QAM Snare Isolator

User Manual

QS-ISO-1.6

9/1/15

This document details the functions and operation of the QAM Snare Isolator leakage detector

Table of Contents

Overview

The QAM Snare Isolator is designed as a tool for close-in leakage detection of QAM channels leaking from the cable television network. There are two scenarios under which it operates: in companion with the permanently vehicle mounted QAM Snare Navigator; or used in companion with a second QAM Snare Isolator as a transmit / detect pair.

QAM Snare technology detects digital leaks by performing a correlation process on a selected QAM channel. The correlation compares samples of the QAM channel from the cable network, with samples pulled off the air at the same frequency using an antenna. If there is correlation between the two signals, that indicates that the leakage detected off-air is the same signal as was carried on the network, and that it is with certainty a leak from the cable network.

For QAM Snare Navigator, the samples of the QAM channel used for correlation originate at the headend, and are transmitted to the field unit via an IP connection. The QAM Snare Navigator continuously correlates the signal set originating at the headend with the signal set pulled off of its local antenna, and when leakage is detected a database at the headend is updated with the relevant information and leak characteristics. For more information on QAM Snare Navigator and Monitor, please consult the respective user manual or the Arcom Digital website, www.arcomlabs.com.

QAM Snare Isolator operates in exactly the same fashion, but it receives the QAM channel samples in a different method. When QAM Snare Isolator pairs with a Navigator, the Navigator changes its operational mode and functions as a data bridge such that samples from the headend are relayed to the Isolator. The Isolator then correlates the headend signal set with the signal set pulled from its local antenna. The wireless 900 MHz ISM band is used for communication between paired devices.

Alternatively, as a method for leakage detection inside a subscriber home or within an MDU – QAM Snare Isolator can also be used as a paired set, where one Isolator unit set to the transmit mode acquires the QAM channel samples by connecting to any convenient location – and then sends the samples over the ISM band to a second unit

set to the detect mode. This second unit correlates the samples received over ISM to samples pulled from its local antenna.

The Isolator also contains a frequency agile wideband pilot detector mode, where high level signals can be injected into the home at the grounding block, and then detected while moving around the home. This provides a useful means to troubleshoot difficult problems caused by deficient shielding of cables and devices within the home.

Screen Navigation

Upon startup there are three operating modes that the user can select. Settings allows for changes to operating parameters. Detector puts the unit in Detector mode such that it pairs with a second device in transmitter mode (either a second Isolator or QAM Snare Navigator), and Transmitter establishes the unit as a transmitter where samples are acquired from the cable network attached to the Isolator F-connector point, and transmitted over ISM to a second paired Isolator.

Navigation is performed with a simple three button scheme, the left and right arrows move the highlighted cursor to the desired item to be selected, and the circular enter/pwr button is used to confirm. The circular button also turns the unit on/off by pressing and holding.

Settings

To access this mode, highlight Settings mode and press enter.

FSK configuration and setup

The ISM band in the US is from 902–928 MHz. Paired Isolators and Isolators used with Navigators will communicate at a configured FSK frequency within this ISM band. The bit-rate of the FSK is 40 kbps and frequency band is <100 kHz. So within this ISM band there are 260 possible FSK channels. The communication between transceiver sets is quasi duplex mode.   **Minimum frequency spacing of multiple transmitters in close proximity should be > 700kHz.**

Changes to the FSK frequency are made through the Settings menu item on the Isolator screen
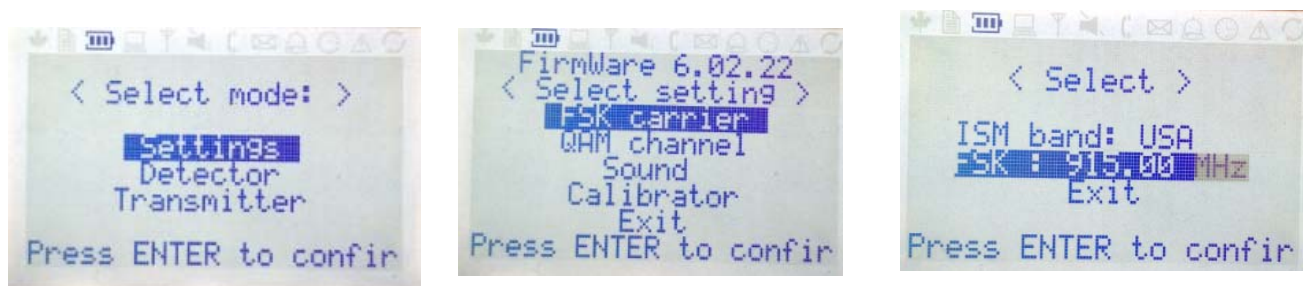
Then use the right and left arrow button increase or decrease FSK to desired frequency, then hit the enter button.

Pilot Probe Mode

There may be occasion where LTE interference from the subscriber handset or tower is interfering with the forward signals. This is due to insufficient shielding effectiveness of cables or devices within the home. With very high handset output level and close proximity to the cable, even devices with relatively good shielding effectiveness could be problematic and could need troubleshooting. In such a scenario, the sensitivity of the Isolator detector in its native correlator mode may not be sufficient to find the very small leak. In order to provide a solution, a Pilot Probe Mode is built into the Isolators.

Through Settings, both the transmitter and the detector need to be switched from QAM mode to Probe mode. The transmitter unit will not begin to transmit the pilot until it received instruction on which channel to transmit from the detector unit.

< Select >
Standard:NTSC
Mode: QAM
Channel 1: 17/141 MHz
Next channel
Exit
Press ENTER to confir

< Select >
Standard:NTSC
Mode:Probe
Channel 1: 17/141 MHz
Next channel
Exit
Press ENTER to confir

The transmitter should be connected to the home network at the grounding block, essentially disconnecting the home from the HFC network. When the detector unit is turned on, it communicates with the transmitter over FSK as to the pilot frequency to use. FSK is only required to begin transmitting, and if the detector wants to select a different frequency. If the detector goes out of FSK range, the transmitter will continue to transmit.


Home cable system IN
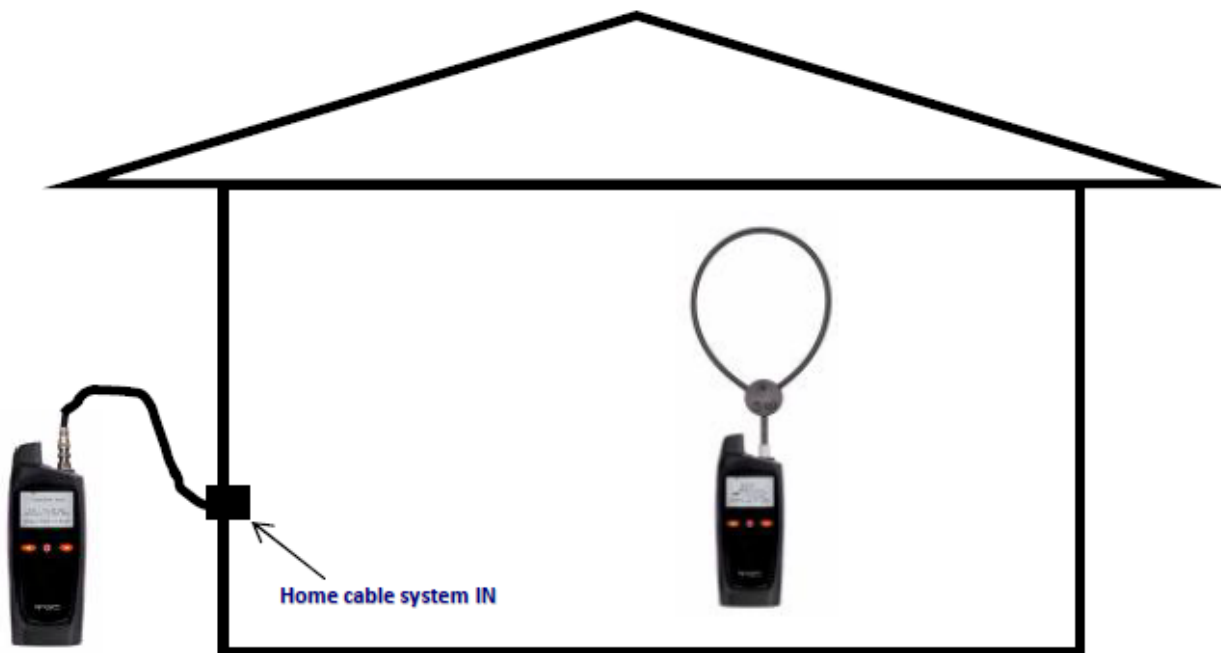
The pilot signal for each channel is actually four pilots that jump at frequencies throughout the channel. This forms a wideband pilot that does not have the multipath issues associated with single pilot approaches. Also, working over the entire channel

6

minimizes close in fluctuation of shielding effectiveness and variability of detected leak level. The 4 probe signal repeats each second as shown below.
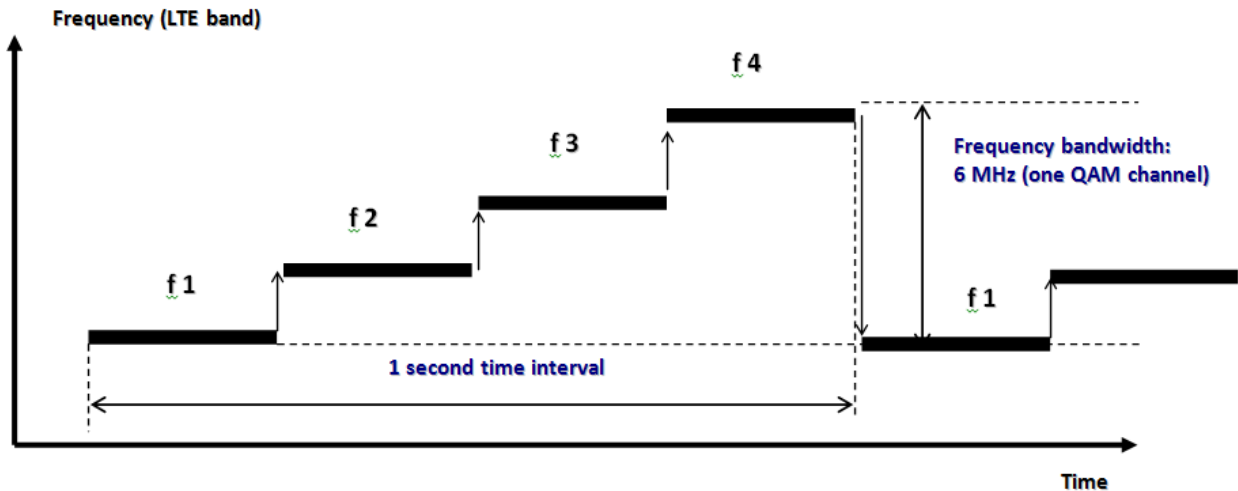
Pilot frequency hopping signal at time and frequency domain (example)

When both the transmitter and detector are in Probe mode, the word Probe clearly flashes continuously.
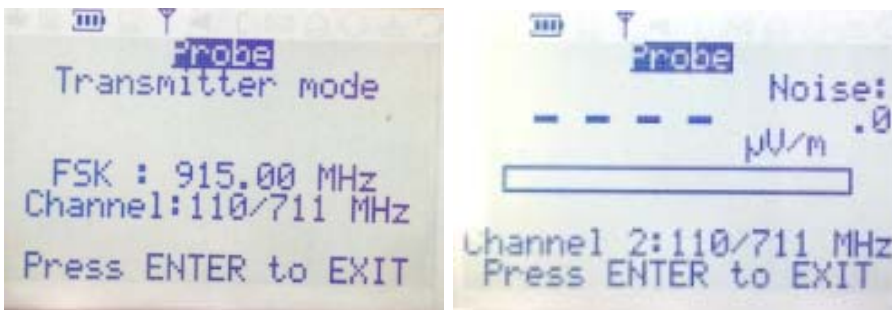
The Probe mode should only be used in application within a subscriber home, where the home is disconneced from the network. In no cases should the Probe mode ever be used in troubleshooting the headend or active parts of the network.

QAM channel setup

Setup of the QAM channel is dependent upon how the Isolator is being used. If it is used in conjunction with a Navigator, then samples of the channel that the Navigator is tuned to are automatically forwarded to the Isolator and no QAM channel setup is required. If the Isolator is used in a paired environment with a second isolator, then the Isolator in the Detector mode control the QAM channel and automatically requests the proper channel to be sent from the paired unit in the Transmit mode. To summarize, the only required QAM channel setup for an Isolator is on the Detector unit when two Isolators are being used. Changes to the QAM channel are made through the Settings menu item on the Isolator screen.

After selecting QAM Channel Settings item, press the center button until the MHz indicator flashes. This indicates that the channel can be changed. Then use the right and left arrows to increase or decrease the channel number, then hit enter to confirm.

Changing Television standard from NTSC to PAL

Changing televison standards is accomplished indirectly through the FSK carrier ISM band selection button. When ISM band is changed from USA to Europe, the television standard automatically switches from NTSC to PAL.   Slight differences within different PAL channel spacing is not relevant to proper QAM Snare operation.

Multiple QAM channel setup

An Isolator detector when used with another Isolator transmitter, has the ability to quickly move through multiple QAM channels if testing at many frequencies is desired. Up to 8 different channels are allowed.

After entering channel 1, select Next channel from the menu item shown below.

Initially, any previously unused channels will show as disabled. Hit the enter button and the MHz indicator will flash. Then use the arrow keys to select the desired channel.

Up to 8 channels can be programmed for use. Then when in the detect mode, pressing the orange arrows buttons will immediately configure operation on the next channel. The user can cycle through channels as desired.

In order to disable a previously configured channel, select the channel and scroll frequency all the way down to the lowest frequency using the left arrow button, then select disable.

Sounds

Audio can be turned ON and OFF through the Sound menu item in settings. Threshold level above which the unit alarms can also be adjusted through this menu item.
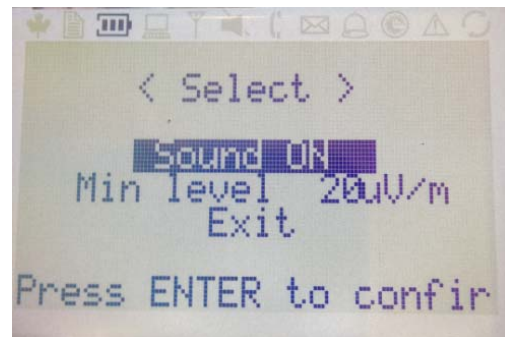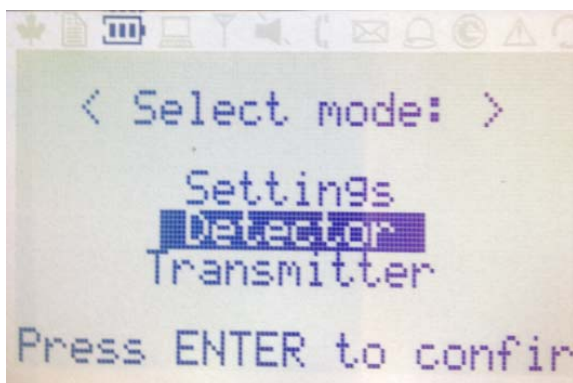
Calibrator

Although not necessary, if desired the Isolator can be calibrated to a known standard by adjusting the Calibration coefficient within this menu item. Without calibration the Isolator just provides a relative measurement, which for the purpose of identifying leak location is perfectly adequate.
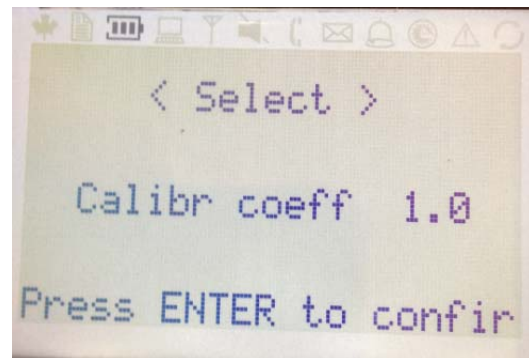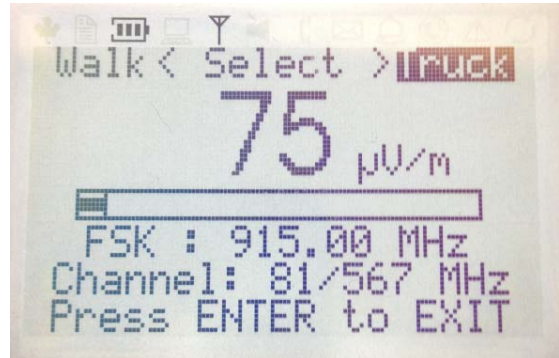
Detector Mode

To put an Isolator into Detector mode, select Detector and hit enter.

The Isolator will automatically pair with any QAM Snare transmitter device that is operating at the same FSK frequency.   If the QAM Snare transmitter device that the Isolator is paired with is a QAM Snare Navigator – two additional operational modes will become available. Truck mode and Walk mode. Modes can be easily switched by pressing the right or left arrow button.

Detector Truck Mode

In Truck mode, the Isolator functions as a remote display showing detected leaks as measured from the QAM Snare Navigator. This mode is also very useful when confirming that a problem has been fixed. If you example you are up in a bucket and think an issue has been resolved, by quickly going into Truck mode you can see if the problem as measured at the truck still exists.
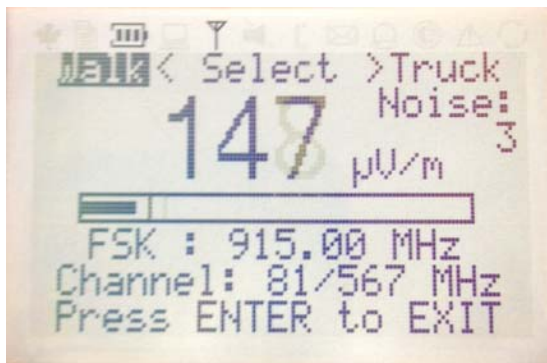
The sampling rate when in Truck mode is the same as for the Navigator, once per second.

Truck Mode and Walk mode indications will not be visible when an Isolator pairs with another Isolator.

Detector Walk Mode

In Walk Mode, the Isolator displays the leak level detected at the present Isolator location with the Isolator antenna. When an Isolator is put into Walk mode, the paired QAM Snare Monitor or Navigator goes into a data bridge mode, wherein the only function it performs is to receive samples from the headend and forward to the paired Isolator over the ISM band. The Isolator then takes these forwarded samples and compares with samples that it receives locally from its antenna to measure leakage. The Isolator in this mode is automatically tuned to whatever frequency the Navigator is configured to, and detects leaks at that frequency.

Sampling rate when in Walk Mode is twice per second. The user therefore needs to move the unit at a corresponding rate when detecting leaks.

11

When an Isolator is in Walk Mode, no data regarding leak level is forwarded to the headend leakage database.

## Detector mode when paired with an Isolator

The Detector Mode when paired with a second Isolator appears as below (Truck and Walk mode banner is not present). QAM samples acquired from the paired transmitter unit (on the QAM channel the transmitter is set to) are forwarded to the Isolator in Detector Mode over ISM, and samples pulled from the Isolator antenna are correlated to measure leakage.

Sampling rate is 2 times per second.

Since there is no communication with the headend, no updates are made to the headend leakage database.
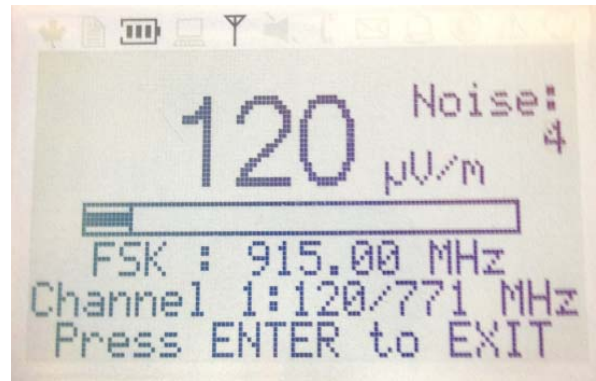
Transmitter Mode
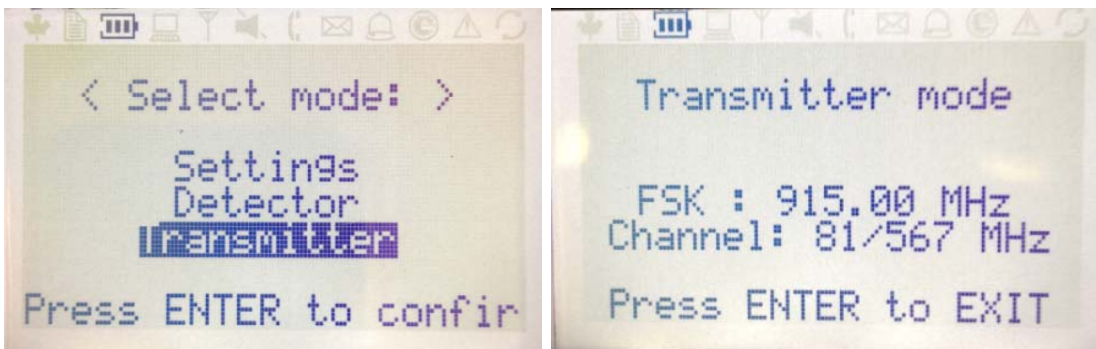
When Isolator is put in transmit mode, the following screen appears. **In order to pair, the FSK of both the Transmitter and Detector must be set to the same frequency.**

12

Leakage Display Level Indicator

When in detector mode, Isolator performs a leakage level calculation two times per second. This sampling is too fast to change the display indicator for every calculation, therefore peak hold techniques are utilized.

The Isolator leak display shows the peak level detected over the previous two seconds.

The bar graph underneath the number indicates the instantaneous measurement (the horizontal component), relative to the last two second peak hold indicator (the vertical component).

When no leakage has been detected within the last two seconds, a dash display is indicated.
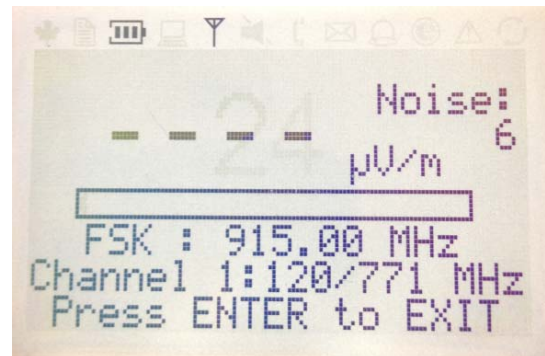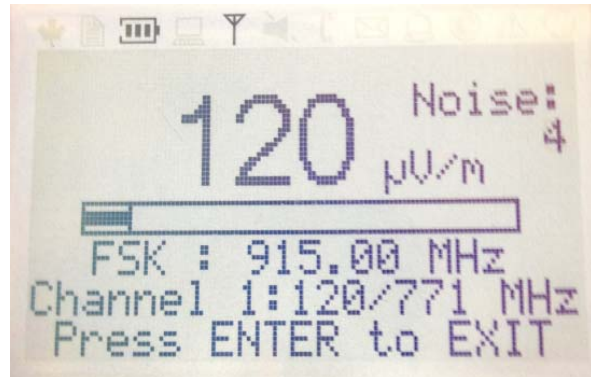
Noise Floor Level Indication

The Isolator contains an indicator that provides feedback as to the Isolator noise floor. The noise floor of the instrument will vary depending upon other off air signals it is subject to. The lower the noise floor, the lower level leak the Isolator will be able to detect. When high noise floor conditions occur, the user should take measures to switch to a nearby channel that has less noise.
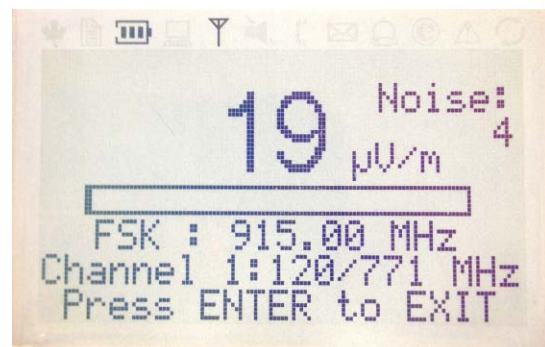
In order to keep the display screen uncluttered, units are not shown – but they are in µV/m, where for example a 1 would correspond to 1 µV/m. This number would correspond to a noise floor level of –60dBmV/m using the convention employed in the Navigator.

Error Messages and Troubleshooting

To assist in troubleshooting any connection or connectivity issues, Isolator will display error messages corresponding to the condition.

No ISM

This is indicated when Isolator is in detector mode, yet no ISM signal is available to pair with. This condition could be resultant from several situations – out of range from the paired unit, the second Isolator is configured for a different ISM frequency, a second transmitter is in proximity with frequency spacing of <700kHz, or ISM antenna from the paired Navigator could be disconnected.

As an additional indicator for ISM connectivity, the wireless icon circled below is always illuminated when the Isolator is paired with another QAM Snare device.
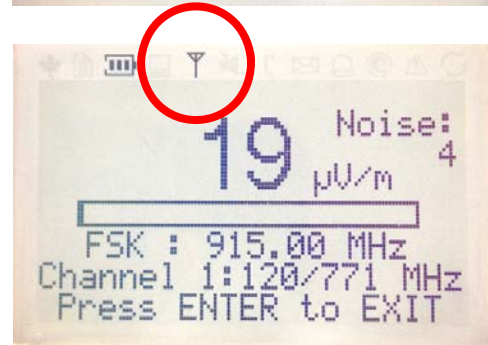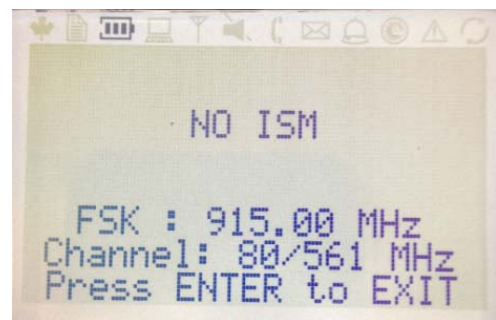
No GPS lock

When paired with a Navigator, if that device loses GPS lock the following message is displayed. Check the GPS signal at the truck or at the Headend.
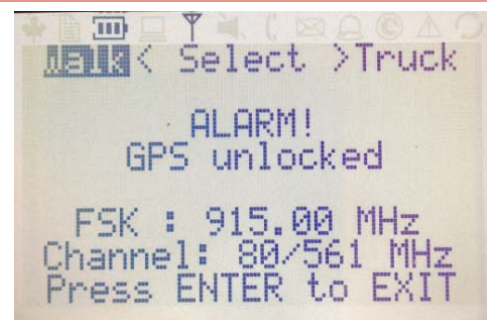
No Wireless

If the wireless connection between the Navigator and the headend is lost, the following message will appear. Since the Navigator keeps the communication socket open while attempting to reconnect, this error message will only be displayed after the communication socket is closed – which is after two minutes for GSM version and 20 seconds for Wi-Fi versions unless it is closed manually.

No Data

If the scenario above, in the interval between when there is no data being received and when the communication between the server is suspended and subsequent error message is received – there is feedback to the user that QAM samples are not being received by the Isolator. This is the purpose of the No Data alarm. It indicates a temporary loss of communication. User needs to wait until communication is restored.
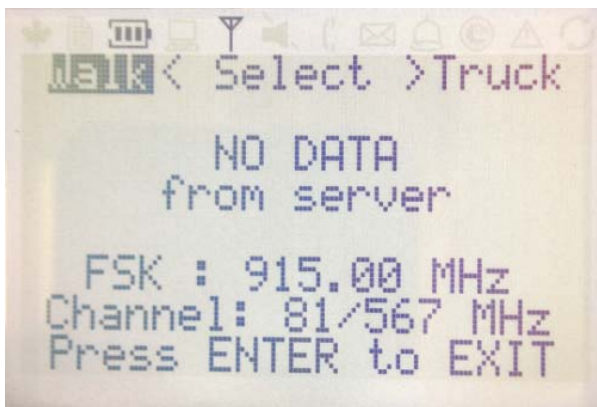
Delay in startup when turning on FSK

The user may notice that when using the Isolator to connect to another QAM Snare device, that there is about a 30 second time delay before the leak level indicator becomes stable when first turning on the FSK or entering Detector mode. The Isolator uses two phase locked loops, which require some time before they lock – 30 seconds for this is normal operation.

15

Antenna

QAM Snare Isolator ships with a coaxial cable dipole loop antenna. This simple antenna has proven to be extremely well suited for use with QAM Snare, especially at some of the higher frequencies.

The bandwidth of the loop antenna are a few hundred MHz, therefore a 600 MHz antenna can adequately cover from 500 to 700 MHz. The antennas are tuned to a specific central frequency, and are available in steps of 50 MHz from 400 MHz to 700 MHz. Below 400 MHz the loop size increases such that a different type of antenna is more suitable. If it is desired to use the Isolator at frequencies less than 450 MHz, then a traditional monopole with a suitable frequency response would be more appropriate. That being said, experience suggests that the vast majority of leaks that are present at lower frequencies are also present at higher frequency – so there is no reason that the final detection and location step cannot be performed at frequency > 400 MHz.

The antenna should be oriented similarly to how one would hold a magnifying glass. These antennas are directional, so the position of the antenna relative to the leak will change the measured value. If the angle of the antenna is a perfect 90 degrees from the leak, no field will be present inside the loop and therefore no leakage will be detected. The loop antenna ships with a bandpass filter attached – the purpose of which is to increase overall sensitivity.

Startup screen

Upon startup, the QAM Snare logo appears along with model number and software version. If Isolator is turned off while in an active Detector or Transmitter state, in order to save time the next startup will immediately go directly to the previous Detector or Transmitter state, bypassing startup and the need to specify Detector or Transmitter.
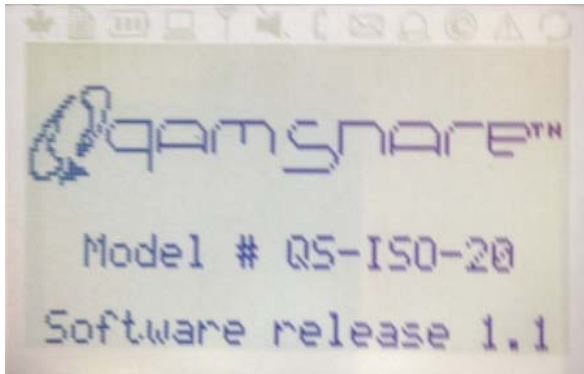
Patents and Copyright

The QAM Snare Isolator is protected by the following patents.