions

Several table editing functions are available when the Supervisor mode is enabled:
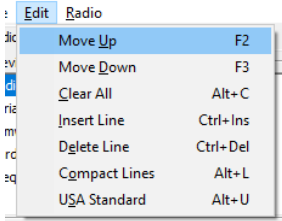
Move Up   F2   Moves the currently selected line up one line, swapping the data from the previous line

Move Down   F3   Moves the currently selected line down one line, swapping the data with the next line

Clear All   Empties the entire frequency table

Insert Line   Adds a blank line at the cursor location, moves all subsequent lines down one line

Delete Line   Removes the line at the cursor, moves all subsequent lines up one line

Compact Lines   If one or more blank lines exists in the table, they are deleted

USA Standard   Sets the most common frequency list as a base to begin editing

Saving and Recalling Frequency Assignments

The 'File: Open' and 'File: Save' options:
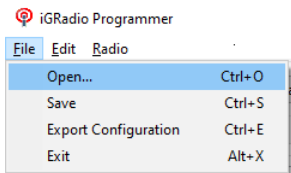
Allow you to save and recall frequency and channel bandwidth table assignments to text files.

A user (non-supervisor) may Open and load a file created for their specific radio; however, they may not use a file from another device. A supervisor is allowed to freely open any device file which allows programming several radios to the same frequencies.

Exporting Radio Settings

The 'File: Export' option:

File	Edit	Radio
Open...		Ctrl+O
Save		Ctrl+S
Export Configuration		Ctrl+E
Exit		Alt+X

Will export a text file that documents the radio settings. After the export the programming tool asks if you would like to open the file:

Information ✕

Exported configuration report to
C:\Users\ms\OneDrive\Documents\iGR_D18900658.txt
Would you like to open the folder?

Yes   No

Click on 'Yes' to open the folder, you can then click on the selected file to view it and optionally print the configuration:
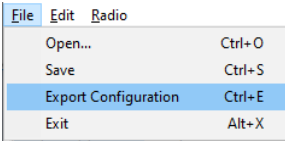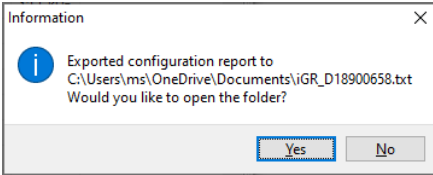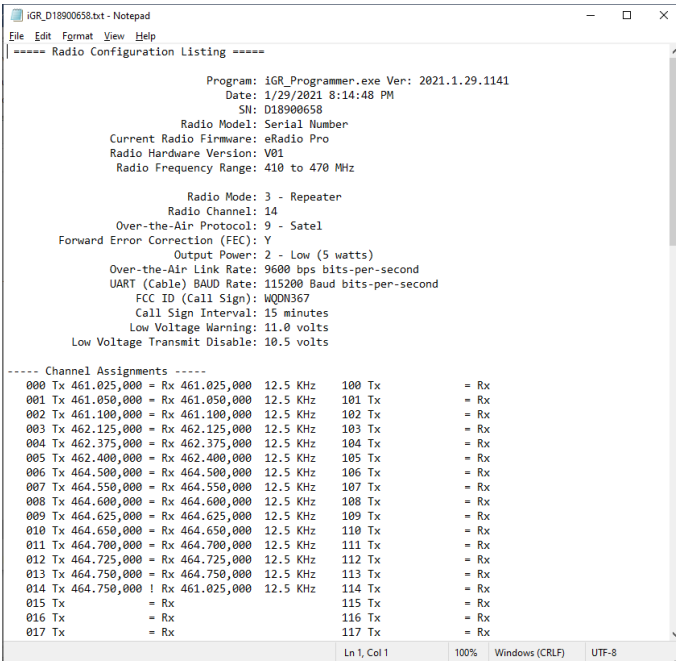
iGR_D18900658.txt - Notepad

File Edit Format View Help

```
===== Radio Configuration Listing =====

                    Program: iGR_Programmer.exe Ver: 2021.1.29.1141
                       Date: 1/29/2021 8:14:48 PM
                         SN: D18900658
                Radio Model: Serial Number
      Current Radio Firmware: eRadio Pro
      Radio Hardware Version: V01
       Radio Frequency Range: 410 to 470 MHz

                 Radio Mode: 3 - Repeater
              Radio Channel: 14
        Over-the-Air Protocol: 9 - Satel
  Forward Error Correction (FEC): Y
               Output Power: 2 - Low (5 watts)
       Over-the-Air Link Rate: 9600 bps bits-per-second
    UART (Cable) BAUD Rate: 115200 Baud bits-per-second
          FCC ID (Call Sign): WQDN367
         Call Sign Interval: 15 minutes
        Low Voltage Warning: 11.0 volts
  Low Voltage Transmit Disable: 10.5 volts

----- Channel Assignments -----
000 Tx 461.025,000 = Rx 461.025,000  12.5 KHz    100 Tx          = Rx
001 Tx 461.050,000 = Rx 461.050,000  12.5 KHz    101 Tx          = Rx
002 Tx 461.100,000 = Rx 461.100,000  12.5 KHz    102 Tx          = Rx
003 Tx 462.125,000 = Rx 462.125,000  12.5 KHz    103 Tx          = Rx
004 Tx 462.375,000 = Rx 462.375,000  12.5 KHz    104 Tx          = Rx
005 Tx 462.400,000 = Rx 462.400,000  12.5 KHz    105 Tx          = Rx
006 Tx 464.500,000 = Rx 464.500,000  12.5 KHz    106 Tx          = Rx
007 Tx 464.550,000 = Rx 464.550,000  12.5 KHz    107 Tx          = Rx
008 Tx 464.600,000 = Rx 464.600,000  12.5 KHz    108 Tx          = Rx
009 Tx 464.625,000 = Rx 464.625,000  12.5 KHz    109 Tx          = Rx
010 Tx 464.650,000 = Rx 464.650,000  12.5 KHz    110 Tx          = Rx
011 Tx 464.700,000 = Rx 464.700,000  12.5 KHz    111 Tx          = Rx
012 Tx 464.725,000 = Rx 464.725,000  12.5 KHz    112 Tx          = Rx
013 Tx 464.750,000 = Rx 464.750,000  12.5 KHz    113 Tx          = Rx
014 Tx 464.750,000 ! Rx 461.025,000  12.5 KHz    114 Tx          = Rx
015 Tx          = Rx                              115 Tx          = Rx
016 Tx          = Rx                              116 Tx          = Rx
017 Tx          = Rx                              117 Tx          = Rx
```

Ln 1, Col 1   100%   Windows (CRLF)   UTF-8

To assist with debugging frequency assignments, channels that have matching Tx and Rx frequencies are listed with '=' notation:

```
000 Tx 461.025,000 = Rx 461.025,000
```

While cross frequency repeater channels are listed with '!' notation:

```
014 Tx 464.750,000 ! Rx 461.025,000
```

Remote Radio Programming

Since only a qualified 'Supervisor' can change the frequency and channel bandwidth table, it is possible for a Supervisor (someone with the iG-Key) to make a channel table then send

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the exported channel table to a file and distribute the file to a user for remote programming.

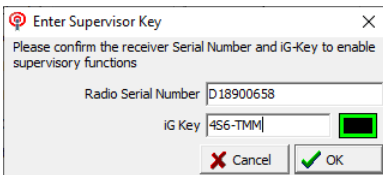Choose the menu option 'Radio: Force Device SN':
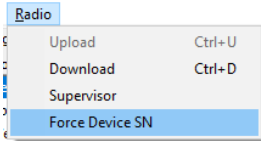
Enter the Serial Number of the device you want to program:
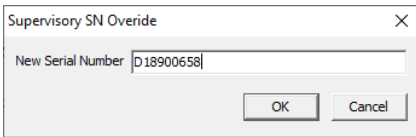
Then click 'OK'.

You will be prompted to enter the 'iG Key' for the spoofed device:

If the 'iG Key' is correct, the OK button will be enabled and you can click it to continue.

The Supervisor mode will be enabled and you will be able to configure a frequency table and channel bandwidths for the spoofed device.

Once your configuration is complete, use the File: Save option to save a configuration file which you can then send to the spoofed radio's user. The non-Supervisor user will be able to load your configuration into their radio without having the Supervisor key.