

2G ALE Overview & Guide

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Overview

What is ALE and what is it used for? Automatic Link Establishment, usually abbreviated ALE, is a standard for digitally initiating and sustaining radio communications on HF. ALE enables a station to contact another station, or a group of stations, via digital signaling, with the goal of providing connections using unskilled operators or to support varying propagation between stations.

Stations that are unable to field a broadband antenna capability, can still utilize single frequency operations to reach scanning stations. This scenario extends the use of ALE significantly and can dramatically increase connectivity options by eliminating the need to coordinate common frequency operations.

ALE itself is a low-level layer that facilitates establishing a connection. The specification contains a large number of features that aren't widely or implemented at all, such as automatic transmit power control. ALE simply establishes a "link" between two stations. After that, some other voice or data operation should occur to utilize the link. There are some limited capabilities such as text messaging that can be sent by ALE, otherwise, outboard applications are needed.

ALE is intended to be on 24x7 normally. While itinerant operations certainly work, if other stations don't know your schedule, it presents a reachability paradox. As with any mode, there are a variety of uses cases. Your use case may be different than someone else's, don't be discouraged if they share a differing view.

ALE can be coupled with any number of applications such as FreeDV, FLdigi, or Winlink. It is possible to run a Winlink RMS with ALE, though it isn't a documented configuration. Winlink Express P2P also functions well.

Remember, ALE is simply a session establishment protocol.

The reference section will list documents such as standards that provide additional information. This guide is not intended to provide in-depth information nor does it represent definitive guidance. It is intended to be a primer or jumping off point for ALE in various services.

Terms

ALE – Automatic Link Establishment.

ALLCALL – An ALE address that opens the receiver of all receiving controllers.

AMBUSH – A slang term for a manually selected channel rather than an LQA chosen channel. Also called “single channel ALE.”

AMD – Automatic Message Display, i.e., text message.

ANYCALL – An ALE address that is a broadcast, which waits for a station to respond via ALE.

AQC – Alternate Quick Call, an improvement over the original ALE signaling protocol.

BER – Bit Error Rate, a measure of the errors in the received signaling.

CAT – transceiver control, used ambiguously to indicate any PC controllable transceiver.

EMCON – emission control, where operations are receive only.

KEY – transmit enable, PTT.

LINK – The called station controller responds to the calling controller, validating two-way communication.

LQA – Link Quality Analysis. A database of received stations with SNR, channel, and time of day.

NET – A defined list of stations in a specific order that all stations in the net uses. The list produces a timed (slotted) hierarchy.

NETWORK – A list of channels that all participating stations use.

POLLING – A process where a calling station iterates through each channel in the called network, using the called stations report to then choose the best channel.

RECHANNEL – first transmit cycle on new frequency.

SNR – Signal to Noise Ratio, a measure of the signal to noise.

WORD – 24 bits (3 alphanumeric characters).

110 – A short term for MIL-STD-188-110(A-D).

ALE Versions

A brief overview of ALE versions. We are focused on 2G.

The original iteration of ALE was largely based on SELCAL blended with defined channelization and was mostly vendor specific.

Second generation, 2G ALE, was the first widely interoperable version, though there are still many disparities with vendors on what and how various capabilities are supported.

Third generation, 3G ALE, went back to being all but vendor specific.

Fourth generation, 4G ALE, looks promising on interoperability, but isn't widely available.

If no version is given in this document, the meaning is either the subject of ALE or 2G ALE.

ALE station variations

“Single channel ALE” – When a station is lacking frequency agility, the station can still use ALE as a method to reduce operator fatigue, by using the mute feature. This allows the radio to be silent until a call is received.

The station can also initiate outbound, single channel calls (aka ambush), to other stations. Ideally the operator will have distance and propagation information to select an appropriate channel. If no information is available, the operator can step through channels until reaching a workable channel. This use case allows a station to reach a destination station at any time of day, by calling on an optimal channel.

“Normal ALE” – The station scans one or more ALE networks, awaiting a call. Broadcast users can send an ALLCALL, resulting in all stations scanning the called channel to stop and listen, allowing broadcast messages to be sent. An ALE broadcast user can step through several channels at a given time of day, executing an ALLCALL on each, to ensure stations at varying distances can receive traffic on the optimal channel. This also allows single channel stations to be reached. While the station scans, any calls or soundings heard will be added to the LQA database. In addition, if the station participates in other networks, the LQA information is stored in frequency blocks

“Hybrid ALE” - A variation of normal ALE is a receive scanning configuration, where a station scans one or more networks, but only transmits as a single channel station.

“Receive only ALE” – is often used with small footprint configurations for reception of notification events. The use of very small receiving loops supports a wide variety of requirements including constrained size, geomagnetic or surge mitigation, or EMCON. This isn't really “link establishment.”

ALE Controllers

Hardware controllers

Are normally built into the transceiver. Examples include Motorola Micom, Codan Envoy, Barrett 4050, and Harris Falcon series. Hardware based systems are very reliable, however, pose some challenges when interfacing to outboard systems such as PC based data services. They may not have displays that can show text messaging, limiting their effectiveness for text alerting. Finally, if you need to modify network configurations frequently, they can be challenging to program, even with computer-based programming options.

Hardware controllers often don't support the full ALE capability set, such as traffic channels.

Software controllers

Software controllers are similar to any other software based digital mode. Audio is routed between the PC and transceiver via a typical soundcard device, either internal to the transceiver or external. Transceiver control is also normally used, but isn't required in all cases. **If you use a digital mode today, you are 2G ALE capable.** It is advised to use hardware keying rather than VOX, though VOX does work.

Ion2G represents the cutting edge of software 2G ALE controllers available today.

Interoperable Features

MIL-STD-188-110

Ion2G contains an embedded 110 software modem capable of supporting MIL-STD-188-110A capabilities via IP connection. Serial connectivity is not supported.

STANAG-5066

Ion2G supports applications utilizing STANAG-5066.

What can you do with ALE?

Call a single channel station via a single channel.

The called station alerts the operator of the call.

Call a normal station via a single channel call.

The called station alerts the operator of the call.

Call a normal station via polling.

The controller calls the destination station on every channel in the defined network, then selects the best channel to make the final call. The called station alerts the operator of the call.

Call a normal station via AUTO.

The controller looks at the previous week of data to determine which channel reported the best channel for the time period the call is initiated in, then makes the call on that channel. The called station alerts the operator of the call.

Note that in any case, the called station can be configured to alert the operator or not, this choice is made by the operator of the called station. Thus, when calling an unattended station, this is normally not an operator facilitated response. After the call is LINKED, the calling operator utilizes the desired messaging system to transfer data.

ALE can disseminate text alerts using only the ALE protocol. The default message is delivered as AMD text. This allows stations that run hardware only or no other outboard software, to receive a notification such as a rally notice. This is an excellent use case for receive only or hybrid stations, which can then move to a rally channel for follow on voice operations.

The Ion2G application allows a user to submit a text message to a network and will automatically send it on the channel or channels selected, with no further operator intervention. Thus, all channels in a network can be messaged with a single user submission, with Ion iterating through each channel.

In an Ion2G heterogenous network, AQC can be utilized, which is a more performant iteration (MIL-STD-188-141B) of the original ALE specification.

What does ALE not do?

It is not a physics bending solution. Stations scattered across broad areas must still follow propagation - MUF and LUF are still present. Thus, an operator that initiates an ALLCALL on a given channel may or may not reach all desired stations on that channel.

Additionally, an ALLCALL transmitted on a channel that spans more than one region, can open any receiver that decodes the call.

Note - There are some channels that are shared with other services, which can be operationally impacted by an ALLCALL.

Review all channel information prior to conducting multi-station calls (ALLCALL, ANYCALL.)

What do you need to use ALE?

Transceiver

Normal or Hybrid ALE stations should use a modern CAT capable transceiver, capable of scanning without the use of mechanical relays. Ion2G supports a number of transceivers natively, with additional transceiver support via the use of FLrig. SDR transceivers such as Flex also work, though still require additional manipulation.

Both the IC-7300 and FT-991A easily support 5ch/s scan rates.

Antenna

The use of a broadband antenna is highly desirable. This type of antenna removes potential issues with electromechanical failures and failure to tune. Folded dipoles (T2FD, T3FD), and conical, are examples.

High speed couplers are a good compromise. These devices also provide the benefit of feed point impedance matching, reducing potential RFI via feedline.

Mechanical auto-tuners do work, but are slower. Ion2G can be configured to send a low power tune signal for a defined time period for these types of tuners to achieve tune.

Manual tuners are viable for single channel ALE use.

Fan antennas can be used for specific, multichannel operations, with good effect for low channel count use.

Receive only ALE can utilize any type of antenna. Small receiving loops are very effective and are highly resistant to EMI and solar events.

Additionally, any of the modes can benefit from the use of dedicated receive only antennas. ALE is normally a wide band application and any antenna tuning that remains in line during receive can impact the reception on non-tuned frequencies.

Note – the use of long antennas for low frequency coverage can produce unintended consequences such as lobing at higher transmit frequencies.

PC

A personal computer running Windows is used to run the ALE controller software and any other outboard applications.

Sound Device

A typical PC/transceiver sound device. These can be internal to the transceiver, internal PC, or external PC devices.

ALE Configuration Information

Codeplug

A codeplug is simply a configuration file. It may contain a complete station configuration or a subset. Ion2G supports several types of codeplug, including ALL, SYSTEM, STATION, and DIRECTORY. Ion allows merge and overwrite for any of the codeplug types. Other names for a codeplug are Communications Planning Application (CPA) if you use radios such as Harris.

ALL contains the complete station configuration. Radio configuration, networks, channels, self-addresses, etc.

SYSTEM contains ALE settings, networks, and channels.

STATION contains self-addresses and radio configuration.

DIRECTORY contains only the directory, which is a phone book of stations.

Merge

Merge will add a codeplug to the existing configuration and leave any existing settings that are duplicated in the imported codeplug. Merge is useful when a new network needs to be added, as you can merge a new network specific codeplug into the existing configuration. Directory additions are also served well by merge – note that it will not update an existing entry using merge.

Overwrite

Overwrite does exactly what it says, any settings already present are overwritten with the data contained in the imported codeplug. This is not a change/update, it is a replace operation. If a setting covered by the type of codeplug is defined, but the new codeplug doesn't have it, the existing setting is not changed.

ALE addressing

ALE addresses (callsigns) are broken into groups of 3 positions called a word. Any tuple (group) of positions requires more time to transmit as well as receive, which increases the probability of error, as well as increases calling times, and which increases congestion on a channel.

Configuration of an ALE controller requires several pieces of information. The three core pieces are listed here.

Self-address

A self-address is the address or callsign of your station on a particular network. You can have more than one self-address on the same network.

Channels

Channels are definitions that contain a frequency, mode, and other variables that are used by the ALE controller to function.

Note – ALE controllers do not currently support a given channel being a member of more than one network. This is due to how ALE works and is not a deficiency of the controller itself. There are networks that overlap and the operator must determine which channel(s) will be members of which network. This can cause issues for a station that needs to generate calls to multiple networks.

Networks

Networks are definitions that contain one or more channels and other variable that are used by the ALE controller to function.

Ion2G Setup

We'll walk through the manual setup of Ion2G version 0.9.8.6. Note the version, 0. Ion2G remains "beta" software currently. That being said, it has been available for several years and is stable.

Go to [ion2g.app](#) and download the appropriate version. For Windows, this will be a zip file.

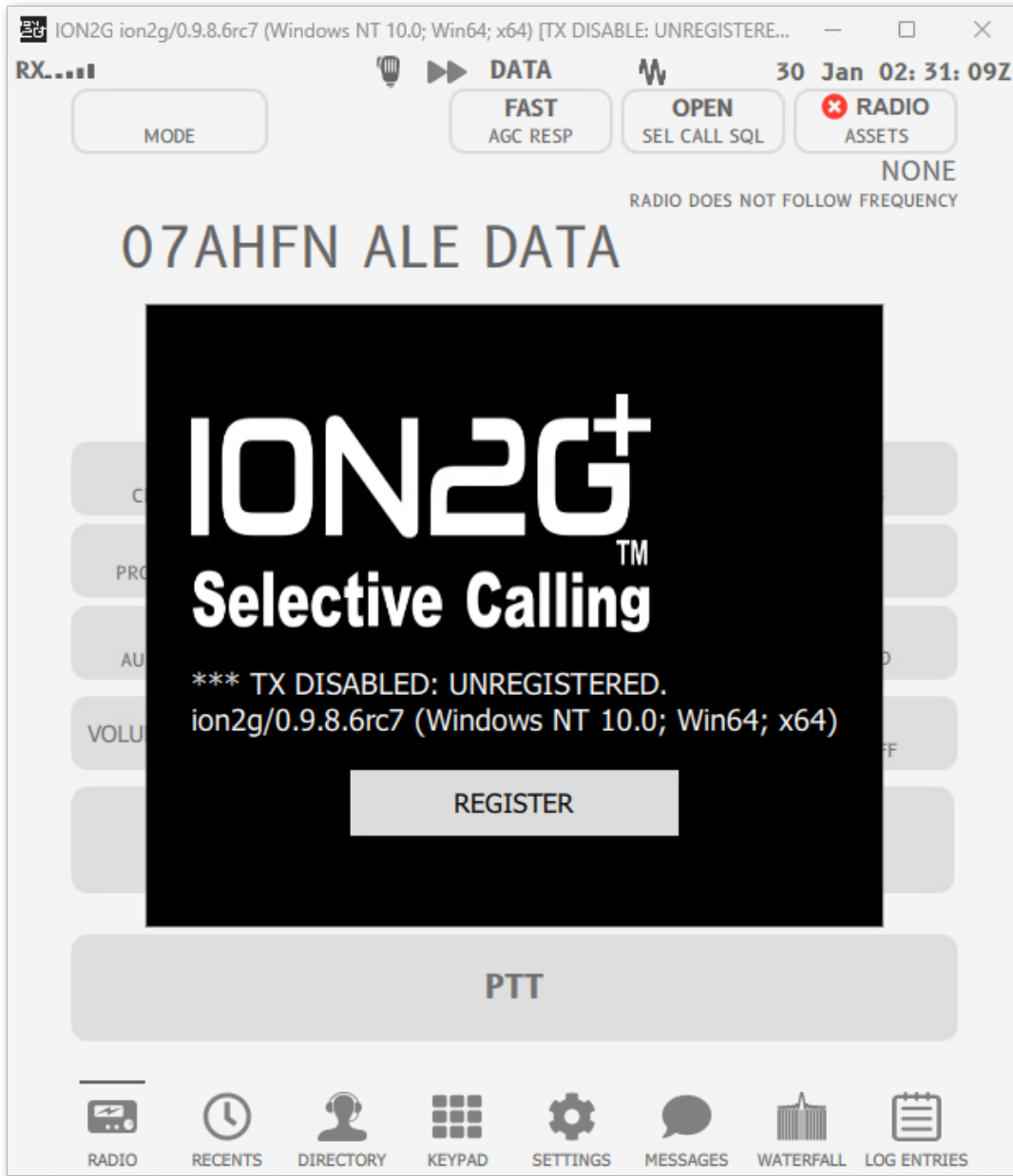
Extract the contents of the zip to the location of your choice.

Navigate to the extracted folder and execute the `ion2g.exe` file. This will open the blank/unconfigured application.

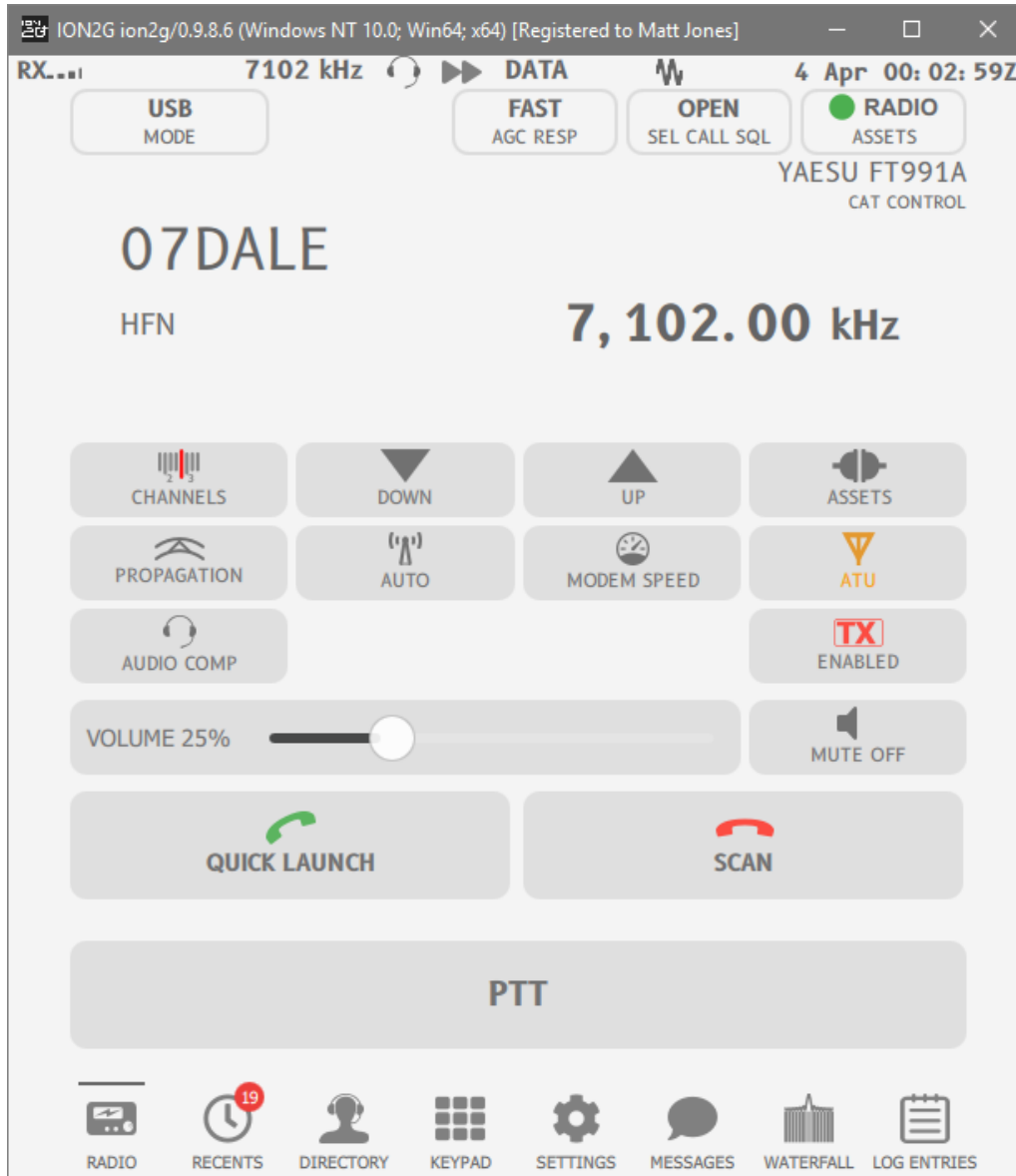
Example graphics are produced from Windows 11 and the transceiver used is an FT-991A.

We'll walk through the Ion2G interface after initial configuration.

This is the initial launch view for a fresh installation. Clicking REGISTER will launch a browser and navigate to the Ion2G registration page.

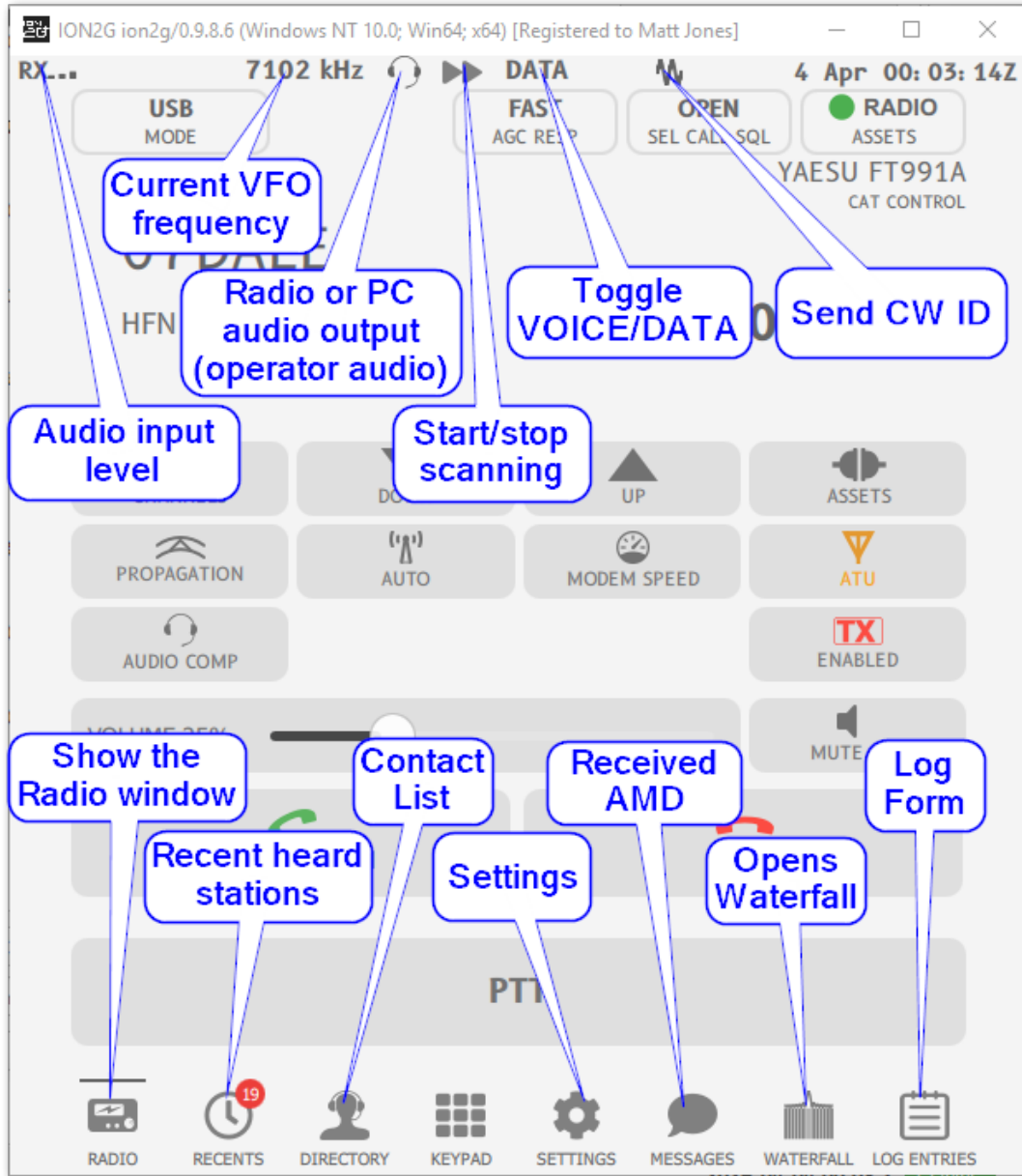


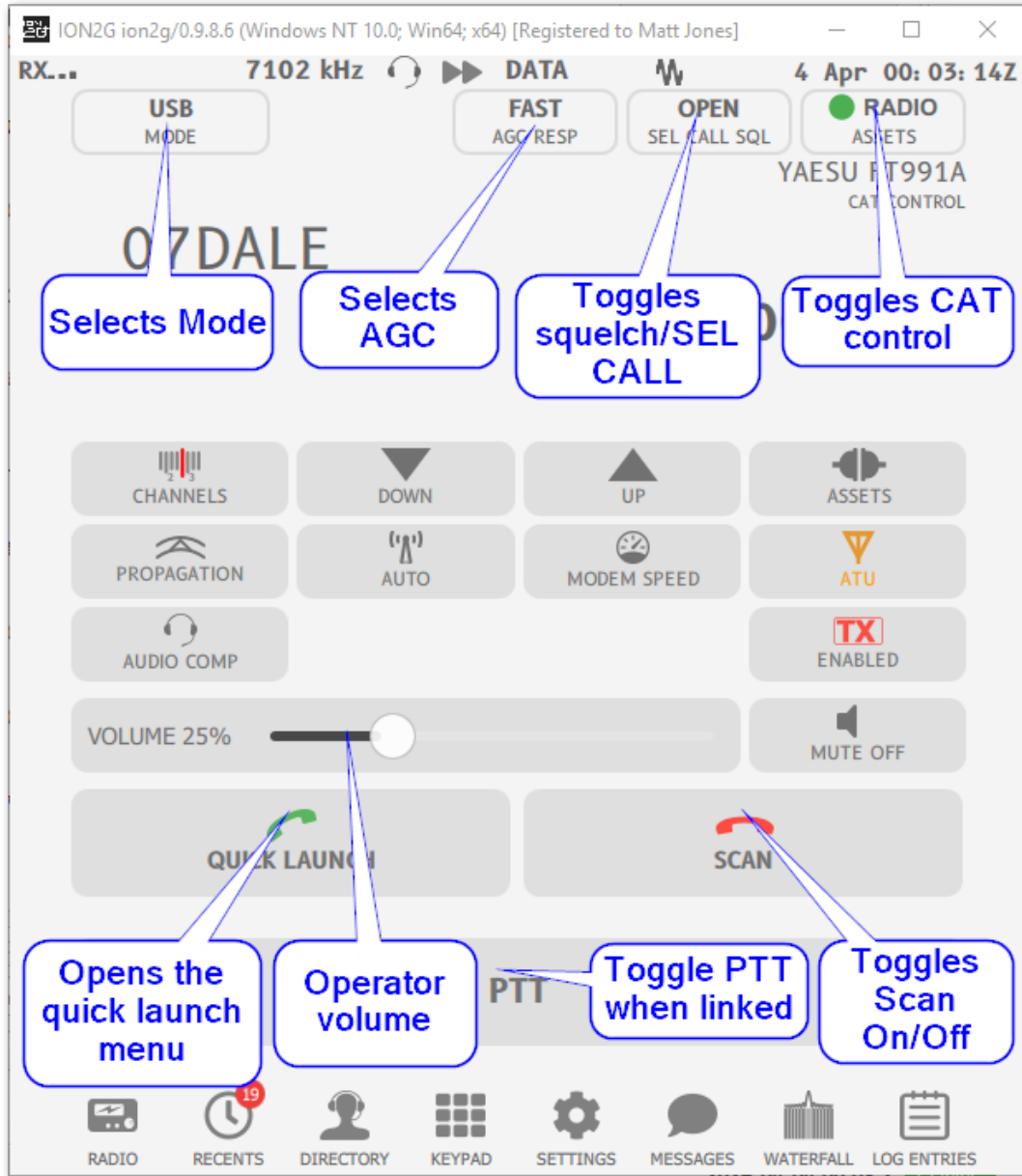
Clicking anywhere else other than the REGISTER button will close the splash screen and expose the unconfigured application.

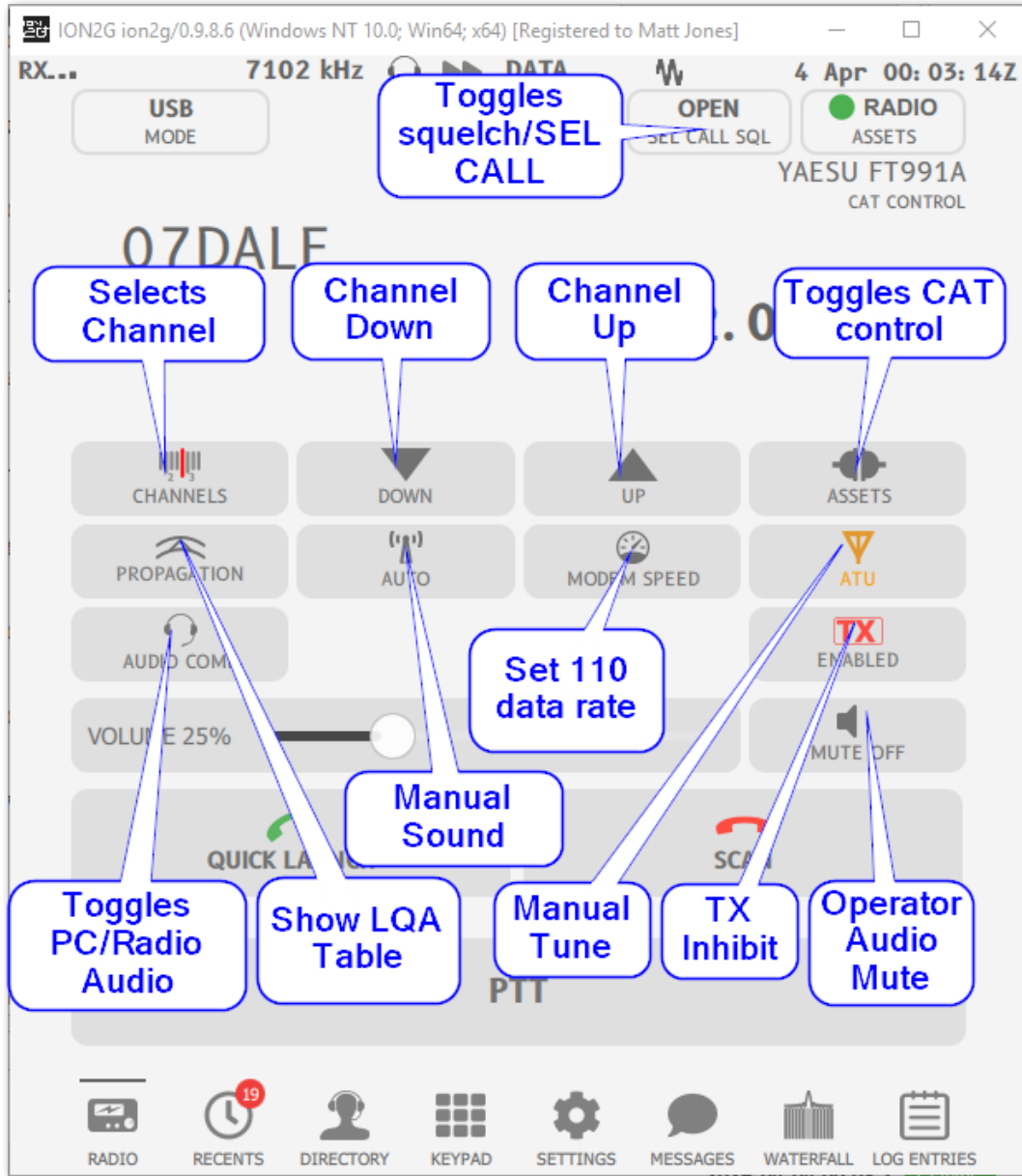


The channel shown isn't really present. Do not be concerned.

We'll cover the various icons and buttons on the next pages before moving into configuration and use.

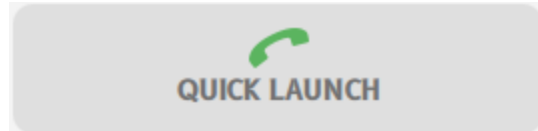






Later, we'll cover additional buttons such as Quick Recall Buttons, that are not shown in the default configuration.

The QUICK LAUNCH button contains several options.



You can type and the entered characters will filter to the available matching options. Otherwise, click on the option you'd like.

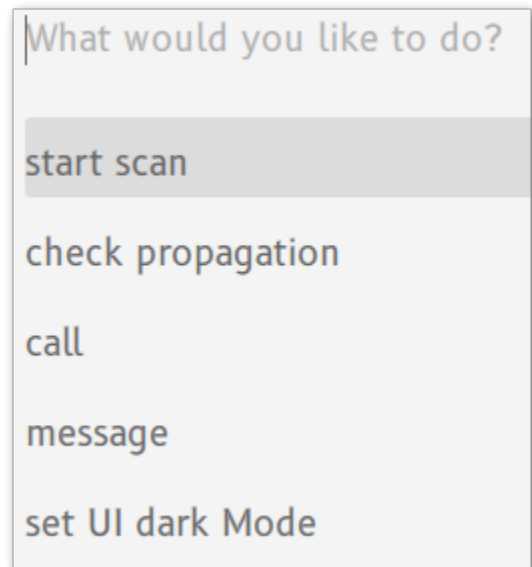
When Ion2G is not scanning, *start scan* is shown. If Ion2G is scanning, this will change to *stop scan*.

Clicking *check propagation* will bring up a *directory* window and if you select an entry, you are presented with the networks that entry is a member of. Click the desired network and an LQA table will display, showing recent hour/frequency data.

Choosing *call* brings up the directory window for entry selection. If an entry doesn't exist, simply type the address you'd like to call, hit enter, then select the network that address is a member of, then choose the channel to call on. Note that a "quick call" like this doesn't give you the ability to poll for best channel. Create a *directory* entry for that capability.

Message behave just like *call*.

Set UI dark Mode or light mode, depending on the existing mode.



Let's jump into Settings and explain the various options to configure and control your station.

Settings

All configuration is done via **Settings** at the bottom of the main window. Clicking on **Settings** opens the window.

Station

Contains basic information about your station, though much isn't used.

GPS connectivity and location reporting (via ALE) are configured in this section.

Code Plugs

Loading and saving code plugs is here.

Audio and Radio

Configuration for audio, radio, tuner, and transmit/receive/antenna switch.

Channels

Channel configuration.

Networks

Configure 2G ALE networks here.

ALE

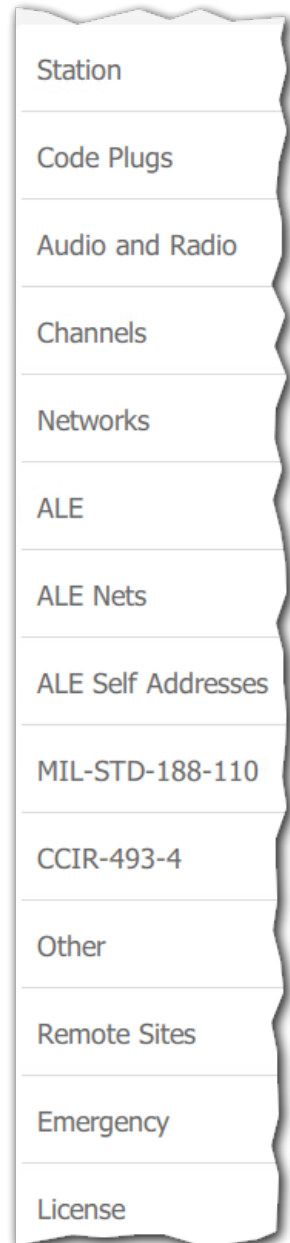
Various 2G ALE parameters are located in this section.

ALE Nets

Net definitions are set here.

ALE Self Address

Define self addresses here.



MIL-STD-188-110

110 parameters are defined in this section.

CCIR-493-4

SELCALL addresses and parameters are here.

Other

ALE scan time, Listen Before Transmit, tune tone level, dark mode, and quick recall buttons are in this section.

Remote Sites

Unused at this time.

Emergency

Emergency SELCALL address.

License

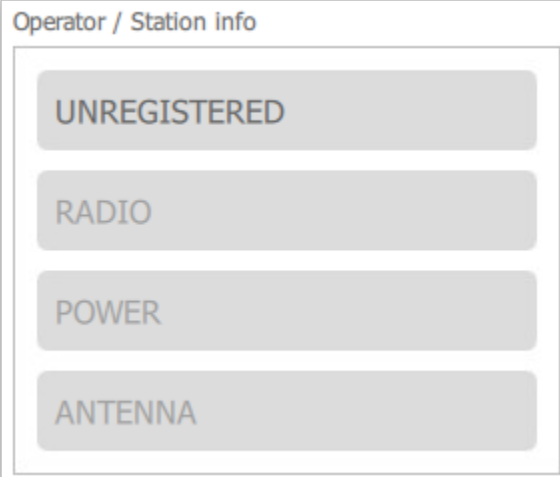
Load and show license information.

Station

Operator / Station

Operator and station information such as name, transceiver, power level, and antenna can be entered in the provided fields. This information is currently not used in any other portion of Ion2G.

There is no requirement to enter information in any of these fields.



Operator / Station info

UNREGISTERED

RADIO

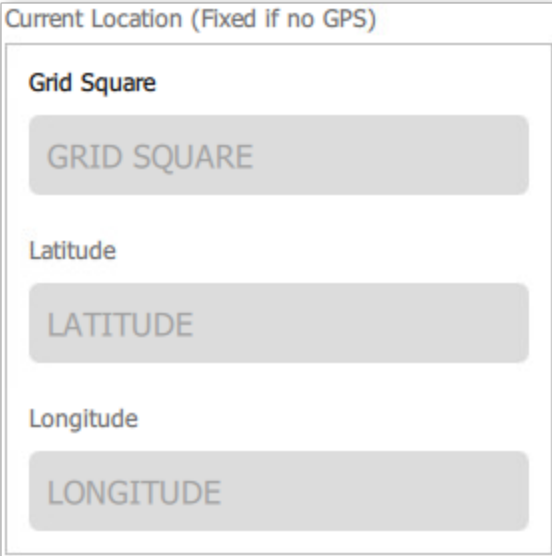
POWER

ANTENNA

This form contains four input fields for station information: 'UNREGISTERED', 'RADIO', 'POWER', and 'ANTENNA'. Each field is represented by a grey rounded rectangle with its label in all caps.

Current Location

If the station doesn't have GPS or other automatic locating system, grid square, latitude, and longitude can be manually entered. Coordinates are decimal. Grid square is currently unused and will not provide any location service.



Current Location (Fixed if no GPS)

Grid Square

GRID SQUARE

Latitude

LATITUDE

Longitude

LONGITUDE

This form contains three input fields for location information: 'GRID SQUARE', 'LATITUDE', and 'LONGITUDE'. Each field is represented by a grey rounded rectangle with its label in all caps. The 'Grid Square' label is bolded.

GPS Device

Checking the **Enable GPS Device** tick box will enable the device configuration settings below. Standard serial port parameters are configurable for the device.

Ion2G does not currently operating system location service support.

When the GPS device is working, but you don't have a fix, the location icon on the status bar of ION2G will flash (just to the right of the DATA indicator).

When a fix is obtained, the icon will be on solid (not flashing). If this icon is off completely, it indicates nothing is being received from the device. In this case check your device settings carefully.

Enable GPS Device

GPS Device

Serial port

Baud Rate

Data Bits
 Seven Eight

Parity
 NONE ODD EVEN

Stop Bits
 One Two

RTS/CTS flow control

Enable Location Query response

Checking the tick box will enable Ion2G to respond via AMD/DBM by sending the manual or automatic coordinates configured above.

Automatic Location Reports

Experimental support for location reporting.

Checking the tick box will enable Ion2G to transmit position reports....

Which ALE network the reports are sent to, as well as the called address, distance of movement (in x) or time interval, are configurable. If reporting to HFLink, a tick box is available to simplify the process.

By default, this is disabled. However, if enabled, and a GPS device is connected to your computer, you can configure ION2G to optionally send your position via ALE AMD message or MIL-STD-187-721D 5.15.2 (one-minute location) ALE messages.

- These reports can be sent to the select destination address of your choosing
- Optionally can be sent to a single station or a defined ALE NET address.

- Sending to ALLCALL is possible but highly discouraged as it will generate a lot of on-air traffic as it sends on EVERY channel in the network to ALL stations.

Valid addresses are ALLCALL (not recommended except in emergencies), a valid NETCALL address, or any valid select station address. All calls will be TWAS (no-link) calls with position report.

- Sending reports to a single station (such as your own base) is more reliable and efficient because it can use LQA to shorten time to send, and also uses 3-way handshake to ensure position was received.

- On Change: If this is set to a non-zero number of kilometers, a report will be sent any time your station has moved more than this distance since the last report.

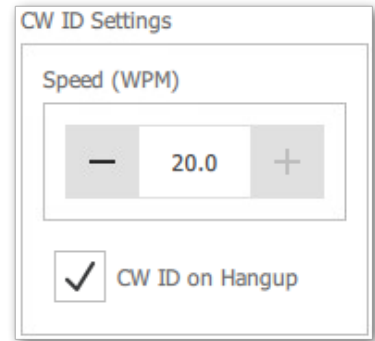
- Use HFLink GPR Format: If enabled, the GPR format will be used to send the report in an AMD message. IF this is not checked, the standard ALE on-minute location encoding will be used. GPR is much less efficient or reliable, but can be received by any ALE radio even those which cannot decode the MIL-STD-187-721 type messages.

The screenshot shows a configuration window with the following elements:

- Two unchecked checkboxes: "Enable Location Query Responses" and "Automatic Location Reports".
- A section titled "Position Report Options" containing:
 - A dropdown menu labeled "(Select Network)" with a downward arrow.
 - A "Report Destination Address" field with a button labeled "ALLCALL".
 - A "Report On Change (disabled)" field with a slider set to "0.0" and minus/plus buttons.
 - A "Report Interval (disabled)" field with a slider set to "0.0" and minus/plus buttons.
 - An unchecked checkbox labeled "Use HFLink GPR Format".

CW ID Settings

If CW ID is needed or desired on link termination, check the tick box and select the desired CW rate.



Code Plugs

Load Code Plugs

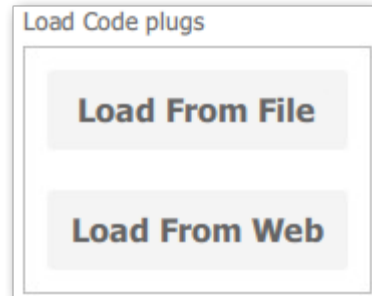
Two options are available, *Load From File* and *Load From Web*. Load From File allows you to import a plug containing a range of information. Load From Web loads the amateur HFL, HFN, and HFS channels and networks only.

When loading a plug from a file, once the file is selected, an option to **Merge** or **Overwrite** is given. Understanding the differences between these two options is important!

Merge simply adds the data in the file into the existing configuration. If you are simply adding channels, networks, etc., then this is the correct choice. If data such as an existing channel/frequency is present, the original data is preserved and the data being loaded from the file that is duplicate is ignored.

Overwrite does exactly what it says – if an existing channel/frequency is present, the original data is overwritten with the data being loaded from the file.

CAUTION – if the station supports more than one network/agency, it is possible that channels may overlap between networks. Please verify if overlap exists prior to loading code plugs and determine the appropriate solution prior to merging or overwriting.



Save Code Plugs

Four options are available, *Save Directory*, *Save Station*, *Save System*, and *Save All Single*.

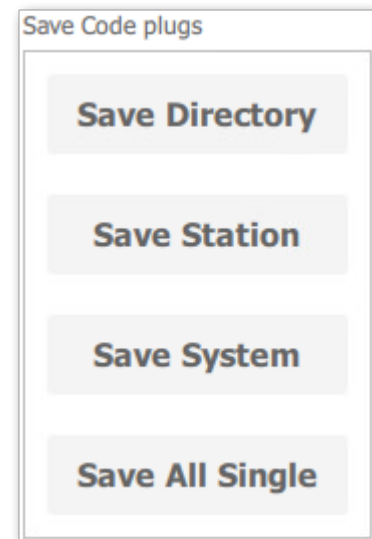
Save Directory does as it implies and exports the contents of the Directory entries.

Save Station exports the radio and audio configuration, as well as the Self Addresses and Location/GPS configuration.

Save System exports the ALE configuration, Channels, and Networks.

Save All Single exports the entire configuration. This is the standard “full backup” file.

Prior to upgrading Ion2G, always perform a Save All Single, so that you have a complete backup. In the event of database changes in new versions, importing your single codeplug is often the preferred method.

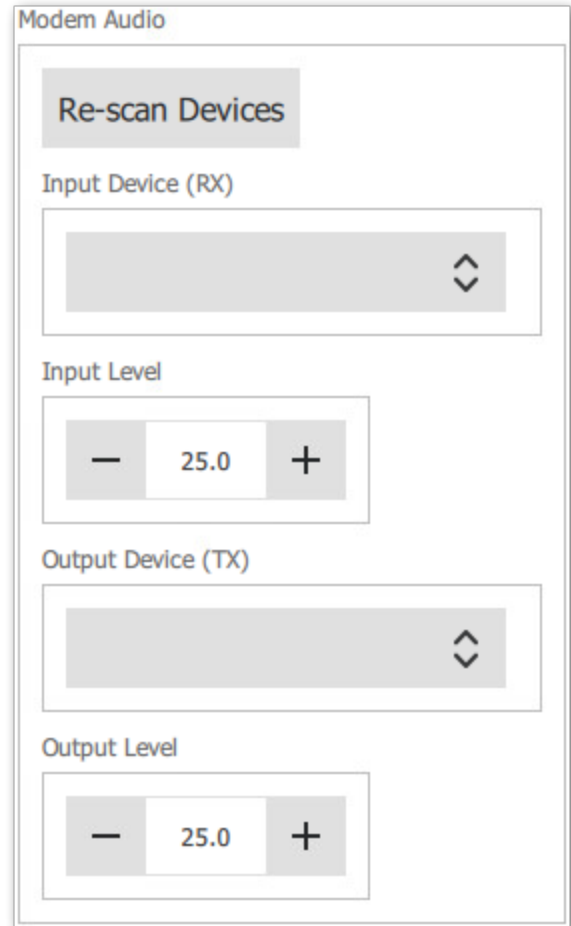


Audio and Radio

Modem Audio

Choose the appropriate audio interface for the *Input* and *Output* devices. The ***Input Level*** and ***Output Level*** can be adjusted as necessary. These levels are internal to Ion2G and do not affect Windows audio device levels.

If you plugged your audio devices in after launching Ion2G, you can click the ***Re-scan Devices*** button and then select the newly detected devices in the dropdowns.



Operator Interface Audio

If you prefer to use PC based microphones and speakers rather than a radio microphone and speaker, check the *Enable* box and select the appropriate *Input* and *Output* devices.

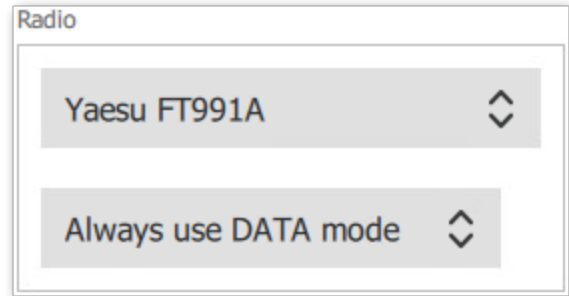
The Input and Output Levels can be adjusted here in addition to other audio levels such as Windows.

Channel Audio enables a variety of sounds to alert you to various receive events. These will sound through the Operator Interface Output Device selected above.

Note - If this is a headset, alerts may not be audible if the operator isn't wearing the headset.

Radio

Select your radio or the appropriate interface from the drop down menu.

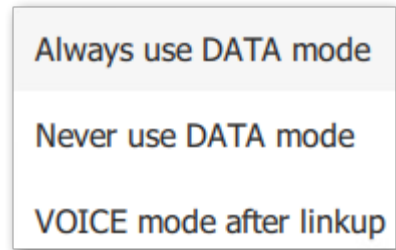


The mode drop down has three options.

Always use DATA mode sets compatible radios in DATA. The purpose of this is to avoid DSP and other signal modification that the operator may wish to use for voice operations.

Never use DATA mode is useful for radios that don't support a DATA mode or for operators that do little signal modification that would disrupt either ALE signaling or follow on data operations.

VOICE mode after linkup allows the operator to run their radio in DATA for sending and receive ALE calls, but once linked, switches to SSB/non-data modes so that the operators audio modifications are presented automatically (when available.)



Note – if additional ALE functions such as AMD, traffic channel change, etc., are performed by the remote station, stations using some DSP functions may not successfully receive these commands.

When using 110, an application that sends data to the modem will follow the mode setting above. I.e., If Always use DATA mode is selected, the embedded 110 modem will switch the transceiver to DATA when transmitting. Likewise, VOICE mode after linkup sends "data" in DATA. Once an ALE link is established, the transceiver will switch to SSB (if supported.) When an application sends "data" to ion2G, it will switch the transceiver to DATA. Ion2G will not switch back to SSB after an application sends "data."

Radio Control Interface

Select the serial port used for controlling the associated radio. Configure the *Baud Rate*, *Data Bits*, *Parity*, and *Stop Bits* used by this port.

Note – if no Serial port is selected, some options such as flow control, will not be visible.

The screenshot shows a configuration window titled "Radio Control Interface". At the top is a "Re-scan Devices" button. Below it are several settings:

- Serial port:** A dropdown menu showing "COM3".
- Baud Rate:** A dropdown menu showing "19200".
- Data Bits:** Radio buttons for "Seven" and "Eight", with "Eight" selected.
- Parity:** Radio buttons for "NONE", "ODD", and "EVEN", with "NONE" selected.
- Stop Bits:** Radio buttons for "One" and "Two", with "One" selected.

At the bottom of the window are three checkboxes for flow control options:

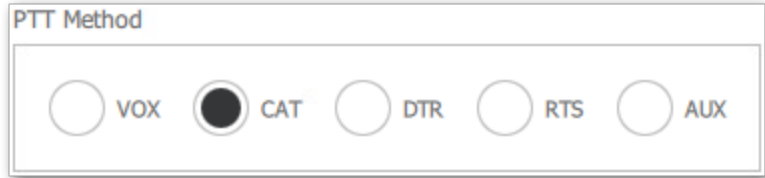
- RTS/CTS flow control
- Pull RTS High
- Pull DTR High

If needed, check the appropriate flow control options.

PTT Method

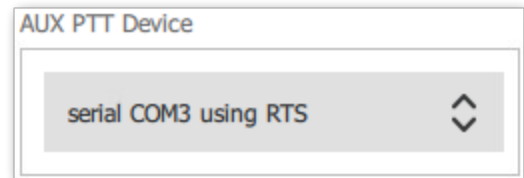
Select the appropriate method to control your radio PTT.

Note – the use of VOX is not recommended.



The image shows a software interface titled "PTT Method". It contains five radio button options: "VOX", "CAT", "DTR", "RTS", and "AUX". The "CAT" option is selected, indicated by a black dot in the center of its radio button.

If your particular station configuration requires an alternative PTT control, choosing **AUX** enables the selection of a different serial port, so that separate RTS or DTR can be utilized.



The image shows a software interface titled "AUX PTT Device". It features a dropdown menu with the text "serial COM3 using RTS" and a double-headed arrow icon on the right side, indicating that the menu can be expanded to show other options.

Tuner Control Interface

Checking the Enable box activates the ability to select a serial interface to control tuner options.

There is a significant amount of flexibility in how you can configure this port and interface to a variety of tuners. Some may simply need +12v or ground asserted as a pulse or held at a level to enable tuning, retune, or receive bypass for scanning.

Some tuners accept serial commands, in which case, the necessary rates and parameters can be specified.

The screenshot shows the 'Tuner Control Interface' configuration window. It features several sections for setting up the tuner's serial communication and control signals. At the top, there is an 'Enable' checkbox which is checked. Below it is a 'Re-scan Devices' button. The 'Serial port' section has a dropdown menu set to 'COM3'. The 'Baud Rate' section has a dropdown menu set to '19200'. The 'Data Bits' section has two radio buttons, 'Seven' and 'Eight', with 'Eight' selected. The 'Parity' section has three radio buttons, 'NONE', 'ODD', and 'EVEN', with 'NONE' selected. The 'Stop Bits' section has two radio buttons, 'One' and 'Two', with 'One' selected. The 'Tune Pulse Duration (ms) (RTS)' section has a numeric input field set to '1,000.0' with minus and plus buttons. Below this is a 'Tune Active High (RTS)' checkbox which is checked. The 'Bypass Pulse Duration (ms) (DTR)' section has a numeric input field set to '1,000.0' with minus and plus buttons. Below this is a 'Bypass Active High (DTR)' checkbox which is checked. The 'Tune Command' section has a text input field containing 'None'. The 'Bypass Command' section has a text input field containing 'None'.

Antenna Switch / PTT-out Interface

Checking the **Enable** box allows the selection of a serial port that can be utilized for the control of antenna switches, transmit/receive switches, or sequencing devices.

The screenshot shows a settings window titled "Antenna Switch / PTT-out Interface". It contains the following elements:

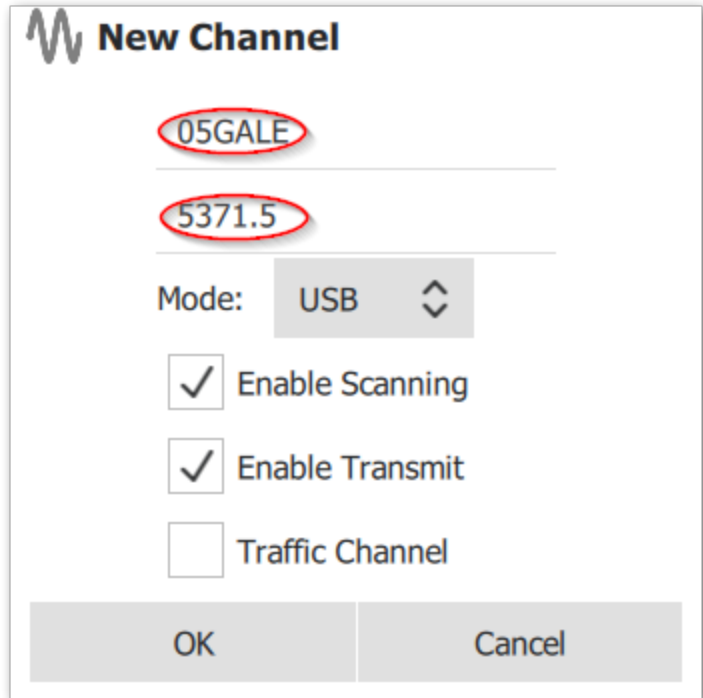
- An "Enable" checkbox with a checkmark.
- A "Re-scan Devices" button.
- A "Serial port" dropdown menu currently showing "COM3".
- A "Sequencer Delay (ms)" spinner control set to "100.0".
- An "Active High (RTS)" checkbox with a checkmark.

Channels

Click **Channels** to enter the channel management window. Clicking + in the upper right adds a channel.

Enter the display name for the channel.

Enter the frequency in KHz.



Checking **Traffic Channel** will disable the Enable Scanning box and indicate to Ion2G that this is an available traffic channel.

If you'd like to scan a specific channel and your antenna system is not capable of transmitting at the configured frequency, unchecking **Enable Transmit** will allow you to receive, but not transmit on this channel.

As you add channels, you'll see them appear in the Channel window.

The screenshot shows the 'Channels Setup' window with a search bar and a table of channels:

Name	Frequency	Mode	Scan	TX	Traffic
01ESEL	1990 kHz	USB	no	yes	yes
03DALE	3596 kHz	USB	yes	yes	no

Networks

Click **Networks** then click the + in the upper right to add a network

Enter the name of the network you'd like to create.

Choose the protocol (ALE in this case.)

Check the **Enable Sounding** box if you wish your station to sound on this network. Some networks, such as HFL, are in voice only segments and sounding is prohibited.

The **Dwell time** determines how long the channel is observed for ALE frames.

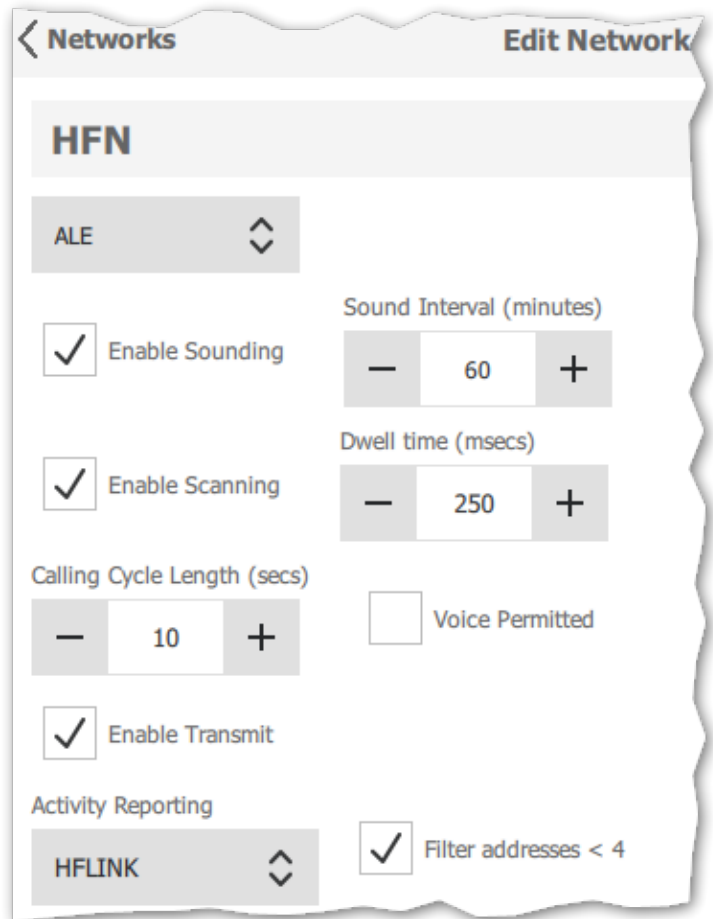
Enable Scanning allows the channels of the network to be scanned.

Voice Permitted supports voice operations such as Voice After linkup. HFN is digital only, clear this box.

Enable Transmit allows the network to transmit. If this is cleared, even though the channels may indicate transmit is allowed, no calls to this network are allowed.

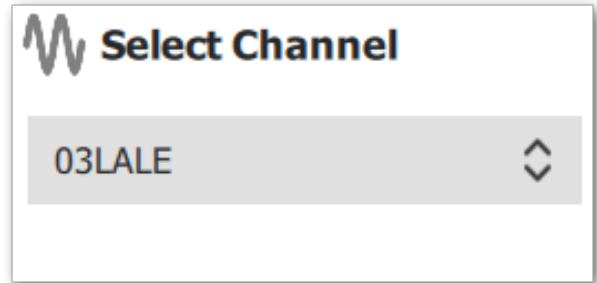
Activity Reporting utilizes internet connectivity to be used for reporting received addresses to online mapping solutions such as HFLink.

Filter addresses <4 allows you to ignore received addresses of less than 4 characters. Some services do use shorter addresses.

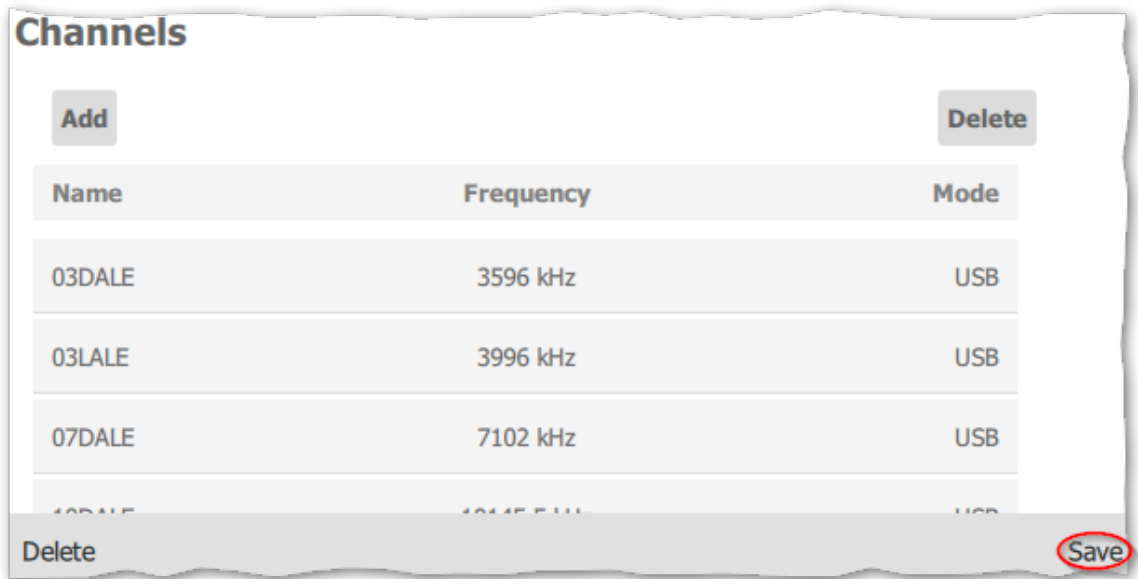


Click **Add** to add channels to the network.

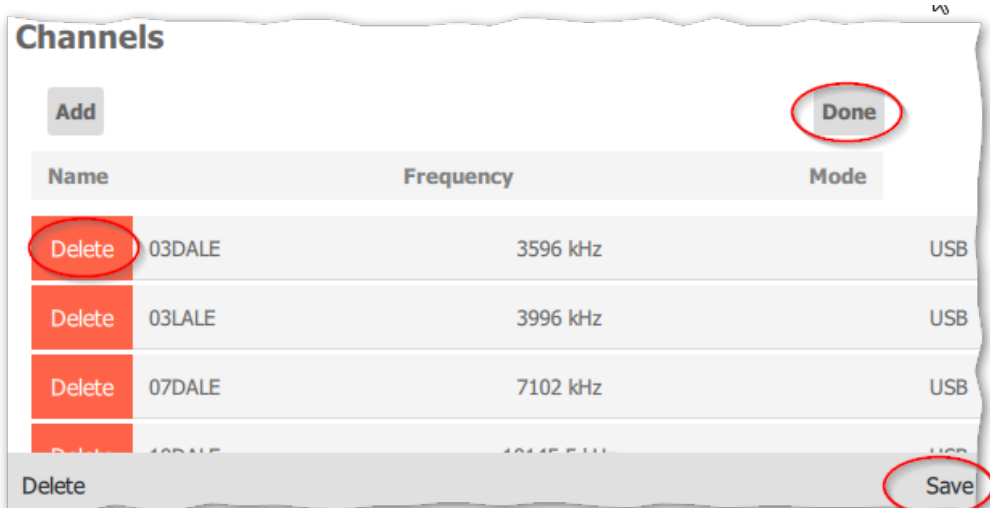
Click the desired channel and you will be returned to the Network window. Click **Add** again to add another channel



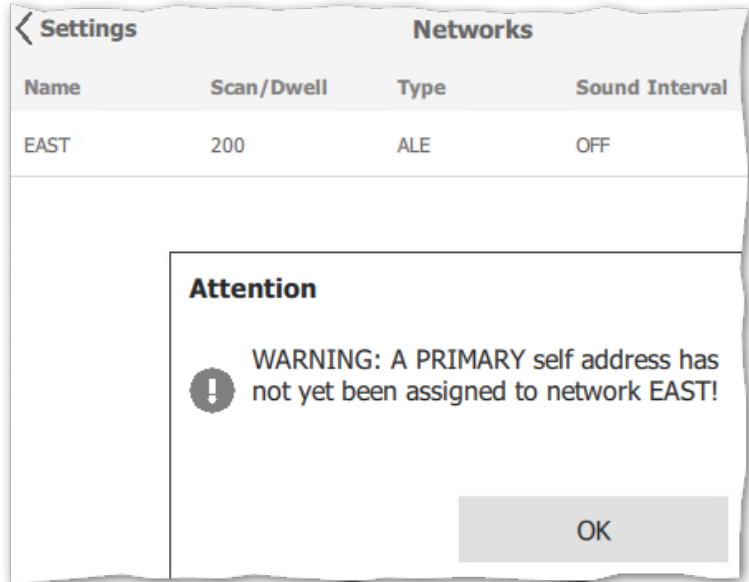
Once you are done adding channels, click **Save** in the bottom right corner.



If you make a mistake and need to remove a channel, click the **Delete** button. This will enable a red **Delete** button to the left of the channel names, click each one you'd like to delete, then click **Done**, which replaced the original Delete button, then click **Save** in the lower right.



When first creating a new network, once you click Save, you should receive a popup window indicating an issue. Click OK to clear the box. Click **Settings** to go back to the menu.



ALE

ALE Settings

Click **ALE**. For a new installation, there is only one check box in this window to change.

ALE Call Detect Threshold controls the sensitivity of the detection process. This is normally not adjusted.

Link Timeout sets how long a link will remain active is no disconnect is received or if no transceiver PTT polling is available for a given transceiver. Radios such as the IC-7300 and FT-991A have PTT polling.

Call Response Timeout sets the waiting period for response after transmitting a call. If a response it not received after this period, Ion2G may make additional calls, based on the Call Retry Count. This affects the calling station.

Call Ack Timeout sets the waiting period for response after transmitting the call response. This affects the called station.

Call Retry Count determines how many call attempts will be made to the called station on a given channel with no response.

Enable Sounding in this section is a global setting. If this is unchecked, then no networks will allow sounding, even if those networks are configured to do so.

LQA Decay controls how long data is retained in the LQA database.

LQA Window controls the span of time analyzed by Ion2G data when an operator wishes to make a call using LQA data. I.e., Ion2G should consider +-1 hour (2 hour window.)

Enable LQA Exchange allows a remote station to query your stations LQA database.

Enable AnyCall allows the use of AnyCall, both inbound and outbound.

Enable Allcall allows the use of Allcall, both inbound and outbound.

Sound on Hangup commands Ion2G to complete a sounding cycle for the network the most recent call executed on, once that call is complete. This is not a recommended setting.

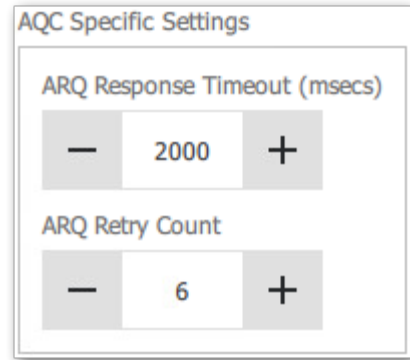
The screenshot shows the 'ALE Settings' window with the following configurations:

- ALE Call Detect Threshold:** 25
- Link Timeout (secs):** 360
- Call Response Timeout (msecs):** 6000
- Call Ack Timeout (msecs):** 4000
- Call Retry Count:** 2
- Enable Sounding:**
- LQA Decay (days):** 7
- LQA Window (hours):** 2
- Enable LQA Exchange:**
- Enable AnyCall:**
- Enable Allcall:**
- Sound on Hangup:**
- Hangup Sound Length (secs):** 3

AQC Specific Settings

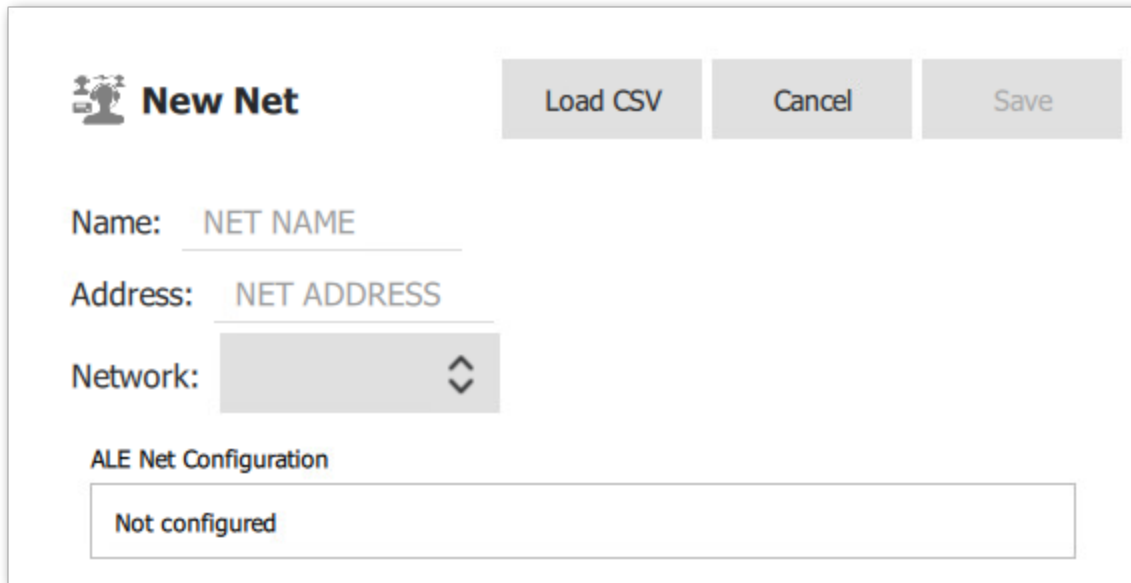
ARQ Response Timeout controls the timeout value to wait for a response. It is not recommended to change this value.

ARQ Retry Count controls the number of retries when sending data with no response.



ALE Nets

Nets may be defined in this section. Click the + in the upper left to add a new net. Once nets exist, they are displayed in the window.



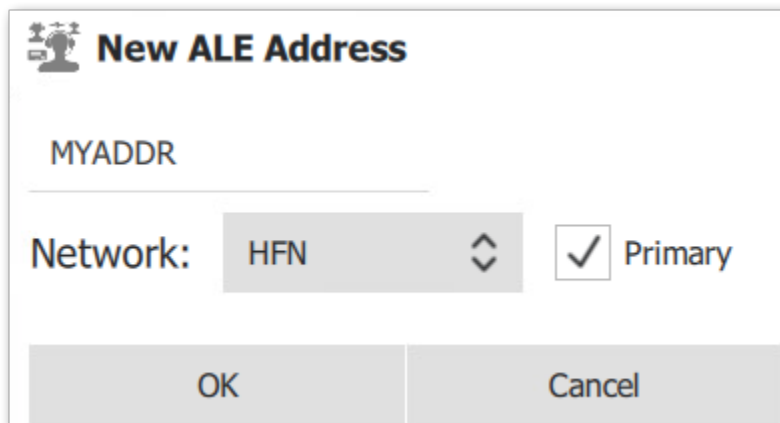
Enter a net name, the address, and the network to associate the net with. Once these are entered, click **Load CSV** to load the net configuration, then **Save** to save it or **Cancel** if you simply wish to exit the screen. An example CSV file is located in the [change log](#), section 5.1.rrr

ALE Self Address

Self addresses are defined in this section. Click the + in the upper left to add a new address. Once addresses exist, they are displayed in the window.

To edit or delete an address, click the desired address and a window will open that allows you to edit or delete the entry.

Multiple self addresses may be defined for a given network, but only one can be the primary address. The primary address is the address used when making outbound calls. Ion2G will prompt you when launching the application if a network is defined that does not have a primary address configured.



MIL-STD-188-110

This option is available via license.

Ion2G supports MIL-STD-188-110A natively and exposes the modem via TCP port. The modem is compatible with software used by services such as MARS.

Checking **Enable MIL-STD-188-110 Modem** enables the feature when licensed.

Transmit Speed / Interleaver is configurable via the dropdown, though most messaging software expose this control in those applications.

Data Format controls the synchronization mode. Some users may be more familiar with the terms SYNC and ASYNC. Data LSB First is sometimes referred to as SYNC and Text LSB First as ASYNC. Most messaging software controls this parameter.

Enable AGC enables internal modem automatic gain.

The following settings should not be changed at this time.

Standard EOM Detection analyzes received data for the end of message frame. This setting is currently ignored due to inconsistent flush times between manufacturers.

Zero run EOM Detection triggers a flush at the end of a received transmission.

Max BER EOM Detection flushes when excessive noise is present or the signal disappears.

ASCII Mode Garbage EOM Detection present to comply with standards, but ASCII is not currently used.

Enable MIL-STD-188-110 Modem

MIL-STD-188-110A Modem

Transmit Speed / Interleaver

600L ⌵

Data Format

Data LSB First ⌵

Enable AGC

Standard EOM Detection

Zero run EOM Detection

Max BER EOM Detection

ASCII Mode Garbage EOM Detection

TCP/IP Data Server

Server Protocol specifies application compatibility information for the received data. MS-DMT is compatible with both v2 and v3 IP implementations. DMTv2 serial configuration is not supported.

Listen Address controls the IP address used by the data server. Leaving the field blank defaults to the local loopback address using IPv6 (::1) if IPv6 is installed. If IPv4 is present or you'd like to use IPv4 instead, that loopback address is 127.0.0.1. You may also specify the address if needed (multi-instance, multi-IP, etc.)

Port Number is the TCP port number used by the data server. Some software applications may need to specify a different port.

TX Match RX Data Rate (autobaud) allows the 110 modem to automatically set the transmit rate according to the last received rate.

The screenshot shows a configuration window titled "TCP/IP Data Server". It has the following elements:

- Server Protocol:** Three radio buttons are present: "AF-DM" (selected), "MS-DMT", and "STANAG-5066".
- Listen Address (leave blank for ANY):** A text input field containing the value "::1".
- Port Number:** A text input field containing the value "63023".
- TX Match RX Data Rate (autobaud):** A checkbox that is currently unchecked.

CCIR 493-4

SELCALL addresses and parameters are configured in this section.

Enable CCIR 493-4 activates the SELCALL functionality in Ion2G.

Selcall Address (4 digit) insert your 4 digit address here.

Selcall Address (6 digit) insert your 6 digit address here.

SELCALL Call Detect Threshold allows the user to change detection thresholds. This is not normally adjusted.

Short Preamble (secs) allows the user to change the preamble detection period for non-scanning calls. This is not normally adjusted.

Call Timeout (secs) specifies the maximum call duration is no additional signaling is used on the call. This setting allows Ion2G to resume scanning if the remote station disappears.

Enable CCIR 493-4

CCIR 493-4 Settings

Selcall Address (4 digit)
3999

Selcall Address (6 digit)
033999

SELCALL Call Detect Threshold
- 50 +

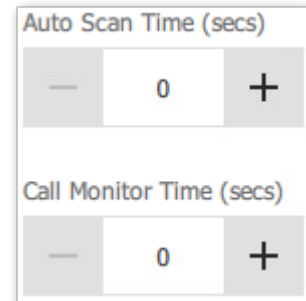
Short Preamble (secs) (for non scanning calls)
- 2 +

Call Timeout (secs)
- 360 +

Other

Auto Scan Time

Auto Scan Time (secs) when set to a non-zero value, sets Ion2G to begin scanning automatically, without user intervention. This is sometimes used for unattended stations where the host PC may be rebooted.

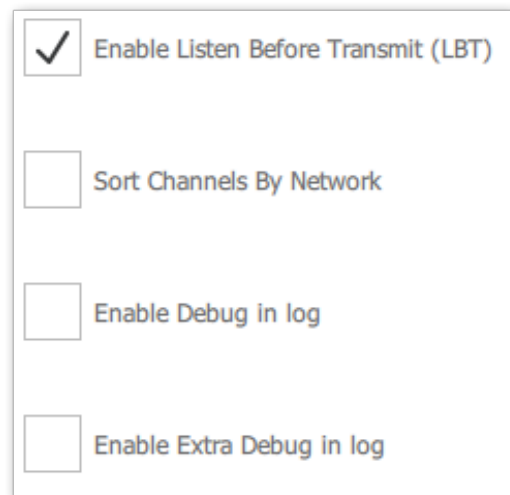


Call Monitor Time

Call Monitor Time (secs) when set to a non-zero value, stops scanning on detected ALE tones so that an operator can monitor intercepted calls. After this timer expires, Ion2G resumes scanning.

Listen before Transmit

Enable Listen before Transmit (LBT) when checked, enables Ion2G to detect other users of a channel, including voice, CW, and other data types.



Sort Channels By Network

Sort Channels By Network sorts channels into groups, based on network. If you have multiple networks defined and scan two or more concurrently, Ion2G will scan one network, then move to the next network, rather than interleaving the channels by frequency. For users with mechanical relays in the receive path, leaving this unchecked can reduce clicking if the multiple networks have common bands.

Enable debug in log

Enable Debug in log supports debug information in the log file.

Enable Extra Debug in log

Enable Extra Debug in log enables additional logging for troubleshooting.

Listen Before Transmit Time

Listen before Transmit Time (seconds) defines the number of seconds to listen before allowing Ion2G to transmit a call or sounding.



TX Tune Tone

TX Tune Tone (msecs) defines the period that Ion2G will transmit the tune tone.

TX Tune Amplitude

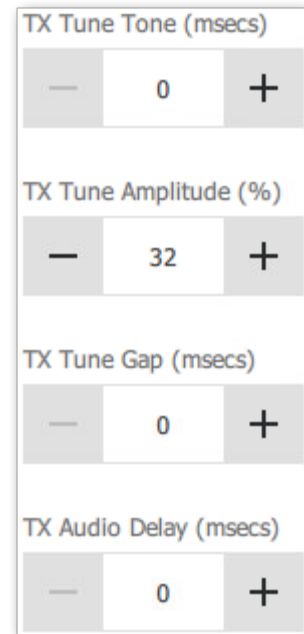
TX Tune Amplitude (%) defines the tone level when the tune tone is transmitted. This is a relative level and should be adjusted as necessary if used.

TX Tune Gap

TX Tune Gap (msecs) when set to a non-zero value, defines a period between transmitting the tune tone and beginning any other Ion2G transmission. Note – any delay set here must be added to the TX Tune Tone duration to determine if other stations ACK timeout may be affected.

TX Audio delay

TX Audio Delay (msecs) when set to a non-zero value, defines a period between asserting PTT and sending audio. Note – any delay set here must be added to the TX Tune Tone duration to determine if other stations ACK timeout may be affected.



Activity Reporting

Enable when checked, allows the reporting of received calls to internet-based mapping solutions.

SHARES report URL

SHARES report URL obtain from the SPO.

SHARES Report Key

SHARES Report Key obtain from the SPO.

HFLINK Report Call Sign

HFLINK Report Call Sign is the callsign reported to HFLINK for ALE mapping.

Activity Reporting

Enable

SHARES Report URL

NotSet

SHARES Report Key

NOTSET

HFLINK Report Call sign

Call History

Call History defines the number of entries in the All Activity list.

Message History

Message History defines the number of AMD messages retained in the MESSAGES window.

Log Buffer Length

Log Buffer Length (lines) defines the length of the Log Entries log. This is a first in, first out log.

Call History

- 100 +

Message History

- 100 +

Log Buffer Length (lines)

- 200 +

ALE Sounding Popup

Enable ALE Sounding Popup Dialog when checked, pops a window showing the current sounding information.

Enable ALE Sounding Popup Dialog

UI Options

Display Inbound Call View

Display Inbound Call View when checked, presents the inbound call window on the called station with Decline / Answer buttons. If the called station clicks Answer, then Traffic Channel, Release Assets, and other functions become visible.

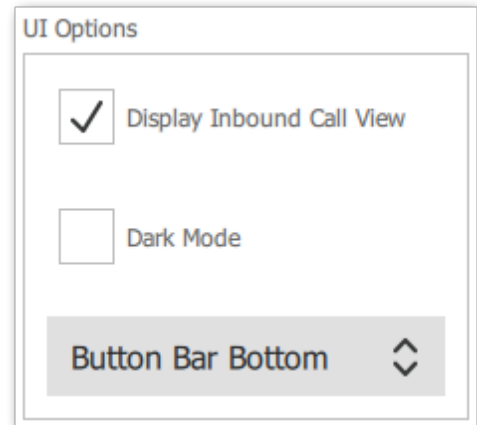
If unchecked, the Decline / Answer window isn't shown and the UI presents Traffic Channel and other functions.

Dark Mode

Dark Mode when checked, enables dark mode.

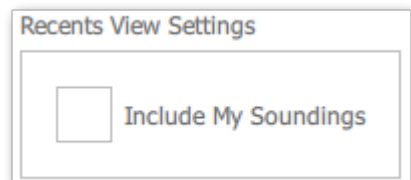
Button Bar

Allows the selection of buttons along the bottom or left vertical edge of the Ion2G application.



Recents View Settings

Include My Soundings when checked, adds your soundings into the RECENTS list.

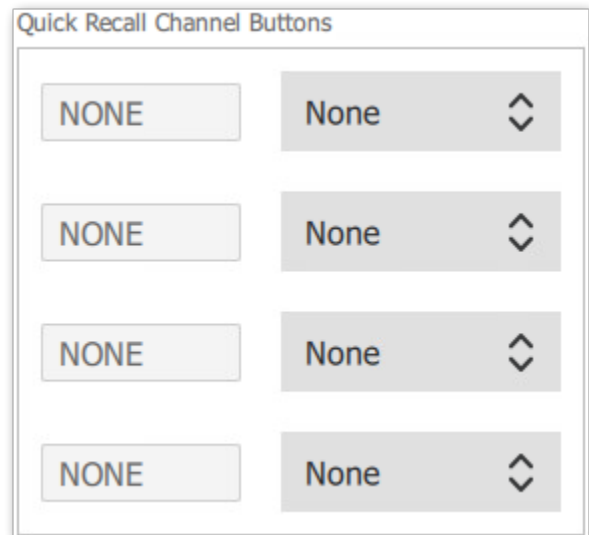


Quick Recall Channel

Quick Recall Channel Buttons allows the user to define up to four buttons that will appear above the top row of buttons in the UI. These buttons when clicked, change to the associated channel. This allows easy access to non-ALE channels without leaving Ion2G.

Channels must be configured in the Channel section before Quick Recall can be configured.

Enter a label into the first edit box, then choose the channel from the drop down next to it.



Remote Sites

Is not used at this time.

Emergency

Emergency Selcall Address

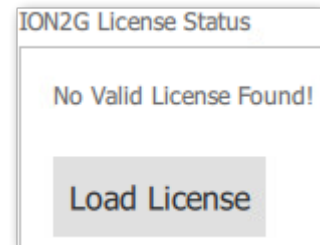
Emergency Selcall Address (4 digits) is a four digit address that is called when the emergency function is used.



License

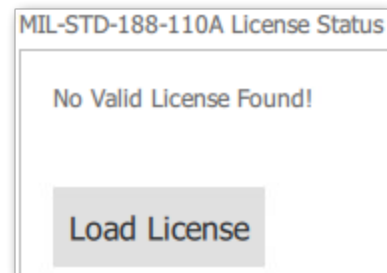
ION2G License Status

Load License when clicked, allows you to load your license file.



MIL-STD-188-110A

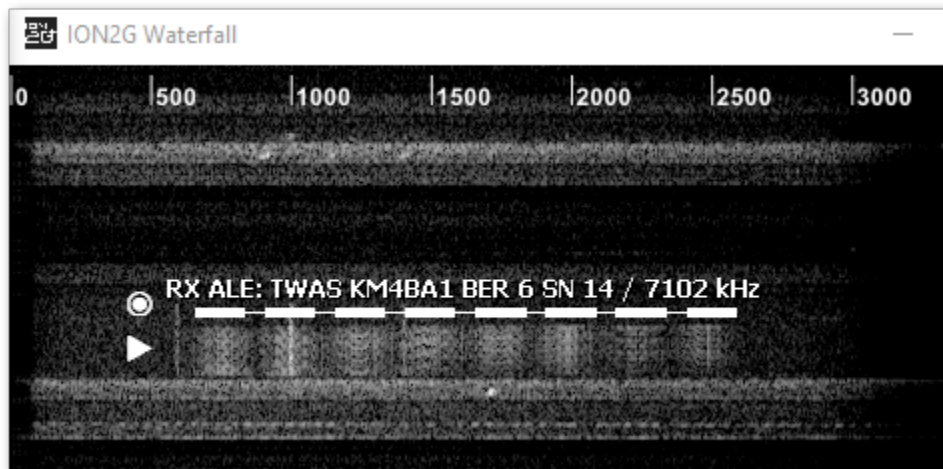
Load License when clicked, allows you to load your license file.



At this point, with the initial configuration, the operator can scan the defined network(s). As other stations transmit, those heard will appear in the *Recents* window and the *Recents* button will show a bubble with an incrementing number. This is an easy method to see, without clicking anywhere, that stations are being heard.

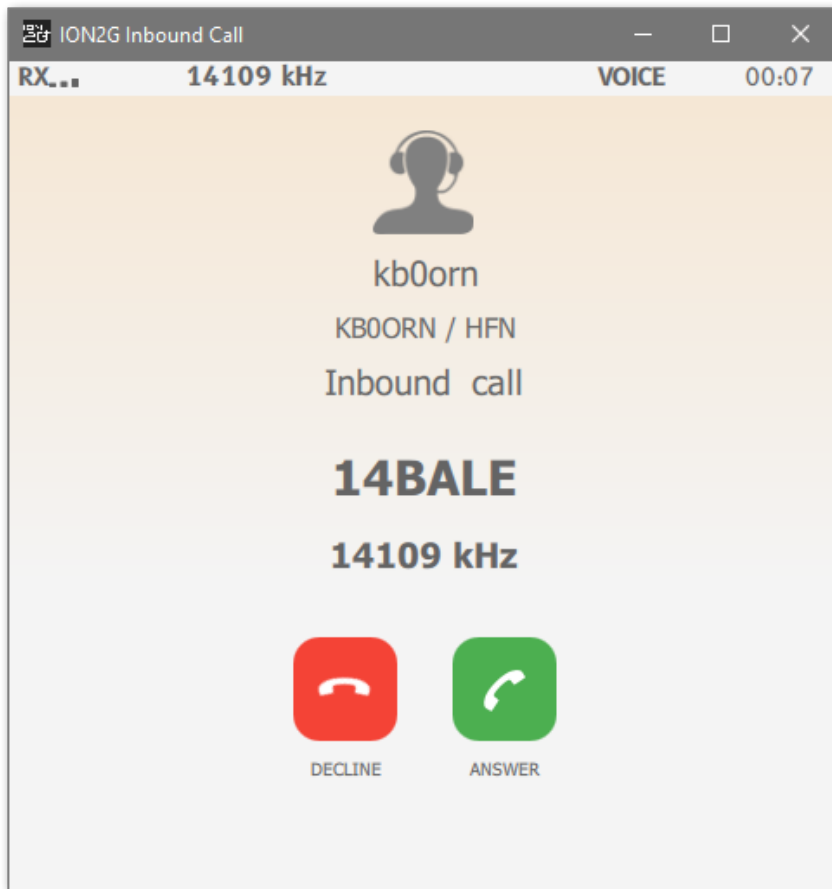
Waterfall

Opening the *Waterfall* will allow you to see the received audio and signaling. The waterfall is handy to see stations that are off frequency and that may be sending incorrect self-addresses. Here is an example of sounding.



Operator Window

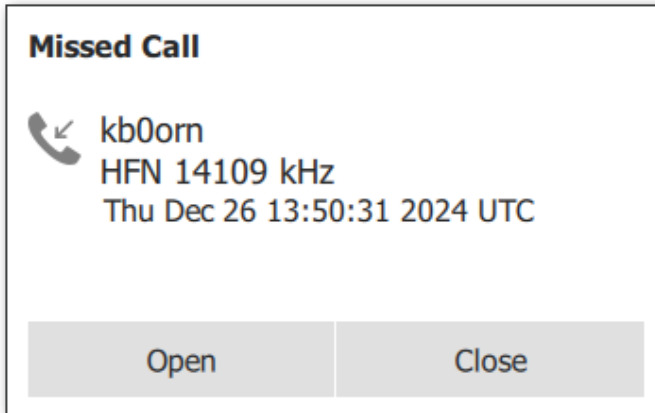
Here is the operator window when the previous ALLCALL broadcast was received and with [Display Inbound Call View](#) enabled.



Note that the operator is not required to *Decline* or *Answer* to receive the data. For ALLCALL broadcasts, you do not need to answer. An ALLCALL window will remain active for the period defined by *Link Timeout* which is 360 seconds by default, or when a disconnect is received by the caller.

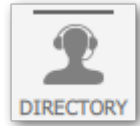
Notifications

Once the link is disconnected, if not otherwise configured, a window will pop showing the missed call. The example below was from the previous channel.

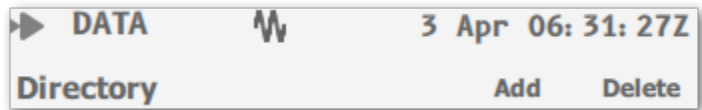


Directory


Creating directory entries simplifies the process for calling a station. From the main window, click *Directory* at the bottom.



Click *Add* in the upper right.



You can include a photo or graphic of the entry if desired. PNG and jpg file types are supported.



(Click image above to set avatar)

Name

TITLE

State

Country

Grid square

Antenna

Radio

Power (Watts)

AQC Support

Name is the field shown in the directory. The name is a human friendly string.

The remaining fields are not necessary for operation. If you choose to enter information, it is not used elsewhere in the application.

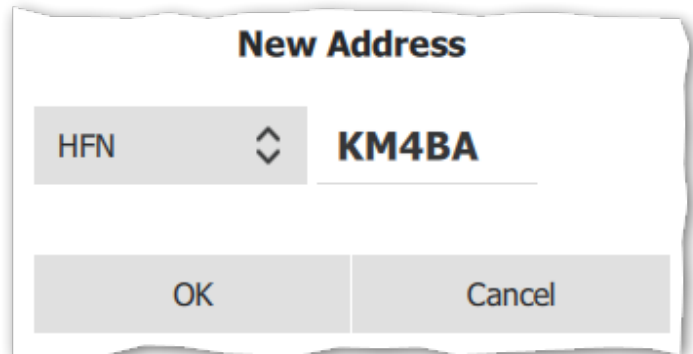
AQC Support

AQC Support controls if AQC is used to call or interact with this directory entry rather than ALE signaling.

Scroll down and click *Add* to the left of Addresses.



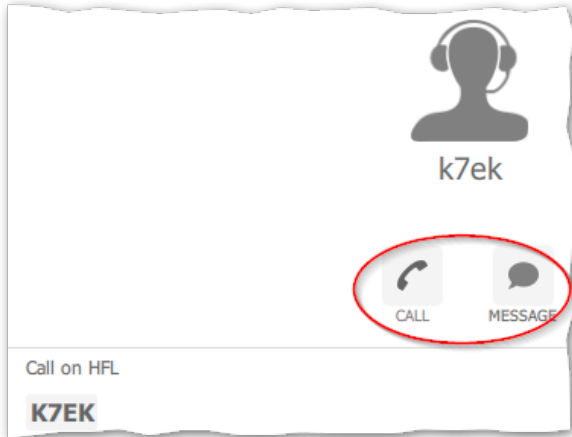
Select the correct network from the dropdown and enter the ALE address.



Click OK when finished.

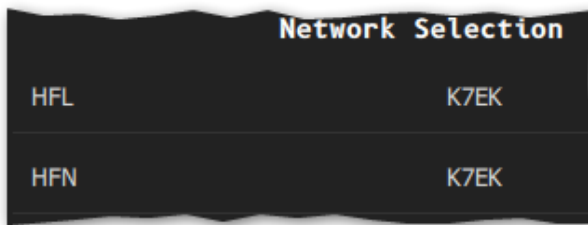
Then click *Save* in the lower right.

If you click on the entry in the directory, it will change to that entry.

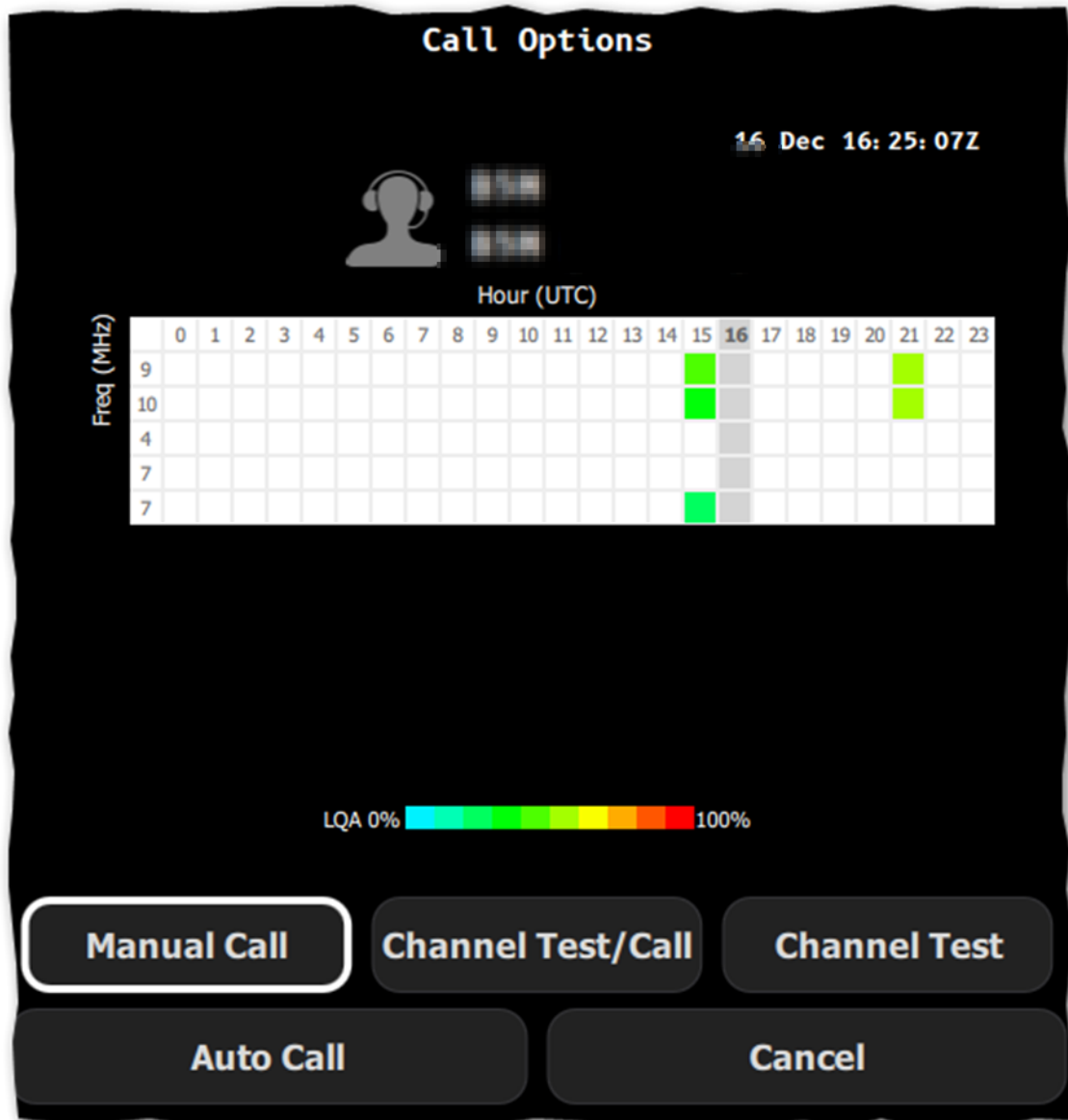


Call from Directory entry

If you click on either *Call* or *Message*, the network selection widow will open.



Click on HFN and the Call Option window will open. I've substituted a different station to show LQA information.



Here we see a matrix of times and bands that K7EK was heard, along with a number of buttons at the bottom of the window. This matrix is built from both linked stations as well as received intercepts. By default, the matrix contains 7 days of data.

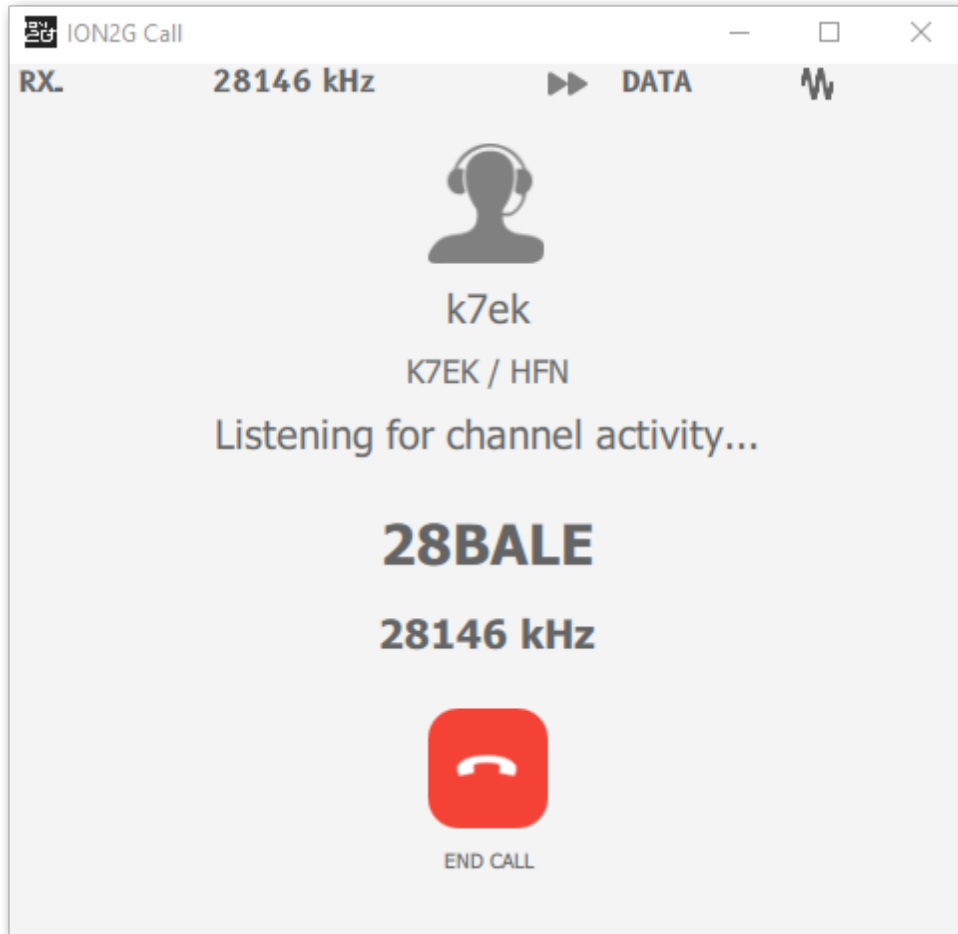
The *Manual Call* button allows the operator to choose the channel, making an ambush call.

Channel Test/Call allows the operator to manually select one or more channels to poll, with Ion2G making the decision after polling of the best channel to make the call on.

Channel Test is a poll without follow on link. It is rare an operator would ever use this.

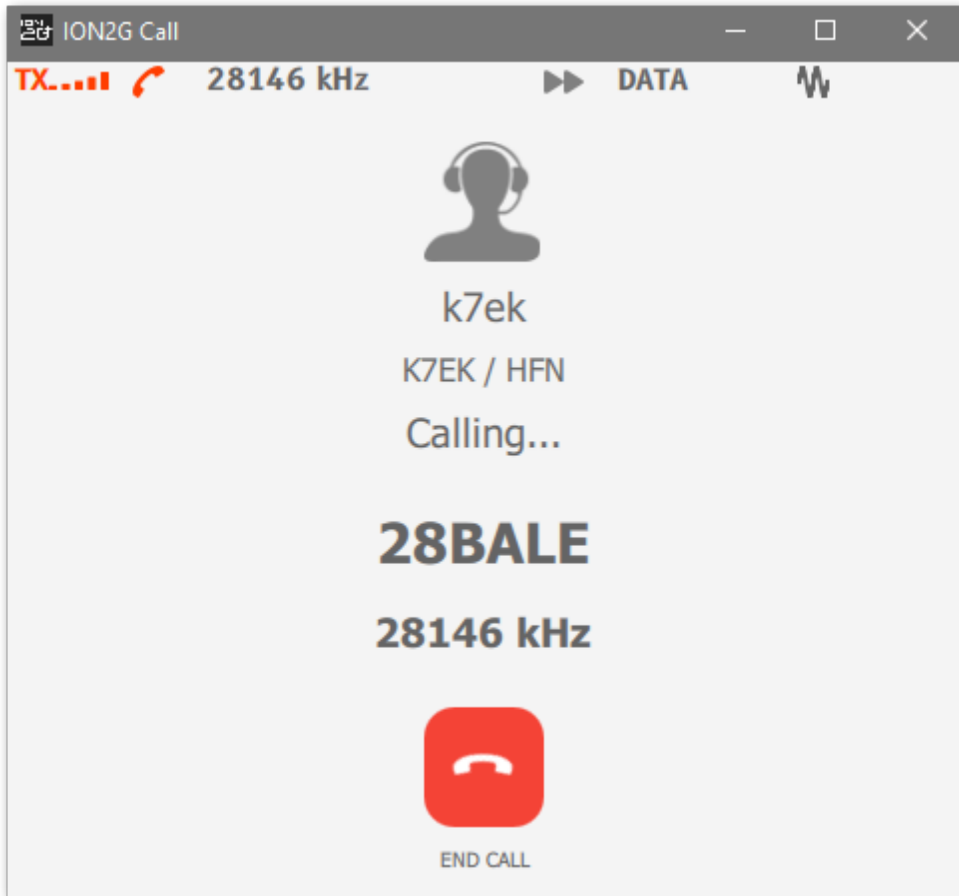
Auto Call lets Ion2G determine the best channel, by using all channels in the network.

Conducting an Auto Call to the station presents the call window.



Since [Listen Before Transmit](#) is enabled, Ion2G waits for 3 seconds, giving you the opportunity to cancel the call if existing traffic is in process, by clicking *End Call*.

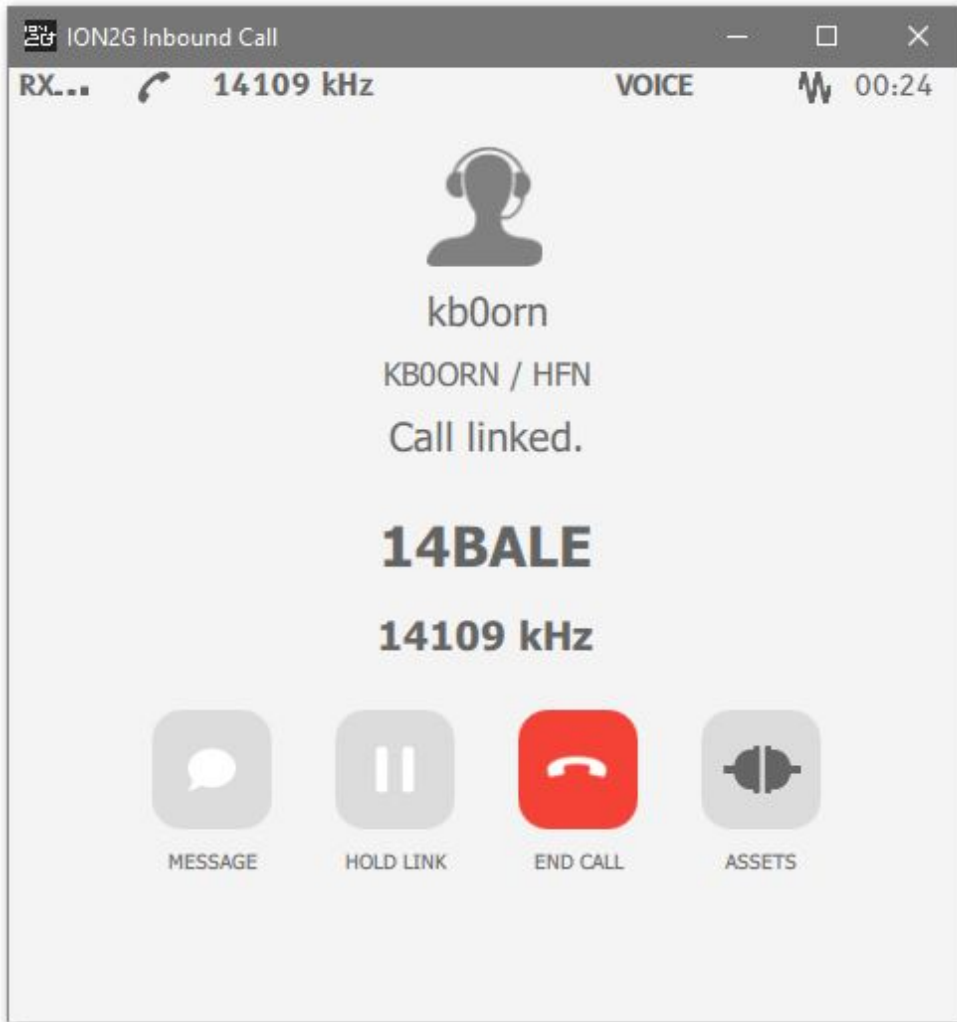
If the operator does nothing, the call proceeds.



Call Linked Window

If the link is successful, the operator has several options to proceed.

- If using data, execute the appropriate actions and end call when your traffic is complete.
- If making a voice call, toggle the DATA at the top of the window to show VOICE, then PTT via your normal method. Once your call is complete, click *End Call*.



Note – some stations may need to click *Release Assets* if using (external) data. Use of the embedded 110 modem does not require asset release. Once the data is complete, click OK in the popup window - DO NOT CLICK OK to simply acknowledge the window, doing so reacquires transceiver control. Only click OK when data is complete.

Note – if using some applications like Winlink Express, ensure to use the *Assets* button, as Winlink Express can make changes to the transceiver that should be reverted. Ion2G does not poll the radio to determine if changes were made and it expects the radio to be in the same state it asserted when Ion2G was launched.

The call window may already show VOICE, this can occur if you choose *Never Use DATA mode* or *VOICE mode after linkup* in the *Settings*, [Radio Controls](#) configuration window.

Text Only Configuration Instructions

Download Ion2G and install. It is not necessary to register/license Ion2G at this time.

Download the Ion2G codeplug from HFLINK. Import the codeplug.

There are many settings that are best practices and some that are required.

Settings

Other

Check *Enable Listen before Transmit*

ALE Self Addresses

Click + and add your address as CALLSIGN, select HFN for the network, check *Primary*, then OK.

ALE / AQC Settings

Check *Enable LQA Exchange*

Check *Enable AnyCall*

Check *Enable Allcall*

Networks

Double click HFN

Ensure *Enable Sounding* is unchecked

Check *Enable Scanning*

Dwell time – determines how many channels per second, 200ms = 5 ch/s

Check *Voice permitted*

Check *Enable transmit*

Save

Audio

Input Device – select the appropriate input device

Output Device – select the appropriate output device

Radio Controls

Radio – choose your radio

The selection box under the radio type has three options, *Always use DATA mode*, *Never use DATA mode*, and *Voice mode after linkup*. What you choose here depends on how you use ALE and your transceiver and what your station configuration is. There is no one way

to configure this setting. Some transceivers use this to select a data (sound) port input and mode. Some transceivers will operate fine regardless of this setting. You must know your hardware, how the audio is being routed, and how you wish to use Ion2G with your transceiver.

Radio Control Interface

Serial port – choose the appropriate CAT interface and serial configuration.

PTT Method – Select the appropriate KEY method

Test Configuration

Connect the transceiver to a dummy load.

Click *Save and Test* – this will check communication with the transceiver and it will KEY the transceiver briefly. It will report an error if there is an issue.

Exit Ion2G, click OK to exit.

Relaunch Ion2G.

Connect your transceiver to a dummy load.

Click CW ID and then OK. This will send a CW ID of your primary address. Verify that the transceiver transmits and outputs power.

You can now begin scanning the HFN network. Click SCAN, check HFN, Start Scan. Your transceiver should start cycling through the defined channels. If you'd like to see a visual display, click WATERFALL. When Ion2G detects ALE signaling, it will stop scanning until the decode is complete and show you the received information with the SNR and BER. If the call wasn't for you, scanning will resume.

Stop scanning.

At this point you can now carry on learning Ion2G.

For stations that require manual tuning and/or antenna selection or that don't have CAT control, you can still utilize ALE to connect to ALE stations on the optimal channel. Choose the appropriate channel and tune your antenna.

Click QUICK LAUNCH, CALL, enter an ALE address, select the appropriate network, and enter the callsign again. You are now presented with channel selection. Ideally, select the correct channel, even though CAT isn't being used, as the link data will be stored for future reference. If the call is successful, the call dialog box will pop in the foreground. Hang up is the only functional button in this configuration.

You can also use ALE as a selective call function, listening on a given channel for other stations to call you, with the transceiver audio muted. Ion2G can be configured to "alert" you with a variety of sounds as well as visually with the call dialog. Additionally, in many cases, it is only the user audio that is muted, FLdigi, Winlink Express, etc., can still receive digital broadcasts.

References

[Mil-Std 188-141B](#) or higher, D is the current version

[Mil-Std 187-721C](#)

[NTIA HF ALE Radio Application Handbook](#)

Release Assets Note

If using other applications, it is IMPERATIVE to use the *Release Assets* buttons prior to and after digital transmissions. Receiving digital transmissions can be accomplished without using DATA modes, though any audio processing functions should be factored into how they will impact the received signal.

IC-7300 Note

As mentioned previously, the only difference in configuration is to choose IC-7300 in the dropdown and set the CI-V address if different from the default.

Users that have hardware modems such as Pactor, will require additional configuration, as the IC-7300 does not support DATA on both the USB and ACC ports concurrently. Typically, an outboard audio mixer is used, along with an external PC sound device, then fed into the transceiver via ACC.

FT-991A Note

The FT-991A can be a challenging radio. The key issue or feature with the 991A is that there are multiple ways to do the “same thing.” Many operators are simply not used to having multiple configuration choices in their setup. When searching for “how to” documents, they find conflicting information, which for each author, may have been “correct,” yet doesn’t address the searchers need.

Yaesu really gave operators a LOT of options with this radio – and this is why so many are frustrated trying to make it work. Yaesu was also gratuitous in confusing operators with ambiguous terms (USB.)

In the arena of amateur transceivers, the FT-991A is unique. While other transceivers in the Yaesu family have higher resolution displays, “better” receivers, and other features, they are also focused on single function. In head to head testing between a 991A and a 710, OFDM digital signals were all but identical at the receiver, with neither transceiver having an edge. Sources such as Sherwood, that rank the 710 high on the receiver list, are very subjective tests. For digital use, there is almost no difference (judging by receive performance.) However, when operational capability is factored, the 991A pulls ahead significantly. The FTDX and FT-710 fall into the same type of use, with menus that are not tailored to multi-mode nets. This is where the FT-991A shines. The FT-710 is not scanning ALE friendly, as it uses relay band switching. The FTDX-10 uses electronic switching.

It is possible to operate the FT-991A without a traditional analog microphone, by routing the audio through the PC and then on to other human interfaces such as Bluetooth headsets. Regular microphones can interface through front or rear ports and data can be interfaced through multiple ports as well. While these capabilities exist with other transceivers, challenges such as “this ACC can only be used for x” and “ACC2 cannot be keyed by PC” don’t exist.

Additionally, transceiver control is simple thanks to Yaesu’s human readable CAT that doesn’t require actual programming skills to use. Soft button interfaces or hard button devices such as Streamdecks are easily configured to facilitate common functions such as channel, power, or filter changes.