ICE Enterprises

ICE-Tray-RM

Rack Mount Signal Processing Appliance

User Guide 2.1

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1 Functional Description

The ICE-Tray-RM is a 1U rack-mounted configurable signal processing device designed to be modular to fit a variety of applications. The ICE-Tray is designed to take full advantage of ICE DSP signal input and output modules with 1GHz bandwidth or dual 500 MHz bandwidth and dual FPGA processor modules enabling real-time processing.

The ICE-Tray-RM is a logical outgrowth of the popular ICE *superPAC* with the addition of a 6-Core Xeon® CPU for more processing power and an added PCIe 8-Lane expansion slot allowing for a second PCIe card to be installed. Users can configure the ICE-Tray with up to four single-site or two dual-site modules or a combination depending on your signal processing needs.

Two UltraScale™ K8M FPGAs or the two of the new UltraScale+™ K8P FPGA processor modules can be installed and have direct access to two QSFP+ network ports. Selection of internal or external SSD capability is also available. Gigabit Ethernet control and three USB 3.1 connections are provided for configuration, control and status.

An optional GPS module may be populated to provide internal 10 MHz reference and 1 PPS indication. Integrated splitters allow replicating internal clock references to multiple I/O modules.

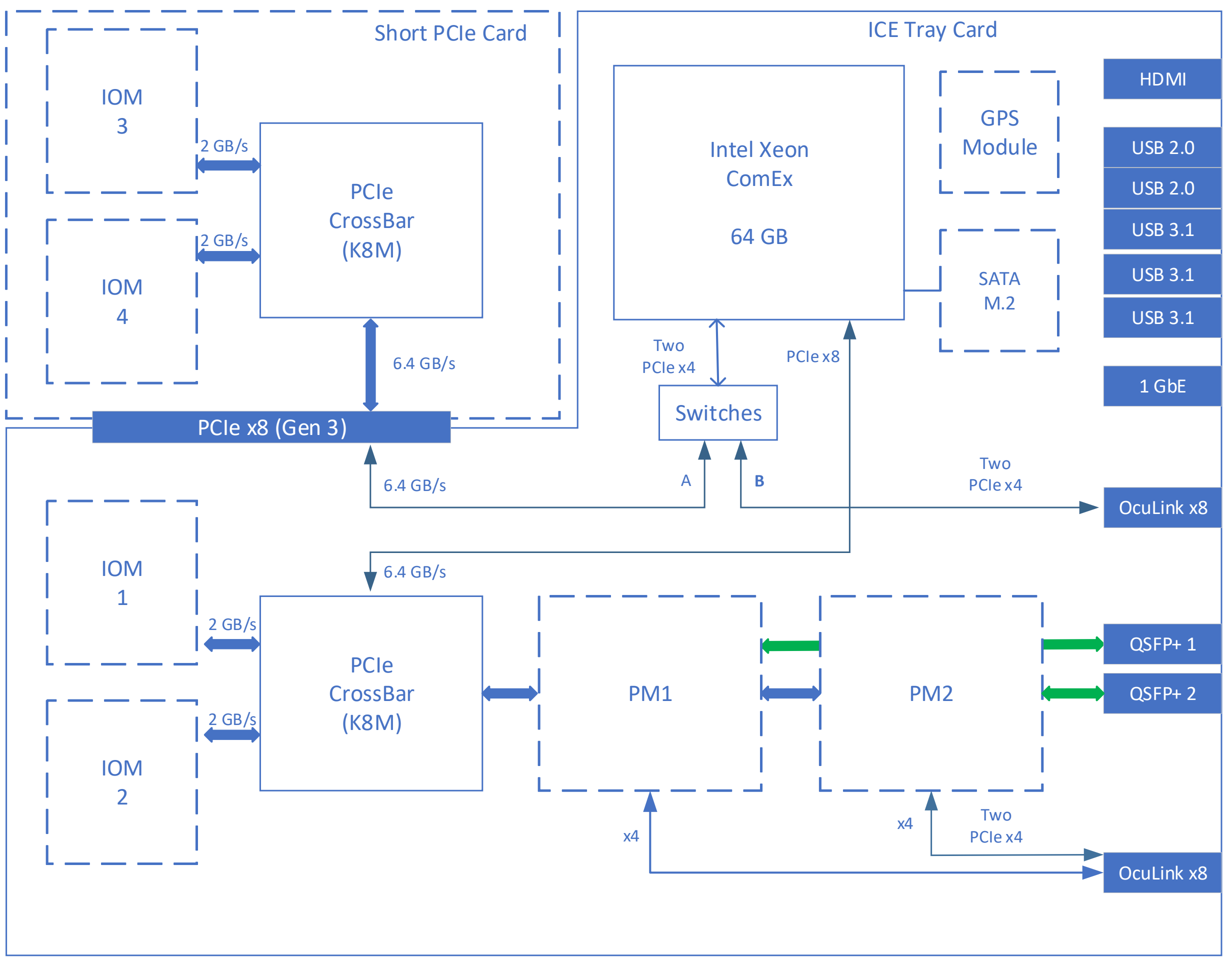
1.1 ICE-Tray-RM Features

- Embedded ICE-PIC8L architecture with I/O Modules and dual processor modules
- Embedded Intel® 6-Core Xeon® 2.7GHz Processor with 64GB of DDR4 memory
- 1GbE network control port
- Three USB 3.1, two USB 2.0 and HDMI 4K2K video
- Flexible I/O site communications to crossbar and processor modules for fast data flow
- M.2 solid-state operating system drive or USB 3.1 boot
- External Storage Options using OCulink or USB 3.1
- Switchable dual x4 PCIe ports allow connectivity to PCIe slot or off-board OCulink port
- PCIe Card slot allows two additional I/O modules (using PIC8S) or 15 TB SSD option
- Dual QSFP+ Ports Direct from Processor modules 1 and 2 for network applications
- Integrated over-temperature protection and over/under-voltage protection
- Configurable to support data reduction, up/down conversions, and real-time processing
- DSP FPGA applications on two optional ICE-K8M Xilinx UltraScaleTM processor modules
- DSP FPGA applications on two optional ICE-K8P Xilinx UltraScale+TM processor modules
- Optional internal GPS module for 10 MHz and 1 PPS references
- Integrated tuner shelf allowing up to four RF Tuners (AR18D, AT18D, AX18) up to 18 GHz
- Dimensions 16.75” x 20.0” x 1.75” with fully redundant AC power supplies
- Up to eight rear-panel SMA connections including RF in, RF out, 10 MHz, 1 PPS, IRIG-B, or GPS antenna

1.2 ICE-Tray-RM Applications

- Wide Band RF, analog, optical, and network processing
- Wideband analog 1GHz (or simultaneous dual 500MHz) bandwidth signal input
- Optical-to-Network conversion (packetized data multicast or OTN/SONET)
- Network processing (packet ingest => filter => analyze => modify => broadcast)
- Cyber security interfaces
- Base station infrastructure
- Sandbox or custom real-time FPGA processing of in/outbound data streams
- High-speed capture, digital tuning, demodulation, and multicast data reduction/distribution
- Instrumentation, test and measurement

ICE-Tray-RM block diagram and configuration options are shown below. Dotted lines indicate configuration options.



2 ICE-Tray Configuration

The table below shows the available model number configurations of the ICE-Tray-RM. The model numbers highlighted in green represent the most common configurations.

ICE-Tray Configurations

Model	IOM1	IOM2	PM1	PM2	PCI Slot	IOM3	IOM4	GPS	Shelf 1	Shelf 2
M2404	A2DM20		K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	R1	-	-
M2408	D2AWGM3	D2AWGM3	-	-	PIC8S	D2AWGM3	D2AWGM3	-	-	-
M2410	A2DM20		K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	-	-	-
M2415	D2AWGM4		-	-	PIC8S	D2AWGM4		-	-	-
M2416	LB2DM3	LB2DM3	-	-	PIC8Q	-	-	-	-	-
M2418	A2DM20		K8M	K8M	PIC8S	LB2DM3		-	-	-
M2421	A2DM20		K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	R3	-	-
M2422	A2DM20		K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	-	-	-
M2423	A2DM20		K8M	K8M	PIC8S	A2DM20		R3	AR18D	AR18D
M2424	A2DM20		K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	R3	AR18D	AT18D
M2425	A2DM20		K8M	K8M	PIC8S	A2DM14	A2DM14	-	AR18D	-
M2426	D2AWGM4		-		PIC8S	D2AWGM4		-	-	-
M2427	A2DM20		K8M	K8M	PIC8S	A2DM20		R3	AR18D	-
M2428	A2DM20		K8P	K8P	PIC8S	A2DM20		-	AR18D	-
M2429	D2AWGM3	D2AWGM3	K8M	K8M	PIC8S	D2AWGM3	D2AWGM3	-	AT18D	-
M2430	D2AWGM3	D2AWGM3	K8P	K8P	PIC8S	D2AWGM3	D2AWGM3	-	AT18D	-
M2431	A2DM20		-	-	DRV-15TB	-	-	-	-	-

Configuration options include I/O modules, processor modules, GPS module, tuner modules, and storage options.

Contact the factory for a custom model number configuration.

Popular I/O modules used on the ICE-Tray include the following:

I/O Module	Description	Features
LB2Dm3	Single channel ADC	L-Band tuner with 800-2300 MHz, 100 MHz BW
D2AWGm3	Single channel DAC	Waveform generator, 400 MHz BW, up to 2500 MHz
A2DM20	Dual 3.0 Gsps ADC	Dual I/O site, two channel, 14-bit, up to 1 GHz BW
D2AWGm4	Dual 12 Gsps DAC	Dual I/O site, two-channel, 14 bit, up to 1 GHz BW

2.1 ICE-Tray-RM Front Panel

The ICE-Tray-RM appliance is delivered as a 1U unit. The front panel simply has an on/off switch and a green LED indicating power status as shown below.

Figure 1. ICE-Tray-RM Front Panel

2.2 ICE-Tray-RM Rear Panel

The ICE-Tray-RM appliance rear panel contains two AC sockets for the redundant power supply and well as several I/O connectors shown below.

Figure 2. ICE-Tray-RM Rear Panel

Rear panel connector definitions: (from left to right)

AUX	On board microcontroller USB Mini A
OCulink 1	Two x4 PCIe links for connection to off-board SSDs
Data Port 1	QSFP+ connector - Four 10GbE network connections to PM1
Data Port 2	QSFP+ connector - Four 10GbE network connections to PM2
1GbE	Management RJ45 ethernet connector
USB3 (x3)	USB type A connectors (super speed)
USB2 (x2)	USB type A connectors (keyboard and mouse)
HDMI	Display connector
OCulink 2	Two x4 PCIe links for connector to I/O Chassis (GPU, PIC8 or dual SSD)

J1-J8 SMA connectivity varies by model number. Units **without** GPS modules will typically use J5 and J6 and units **with** GPS modules will **not** use J5-J8. Internal buffering is provided in the ICE-Tray hardware to allow duplicating clock and PPS signals to multiple destinations.

J1: RF 1 in
J2: RF 2 in
J3: RF 1 out
J4: RF 2 out
J5: 10 MHz reference clock output
J6: 10 MHz reference clock output
J7: 1 PPS output
J8: GPS antenna input

Note: Any external SMA cables (J1-J8) should not be torqued more than 4 in-lbs.

2.3 Tuner Tray

The ICE-Tray-RM supports up to two tuner trays, where a tuner tray houses an ICE-XCVR board with two sites for tuner modules. Refer to the AR18, AT18 and AX18 datasheets for more details.

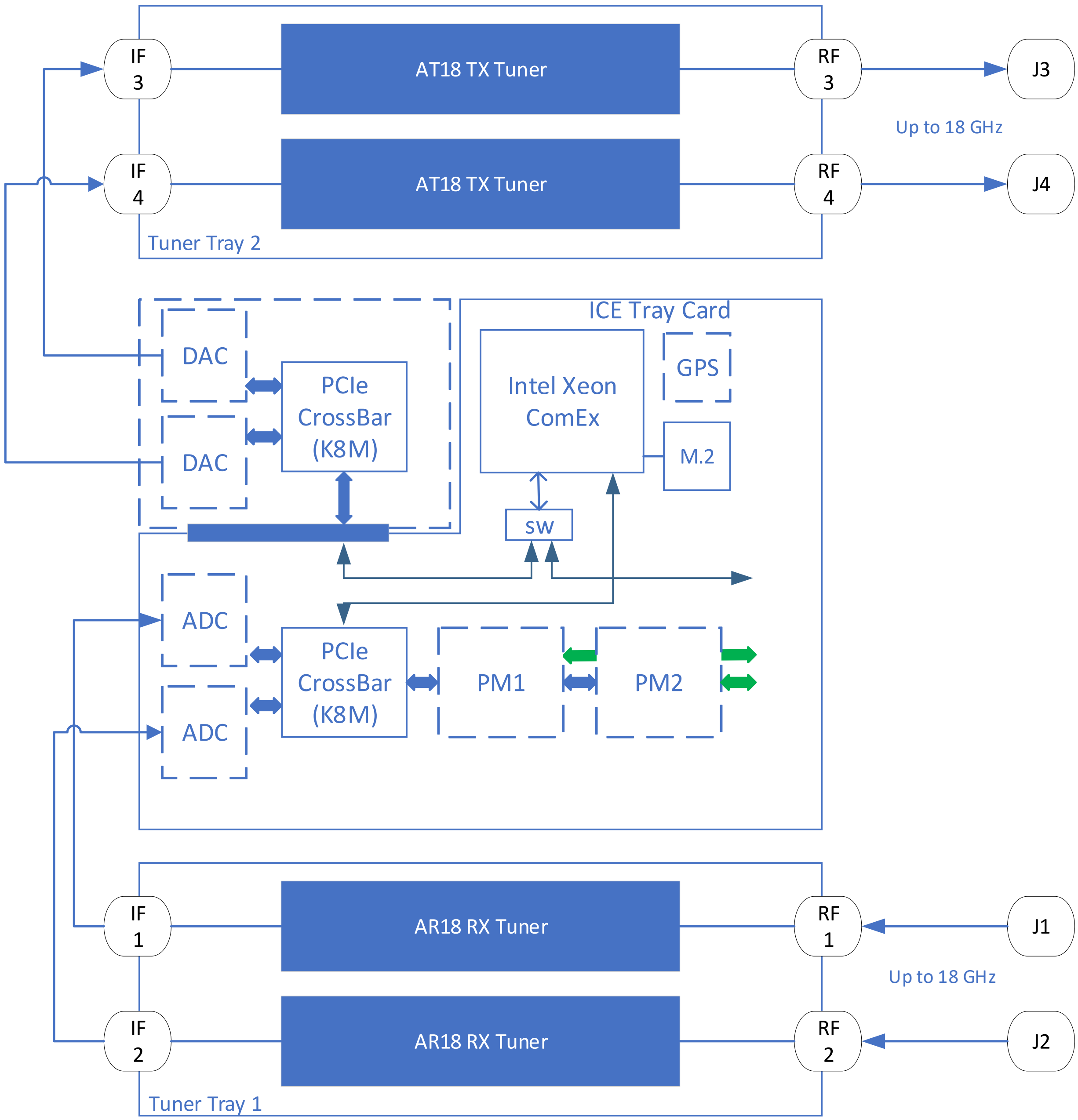


Figure 3. Example ICE-Tray with two tuner trays

2.4 Power Requirements

Two redundant, 1+1, 600-watt, hot-swappable power modules are used to power the ICE-Tray-RM Appliance through standard AC 120V cables.

- Power consumption at idle: 60 Watts
- Power consumption (typical, no Tuners) 130 watts
- Power consumption (typical, two dual Tuners) 180 watts

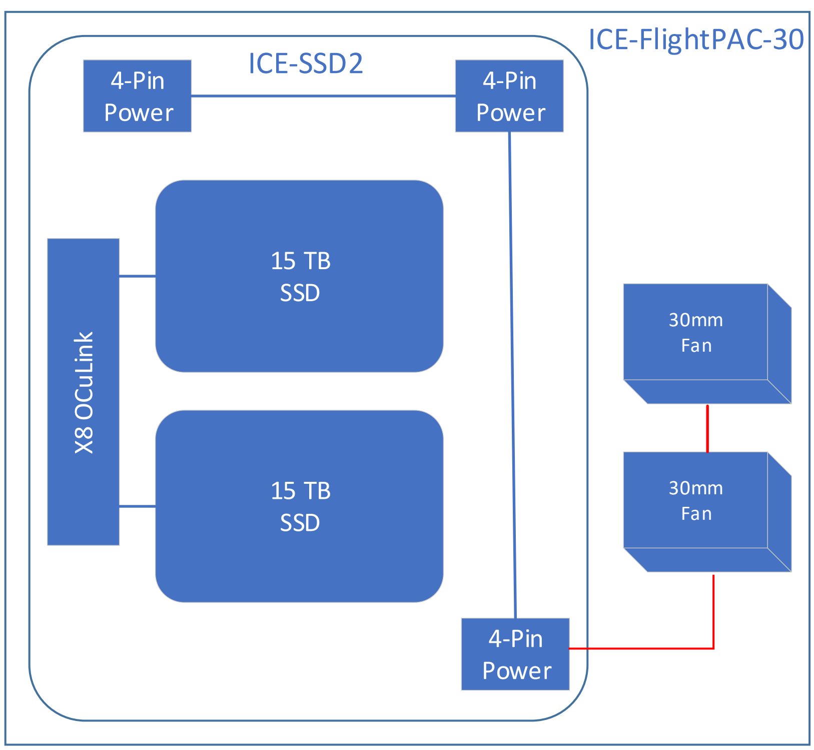
2.5 ICE-Tray Accessories

There are a few accessories available for connection to the OCuLink ports on the rear panel of the ICE-Tray:

- ICE-Flight PAC
- I/O Chassis

2.5.1 ICE Flight PAC

The FlightPAC-30 is a standalone 30 TB Dual-SSD module that may be connected to the ICE-Tray. The block diagram for the ICE Flight PAC is shown below for reference. The ICE-FlightPAC-30 features one ICE-SSD2 PCB, one x8 OCulink connector and two 15 TB SSDs with integrated fans.

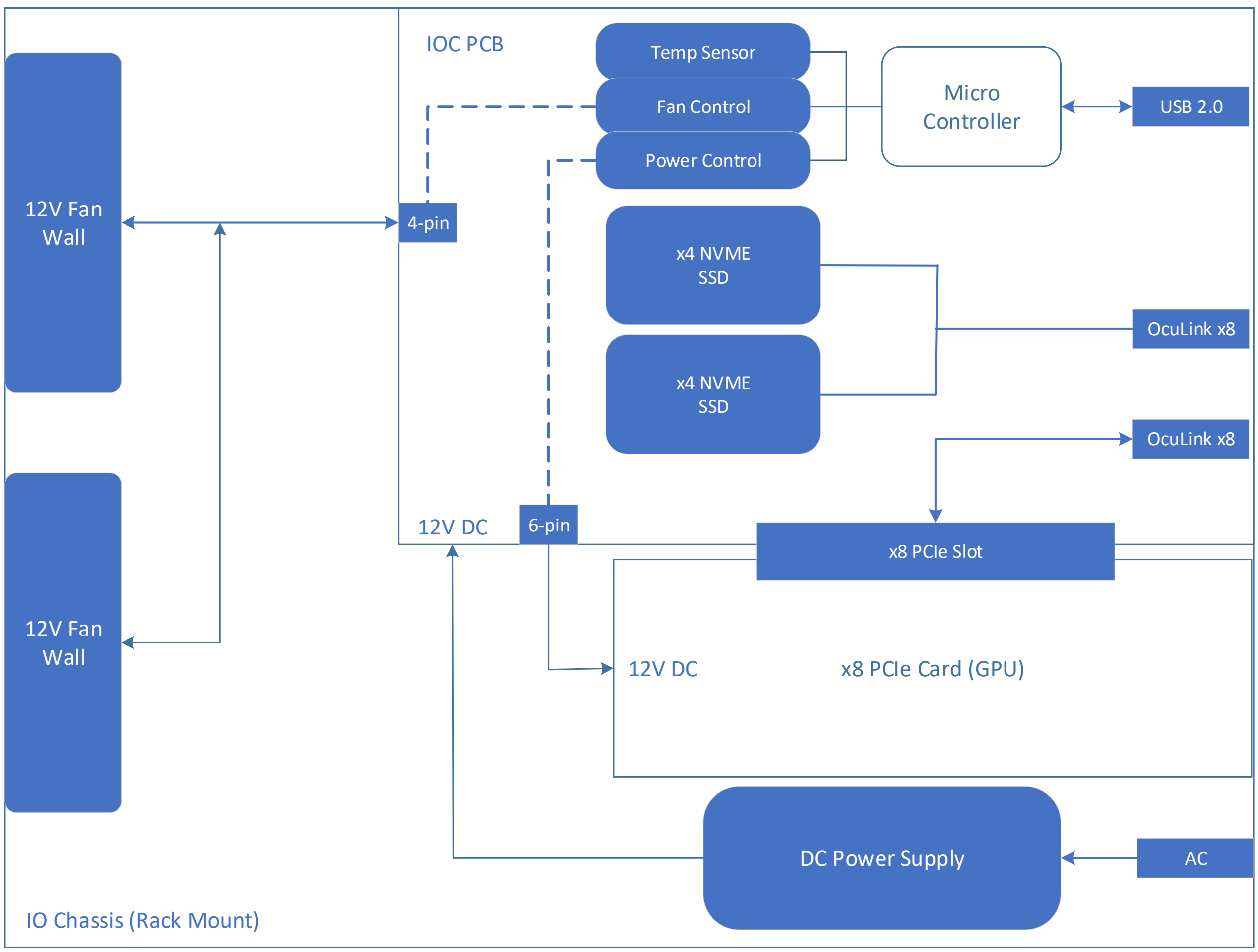


2.5.2 I/O Chassis

An I/O Chassis (IOC) may also be used with an ICE-Tray. The IOC is a rack -mounted chassis complete with a x8 PCIe slot and two x4 NVMe removable SSDs. There are two x8 OCulink connectors which may be cabled to the ICE-Tray OCulink connectors. The x8 PCIe slot may be used for an additional ICE-PIC8 card or a GPU card and operates at PCIe Gen 3 speeds.

A Micro-B USB connector is used to control and monitor the power, temperature, and fan speeds. This USB connector is typically cabled to one of the Type-A USB connectors on the ICE-Tray rear panel.

The IOC does not have an on/off switch but has an integrated AC/DC supply capable of handling GPU cards up to 200 Watts. The IOC block diagram is shown below for reference.

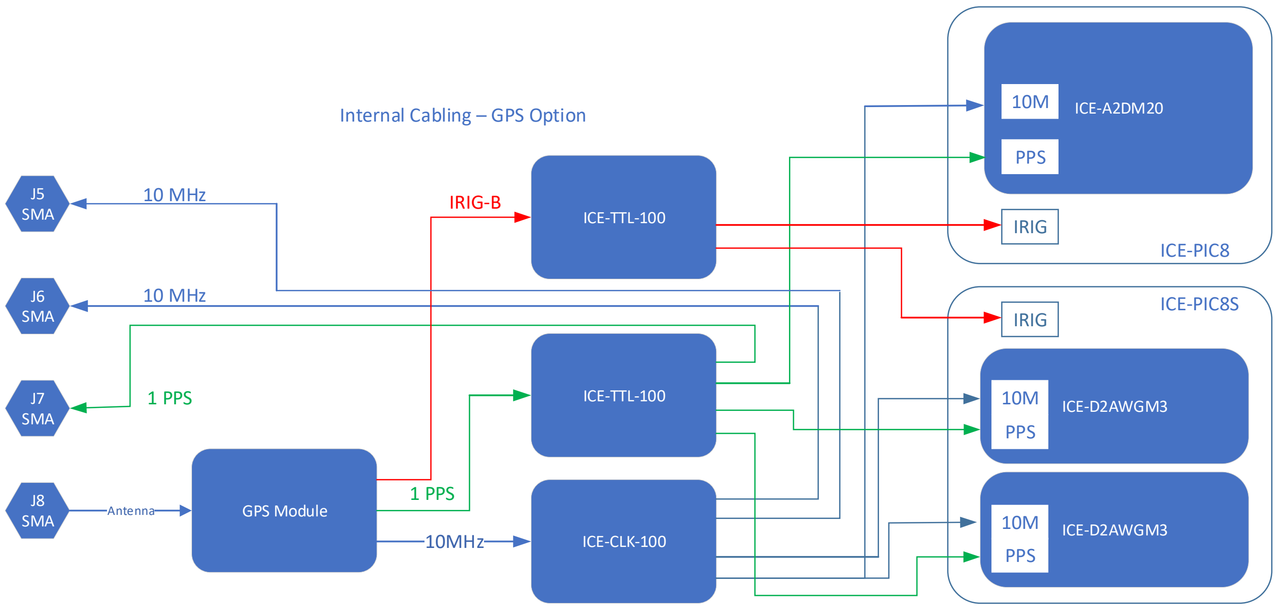


2.6 Internal Cabling

There are several options for internal ICE-Tray cabling. Two options are detailed below for reference. The ICE-CLK-100 and ICE-TTL-100 are ICE printed circuit boards (PCBs) used to replicate an input either four or eight times.

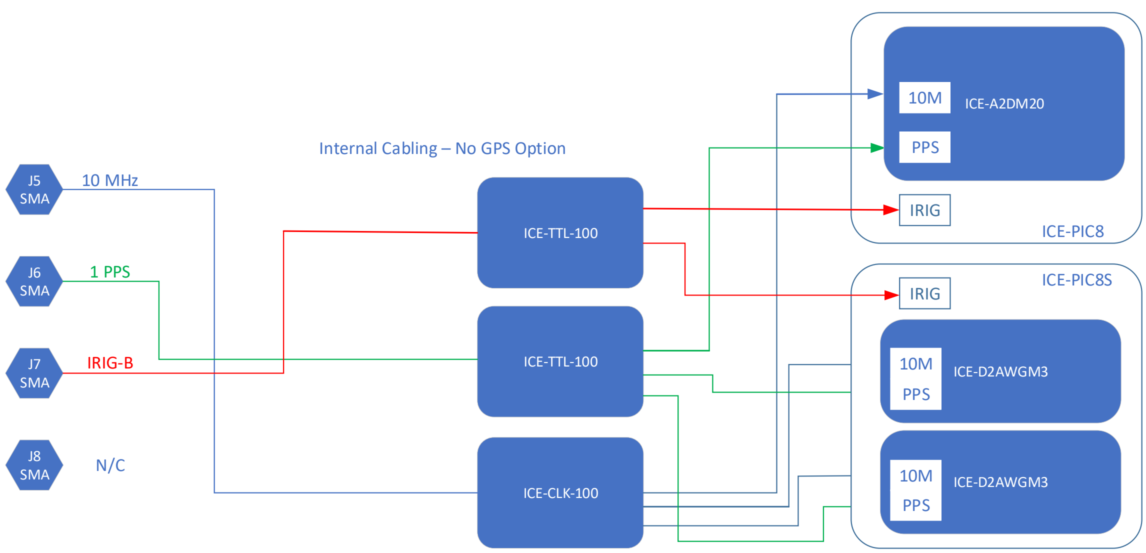
2.6.1 Internal GPS Cabling

The diagram below shows how the ICE-Tray is cabled when the internal GPS module is used.



2.6.2 No GPS Option Cabling

The diagram below shows how the ICE-Tray is cabled when no GPS module is present.



3 ICE-Tray Operation

Connect an HDMI monitor to the HDMI port. The power on the monitor must be on and the HDMI cable must be attached prior to turning on the unit for the display to be detected. Connect a USB keyboard and mouse. It is recommended to use the USB 2.0 ports as the USB 3.0 port can be used for higher speed external devices.

Figure 4. Direct connection using HDMI monitor

3.1 Remote Operation using 1 GbE port

Connect an RJ45 Network Cable.

The default IP address of the management port on the ICE-Tray-RM is 192.168.0.123. After powering on the ICE-Tray-RM unit, with a local computer set to the same base network (192.168.0.###), open a terminal window. From a Linux machine, a terminal window is usually accessed with "right-mouse-click" on the desktop. [For Windows open the VNCVIEWER application on a Windows machine).

3.2 Login

Inside the terminal window execute the Linux command "vncviewer 192.168.0.123:1". This will produce Graphic Screen dialog box similar (Figure 5) to the one shown below. There is no need to type in a user name. Simply enter the password (default is "[redacted]"). The reason why there is no need to enter a user name is because the "vncservers" file (located in /etc/sysconfig/vncservers) is already expecting the user name to be "iceman".

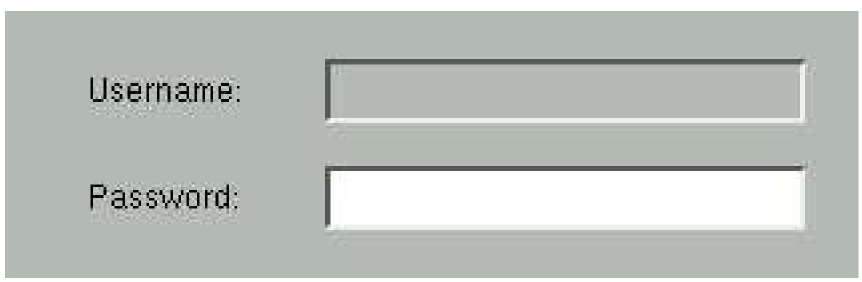


Figure 5. vncviewer login dialog box

Enter "[redacted]" and press return and the Desktop, shown on the next page, will appear.

Figure 6. vncViewer Desktop

Figure 7. Menu for vncViewer

Pressing the F8 key shows VNC session options. A dialog box that allows you to go "full screen". If not full screen, then some scrolling might be necessary on the display.

Next, right-mouse-click on the desktop (see dialog box below) and choose QuickMenu / Terminal.

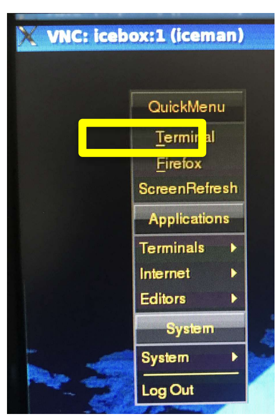


Figure 8. Opening a Terminal

3.3 VNC Account :

Login: iceman
Password: [redacted]

3.4 VNC access For LINUX users:

This method of VNC access assumes you are logging in from a remote UNIX/Linux™ server via an RJ45 gigabit network cable. With a gigabit Ethernet cable attached, open a terminal window and type the following:

vncviewer 192.168.0.123:1

The unit will display the desktop with a 1280x1024. The file on the ICE-BFCS-01NH to set the geometry is /etc/sysconfig/vncservers. Your local computer must be on the same network path – 192.168.0.###.

3.5 VNC access For Windows: (Self Support)

This method available but without support. It is relatively straight forward to use and the instructions for installation on a windows based computer are on the website. It is provided "as is" from the website for your version of the Windows Operating System. We do not endorse this website and proper network safeguards should be used when downloading anything from the public internet.

Download VNC Viewer for your version of Windows vnc viewer website and install it as specified. Download and Documentation site for the VNC Viewer is

https://www.realvnc.com/en/connect/download/viewer/

Double-Click on the VNCviewer icon on your desktop and a dialog box will appear. Initially on first use, VNCviewer will most likely not have an IP address in the server text window. Use the following default IP address on the Server line: 192.168.0.123:1

The next dialog box that appears requires only the password. The password is factory set as "[redacted]".

The full screen display (1280 x 1024) for the unit will now appear.

NOTE: It may be necessary to press F8 and click on the "full screen" option to see the menu bar or use the scroll bars to position the screen. To exit from the full screen mode simply press F8 again and toggle full screen mode to off.

3.6 ICE Web Server

From a graphical session, open a terminal window by right-clicking on the desktop and selecting the *Terminal* menu item under *QuickMenu*. By default, the current working directory will be `iceman`'s home directory `/home/iceman`. Confirm by typing `pwd`.

As `iceman`, start the ICE HTTP Web Server, which provides access to the server's control interface:

./icebox.vnc

Now to verify that the configuration is working properly, open a web browser and go to http://192.168.0.123:8080. This activates the *ICE WebKit Interface*, with which it is possible to interact with ICE software via HTTP requests. See the *ICE WebKit Interface* section below for details and documentation.

Note on Firewall settings: For the WebKit Interface to function properly, make sure that ports 8080 and 9000-9999 are open for both UDP and TCP traffic.

3.7 ICE WebKit Interface (Advanced Users)

The ICE WebKit Interface provides a language-independent means of controlling and monitoring ICE hardware through simple HTTP requests. This facilitates the development of custom APIs by providing a universal access protocol.

As discussed in the *Quick Start* section, the home page of the WebKit Portal is viewable by directing a browser to the IP address of the Management Ethernet device at port 8080, e.g., http://192.168.0.123:8080. This page provides an overview of the system, including ICE-PIC cards, NIC ports.

The functionality of the WebKit Interface is dependent upon the underlying NeXtMidas SNAPAPP macro and its SNAPPER children running in server mode. All of the controls in SNAPAPP and SNAPPER are accessible via the WebKit interface.

To get or set a widget value, send an HTTP request with the appropriate command. By default, the global SNAPAPP macro can be accessed through port 9000, and each Snapper children through ports 9001 through 9*NNN*. Consider the following examples:

For more information, please refer to the ICE Help and Explain files on Service, Snapper and SNAPAPP, included with the ICE Option Tree/Toolkit.

3.7.1 Controls

Global Monitor (Real Time Memory):
`http://192.168.0.123:9000/Controls/Set?ACTION=Monitor`

Returns:
`/Controls/Ack?ACTION={Monitor}`

Note the command is now *Ack* indicating that the *Set* request was acknowledged and the new value is returned.

Global Stop:
`http://192.168.0.123:9000/Controls/Set?ACTION=Stop`

Global Exit:
`http://192.168.0.123:9000/Controls/Set?ACTION=Exit`

Start Real Time Memory on Snapper child 1:
`http://192.168.0.123:9001/Controls/Set?MODE=RTMemory`

Stop activity on Snapper child 2:
`http://192.168.0.123:9002/Controls/Set?MODE=Setup`

3.7.2 Get Widget Values

Get commands return a plain text string in the following format, which can easily be parsed, for example, the command
`/Controls/Get?{NAME1,NAME2,…}`

Returns:
`/Controls/Ret?{ NAME1=X, NAME2=X,…}`

Get the global scenario (from table file's APPLIST):
`http://192.168.0.123:9000/Controls/Get?Scenario`

Returns:
`/Controls/Ret?Scenario={NAME_OF_SCENARIO}`

Get the RF Power value from Snapper child 1:
`http://192.168.0.123:9001/Controls/Get?RFPWR`

Returns:
`/Controls/Ret?{RFPWR=-45}`

It is also possible to get multiple values with one request:
`http://192.168.0.123:9001/Controls/Get?{RFFREQ,RFBW,RFGAIN}`

Returns:
`/Controls/Ret?{RFFREQ=1500,RFBW=120,RFGAIN=10}`

3.7.3 Set Widget Values

Set global scenario (from table file's APPLIST):
`http://192.168.0.123:9000/Controls/Set?SCENARIO=NAME_OF_SCENARIO`

Returns:
`/Controls/Ack?Scenario={NAME_OF_SCENARIO}`

Set the RF Frequency value for Snapper child 1:
`http://192.168.0.123:9001/Controls/Set?RFFREQ=1500`

Returns:
`/Controls/Ack?{RFFREQ=1500}`

It is also possible to get multiple values with one request:
`http://192.168.0.123:9001/Controls/Set?{RFFREQ=1500,RFBW=120,RFGAIN=10}`

Returns:
`/Controls/Ack?{RFFREQ=1500,RFBW=120,RFGAIN=10}`

3.7.4 Units

Many of the values that may be queried with Get or Set commands are numeric without specified units. The following table provides a sampling of the units for common widget values:

Widget Field	Description	Unit
RFFREQ	RF Frequency	MHz
RFBW	RF Bandwidth	MHz
RFATTN	RF Attenuation	dB
RFGAIN	RF Gain	dB
RFPWR	RF Power	dB
RATE	Sample Rate	MHz
LENGTH	Buffer Length	Seconds
FREQ	Frequency	MHz
GAIN	Gain	dB
MGAIN	Module Gain	dB
PSDR	Display Rate	Hz
PSDA	Display Average	Frames
EXPA	Exponential Average	Frames

3.7.5 Script Example

The following BASH script is an example of how the RF Power value on Channel 1 might be obtained:

```
#!/bin/bash

RFPWR1=$( curl http://192.168.0.123:9001/Controls/Get?{RFPWR} 2> /dev/null
)
RFPWR1=$( echo "$RFPWR1" | sed -e 's/.*RFPWR=\([-0-9]\+\).*/\1/' )
echo "Channel 1 RF Power: $RFPWR1"
```

Example output:

```
Channel 1 RF Power: -45
```

Note: This example uses `curl`; `wget` is another option.

3.8 ICENET

The ICENET routine in the `$ICEROOT/test` directory can be used to control and/or test ICE Network Appliances.

The public interface includes all control widgets exposed by the macro. These controls are accessed by key=name pairs where the key is the label of the control. The labels are listed in the page http://<host>:<port>/Controls or by the readout when a graphical widget has focus. To set a control, use the key=name syntax and just the key or key= to perform a get.

To start or stop an appliance that has already been instantiated:

```
ice net SET udp:192.168.0.199:7777/192.168.0.123:9000 ACTION=REC
ice net SET udp:192.168.0.199:7777/192.168.0.123:9000 ACTION=STOP
```

where 192.168.0.199 is the address of the controller NIC card and 192.168.0.123 is the address of the ICE Appliance.

To change the frequency of the 1st snapper case in the appliance:

```
ice net SET udp:192.168.0.199:7777/192.168.0.123:9001 FREQ=10
```

By default, the SET and GET verbs address control widgets only. The routine can also be used to access any other object in the macro registry or results table. For instance:

```
ice net SET udp:192.168.0.199:7777/192.168.0.123:9001
"/Controls?FREQ=10"
```

Sets the same control as the previous example, and

```
ice net GET udp:192.168.0.199:7777/192.168.0.123:9001
"/Registry/SP?CYCLE"
```

The ICENET routine can also acquire a snapshot of packet data off a local NIC card. By default, this routine checks for packet sequence error and determines the aggregate data rate. To test a packet stream coming from an ICE Appliance for rate and/or drops:

```
ice net ACQ udp:192.168.0.199:7777/224.1.40.%d:7777 testfile ICE 40e6
10
```

The loop count can be used to run the command multiple times with a single call. If the multicast address contains a %d, the loop count will be inserted to allow looping through a series of channels as if from a tuner bank.

For a description of each parameter, type:

```
ice net
```

3.9 Firewall

The default firewall settings are on for almost all functions. Initially turning firewalls off, allowing data to move freely, is desired. After testing, specific firewall settings can be added by a network administrator.

To turn off firewalls:
As root issue the following commands:

```
/etc/init.d/iptables stop
/etc/init.d/ip6tables stop
```

3.10 IPMICE

IPMICE is a command line utility that provides status and control information for the current platform as well as any accessories like Tuners or I/O Chassis.

Type IPMICE at the Linux command line to show options such as status, fan speed, temperature, power and Tuner commands.

4 NeXt-Midas

The interface software used to access the digitizer hardware is NeXt-Midas™. This software is ICE Enterprises, Inc. Trademarked software.

In the terminal window type:

`nms` (This command initializes the NeXtMidas Shell)

Next, type:

`nm` (This command puts you inside the NeXtMidas Shell)

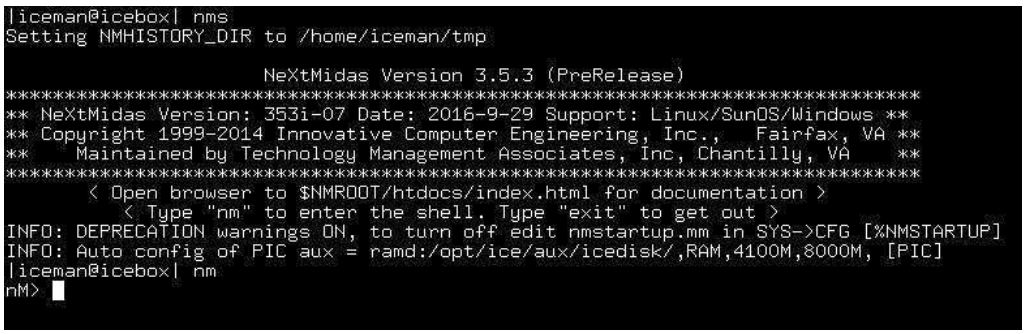


Figure 9. Starting the NeXtMidas shell

Once you are at the **`nM>`** prompt the following pre-configured scenarios have been programmed and included as example table files for use. The full text of the table files for the scenarios are located in the /home/iceman directory.

4.1 Wideband Input Scenarios

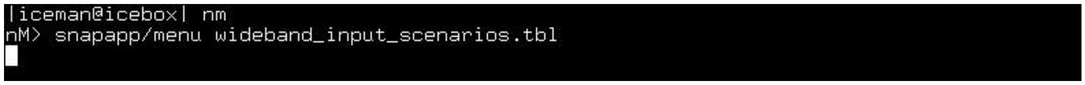


Figure 10. Wideband Input Scenarios Command

In the terminal window type: nms `|iceman@icebox|` **nms**
Next, type: nm `|iceman@icebox|` **nm**

Next, type the following line:
nM> `snapapp/menu wideband_input_scenarios.tbl`

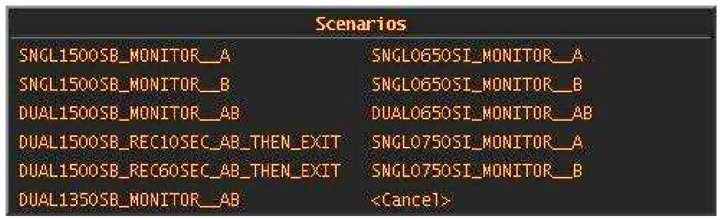


Figure 11. Wideband Input Scenarios

The above scenarios that are “1500” provide 750 MHz of NyQuist bandwidth. The “1350” provides 675 MHz of NyQuist bandwidth. The “650” provides 325 MHz of NyQuist bandwidth. The “750” provide 375 MHz of NyQuist bandwidth. There are different dynamic ranges when choosing scalar byte “SB” or scalar integer “SI”.

To take full advantage of the dynamic range of the A2Dm18 it is important to have the correct input power level. The power level of the signal coming into the unit is expected to be around from 0 dBm to -5 dBm. Additional amplification can be applied with the MGAIN up to 25 dB. The MGAIN can also be attenuation if the number is negative.

Where’s my data?

The files are written to /mnt/data11/iceman/filename. FTP or SCP software copy/transfer routines may be used to move the data.

Toggling through 3 different “Cntrls” screens displays the less (or more) of the graphical interface. Spectrum and z-axis raster are shown here. This mode shows only basic loading profiles. This can be customized to display specific items.

4.2 Spectrum Analyzer (500 MHz I.F.) Input Scenarios

Figure 12. Spectrum Analyzer Input Scenarios Command

In the terminal window type: nms `|iceman@icebox|` **nms**
Next, type: nm `|iceman@icebox|` **nm**

Next, type the following line:

nM> `snapapp/menu specan_digitize.tbl`

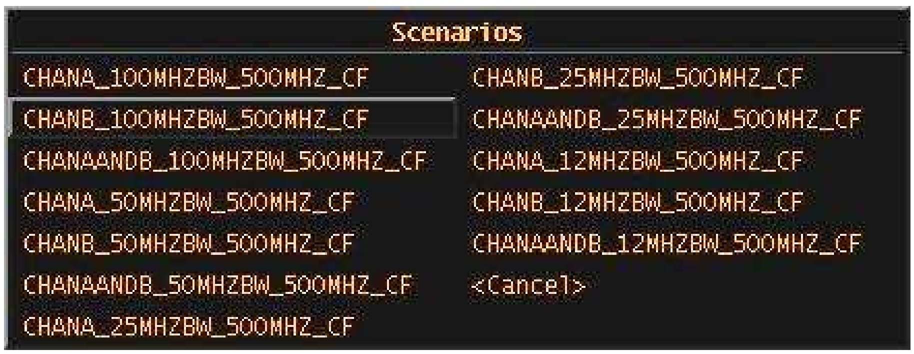


Figure 13. Spectrum Analyzer Input Scenarios

The above scenarios are 100MHz, 50MHz, 25MHz, and 12.5MHz bandwidth (both single and dual channel choices) and are all centered at 500 MHz input center frequency. It is assumed that the I.F. output from a spectrum analyzer is used for this application.

Again, the proper input power is between 0 dBm and -5 dBm. It might be necessary to amplify the 500 MHz output of the spectrum analyzer prior to input to the A2D channel.

4.3 ISM Band 2400-2480 MHz (WiFi) Input Scenarios

Figure 14. ISM Band Input Scenarios Command

In the terminal window type: nms |iceman@icebox| **nms**
Next, type: nm |iceman@icebox| **nm**

Next, type the following line:

nM> `snapapp/menu ismband_2400-2480.tbl`

Figure 15. ISM Band (WiFi) Input Scenarios

The ismband_2400-2480.tbl is for input of the 80 MHz wide ISM band centered at 2440 MHz.

4.4 Wideband Input Scenario Dual Channel Recording

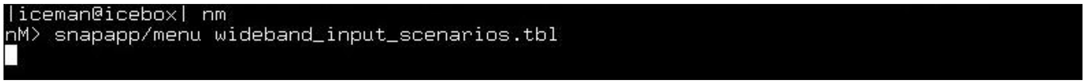


Figure 16. Wideband Dual Channel Recording Command

In the terminal window type: nms |iceman@icebox| **nms**
Next, type: nm |iceman@icebox| **nm**

Next, type the following line:
nM> snapapp/menu wideband_input_scenarios.tbl

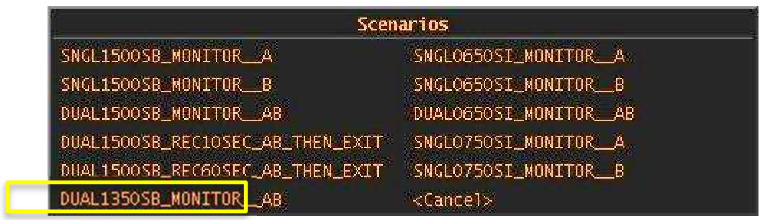
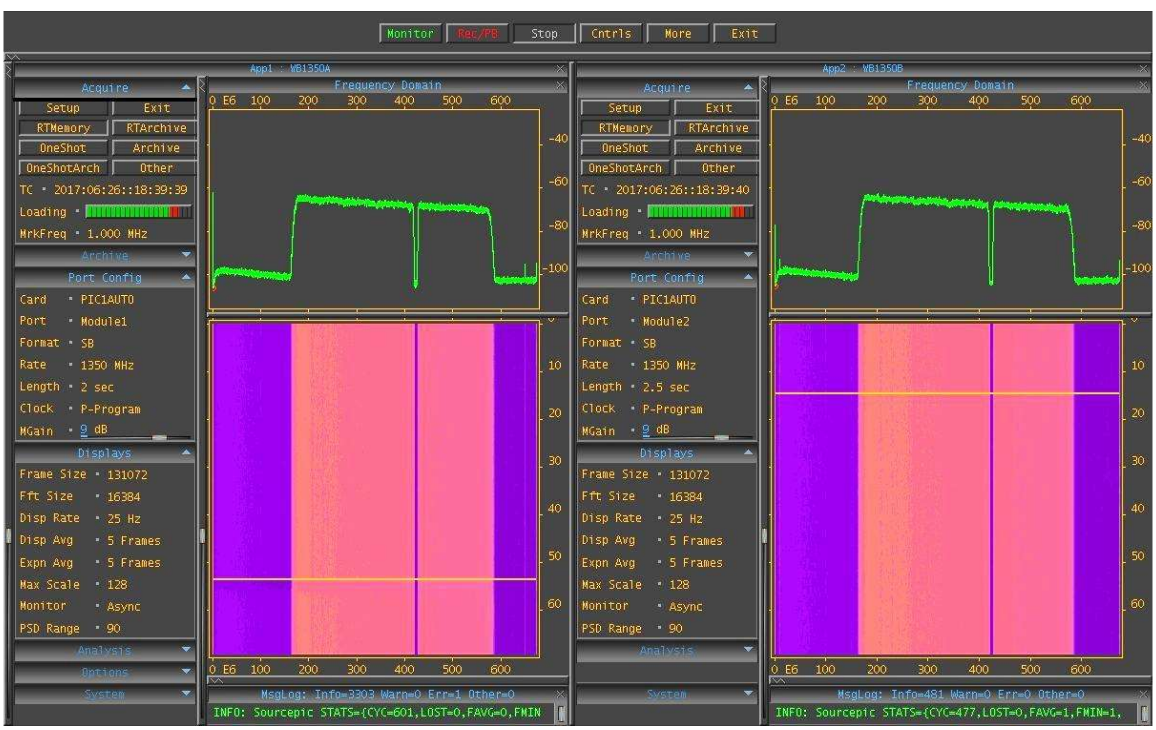


Figure 17. Selecting a Wideband Dual Channel Scenario for recording

After choosing scenario "DUAL1350SB_MONITOR__AB" the below GUI will appear and already be in **Monitor** mode. The signal input to both channels, in this example, is an NPR centered at 1125 MHz split into two inputs with input power at -5 dBm. The A2D loading being "two blocks" into the red zone is peak loading for the A2D.

Press the **Rec/PB** button on the top of the GUI to begin recording both channels. A default filename with appended date and time is automatic.



4.5 Wideband Input Scenario Single Channel Recording

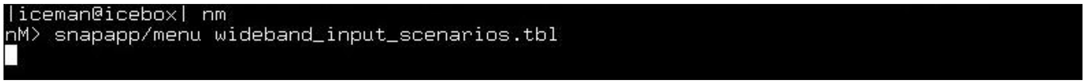


Figure 18. Wideband Single Channel Record Command

In the terminal window type: nms |iceman@icebox| **nms**
Next, type: nm |iceman@icebox| **nm**

Next, type the following line:
nM> snapapp/menu wideband_input_scenarios.tbl

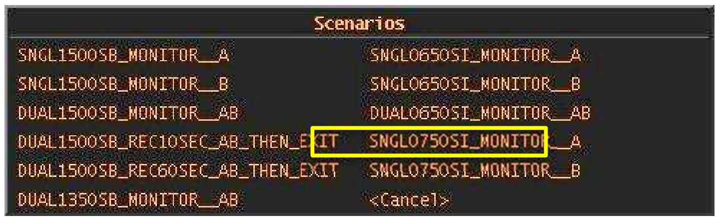


Figure 19. Selecting a Wideband Single Channel Scenario for recording

After choosing scenario "SNGL0750SI_MONITOR__A" the below GUI will appear and already be in **Monitor** mode. The signal input to both channels, in this example, is a TONE at 125 MHz with input power at -3 dBm. The A2D loading being "two blocks" into the red zone is peak loading for the A2D.

Press the **Rec/PB** button on the top of the GUI to begin recording the channel. A default filename with appended date and time is automatic.

Figure 20. Monitoring inbound data prior to pressing record

4.6 ISM Band 2400-2480 MHz (WiFi) Input Scenario Recording

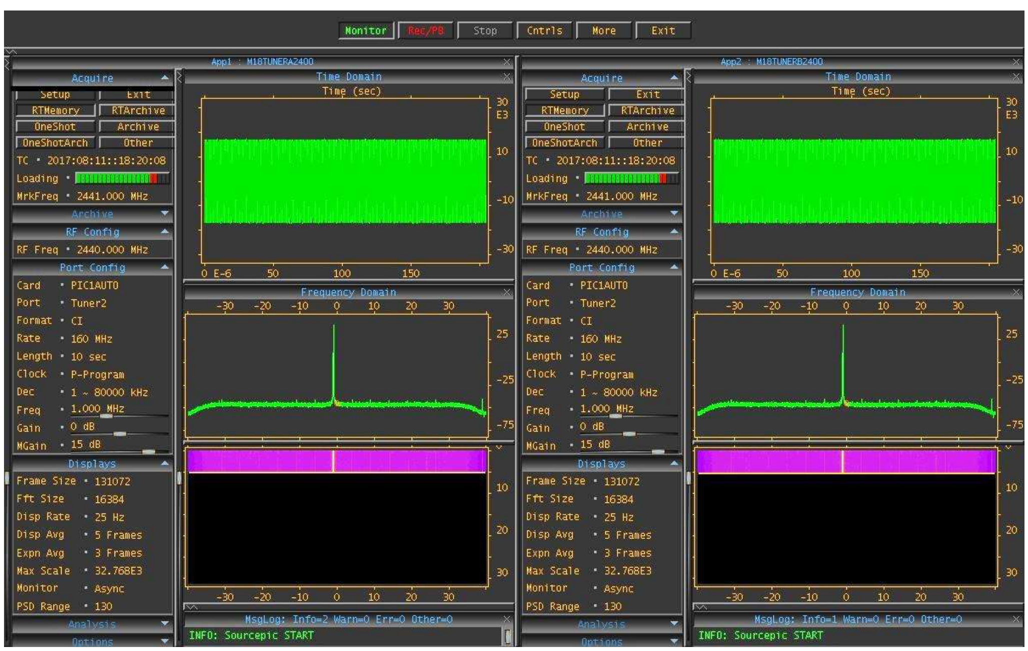
Figure 21. WiFi Recording Command

```
nM> snapapp/menu ismband_2400-2480.tbl
```

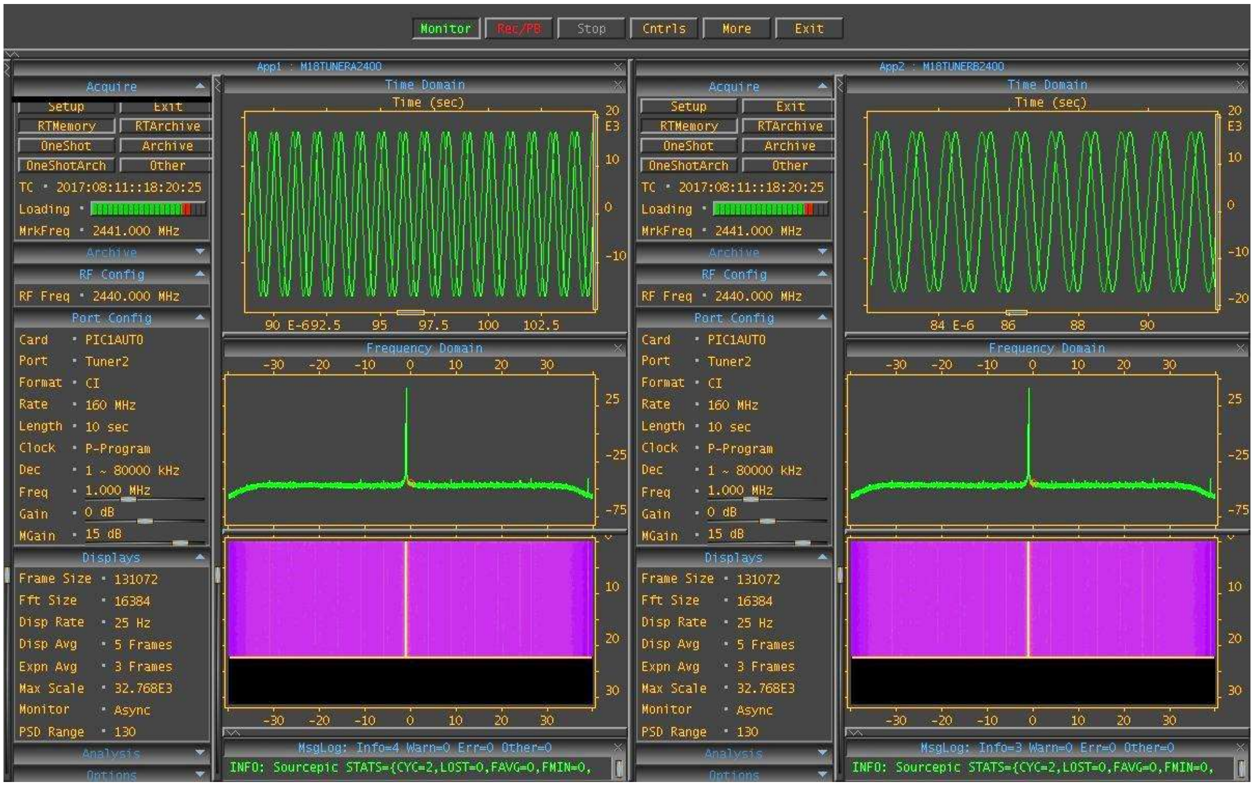
Figure 22. Selecting 2400 MHz Tuning with 80 MHz bandwidth

After choosing scenario "CHAN1ANDB_80MHZ_2400ISMBAND" the below GUI will appear and already be in **Monitor** mode. The signal input to both channels, in this example, is a TONE at 2440 MHz split into two inputs with input power at -3 dBm. The A2D loading being "two blocks" into the red zone is peak loading for the A2D.

Press the **Rec/PB** button on the top of the GUI to begin recording both channels. A default filename with appended date and time is automatic.



While in **Monitor** mode zooming is allowed on the graphical sections. The below zooms of the time series plots allows closer viewing of the complex sine wave.



4.7 Spectrum Analyzer (500 MHz I.F.) Dual Channel Recording

Figure 23. Spectrum Analyzer Input Recording

In the terminal window type: nms |iceman@icebox| **nms**
Next, type: nm |iceman@icebox| **nm**

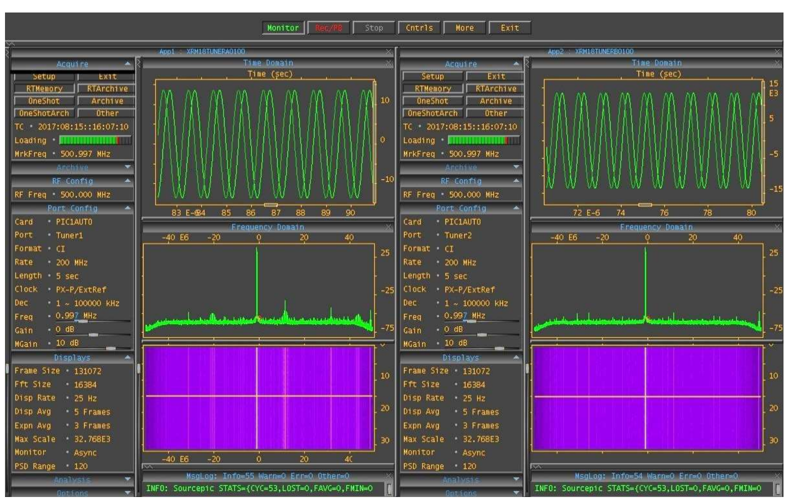
Next, type the following line:
nM> `snapapp/menu specan_digitize.tbl`

Figure 24. Spectrum Analyzer Scenario Recording

The above scenarios are 100MHz, 50MHz, 25MHz, and 12.5MHz bandwidth (both single and dual channel choices) and are all centered at 500 MHz input center frequency. It is assumed that the I.F. output from a spectrum analyzer is used for this application. Again, the proper input power needs to be between 0 dBm and -5 dBm. It might be necessary to amplify the 500 MHz output of the spectrum analyzer prior to input to the A2D channel.

After choosing scenario "CHANAANDB_100MHZ_500MHZ_CF" the below GUI will appear and already be in "**Monitor**" mode. The signal input to both channels, in this example, is a TONE at 500 MHz split into two inputs with input power at -3 dBm. The A2D loading being "two blocks" into the red zone is proper peak loading for the A2D.

Pressing the **REC/PB** button on the top of the GUI will begin recording both channels. A default filename with appended date and time is automatic.



4.8 Viewing a file from storage

In the terminal window type: nms |iceman@icebox| **nms**
Next, type: nm |iceman@icebox| **nm**

Next, type the following line:
nM> snapapp/menu view_file.tbl

Figure 25. View Digitized File Menu

Click on the **VIEW_DIGITIZED_FILE** scenario.

The following screen appears. Click on the Archive Drop Down tab to reveal the “File:” select field.

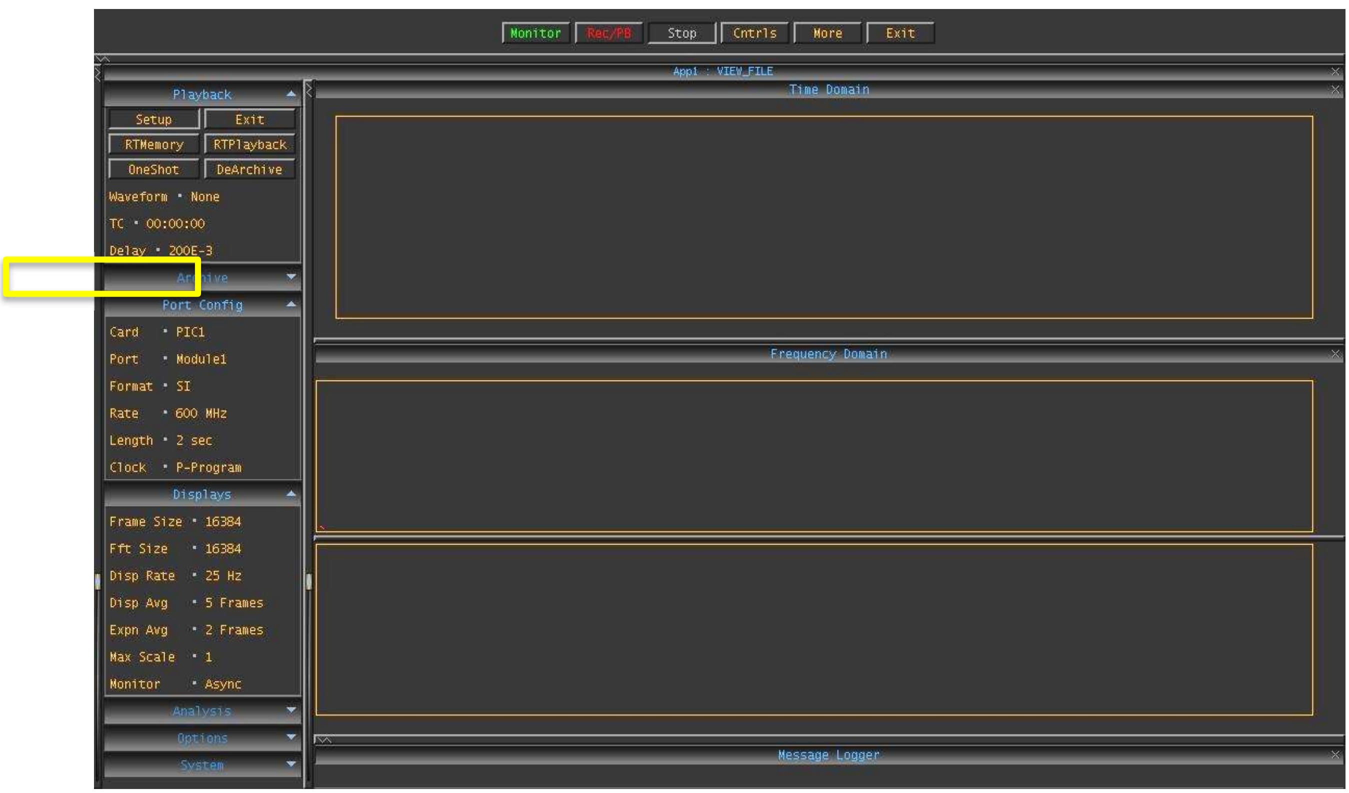


Figure 26. First Screen in View Digitized File Procedure

Click on archive the word in the “File:” select field.

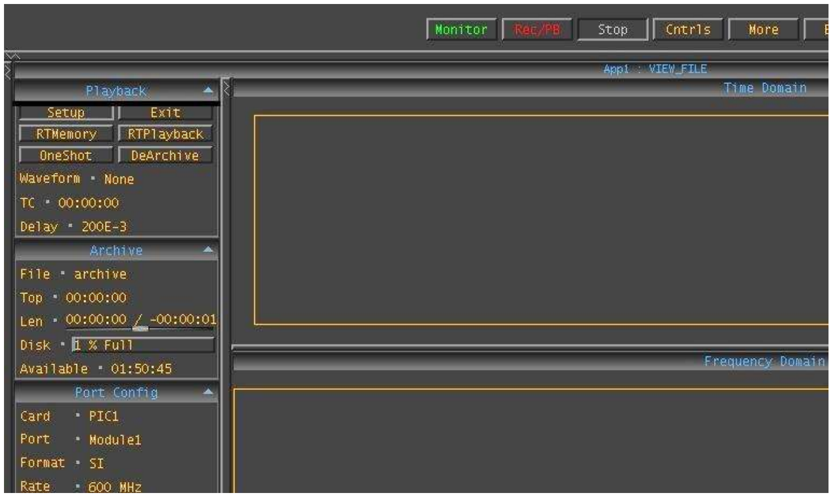


Figure 27. View Digitized File -File Selection

The following dialog box appears. In this dialog box the Auxlist defaults to 11 which is the storage location for recorded files.

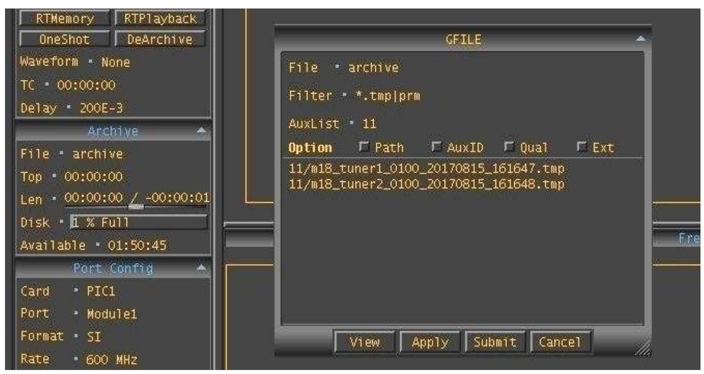


Figure 28. View Digitized File - Dialog Box

Highlight the file to be played back. The filename turns blue. Click the Submit button at the bottom of the screen.

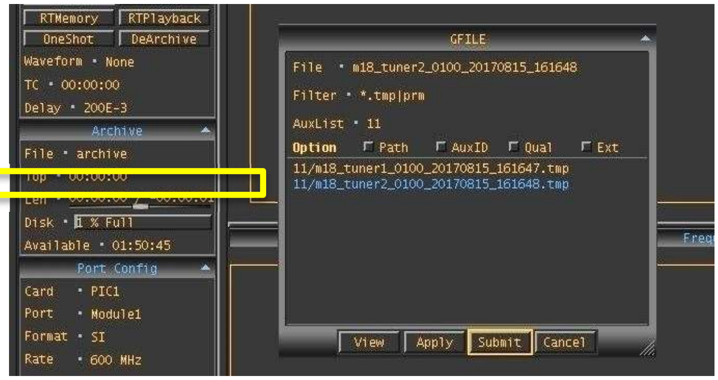


Figure 29. View Digitized File - Submit

Click on **RTPlayback**. Please note this this feature is ONLY FOR OBSERVATION of the the file on the screen. This recording has no capability to play the file out with a digital to analog conversion function. You will only be able see the spectrum play as in the example shown on the below screen. Duration of the recording is provided in the Len field under the Archive drop down tab.

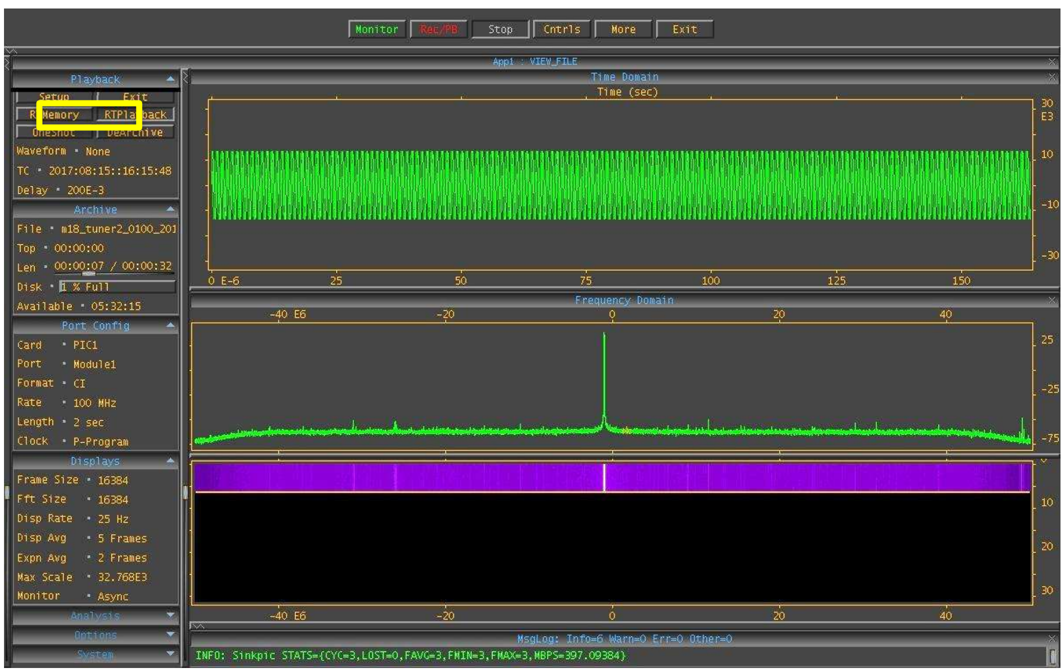


Figure 30. Beginning RTPlayback of the Selected Digitized File

It is possible to zoom in on the displays. It is not currently possible to playback a small portion of the recording. This function is mainly to verify that a recording actually took place. It is not meant as an analysis tool.

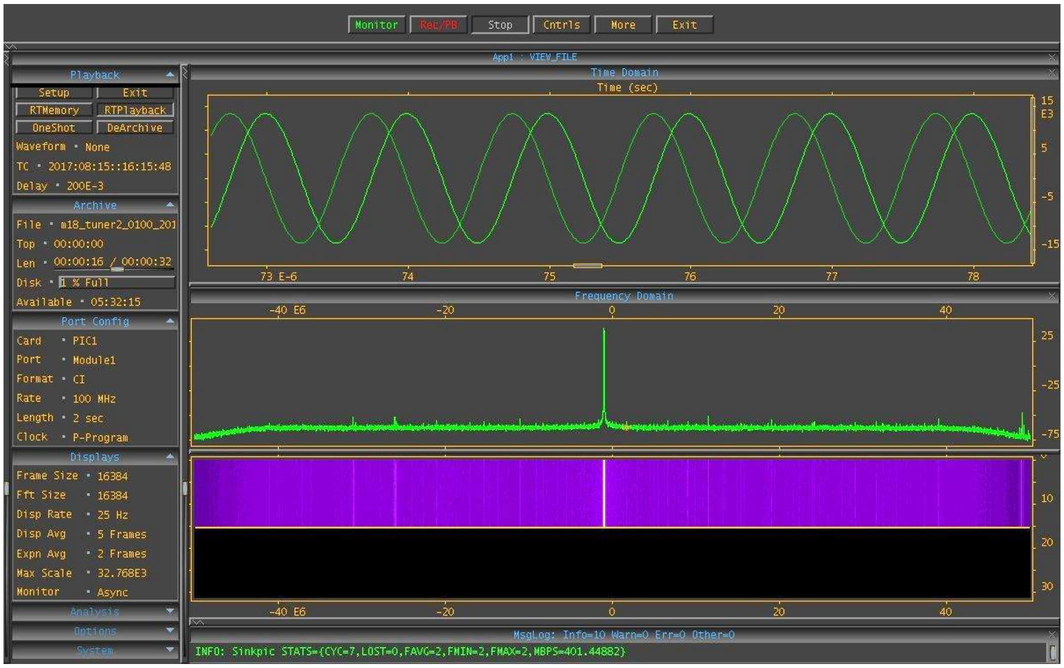


Figure 31. Options to zoom in on digitized data being played back

5 Hardware & Software

5.1 Hardware Overview

Chassis	Standard 1U 20" rackmount chassis, 16.75" x 1.75" x 20.0"
Motherboard	Embedded Linux stand-alone processor
Processors	Single Board Computer XEON Hex-core Processor
Memory	64 GB
Storage	1 TB SATA M.2 Off-board OCulink – two removable NVME SSDs Optional Removable NVME Drive (15 TB) – SSD card
Network Ports	Single GbE control port Dual QSFP+ Port with breakout cable to four 10GbE data ports
Processor Modules	Dual Processor module sites (K8M or K8P)
I/O	Two I/O sites on ICE-Tray Optional two I/O sites on PIC8S in PCIe slot
Tuners	Optional - Up to two Tuner Trays (up to 18 GHz)
GPS	Optional – on board GPS
Power	Dual redundant 600W hot-swap power supplies 1+1

5.2 Installed Software

This system comes with the following software installed and preconfigured:

- Fedora Linux
- NeXtMidas™
  - ICE Enterprises, Inc. is the author of this software
  - ICE Enterprises, Inc. owns the Trademark to NeXtMidas™
- ICE Option Tree/Toolkit for control of ICE Hardware
  - ICE Enterprises, Inc. is the author of this software

The ICE Hardware control software packages are installed in `/opt/ice/pkg/` – DO NOT modify anything in this directory, including soft links: the software installed here provides the operational interface for the unit.

- The active version of NeXtMidas is the target of the /opt/ice/pkg/`nmxxx` soft link
- The active version of the ICE Option Tree is the target of the /opt/ice/pkg/`icexxx` soft link

5.3 Disclaimer

The installed software is configured to function perpetually without upgrades. It is configured to function as a stand-alone device. Data captured can be offloaded via FTP to another system for analysis. The ICE-Tray's operating system is a highly customized configuration of Red Hat Inc. RHEL 6.8/CentOS 6.8. Any attempt to add additional packages or otherwise modify the system configuration may render the digitizer/recorder unusable and **VOIDS THE WARRANTY**. Please contact ICE Enterprises, Inc for modifications.

6 Revisions

Revision No.	Date	Description
1.0	21 August 2017	Initial release
2.0	22 April 2022	Updates for ICE-Tray-RM
2.1	30 November 2022	Updates from QMS audit