Seismic Source

FORCE-III

Vibrator Controller

User's Manual

Force III System User's Manual

Printed in U.S.A.

Seismic Source reserves the right to make changes and
improvements to its products without providing notice.

Trademarks

FORCE-III, Universal Encoder-II, SourceLink are trademarks of Seismic Source Co.

Seismic Source Co.

2391 East Coleman Rd.
Ponca City, OK 74604
USA
Telephone: (580) 762-8233
Fax: (580) 762-1785
Email: mail@seismicsource.com

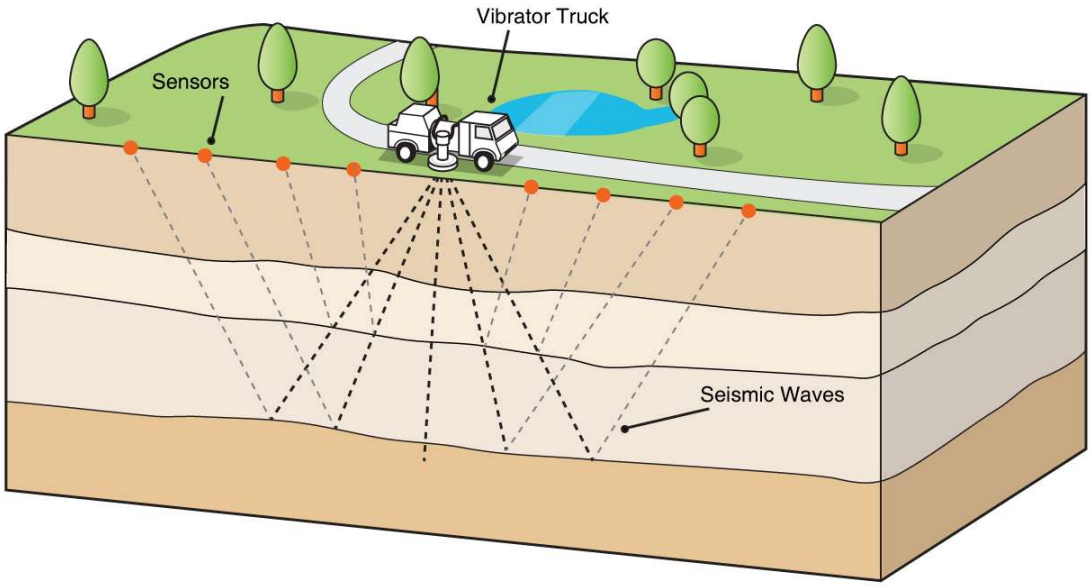
www.seismicsource.com

Table Of Contents

1 Introduction

Throughout this manual we are using names FORCE-III, Force 3 and F3 interchangeably. This manual contains information about installation of FORCE-III controller, main features, operational procedures, timing diagrams and unit's revision history

Basic Seismic Operation



An Energy Source is synchronized in time with the Sensors recording the Ground movement. The Seismic Energy Reflect off the various layers of the Earth and the time of the Seismic Waves arrival at the Sensors is recorded. The time of the arrivals can be converted into depths by accurately knowing the velocity of the Earth.

The UE2/Force 3 Encoder with the SourceLink software is used to control all the sources on a typical seismic crew.

- The Force 3 Decoders are used in the Vibrator Trucks to synchronize the Energy and report the quality control data to the Central Encoder system for a Vibroseis Source Points.
- The BoomBox 3 decoders are used to synchronize and report the quality control data to the Central Encoder system for a Dynamite Source Points.
- The RTM3 decoders are used to synchronize and report the quality control data to the Central Encoder system for all the Weight Drop Source Points.

1.0 System Description

The Force III (F3) system is designed to control Servo-Hydraulic Vibrator Trucks on a Seismic Crew. The F3 system can be used with a single vibrator truck or groups of vibrator trucks.
For normal seismic operation there is a Central System that controls all of the F3 source control units. The F3 can operate with the following central systems:

- UE2 – Universal Encoder II – TDMA mode or Legacy Mode
- UE1- Universal Encoder – Legacy Mode only
- Force 3 Encoder mode – TDMA or Legacy Mode
- VibPro Encoder – Legacy Mode only
- VibPro HD Encoder – TDMA or Legacy Mode

The UE1 and UE2 Encoder Units control the operation of the Vibrator trucks via a VHF or UHF radio. Commands are sent over the radio network to start, control and perform quality control of the Vibroseis system.

There are two main types of radio telemetry used with the Force III system Legacy Mode and TDMA Mode.

The Force 3 system can be used as an Encoder or Decoder. This allows a single "spare" unit to be used. A software setting on the Force 3 changes the system from Encoder Mode to Decoder Mode.

The block diagram below shows a basic UE2 (Encoder) and Force 3 (Decoder) system.

The Force 3 is connected to the Servo Hydraulic vibrator and the UE2 is connected to the Central Recording system.

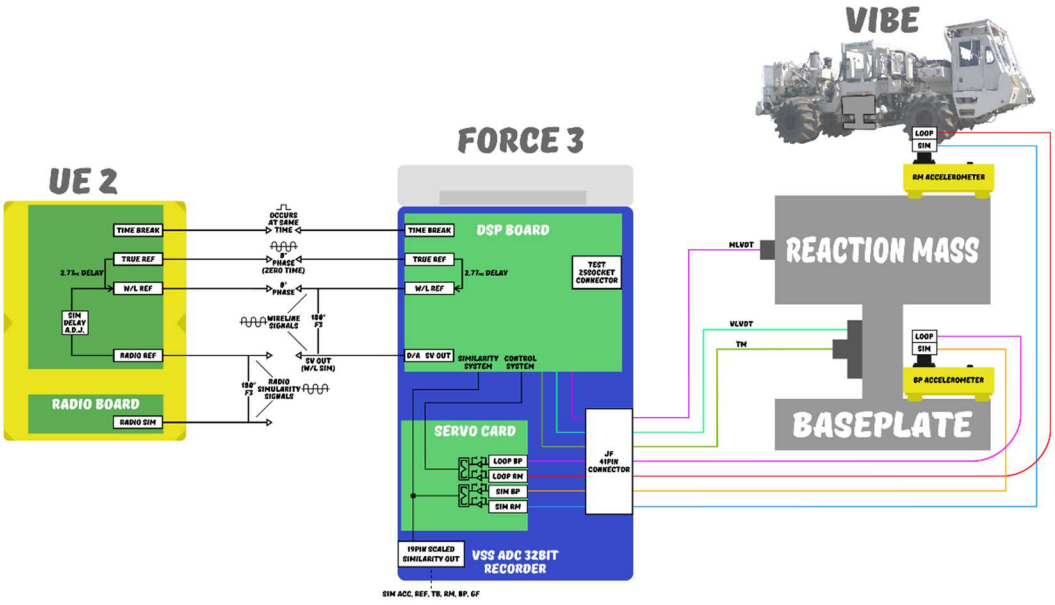
The Force 3 controls the “Weighted Sum Force Estimate” from the Reaction Mass and Baseplate accelerometers.

Radio delays are adjusted to align the Time Breaks and Reference signals from the UE2 and the Force 3 units.

The “Loop” accelerometer signals are used to control the vibrator system, while the “Sim” accelerometers are use for the similarity signals. The redundant accelerometers (Loop and Sim) are used to verify that all of the accelerometers are working correctly.

The Force 3 has a built in seismic recorder to record all of the vibrator signals on every sweep.

The Force 3 also has a built in QC system to provide analog QC signals of the Reference, Baseplate Accelerometer, Reaction Mass Accelerometer, and the Weighted Sum Force estimate. This allows an independent seismic recorder to record these QC signals



1.1 Legacy Mode – UE Mode

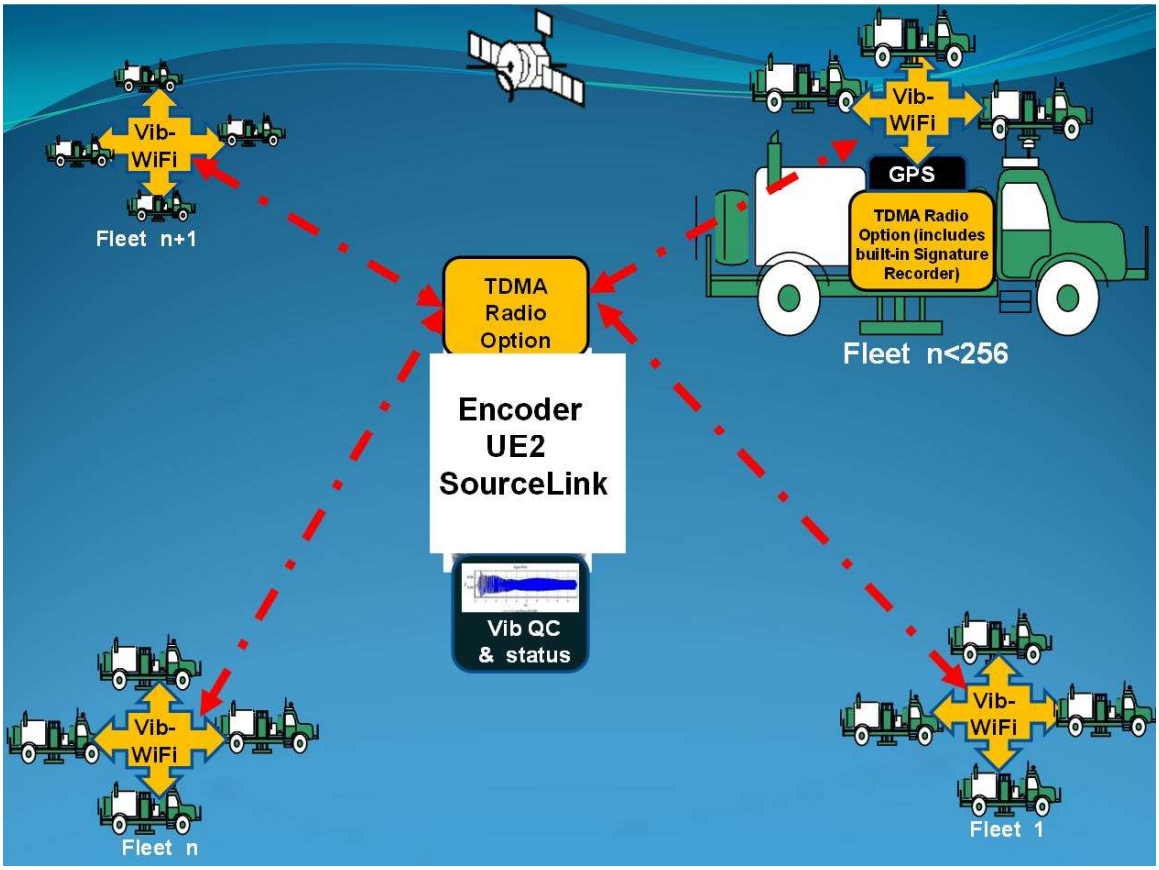
The Legacy Mode is compatible with the older generation of Source Control Units like the Force 2 vibrator control system and the Boom Box 1 Blaster system.
In the Legacy mode the Radio start commands are used to synchronize the sources. The time delay of the radio network must be tested and compensated for correct start times. After the Vibrator Truck sweep is completed, then each Vibrator Truck sends the Quality control information (PSS data) back to the central system via predefined time slots.
A feature of the Force 3 system is to use the GPS time to verify the Legacy Mode operation. When GPS units are used, the Force 3 compares the GPS time of the UE2 and F3 starts and can automatically correct or display the time errors of the starts.

1.2 TDMA Mode – F3 mode

The TDMA mode is a telemetry protocol that allows the High Production Vibroseis modes (HPV) that were very difficult to perform with the Legacy mode of operation. The following are some of the features of the TDMA mode

- GPS time is used to start vibrators (no radio delay)
- HPV(High Production Vibroseis) modes supported
  - ISSS
  - DSS
  - Slip Sweeps
- Reduced time between standard sweeps – improves production rate
- Analog or digital radios can be used
- Standard VHF radios – does not require special TDMA radios
- Analog Radio sims – Can still perform analog radio sims to assure the vibrator trucks are performing correctly
- WiFi Groups
  - Vibrators can be Grouped using WiFi system
  - Reduces number of radio messages when using the WiFi groups
  - Improves VHF radio reliability and throughput

TDMA Mode



1.3 SourceLink software

SourceLink software is used with the UE2 Encoder to control the Force III Vibrator Units and other sources. The SourceLink software is a complete Recording System frontend that controls the Recording system and the Source Units. It is specifically designed to be used with continuous recording systems like the ISEIS Sigma system, Fairfield Node system, and OYO/GeospaceGSR system. SourceLink will also work with the older cable system. A separate manual describes the UE2 and SourceLink operation.

1.4 Source Signature System - VSS

The FORCE-III units have a built-in Scaled Similarity System and Source Signature Recorder. This system uses 32 bit A to D convertors to provide a low noise and high resolution recording of the vibrator's performance. After the data has been downloading using the "Data Collector" or "Signature" software, the following signals are recorded:

- Trace 1 :Reference Signal – (Pilot signal)
- Trace 2: Reaction Mass acceleration signal
- Trace 3: Base Plate acceleration signal
- Trace 4: Ground Force approximation using the weighted sum method

Also recorded in the header

- GPS position
- Time of start – nanosecond resolution
- Selected Flag or Near Flag – Nearest source point
- Shot ID/File Number

1.5 Vibrator QC system - VibQC

The Force III system built in Vibrator QC system that allows viewing and storing all of the Vibrator control signals.

- True Reference signal
- Loop Reaction Mass Accelerometer
- Loop Baseplate Accelerometer
- Similarity Reaction Mass Accelerometer
- Similarity Baseplate Accelerometer
- Torque Motor Current
- Valve LVDT signal
- Reaction Mass LVDT signal
- Drive signal from the control system

1.6 Similarity System

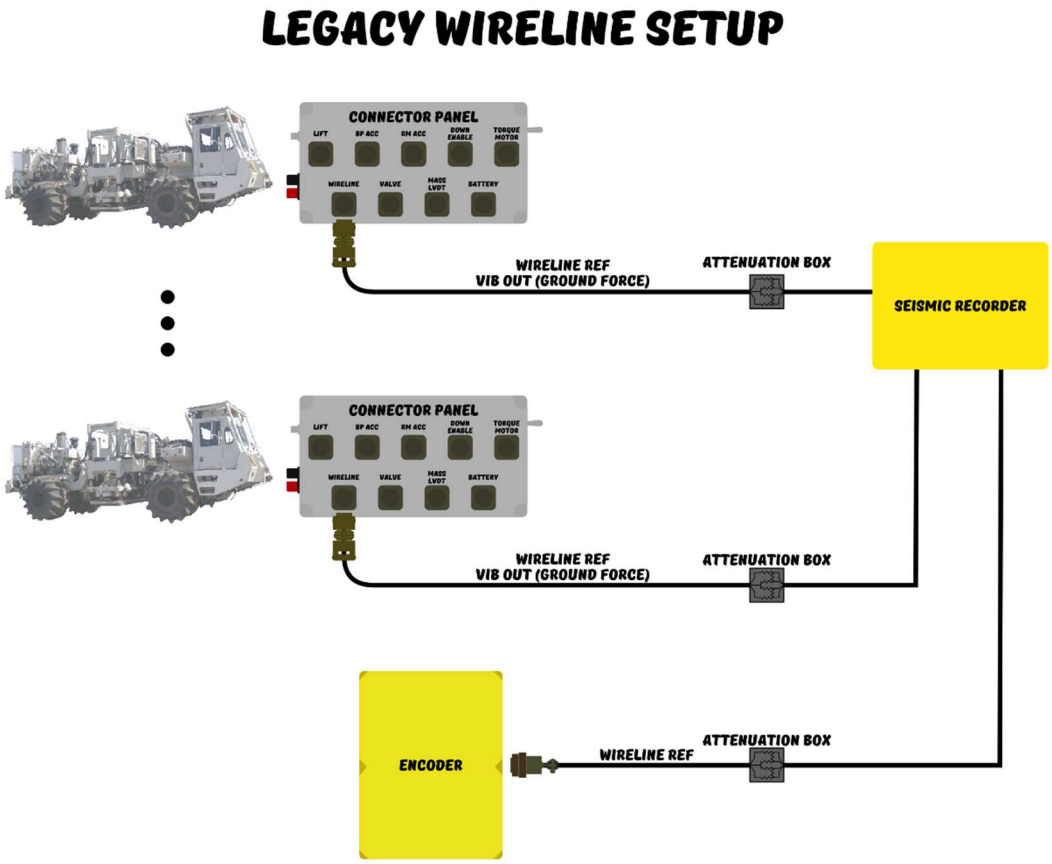
The Force III has multiple similarities systems built into the hardware.

1.6.1Radio similarities

Each F3 unit can be selected to transmit a radio similarity. The analog Radio similarities are used to verify that each vibrator unit is performing correctly. The radio similarity from the vibrator is compared with the Radio Reference signal from the Encoder unit. Only one vibrator can be tested at a time. The timing of the Radio Reference must be set properly to compensate for the Radio Similarity Delay. This is done by setting the Similarity Delay in the Encoder settings using either SourceLink or Source Control software.

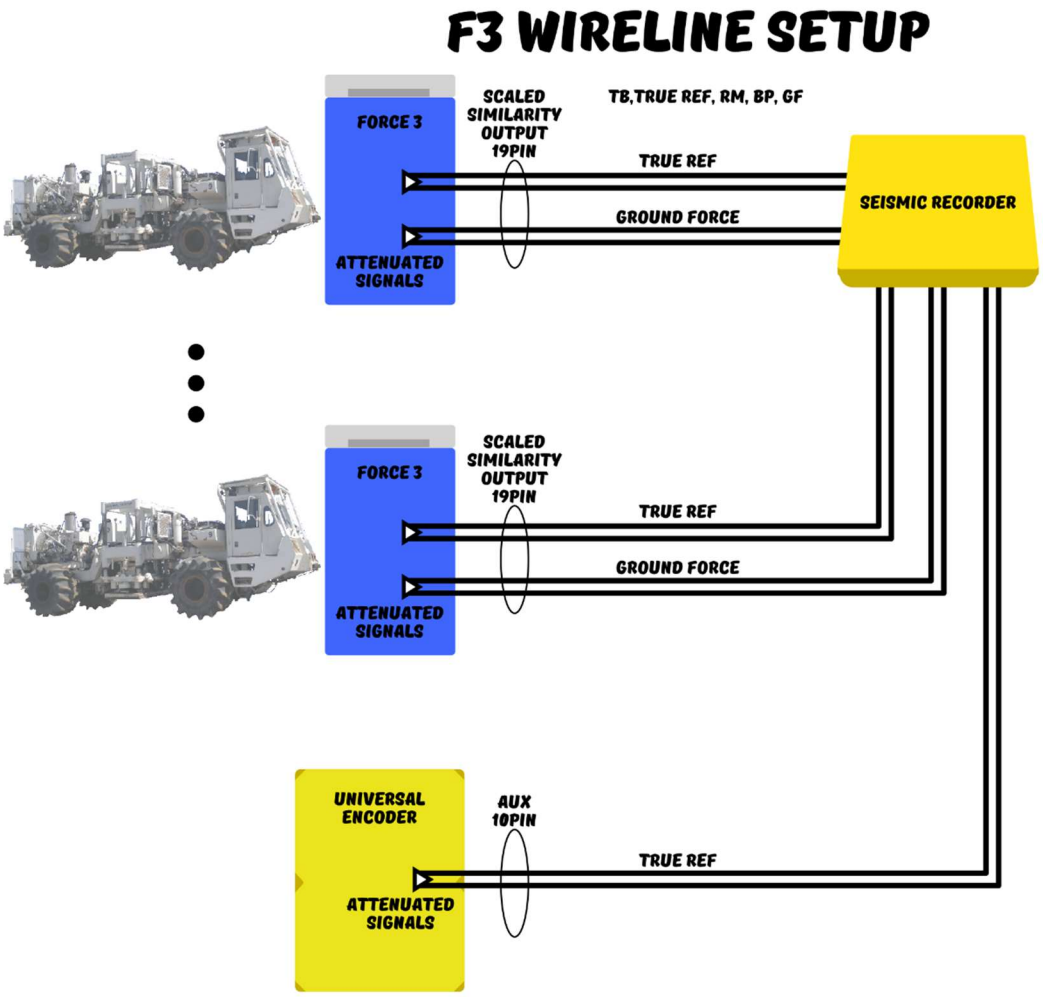
1.6.2 Legacy Wireline Similarity System

The Legacy similarity system uses the Wireline Reference and Wireline Vibrator Output signals. These signals are compatible to the previous generation of vibrator electronics like the Force 2 system. The Wireline signals are compared with the Wireline Reference from the Encoder unit. The Wireline Reference signals and Wireline Vibrator signals are filtered signals. The filter delays the signals by about 2.78 msec when compared to True Reference. Multiple vibrators can be tested simultaneously. A separate recording system is required to record these signals. The Legacy Wireline Signals are available on the 4 pin Wireline Plug on the Vibrator's Connector Panel. These signals are +/-5 volts and need to be attenuated for most recording systems. **Resistor values used for the attenuation circuit may cause some phase errors with some recording systems. It is important that the exact same values of resistors be used for all channels.**



1.6.3 F3 Wireline Similarity System (VSSS)

The unfiltered accelerometer signals and the True Reference signals are available on the Vibrator Scaled Similarity System 19-pin connector (VSSS). These analog differential signals have been attenuated and can be recorded directly by most seismic recording systems. These signals should be compared to the True Reference or Pilot signal from the Encoder Unit. Multiple vibrators can be tested simultaneously. A separate recording system is required to record these signals.

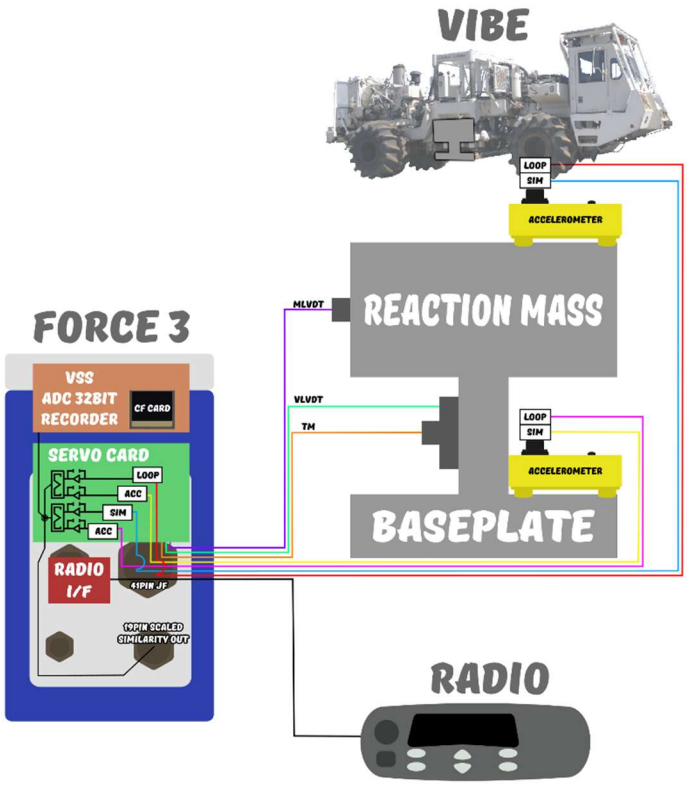


1.7 F3 System Block Diagrams

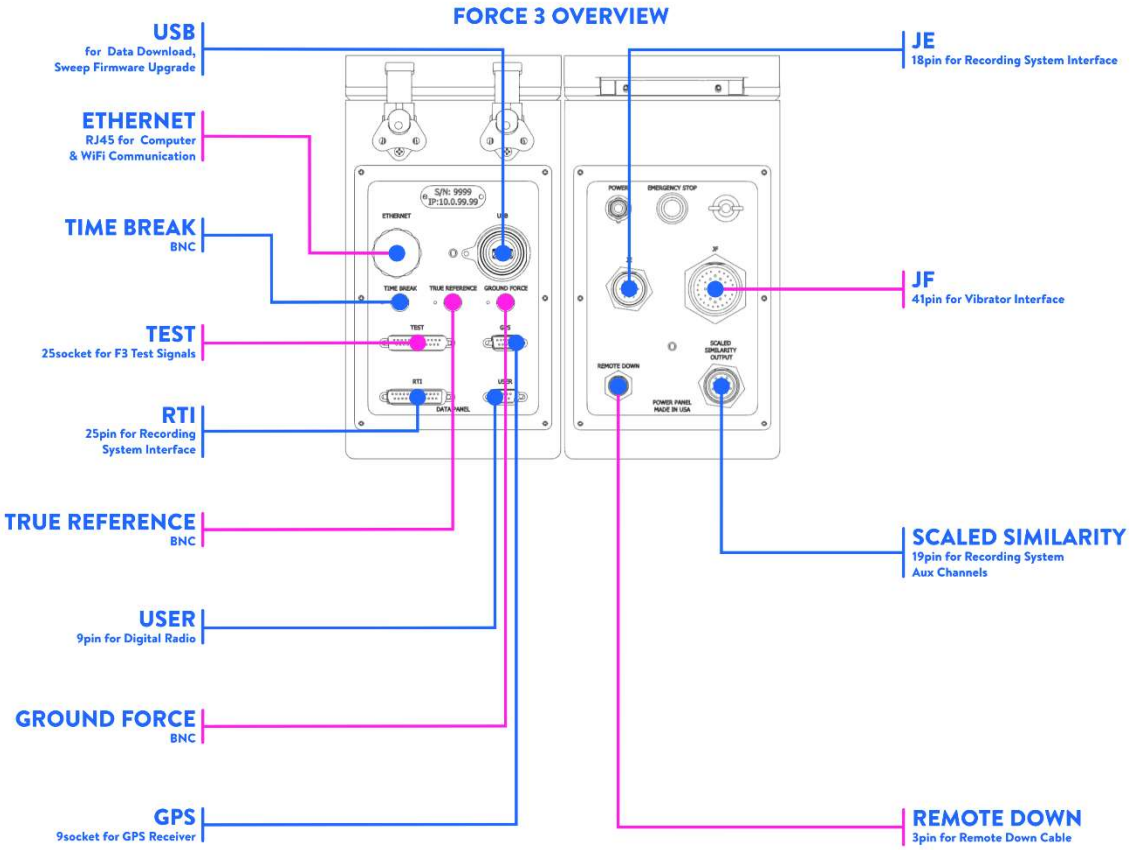
1.7.1 Basic F3 Unit

The basic Force 3 Decoder units is used to synchronize and control a servo-hydraulic vibrator unit.

The unit includes of a Radio Interface circuit for analog or digital radios, a servo interface system, 32 bit VSS recorder system, and VSSS – Scaled Similarity System.

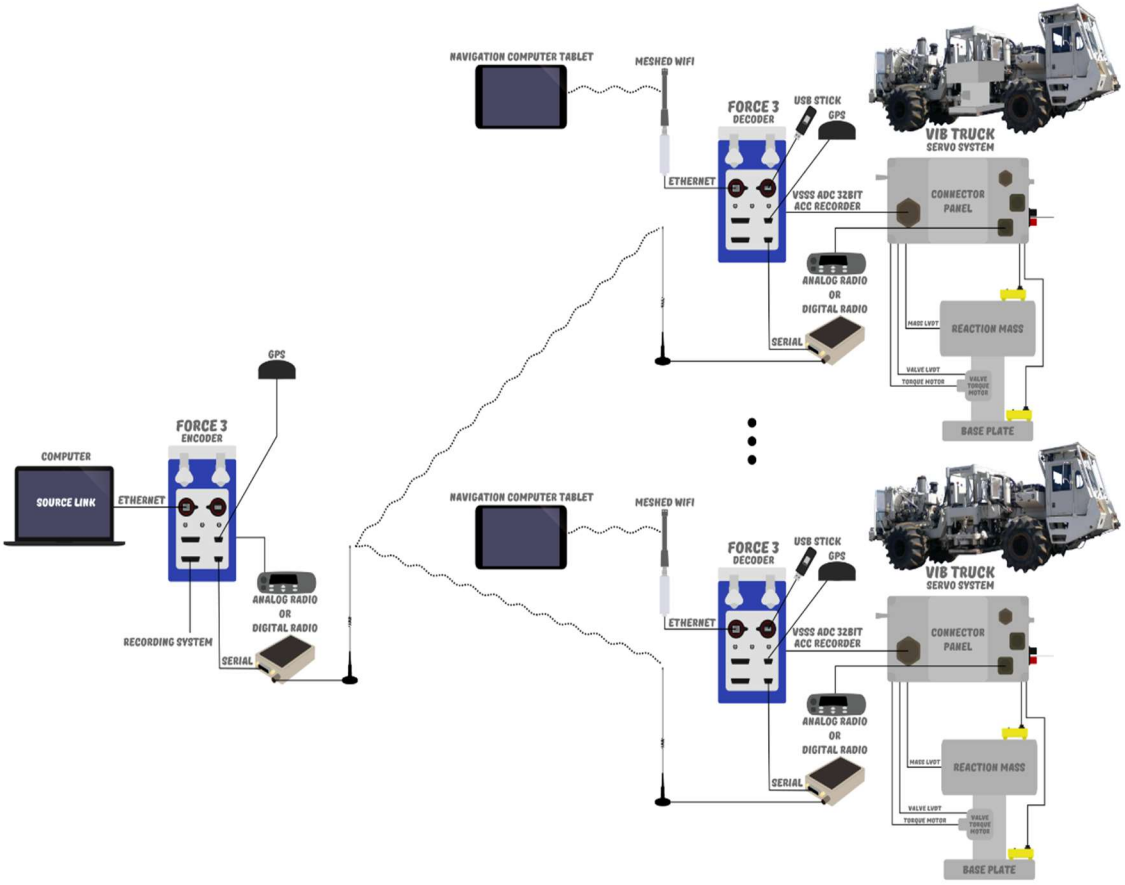


1.7.2.1 Force3 unit overview



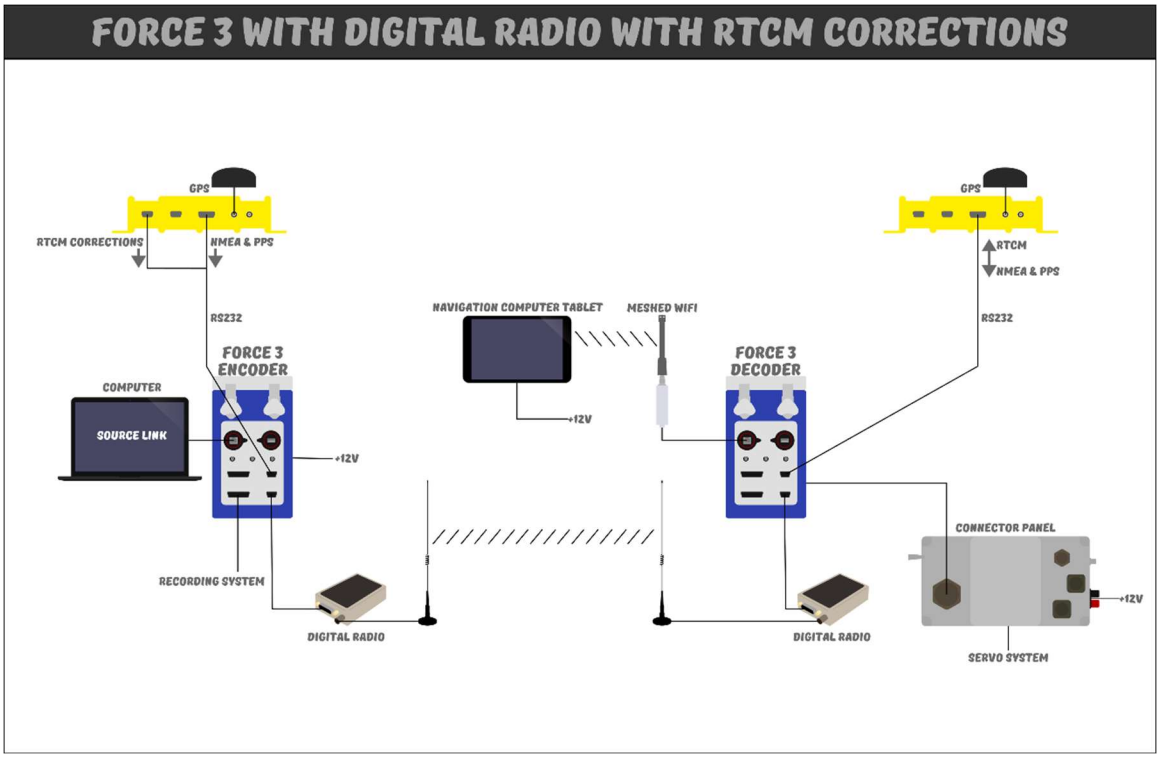
1.7.2.2 Basic F3 system

The basic F3 system consist of an Encoder unit (Force 3 or UE2) and at least one Force 3 Decoder unit. The Encoder and Decoder communicate via a radio. A VHF radio is typically used. This radio can be setup for “Analog Mode” or “Digital Mode”. Special connection is available on the Force 3 units for RS232 serial telemetry using a digital radio.
N



1.7.3 F3 Encoder system with RTCM GPS correction

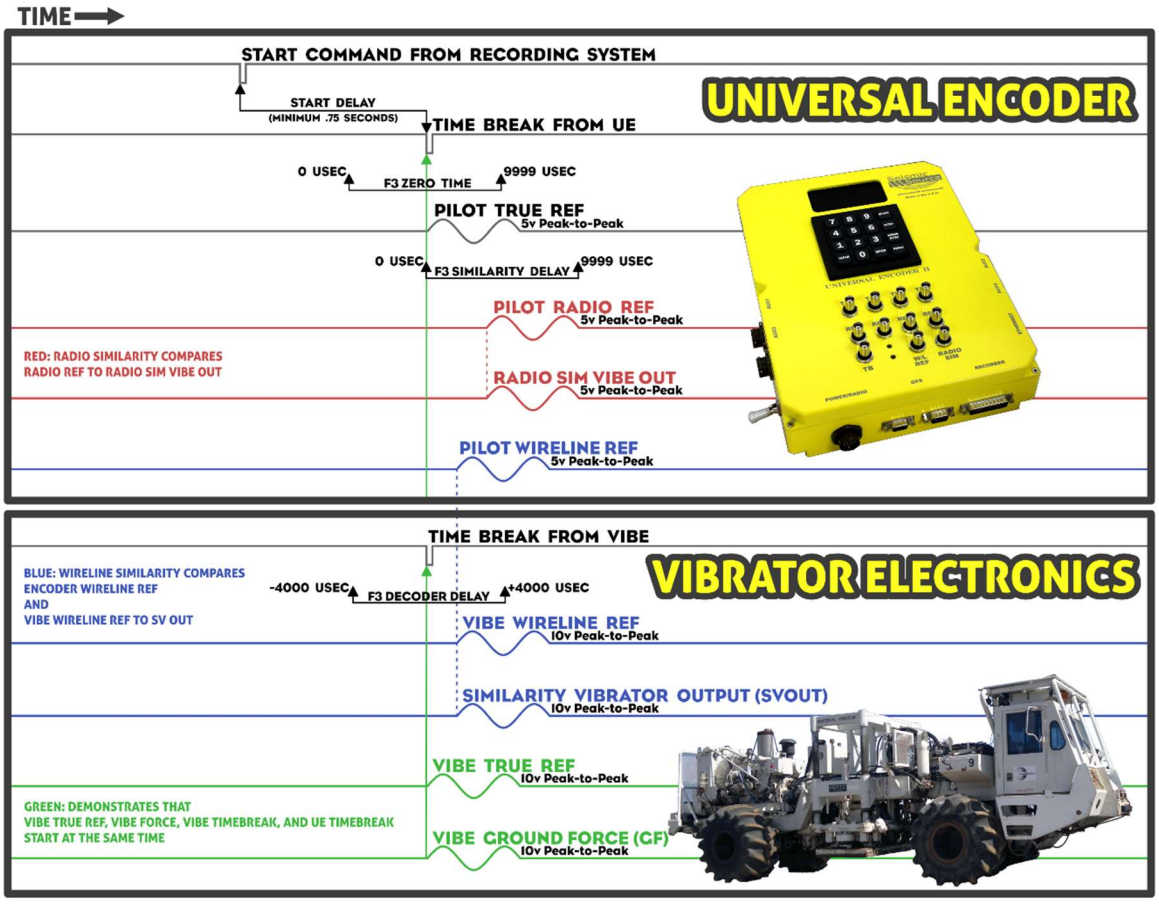
The F3 Encoder allows transmitting the RTCM correction signals over a single radio link.



1.7.4 F3 system Synchronization

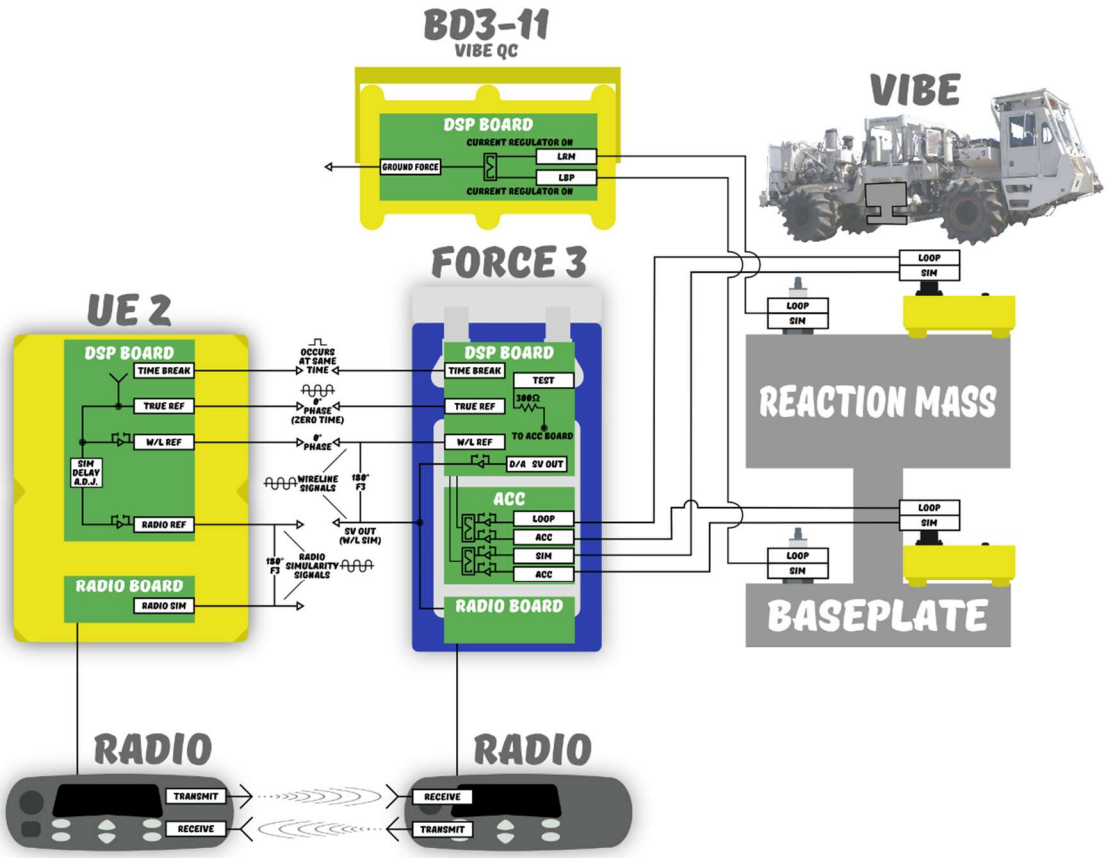
The Encoder and Decoder radio telemetry is used to synchronize the two systems. When properly synchronized the following signals will match

- Encoder TB matches Decoder TB – Legacy Mode use Encoder Radio Delay
- Encoder True Reference matches Decoder True Reference– Legacy Mode use Encoder Radio Delay
- Wireline Reference is delayed from True Reference by 2.77 msec
- Encoder Wireline Reference matches Decoder Wireline Reference -– Legacy Mode use Encoder Radio Delay
- Encoder Radio Reference matches Radio Vibrator output – use Radio Reference Delay
- F3 Decoder delay can be used to fine tune the delay for each decoder unit. Normally want to set this value to 0



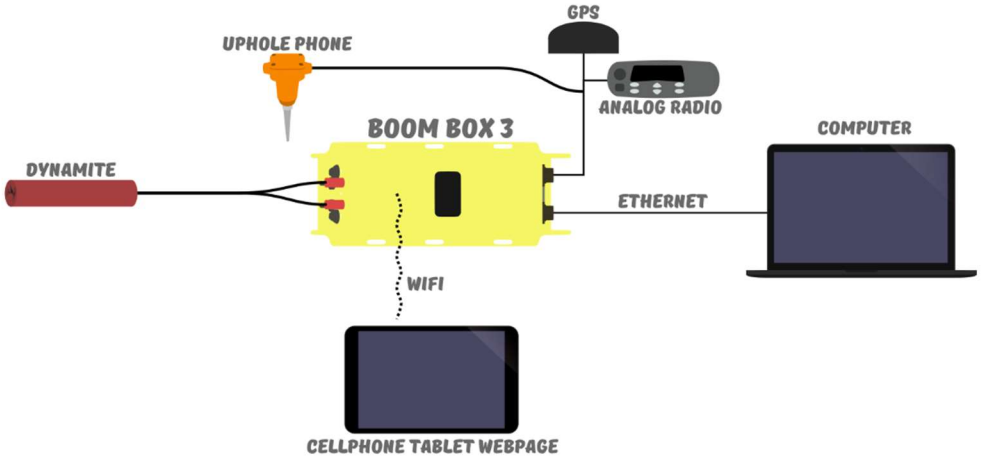
1.7.5 Bird Dog Independent Testing

The BD3-11 can also be used to record the various signals and verify that the system is operating correctly. The BD3-11 also has an option to use independent accelerometers, this allows the complete system to be tested and verified.

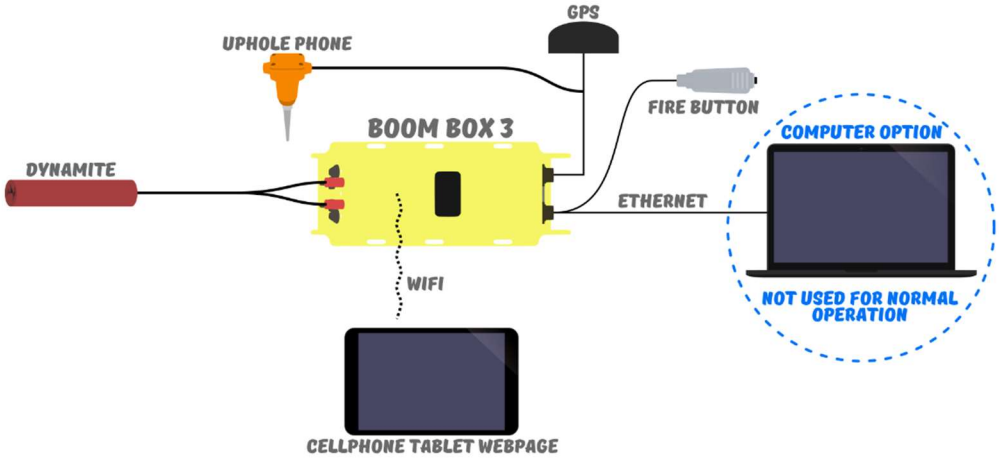


1.7.6 Boom Box 3

The Boom Box 3 dynamite synchronization system is 100% compatible with the UE2 Encoder and Force 3 system. The Boom Box 3 dynamite shots can be easily performed on the same crew as the Force 3 vibrator system.

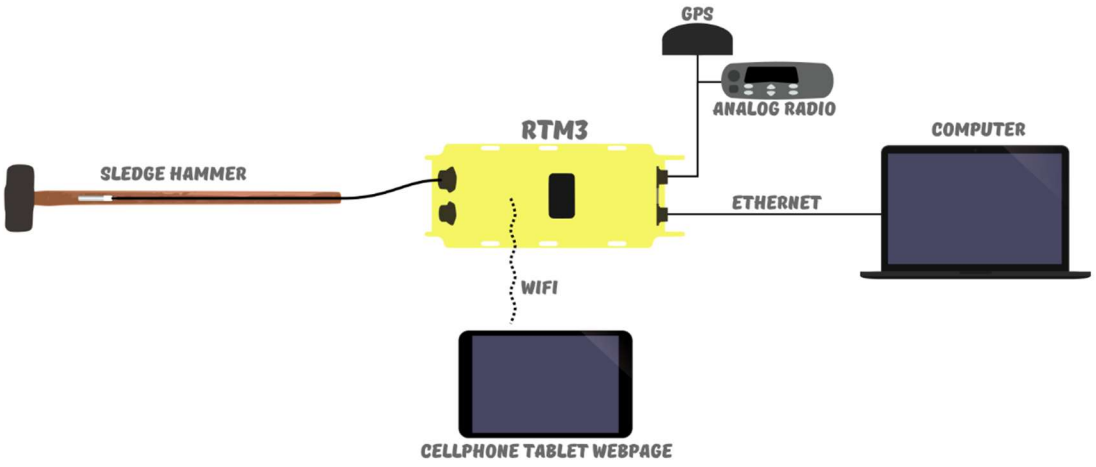


Autonomous Boom Box 3 – No radio Required. All timing and positioning via internal GPS receiver.



1.7.7 RTM3

The RTM3 Weight Drope synchronization system is 100% compatible with the UE2 Encoder and Force 3 system. The WTB3 Weight drop shots can be easily performed on the same crew as the Force 3 vibrator system.



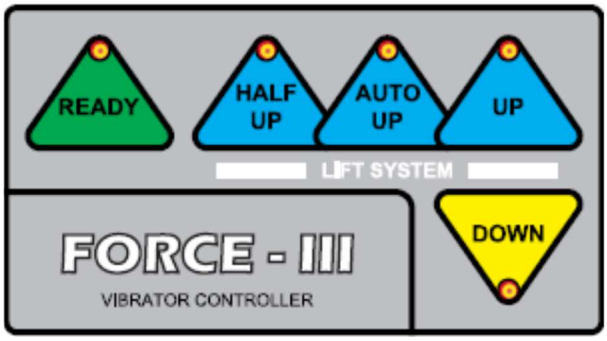
2.0 FORCE-III Unit

2.0 Top panel description

FORCE-III unit can be used as an Encoder or Decoder Unit. Software selection allows changing the Mode of the unit from Encoder to Decoder.

The F3 Decoder enclosure is designed to fit between seats in the vibrator cabin and the front panel is oriented in the long axes of the unit. The front panel consists of three parts: Lift panel, display and keypad panel.

2.1.1 Lift panel

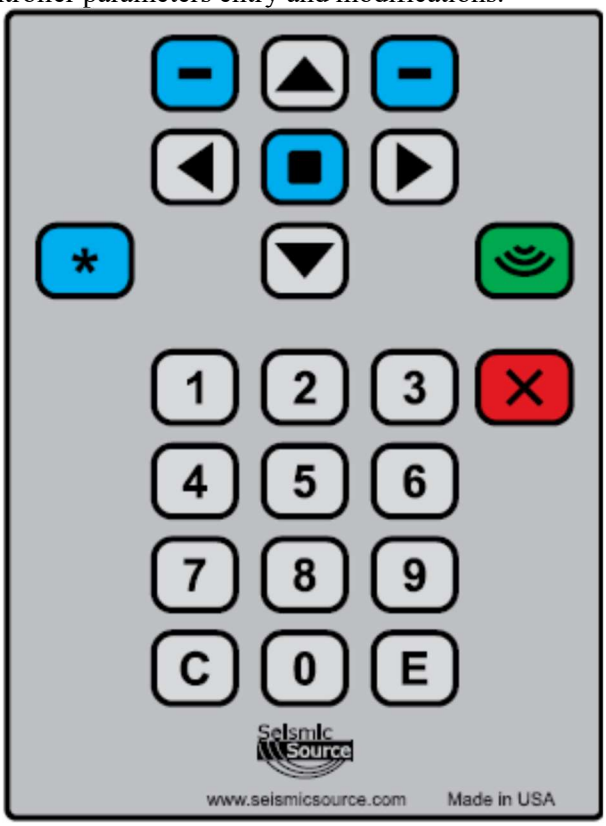


Lift panel consists of five predefined function keys and provides following functionality:

- READY – button and green light. By pressing Ready button operator can manually send "Ready" message over radio communication link. When the green light is on without blinking the F3 is Ready to start a sweep. When the F3 is transmitting data over the Radio the Green LED will be Flashing .
- HALF UP – button and red light. Pressing Half Up button toggles this function. Red light indicates Half Up is active. When function is active, vibrator Base Plate is driven by Half Up line.
- AUTO UP –button and red light. Pressing Auto Up button toggles this function. Red light indicates Auto Up is active. When function is active, vibrator automatically raises the Base Plate after the user selected number of sweeps has been completed.
- UP – button and red light. Manual Base Plate Up command.
- DOWN – button and red light. Manual Base Plate Down command. When button is pressed, F3 controller takes "XD" pressure switch readings. If switch is reading is open, then the F3 controller waits for it to become shorted (closed) before generating Ready state. If switch state is reading as closed (shorted), it is assumed the pressure switch is not installed and/or a shorting plug is installed. In this case F3 controller uses a four seconds time delay after the Down button is pressed. The Down light flashes during the lowering of the Baseplate or if the XD line becomes open circuit.

2.0.2 Keypad panel

FORCE-III lower panel provides full screen navigation functionality and contains complete numeric keypad for controller parameters entry and modifications.



Keypad panel consists of the following buttons:

- Two “soft” keys, labeled as “-” on the panel just below the display. These buttons activate the functions listed above the switch on the display.
- Four “arrow” keys help to navigate on display during menu scrolling and parameter entries.
- “Menu” key, labeled as a black square. The key enters currently selected (highlighted) menu item.
- “0” through “9” numeric keys for parameter value entries.
- “C” – clears selected entry key.
- “E” – enters edited parameter.
- “Star” button, labeled as “*” on keypad.
- “Start” button, green background, labeled as energy waves. Start Button is used to start a manual sweep start. The button is also used to quickly select the “operate mode”during pressure-up procedure.
- “Stop” button, red background, labeled as “X”. Stop Button is used to abort the sweeps.

2.0.3 Front Data Panel

FORCE-III Front Data Panel is located on front side of the unit and contains following elements:

- DATA A connector for Ethernet connectivity
- DATA B connector for external USB memory
- Time Break BNC – This is a pulse that occurs at the start of the sweep. Normally a 6 volt, 10 millisecond pulse. Polarity is user selectable
- True Reference BNC – 10 volt peak to peak “True Reference” analog output.
- Ground Force BNC
- 25-pin TEST connector for Vibrator Quality Control
- 9-pin GPS connector for external GPS
- 25-pin RTI connector for basic Recording Truck Interface functionality
- 9-pin USER connector for additional RS-232 port (Digital Radio)

2.0.4 Rear Power Panel

FORCE-III Rear Panel is located on the back side of the unit and contains following elements:

- Power On/Off switch
- Emergency Stop button –

Warning Pressing Emergency Stop button will not stop the Lift Motion

- Fuse holder and 6A Fuse
- 41-pin connector to Vibrator Connector Panel
- 3-pin connector for Remote Down and/or Ready extension cable and buttons
- 19-pin connector for Scaled Similarity System (Wire Line Similarity)

2.1 Force 3 Encoder Basic Operation

The Force 3 unit can be setup has an Encoder unit.

A special mounting bracket is used for the Encoder configuration. This mounting bracket allows the Force 3 unit to be mounted on a Table.

Connect the 41 pin connector to the F3 Encoder to provide power and VHF radio connection.

The interface to the Recorder system can be connected using the 18 pin JE connector similar to the VibPro Encoder connections, or it can be connected using the 25 pin D-Sub connector similar to the UE2 connections.

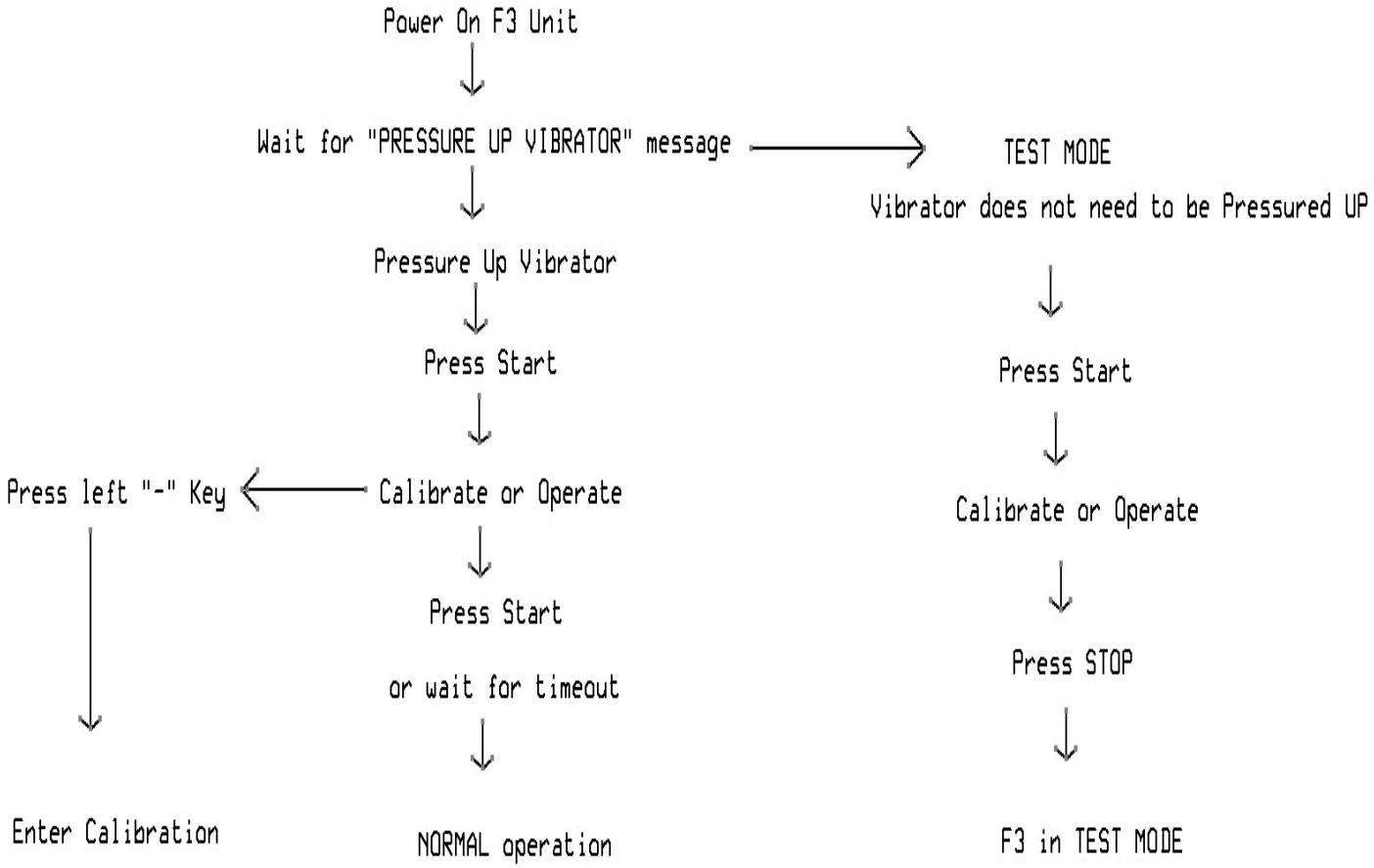
The Computer running the SourceLink software is connected to the Ethernet port of the Force 3 Encoder

An accurate GPS is connected to the GPS -9 pin D-sub connector. The GPS is used to provide accurate timing to the Encoder system.

2.2 Force 3 Decoder Basic Operation

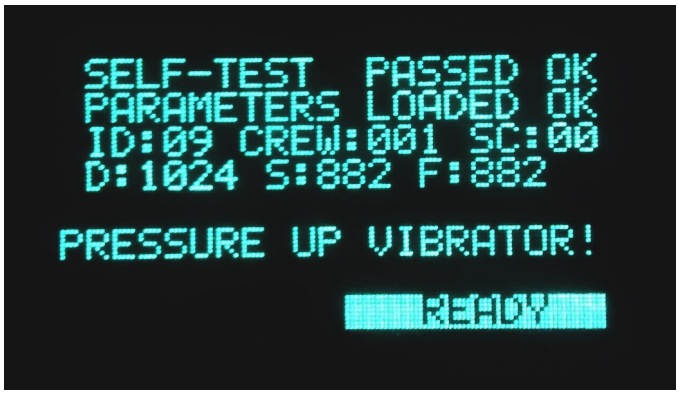
The following flow chart describes how to select the 3 different F3 Modes

- Normal Operation – select for Normal Operation
- Calibration – Calibration is required with new electronics or a new vibrator unit
- Test Mode – used to test radios and other F3 operation with vibrator pressured down



2.2.1 Power-up screen

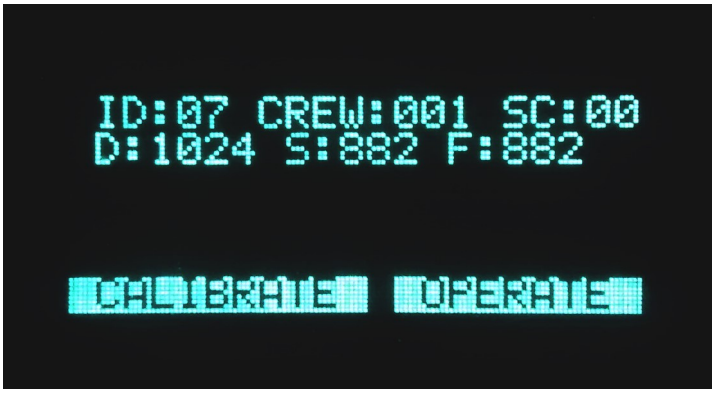
During power-up sequence, F3 controller performs self-test and loads operational parameters. The Power Up screen displays the following information.



- ID: #- 09 is shown – controller Id = 9. Part of privacy codes.
- CREW: #- 001is shown – Crew number. Part of privacy codes.
- SC: #- 00 is shown – Radio Start Code number. Part of privacy codes.
- D: ### – DSP firmware version, 1024in this example.
- S: ### – Servo Card firmware version, 882in this example.
- F: ###– Front Panel Card firmware version, 882 in this example.

This Power up screen stays on until operator pressures up vibrator and then presses right “soft” key or the “Start” button to continue.

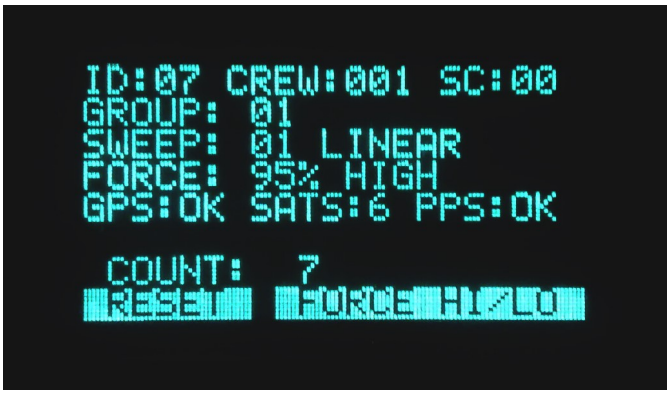
2.2.2 Calibrate/Operate Screen



This screen presents a chance to start vibrator calibration or enter the Test Mode. User has limited time to make this decision, since this screen will be timed out in five seconds and F3 controller automatically goes to Operate mode. Either action can be manually executed by pressing corresponding “soft” keys.
Pressing “STOP” will go to TEST Mode
Pressing “START” will go to Operate Mode

2.2.3 Normal Operation screen

When controller is in standard vibrator Operation mode and in idle state, the Normal Operation Screen is displayed.



- Privacy settings, such as Controller Id, Crew number, Start Code number
- Local vibrator network Group number
- Manual sweep number and type selection
- Target Force setting for the manual start
- Status of GPS, with number of satellites and PPS status
- Status of VSS recording and VIB QC Recording
- Sweep count, for Base Plate Auto Up operation or if used as simple counter. Maximum value of the sweep counter is set by the “Auto up after x sweep” keyboard entry.
- “Reset” and “Force Hi/Lo” “soft” keys. Reset key will clear sweep counter (as well as lifting Base Plate up) and Force “soft” key toggles between high and low target force entries

2.2.4 Normal Operation Hot Keys

The Following Keystrokes perform the following “Hotkey” actions

Up Arrow – Increments manual sweep #
Down Arrow – Decrements manual sweep #
“E” – shows results of last sweep
“C” – Resets the Force and Phase control presets
Left “-“ – Clears Counter
Right “-“ – Toggles between High and Low force selection for Manual Sweeps

2.2.5 Active sweep screen

During a sweep, FORCE-III displays current sweep and control performance information.

This screen example provides following information to the operator:

- Sweep number and type.
- Current sweep count and current sweep instantaneous frequency.
- Force control – current sweep average and maximum peak force. Sweep frequency at the moment of peak detection.
- Phase error control – current sweep average and maximum peak phase error. Sweep frequency at the moment of peak detection.
- Total harmonic distortion - current sweep average and maximum THD. Sweep frequency at the moment of peak detection.
- Control limits – multiple control limits flag indication is shown below the text. Each flag is displayed at the moment the limit is reached.

2.2.6 Cold Start procedure for Operation

- Start Vibrator Engine (warm up)
- Turn ON F3 electronics(check screen status for parameters loaded OK)
- Pressure up Vibrator (wait until pressure reached)
- Open Base Plate **Lift Latches** Out
- Press **Down** button to lower Base Plate
- Press **Ready** soft-button on F3 front panel, Fig. 1
- Press **Operate** soft-button (or wait 5 seconds and F3 goes to Operation mode automatically, Fig. 2)
- Centering Mass message will appear for a few seconds
- Main operation screen appears (check for Vibrator ID, Crew number, Start Code and GPS status)
- Press **Menu** button, select TESTS, then select ACC PULSE TEST (check test results)
- Press **X (Stop)** button or Return soft-button to return to Main operation screen
- Start few sweeps manually to warm up vibrator and set sweep presets

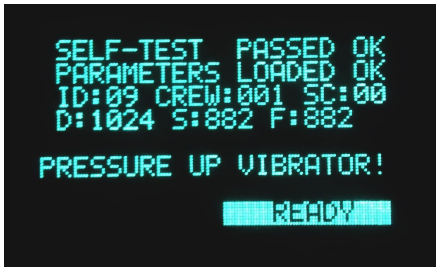


Fig.1

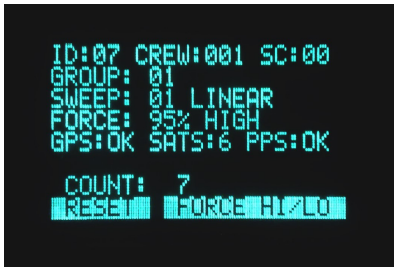


Fig. 2

2.2.7 Cold Start procedure for Calibration

- Start Vibrator Engine (warm up)
- Turn ON F3 electronics (check screen status for parameters loaded OK)
- Make sure vibrator parameters entered correctly (Weights and Accelerometers sensitivity)
- Pressure up Vibrator (wait until pressure reached)
- Open Base Plate **Lift Latches** Out
- Press **Down** button to lower Base Plate
- Press **Ready** soft-button on F3 front panel
- Press **Calibrate** soft-button (you have 5 seconds to make this decision, Fig. 3)
- Follow on screen calibration instruction

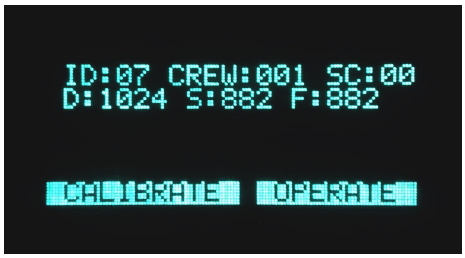


Fig. 3

2.2.8 Warm Start procedure for Calibration

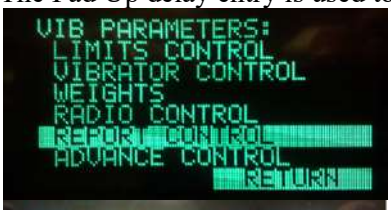
- Vibrator in Operation mode and pressured up
- Open Base Plate **Lift Latches** Out
- Press **Down** button to lower Base Plate
- Press **Emergency Stop** button (for less than 5 seconds). Button is located on F3 power panel. This will lower mass to the bottom
- Press **Calibrate** soft button (you have 5 seconds to make this decision)
- Follow on screen calibration instruction

2.2.9 End of the day shutdown procedure

- While vibrator is pressured up and Base Plate on the ground, Press **Emergency Stop** for less than 5 seconds. Button is located on F3 power panel. This will lower mass to the bottom
- Press **UP** button on F3 to lift Base Plate
- When UP is completed, switch **Lift Latches** to IN position
- Pressure down vibrator (switch from Vibrate to Drive mode)
- Power down F3 electronics

2.3.0 Sweep Counter

F3 display provides VP sweep count information to operator. “Pad up after X sweeps” needs to be set to number of sweeps in the VP.
Once sweep number is set, the F3 unit can be set to automatically lift the Base Plate.
The Pad Up delay entry is used to delay the automatic lift after the sweep.



The “Pad Up Delay” must be entered in milliseconds. This parameter defines delay between sweep end and lift UP command. For example, if delay 4 seconds must be selected, enter 4000.

Once in the main screen, Left and Right Arrow keys can be used to increment and decrement counter, left soft-key can be used to reset it and Lift Up-Down cycling also resets sweep counter.

2.4 Calibration Errors

During the Force 3 calibration procedure the F3 displays Error messages in numeric codes.

Error	Error description	Possible reasons
1	F3 Instrument does not have any calibration information history in the memory	a) New F3 unit or board b) F3 memory problem
3	No Valve oscillation detected during calibration during Valve Feedback setup procedure	a) Very cold weather and hydraulic oil. b) Valve Problem c) Valve LVDT problem or cable d) Connector Panel or Cable
5	TM current failed to reach 30 mA during Mass Feedback calibration	a) Bad TM or wiring, cables or connector panel b) F3 Hardware problem
6	F3 Instrument failed to set Reaction Mass to center during TM and Valve offset measuring	a) Problem with valve or actuator b) No Hydraulic Pressure c) Valve or Mass LVDT problem d) Cable Problem e) F3 problem
7	TM offset more than 20%	a) Pilot stage of servo valve needs to be adjusted b) Mechanical Problem with Pilot stage c) Hydraulic or Mass Centering problem
8	Valve offset more than 14%	a) Valve LVDT needs to be adjusted b) VLVDT problem cable or connector
9	TM current failed to reach -40 mA with Mass in the top position	a) Bad TM or wiring, cables or connector panel
10	Time-out during Mass centering procedure (30 seconds expired)	a) Problem with valve or actuator b) No Hydraulic Pressure c) VLVDT or MLVDT problem d) No Hydraulic Pressure
11	Mass offset more than 10%	a) Mass LVDT needs to be adjusted b) MLVDT wiring problem c) F3 problem
12	Accelerometer test failed	a) See test screen results for details b) Mass and BP cables reversed c) Wrong TM polarity d) Replace failed Acc and rerun test

3.0 Force 3 Setup Menus

When user presses Menu key, the following screen will display selection of the following self-explanatory entries.
By pressing corresponding arrow keys, menu keys and soft keys, the user can select menu item, return to main operations screen, see log messages, display current status, or change controller parameters.

Press the Force 3 center blue button to enter the Setup Menus.

There are 5 main setup menu Categories

- Active Configuration
- Sweep Table
- Vib Parameters
- Current Status
- Service

3.1 Active configuration

Vibrator ID – Enter the ID # of the vibrator unit. (1-64)

Group Number – Each Vibrator Group can be assigned a number. Enter the Group number. (1-64)

Manual Sweep # - Enter the sweep # that will be used when the "local" start button is pressed. Enter number between 01 and 32

Menu Password – A password can be entered to prevent unauthorized keyboard entries. Select any 4 digit number for the password. A password of "0000" disables the password protection. The password "1907" will always allow access to the menus.

Mode Decoder or Encoder – Changes operating mode of the Force 3 unit.

The Force 3 "Autonomous" and "Decoder" modes are similar.

Both modes will receive analog radio messages from the Central Encoder. So, the radio polling, and occasional radio sims should work in either mode.

The "Autonomous Mode" has a some of extra features. These features are selected in the "Autonomous Setup" in the Vibrator Parameter menu in the Force 3 units

1) Sweep Start Auto - Set to ON
    a. Requires the Force 3 to be in Autonomous Mode
    b. Auto up button must be enabled
    c. When the Pad Down is commanded, and the pad is down (XD switch is ON or time out). Then the Vibrator will automatically start

    d. This is useful when using the Navigator Program and maximum acquisition speed is required.
2) Min GPS Quality
    a. This sets the minimum GPS quality allowed when in Autonomous Mode
    b. GPS Quality =1 is just a valid position
    c. GPS Quality =2 is differential
    d. GPS Quality =3 is typically RTK (Check on specific GPS receiver being used)
    e. “GPS Quality LOW” will be displayed on the Screen. When sweep start is commanded but GPS quality is lower than the set value.
    f. This entry is especially useful for assuring that all ISS mode sweeps have high quality GPS
3) When using Navigator or NavLink in the Vibrator, the start message will be sent out the WiFi to start other vehicles in the group. This is useful when using multiple vibrators in group for ISS mode
4) “Ready” message – in Autonomous mode will start sweep. With older firmware – pressing the “Ready” button will start the sweep when the F3 is set to Autonomous mode. This has been disabled with the latest firmware. This feature was causing the Reference to be time shifted in the DAT files.

3.2 Sweep Table

Select Sweep 1 through 16 to modify the sweep parameters

Sweep Types:

- Linear
- Db/Hz Constant range: +/- 0.001 to 0.500. Constant = 0.000 is not allowed
- Db/Oct Constant range: +/- 0.001 to +10.000. Constant = 00.000 is not allowed
- T-Power Constant range: 0.3 to 3.0
- Random Constant range: -10.000 to +10.000
- Pulse – Constant sets the delay in milliseconds before the pulse will occur
- Shot Pro
- Stored – (Constant defines sweep number to use)
- Test
- Pause

Start Frequency: Entered in Hz, with resolution of 0.1 Hz. Range from 0.1 to 800.0 Hz

End Frequency: Entered in Hz, with resolution of 0.1 Hz. Range from 0.1 to 800.0 Hz.

Sweep Length: Range from 0 to 65.535 seconds. Entry resolution is 1 millisecond (0.001 second).

Start Taper Length: Range from 0 to 65.535 seconds. Entry resolution is 1 millisecond (0.001 second).

End Taper Length: Range from 0 to 65.535 seconds. Entry resolution is 1 millisecond (0.001 second).

- Taper Type:
  - Blackman
  - Cosine.

Initial Phase: Entry range from 0 to 359 degrees, with resolution of 1 degree.

Constant: See sweep types for constant values to use. All non-linear sweeps are defined for dwell "after correlation". Example a 6 dB boost after correlation is equal to a 3dB boost before correlation.

You can delay the pulse by using sweep constant. Whatever number you put there is the delay in milliseconds.

3.3 VIB Parameters

3.3.1 Phase Control

Phase Loop Gain – Enter value from 0 to 999. This entry controls the speed of the phase control system. Set this value to improve the phase control of the vibrator unit. For normal operation, never enter a value greater than 100. Phase loop Gain of 000 disables the phase control system. Normal entry is 80

Predictive Phase Gain– Not currently operational set to 000

Phase control Type – Normally set to Cycle

Similarity Signal Code- Selects the signal that will be used for Radio and Wireline similarities. Select "Reference" when setting radio Reference delay in the Encoder. Other selections can be used for troubleshooting bad accelerometer signals. Normal selection is "SimGF"

Phase Control Signal is not an entry. The Force 3 always selects the Ground Force signal for phase control

3.3.2 Force Control

Force Loop Gain- Enter value from 0 to 255. This entry controls the speed of the force control system. Set this value to improve the force control of the vibrator unit. For normal operation, never enter a value greater than 150. Force Loop Gain of 000 disables the Force control system. Normal entry is 80

High Force Out – Enter Value between 000 and 100. This entry sets the fundamental force set point for the Force Control system when "high" force is selected. Normal maximum entry is 070.

Low Force Out – Enter Value between 000 and 100. This entry sets the fundamental force set point for the Force Control system when "low" force is selected. Normal maximum entry is 035.

Test Drive Attenuation – Enter value of 000 to 255. This value is normally set to 000 for automatic control. A value of 1 to 255 disables the Force Control system and sets the system for Fixed Drive. A setting of "1" is maximum drive level, and a setting of "255" is minimum drive Level.

Predictive Force Loop Gain -Enter value from 0 to 100. This entry controls the speed of the predictive force control system. Set this value to improve the force control of the vibrator unit. Not currently operational set to 000

Test Force Preset – The Force Preset is only used when a Clear Preset command is performed. The "C" on the keypad is used to perform the "Clear Preset" command. This command reset the Phase and Force Presets. A value of 000 sets the Force Preset to a low initial value to prevent overdriving the system. A value of 1 to 500 sets the "Clear Preset" value to a user defined setting. A value of "1" is the minimum force preset that can be entered, while a value of 500 is the maximum Force Preset that can be entered. Changing these values will have no effect on the sweep unless a "Clear Preset" command is issued. Even a "Power Cycle" does not reload the "Test Force Presets"

Pulse Sweeps Drive setting - **Pulse Sweeps Drive setting** - Pulse keyboard sweeps are controlled differently from a standard sweep. The phase and Force control are disabled for a "keyboard Pulse" sweep. The Fixed Drive output is set by the "High force out" or "Low force out" settings if the "Test Drive attenuation is set to "000". High Force output setting of 99 is maximum and 1 is minimum.
Test Drive attenuation can be used to set the drive level of the Pulse. Setting the Test Drive Attenuation level to 1 will provide maximum drive to the Pulse, setting the Test Drive Attenuation to 255 will provide minimum drive to the pulse.
Pulse Sweep Constant is used to delay the Pulse.

- Constant = 000 Drive Pulse occurs at Time Break
- Constant = 1.000 Drive Pulse occurs 1 second after Time Break
- Etc..

3.3.3 Limits Control

TM Current Peak to Peak– Allowable entry 000 to 200. Set to maximum allowable Torque Motor Current- Should never exceed 80 or damage to Torque Motor may occur. Entering "000" disables this limit control.Typically set to 70 mA

Valve Displacement Limit – Allowable entry 000 to 100. Set to maximum allowable main valve spool displacement. Entering "000" disables this limit control. Typically set to 80.

Mass Displacement Limit – Allowable entry 000 to 100. Set to maximum useable Reaction Mass Stroke. Entering "000" disables this limit control. This is typically less than 100%, Typically set to 80.

Peak Force Limit – Enter a value between 000 and 200. Normally set to 90 % to prevent Vibrator decoupling and overdriving the vibrator unit. For Peak Force control set "High Force output to 100 and Peak force to 90. This will change the Force control to limit on the Peak force for most of the sweep. Entering "000" disables this limit control. Typically set to 90

Reaction Mass Force Limit – Enter a value between 000 and 200. This entry prevents the Reaction Mass Force from exceeding the entered values. Entering "000" disables this limit control. Typical entry is 100

3.3.4 Vibrator Control

Accelerometer Sensitivity – Allowable entry of 1 to 1000. Set entry to 25 mV/G for use with SSC's M6 accelerometers.

Mass Offset – Allowable entry 0 to 100. Set to 50% to center the Reaction Mass.

Test Mass Feedback – Allowable entry of 000 to 255. A larger value applies more Reaction Mass LVDT feedback to the servo control system. Manual settings of 180 to 200 usually work. An entry of 000 allows the automatic setting found during calibration to be used. Normal entry =000

Test Valve Feedback – Allowable entry of 000 to 255. A larger value applies more Valve LVDT feedback to the servo control system. Manual settings of 180 to 200 usually work. An entry of 000 allows the automatic setting found during calibration to be used. Normal entry =000

Special entry of 255 is used for single stage "Mini Vib" operation. An entry of 255 will ignore the Valve feedback signal.

3.3.5 Weights

Reaction Mass Weight – Allowable entry 10 to 655350. Enter weight in pounds or kilograms. Enter weight of the Reaction Mass Structure. All weights should be entered in the same units.

Baseplate Weight – Allowable entry 1 to 65535. Enter weight in pounds or kilograms. Enter weight of the Baseplate structure. All weights should be entered in the same units.

Hold down Weight – Allowable entry 1 to 65535. Enter weight in pounds or kilograms. Enter the applied hold down weight of the Vibrator unit. All weights should be entered in the same units

3.3.6 Radio Control

Start Code – Allowable entries 0 to 3. Start code must match the Encoder start code for the unit to start.

Crew Number – Allowable entries 0 to 255. Crew number must match the Encoder crew number for the unit to start.

PSS type – Allowable entries 1, 2, 4, 5, 11, 12, 14, and 15.

1-Flags or Status information only.
2-Flags/Status and Correlation wavelet
4-Flags/Status and Source Signature Status
5-Flags/Status, Correlation wavelet and Source Signature Status
11-Flags/Status and GPS position
12-Flags/Status, Correlation wavelet and GPS position
14-Flags/Status, GPS position and Source Signature Status
15-Flags/Status, Correlation wavelet, GPS position and Source Signature Status.

PSS Type	Time Required to Receive 4 Vibrators
1	2.8 sec
2	4.9 sec
4	2.9 sec
5	5.1 sec
11	3.1 sec
12	5.3 sec
14	3.2 sec
15	5.4 sec

Decoder Radio Delay – Allowable entries -4000 to 4000 microseconds. This entry allows fine tuning of the starts for multiple Decoder units. This entry is only valid for legacy start codes. Normal entry = 0000

Microphone Polarity – Normal or Reversed. This entry sets the radio polarity for the transmitting radio signals. The correct polarity must be set for reliable radio transmissions.

Speaker Polarity – Normal or Reversed. This entry sets the radio polarity for receiving radio signals. The correct polarity must be set for reliable radio transmissions

Subcarrier size – Sets the length of the subcarrier for all radio transmissions. This is the time required to key up the radio before transmitting data. The subcarrier size affects all A3 messages. Normal entry =400.

3.3.7 Lift Control

Pad up after X sweeps – When auto up is selected the pad will automatically go up after x sweeps. Enter the number of sweeps required before the pad will automatically go up.
Valid Entries are 1 to 100.

Pad up delay- After the last sweep the Pad up can be delayed. Sometimes it is necessary to wait until the listen time is over before raising the pad. Normal entry =0

Note: **Counter Operations**
The **Counter** on the Front Panel Display is based on "Pad Up After X Sweeps" Entry
If "Pad Up After X Sweeps" is set to 10, then the counter will update 1 through 9, and then on the 10th sweep it is reset back to 0
The LEFT Arrow on the KeyPad will decrement the counter, the RIGHT Arrow on the KeyPad will increment the counter.
If this entry is set to 1 - The counter appears to never work, because when it is incremented to 1 it is immediately reset back to 0
When "Auto UP" is selected the Lift will go UP when the counter reaches the entered value and the counter will reset back to 0

3.3.8 Advance Control

Phase Preset - Sets the default value for the first sweep after a phase control reset. Normally set to 000

Init Advance – set to best value for phase control. Normal entry = 12

Harmonic Cut off Frequency – set for upper limit of harmonic distortion calculations. Normal entry = 200

Force Preset Time – not currently used. Set to 000

3.3.9 Hardware Setup

Time Break Active – High or Low

VSS Sample rate – VSS sample rate must be set to a valid number for the VSS system to operate. Normally set to same value as recording system. Normal entry =2 milliseconds

VSS Low Cut Filter – ON/OFF – Enables the 0.1 Hz low cut filter. Normal entry is ON.

3.3.10 Parameter Checksum

The following are the only entries that affect the Parameter Checksum:

- High Force Output
- Low Force Output
- Reaction Mass Weight
- Baseplate Weight
- Hold Down Weight
- Accelerometer Sensitivity

3.4 Current Status

Voltages

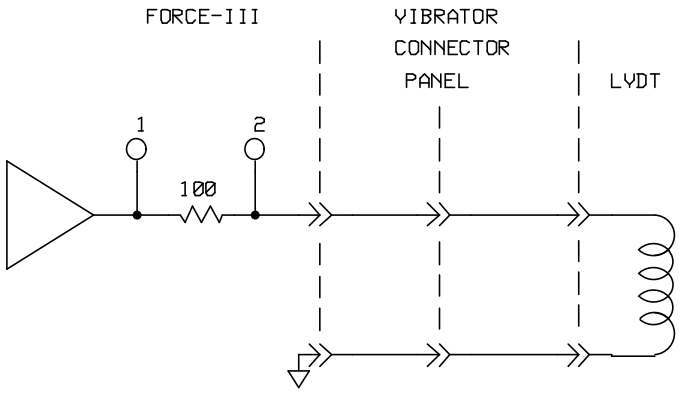
Select Voltages to check F3 system voltages.

LVDTs

To see LVDT voltages, select LVDTs from menu list.
Typical LVDT voltages on VS10 simulator look like as shown below.

Two voltages for each LVDTisdisplayed.Valve Excitation 1, Valve Excitation 2, Mass Excitation 1 and Mass Excitation 2.

These voltages (1 and 2) are taken from these points – 1 and 2, as shown on the schematic below. You can see 100 Ohm resistor in between point 1 and 2. Voltage and current flow through this resistor can be good indicator of the circuit.



If connection to LVDT primary coil is broken, then the voltage drop on 100 Ohm resistor should be small, which will be reflected on LVDT status screen. Current reading will be low.
If connection to LVDT is shorted, then voltage drop on 100 Ohm resistor should be high, with high current reading as well. See screen examples below:


LVDTS:
VALVE EXCIT.1: 4.2 V
VALVE EXCIT.2: 0.0 V
VALVE CURRENT: 41.3 mA
MASS EXCIT.1: 4.2 V
MASS EXCIT.2: 4.1 V
MASS CURRENT: 0.4 mA
RETURN
VALVE LVDT IS SHORTED
MASS LVDT IS OPEN

Accelerometers

Check Accelerometer Bias voltages,

Calibration Results

To access last calibration results, please select it from Current Status menu.

This example shows:

- Errors: None
- TM Polarity: Positive
- Valve Feedback: 74
- Mass Feedback: 63
- Pilot Stage Error: -10% (Mass Offset)
- Valve LVDT Error: 5%
- Mass LVDT Error: 1%
- All Accelerometers tested Ok and their polarity is positive

GPS Status

To see current GPS status, select it from Current Status menu list. The screen will show most of available GPS data.

Sweep Generator Status

Select to view

- Sweep Checksums
- Length of Each sweep
- Available Free memory
- Status of USB

Press Mode button to toggle between checksums, lengths and sweep #

Memory Free Space

Select to view

- Compact Flash memory
- Sweep memory

3.5 Service and Tests

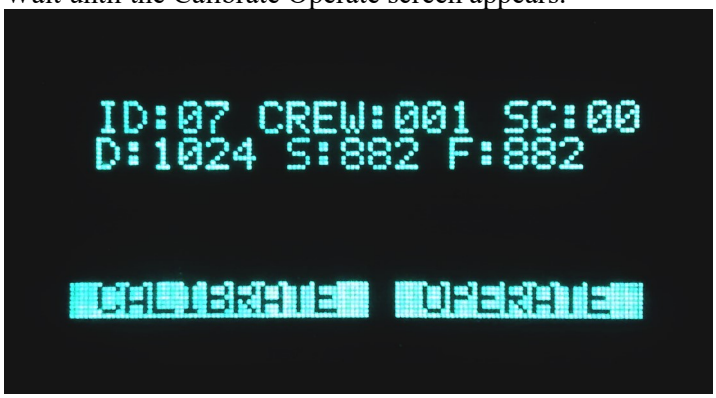
Adjust

Zero Time Adjust Mode – TEST MODE

A special menu is provided for this mode to allow the F3 unit to start without being pressured up.

The simple way to set the F3 in this mode is to start the F3 unit. (See Section 2.2 flow chart for quick way to enter the TEST Mode)

Wait until the Calibrate Operate screen appears.



PRESS STOP BUTTON to enter the Zero Time Adjust Test mode

.

To enable this mode, power up F3 unit in Normal Mode (there is no need to pressure up vibrator or even running its engine). Press Menu button and select Service menu, select Adjust and select "0Time Adjust Mode". Turning this option "ON" enables TEST Mode.

After setting "TEST Mode", return to the main screen. The F3 is ready to receive starts and generate True Reference signal. Because of no pressure on the Vibrator, the GF or Vib signals will all be zero.
F3 instrument in "Zero Time Adjust Mode" mode does following:

- Ignores Lift system
- Does not update Force and Phase Presets
- Receives and transmits radio messages
- Receives GPS
- Generates True REF signal
- Generates VSS and Wireline REF

Note: You must reset the F3or power cycle F3 instrument for normal mode of operation.

TESTS

Calibration

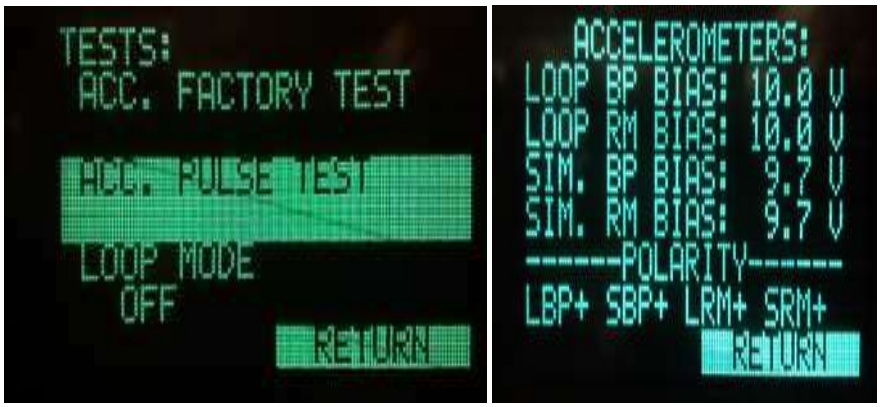
Go to this selection to start calibration

Accelerometer Factory Test

Factory Test only.Used to test the accelerometer circuitry on F3 unit. Do not Select

Accelerometer stand-alone pulse test

The ACC PULSE TEST option allows operator to test all accelerometers independently, during cable or accelerometer repairs. Screen below shows this selection and example of Accelerometers test results.



Vib Record

Turn this option “ON” to record the VibQC signals

A3 GPS Correction

Turn this option ON to start on GPS time using the Legacy start codes.

Loop Mode

This mode is only for test. When enabled, the sweep will continue to restart until it is stopped.

3.6 Force 3 Control Parameters Summary

The following vibrator control functionality is implemented at the time of this manual revision is published:

Phase control:

- Phase Loop Gain 0-999%
- Predictive Phase Gain 0-100%
- Phase Control Type: Cycle, Sample, Adaptive
- Similarities Signal: Reference, Sim G/F, Sim B/P, Sim R/M, Loop G/F, Loop B/P, Loop R/M

Force control:

- Force Loop Gain: 0-255%
- High Force Output: 0-100%
- Low Force Output: 0-100%
- Test Drive Attenuation: 0-255
- Predictive Force Gain 0-100%
- Test Force Preset: 0-500%

Control limits:

- Maximum Torque Motor Displacement Limit: 0-200 mA peak-peak, where 0 indicates no limit
- Maximum Valve Displacement Limit: 0-100% , where 0 indicates no limit
- Maximum Mass Displacement Limit: 0-100% , where 0 indicates no limit
- Peak Force Limit: 0-200% of Peak Force, where 0 indicates no limit
- Reaction Mass Force Limit: 0-200% of Peak Force, where 0 indicates no limit

Vibrator:

- Mass Offset: 0-100%
- Accelerometer Sensitivity: mV/g
- Test Mass Feedback 000-255
- Test Valve Feedback 000-255

Weights:

- Reaction Mass Weight: 1-65535 lbs. or kg
- Base Plate Weight: 1-65535 lbs. or kg
- Hold Down Weight 0-655350 lbs. or kg

Note: Mass conversion rates: 1lb = 0.45359 kg or 1 kg = 2.20 lb.
Force conversion rates: 1lbf = 4.448 N or 1 N = 0.2248

Radio:

- Start Code: 0-3
- Crew Number: 1-255

- PSS Type 1,2,4,5,11,12,14,15
- Decoder Radio Delay: +/- 0-4000 usec
- Microphone Polarity: Normal or Reversed
- Speaker Polarity: Normal or Reversed
- Subcarrier Size: 400, 200, 150, 125, 100 msec

Report Control:

- Auto Pad Up Counter: 1-100
- Auto Pad Up Delay: 0-65000 msec

Advanced Control:

- Phase Preset: 0-359 deg.
- Initial Advance: 0-45 msec
- Harmonics Cut-off Frequency: 0-999 Hz

Hardware Setup:

- Time Break Active: High/Low
- VSS Sample Rate 8, 4, 2, 1, 0.5, 0.25 msec
- VSS Low Cut Filter ON/OFF

Errors and Warnings Indication (in PSS – Post Sweep Service or Post Sweep Report):

- Battery Warning
- Power Supply Warning
- +30VDC Warning
- -30VDC Warning
- +15VDC Warning
- -15VDC Warning
- +5VDC Warning
- Accelerometer Warning
- Accelerometer Mass Similarities Bias Warning
- Accelerometer Mass Loop Bias Warning
- Accelerometer BP Similarities Bias Warning
- Accelerometer BP Loop Bias Warning
- Valve Excitation Warning
- Mass Excitation Warning
- Lift Error
- Not Ready for VP Error
- Sweep Aborted Error

4.0 Sweep Generation

The Force 3 system operates with a 4000 sample per second sample rate. There are two standard modes of generating the sweep
Standard Keyboard sweeps – enter the sweep parameters into the Force 3 electronics and the Force 3 automatically computes the Sweep samples
Stored mode – The sweeps are generated using a computer program. The sweeps are then uploaded using either the FLASH software program or the USB sticks

4.1Standard Sweeps

There are 16 sweeps in the sweep table of FORCE-III. Each sweep can be used as individual or combined with other sweeps to generate sweep segments. This paragraph describes in details single sweep definitions.

Each sweep is described by 9 key parameters:

- Sweep Type
- Start Frequency
- End Frequency
- Sweep Length
- Taper Type
- Start Taper Length
- End Taper Length
- Initial Phase
- Constant

- Sweep Types:
    - Linear
    - Db/Hz Constant range: +/- 0.001 to 0.500. Constant = 0.000 is not allowed
    - Db/Oct Constant range: +/- 0.001 to10.000. Constant = 00.000 is not allowed
    - T-Power Constant range: 0.3 to 3.0
    - Random Constant range: -10.000 to +10.000
    - Pulse (Constant defines delay of the pulse in milliseconds)
    - Shot Pro
    - Stored– (Constant defines sweep number to use)
    - Test
    - Pause
- Start Frequency, End Frequency: Entered in Hz, with resolution of 0.1 Hz. Range from 0.1 to 800.0 Hz.
- Sweep Length, Start Taper Length, End Taper Length: Range from 0 to 65.535 seconds. Entry resolution is 1 millisecond (0.001 second).
- Taper Type:
    - Blackman
    - Cosine.
- Initial Phase: Entry range from 0 to 359 degrees, with resolution of 1 degree.
- Constant: See sweep types for constant values to use

4.2Stored Sweeps (Flash Sweeps)

The Force 3 Stored sweep mode can be used to load any sweep that can be sampled at 0.25 millisecond sample rate (4000 sample per second). The Stored Sweeps have two values in the basic file, amplitude envelope and instantaneous phase.
The amplitude envelope of the Stored Sweeps is used to control the Force output of the Vibrator. If the envelope amplitude is set to 50%, then the output of the vibrator will be reduced to 50 % of the set point. This amplitude ramp can be used to reduce the amplitude of the vibrator at specific frequencies.
The instantaneous phase is used to control the frequency of the vibrator. Random sweeps and conventional sweeps can be loaded using the Stored Sweeps option

Each Stored sweep is loaded into a specific memory location. The Stored Sweeps are numbered 1-16. These numbers are not the sweep numbers and are used independently from the actual sweep numbers.

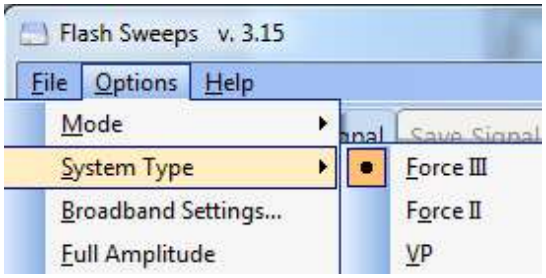
To define a Stored sweep.
Select Mode = STORED
Constant = Stored SWEEP #
Phase = Additional Phase that will be added to the Flash sweep

This Allows the Same Stored sweep to be used for different sweep numbers with unique starting phase angles.

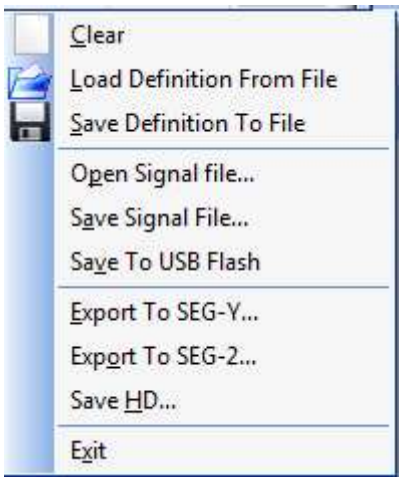
4.2.1 FLASH sweep program

The Flash Sweep software program is used to generate and load the Stored sweeps.

First Set the Mode to Force III mode. Go to Options- System Type and select Force III.



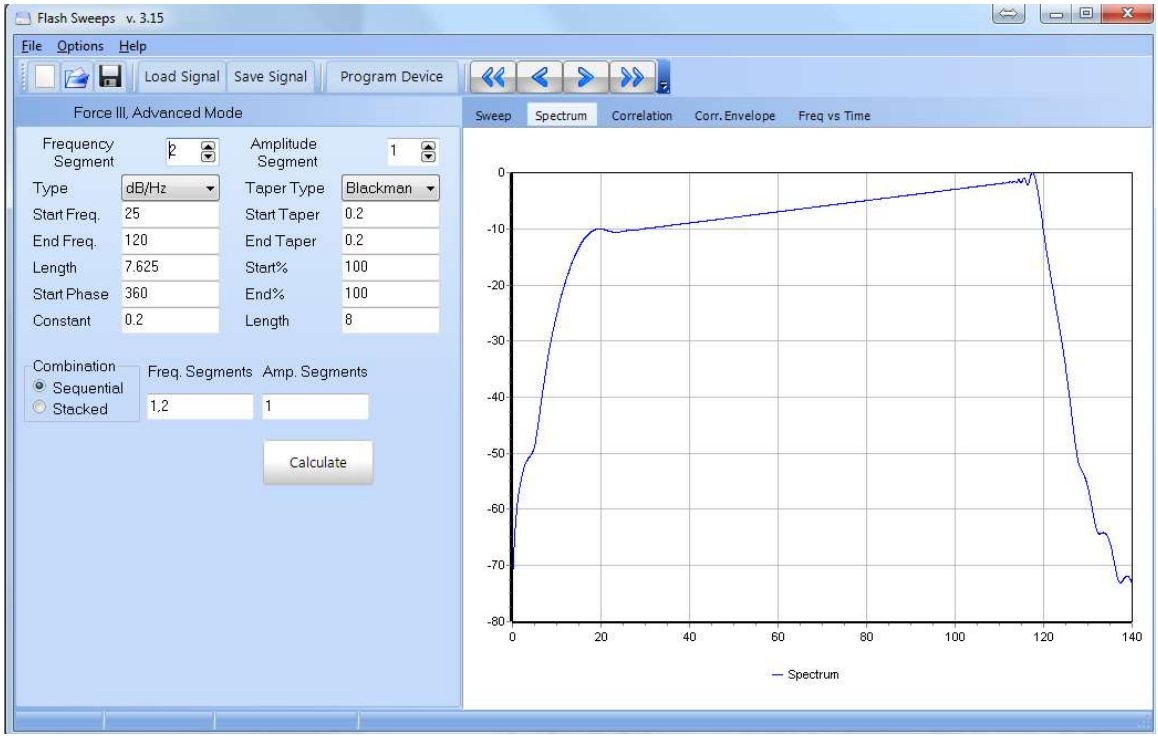
Set the Mode to either Advance or Normal Mode



File Menu

- Clear button will clear the memory
- Load Definition from file- Loads the Sweep Definition from the saved definition file. The definition file only contains the definition of the sweep. i.e. Start Frequency, Ende Frequency, sweep length, Sweep type. Etc....
- Save Definition to file – saves the Sweep definition to File
- Open Signal File – loads the actual Sweep. This file contains the information for each sample of the data.
    - Signal Files use standard SSC Sweep Files
    - Signal Files use standard Pelton Sweep files
    - Signal files can use standard Sercel Sweep files
- Save Signal File – saves the actual Sweep data.
- Save the data to USB stick. This USB stick can then be plugged into the F3 Decoder units and the sweep data can be uploaded to the Decoder
- Export to SEG-Y format
- Export to SEG-D format
- Export to HD
- Exit the Program

Sweep Definition
Advance Mode
In Advanced Mode, multiple segments can be defined.



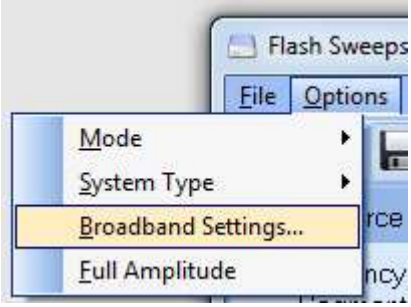
Frequency Segments and Amplitude Segments can be defined separately.

In the above example, there are two Frequency Segments defined. The first Frequency segments is 8 to 25 hz for 0.375 seconds. The second Frequency Segment is 7.625 seconds in length. The total length for the two segments is 8 seconds.

There is only 1 amplitude Segment for 8 seconds.

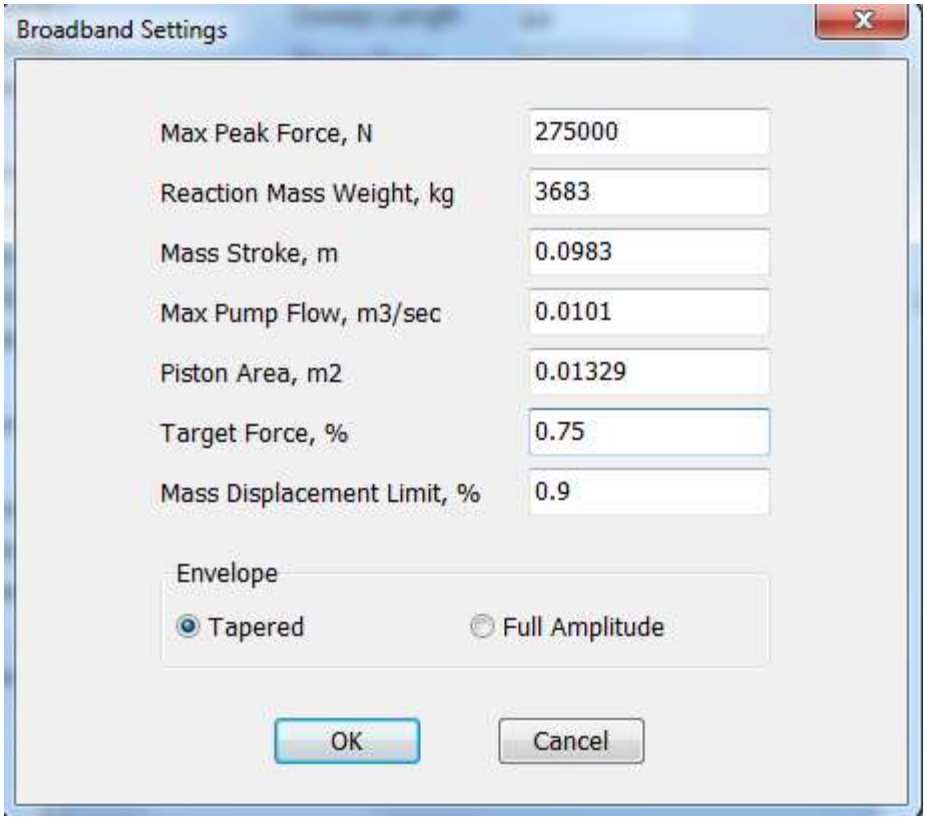
The Second Frequency Segment is set for a “Start Phase =360”. This is a special entry that allows the second segment to have continuous phase when linked to the first segment. This means that the ending phase of the first sweep will be used to determine the starting phase of the second segment. This mode is important when linking multiple segments together to form one sweep.

Broadband Sweeps



There is a special option for generating “Broadband” Sweeps.

Go to the Options- Broadband settings
(PL362 settings)

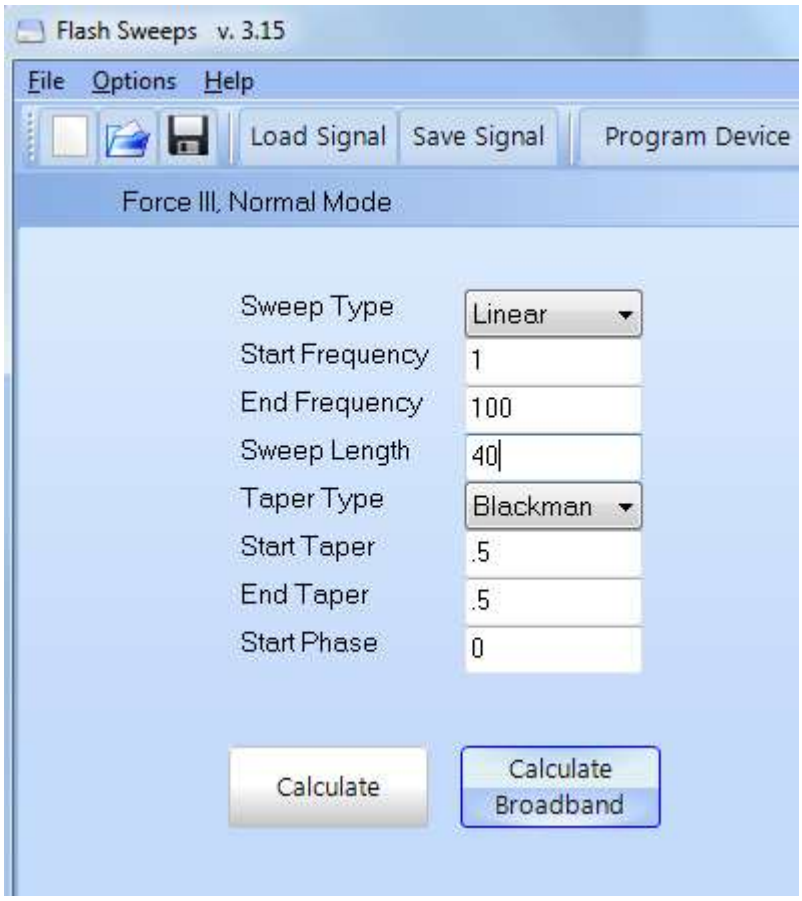


The Vibrator Parameters must be entered in the Broadband settings

Typically enter the Max pump flow to be 80% of the rated flow.

After entering the proper Vibrator Settings

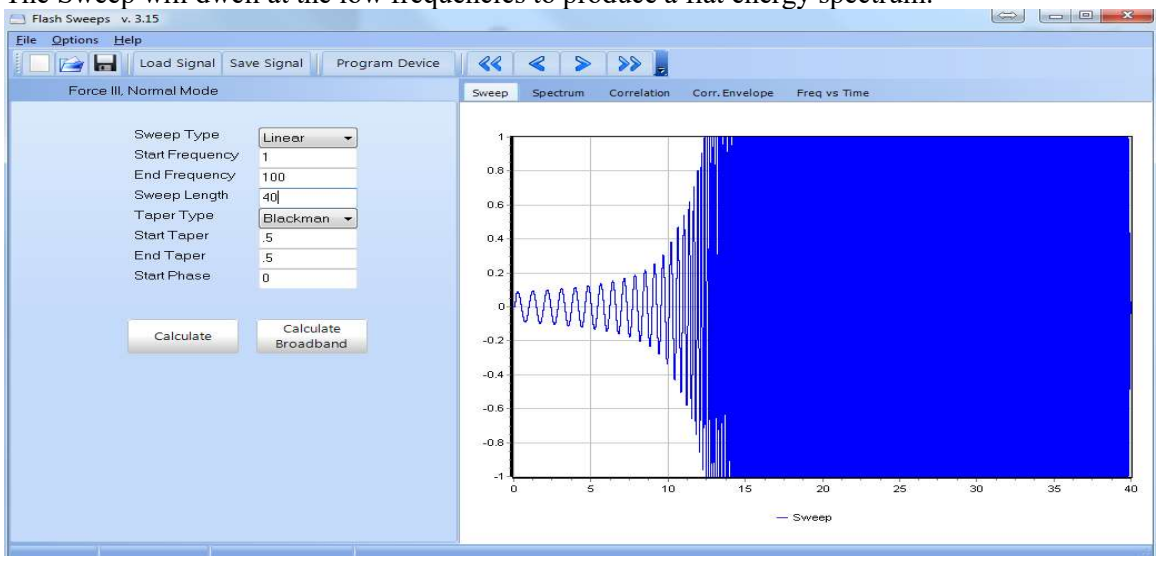
Enter your Sweep Parameters



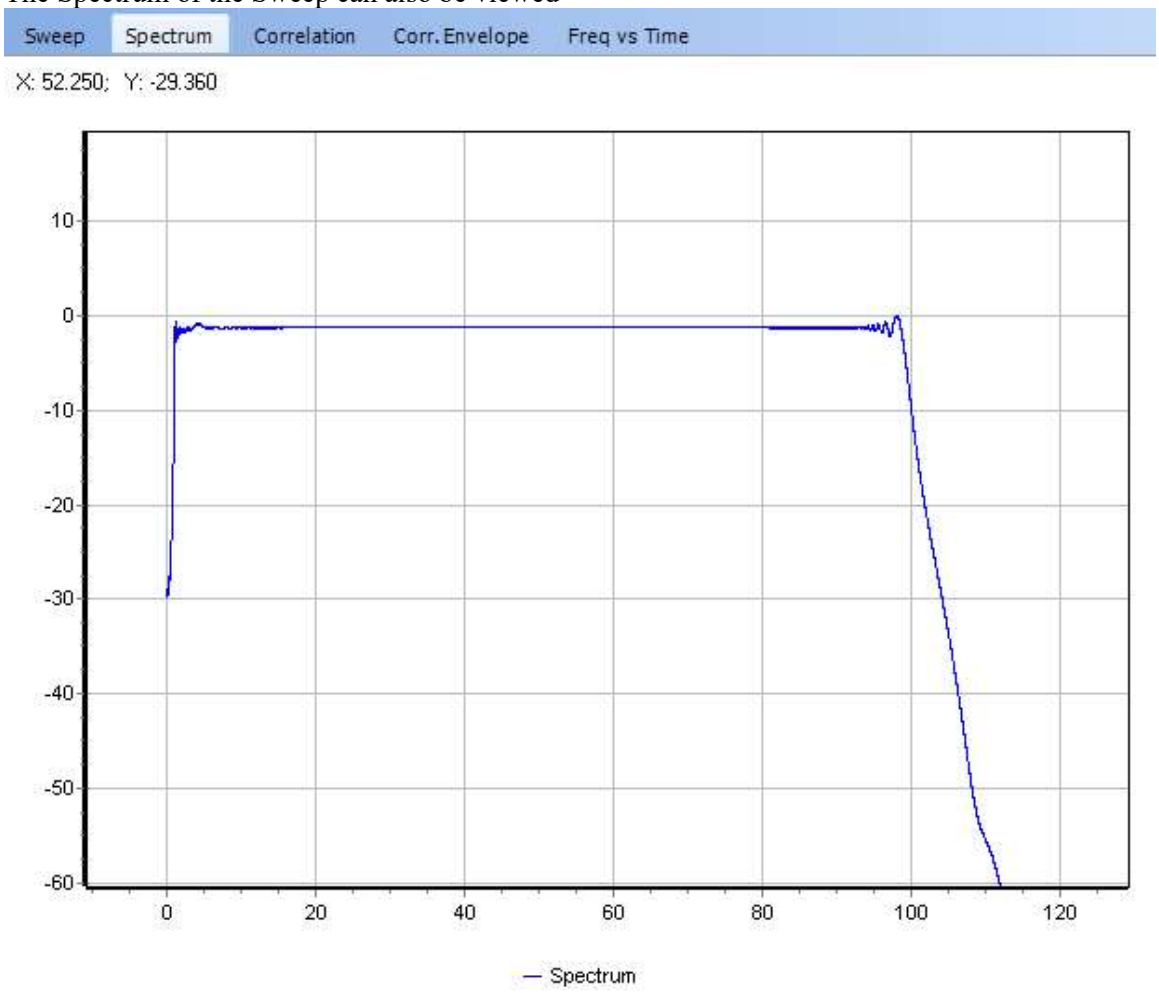
Press the Calculate Broadband Sweep.

The Reference sweep will be attenuated to match the attenuation required in the Vibrator to reduce the Force output at the low frequencies.

The Sweep will dwell at the low frequencies to produce a flat energy spectrum.



The Spectrum of the Sweep can also be viewed



Typical Vibrator specifications

INOVA Vibrator Specifications			
	PLS-326	**PLS-362**	**PLS-364**
Max Peak Force, N	26,000 lbf (115 kN)	61,800 lbf (275 kN)	61,800 lbf (275 kN)
	115,000 N		
Reaction Mass Weight	2,610 lb (1,184 kg)	8,120 lb (3,683 kg)	11,020 lb (4999 kg)
	1,184 Kg		
Baseplate Weight	1,010 lb (458 kg)	4,020 lb (1,832 kg)	4,469 lb (2,027 kg)
Mass Stroke, m	4.0 in (10.1 cm)	3.87 in (9.83 cm)	3.87 in (9.83 cm)
	0.101 m		
Max Pump Flow, m^3/sec	0.0024 m^3/sec	0.0101 m^3/sec	0.0101 m^3/sec
Piston Area, m2	8.64 in^2 (55.7 cm^2)	20.6 in^2 (132.9 cm^2)	20.6 in^2 (132.9 cm^2)
	0.00557 m^2		

SERCEL Vibrator Specifications			
	Nomad 15	**Nomad 65 Neo**	**Nomad 90 Neo**
Max Peak Force, N	17,366 lbf (77.2 kN)	62,400 lbf (278 kN)	89,920 lbf (400.3 kN)
Reaction Mass Weight	2,204 lb (1,000 kg)	10,352 lb (4,700 kg)	15,432 lb (7,000 kg)
Baseplate Weight	705 lb (320 kg)	3,490 lb (1,584 kg)	5,066 lb (2,300 kg)
Mass Stroke, m	2.75 in (7 cm)	4 in (10.12 cm)	4 in (10.16 cm)
Max Pump Flow, m^3/sec	0.0037 m^3/sec	0.0076 m^3/sec	0.0106 m^3/sec
Piston Area, m2	4.87 in^2 (31.4 cm^2)	17.45 in^2 (112.6 cm^2)	25.11 in^2 (162 cm^2)

IVI Envirovibe Vibrator Specifications					
	Minivib 26	**Minivib 15**	**Minivib 6**	**Minivib S6**	**Minivib 12**
Max Peak Force, N	22k –26k(97,861-115,654 N)	15,000 lb (66,000 N)	6,000 lb (26,689 N)	6,000 lb (26,689 N)	11,970 lb (53,245 N)
Reaction Mass Weight	3,250 lb (1,474 kg)	1,750 lb (794 kg)	311 lb (141 kg)	311 lb (141 kg)	990 lb (449, 1 kg)
Baseplate Weight	1,500 lb (680 kg)	895 lb (2273.3 kg)	370 lb (168 kg)	370 lb (168 kg)	855 lb (388 kg)
Mass Stroke, m	3 in (7.62 cm)	2.75 in (6.99 cm)	1.88 in (4.78 cm)	1.88 in (4.78 cm)	2.75 in (6.99 cm)
Max Pump Flow, m^3/sec	0.0051 m^3/sec	0.0038 m^3/sec	0.0031 m^3/sec	0.0031 m^3/sec	0.0038 m^3/sec
Piston Area, m2	8.69 in^2 (56 cm^2)	3.99 in^2 (2.54 cm^2)	1.5 in^2 (9.7 cm^2)	1.5 in^2 (9.7 cm^2)	3.99 in^2 (25,7 cm^2)

IVI Birdwagen Vibrator Specifications			
	ATS 60	**HEMI 60**	**HEMI 50**
Max Peak Force, N	62,000 lb (276,000 N)	61,620 lb (274,099 N)	50,160 lb (22,752 kg)
Reaction Mass Weight	8,650 lb (3,924 kg)	8,250 lb (3,742 kg)	5,820 lb (2,640 kg)
Baseplate Weight	3,875 lb (1,760 kg)	4,700 lb (2,131.88 kg)	4,490 lb (2,036 kg)
Mass Stroke, m	± 1.50 in (± 3.81 cm)	± 1.75 in (± 4.45 cm)	3.0 in (7.62 cm)
Max Pump Flow, m^3/sec	0.0088 m^3/sec	0.0088 m^3/sec	0.0189 m^3/sec
Piston Area, m2	20 in^2 (129 cm^2)	20.54 in^2 (132.5 cm^2)	16.72 in^2 (42.46 cm^2)

Metric Conversion required for program

- Max Peak Force N
  - 115 kn = 115,000 N - Multiply by 1000 to get Newtons for Max Peak Force
- Reaction Mass Weight kg
  - 1184 Kg – Enter shown Reaction Mass Weight
- Mass Stroke, m
  - 10.1 cm = 0.101 m Divide cm by 100 to get Mass Stroke in Meters
- Max Pump flow
  - 0.002416 m^3/sec Enter value for Max Pump Flow (or reduce by 80% to compensate for weak pump)
- Piston Area
  - 55.7 cm^2 = 0.00557 m^2 divide by 10,000 to get m^2 from cm^2
- Target Force Percent
  - Enter Decimal value to for target Force output (Does not reduce amplitude of sweep). Value should match the % high Force output entry in the Force 3 system. Typical is 0.7
- Mass Displacement Limit
  - Enter decimal Value of the peak Mass Displacement Limit. Example: an entry of 0.9 will reduce the Mass Stroke from 10.1 cm to 9.09 cm

The Flash program can load or save computer generated files. Go to the file load menu to load a Flash file. These files will normally be provided by the client.

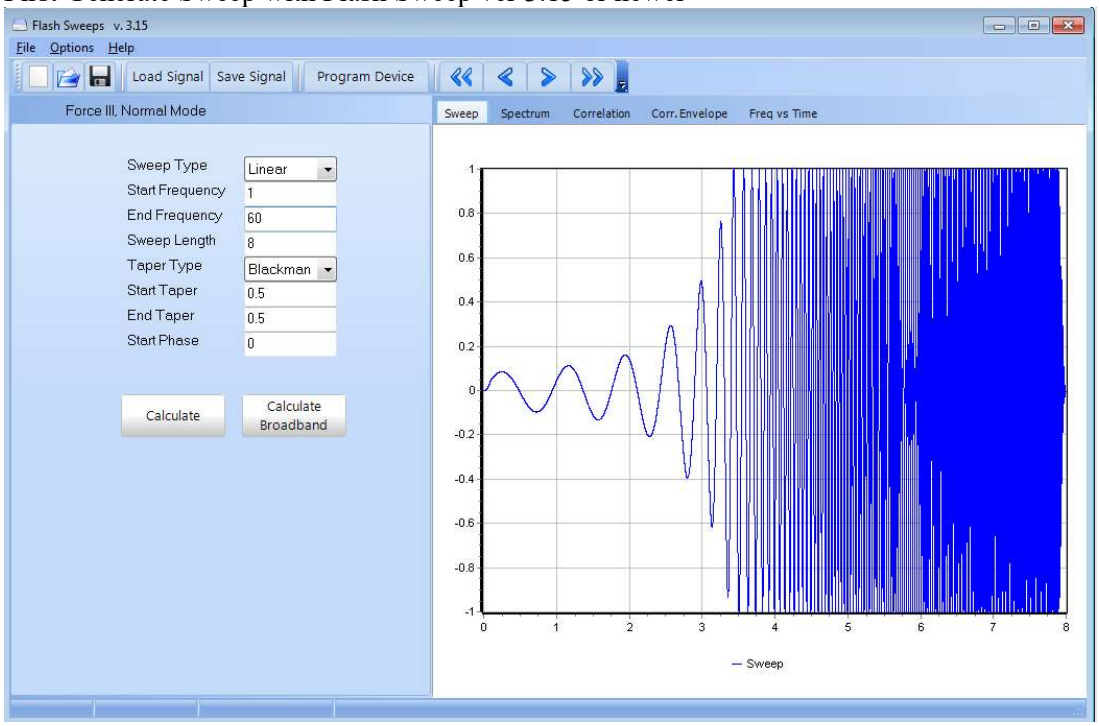
After defining the Flash sweep, press the "Calculate" button to generate the samples. The Sweep can now be viewed with the Flash program. The spectrum and correlation can also be analyzed.

After the sweep has been correctly loaded or generated by the Flash program, you can then load the sweep to the Force III electronics.
Connect Ethernet Cable from computer to the F3 unit
Be sure the IP address of your computer is set correctly (normally it is set to fixed IP address of 10.0.0.101.)
Press the "Program" button on the screen and select the Flash Sweep number to be loaded.

4.2.2 Saving and Loading Stored Sweep from USB Flash Memory

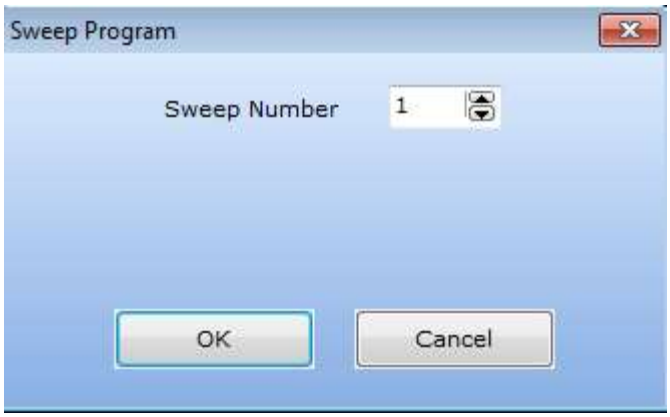
After generating the sweep with the Flash program, the Sweep File can be loaded onto a USB stick and used to upload to the Force III electronics.
The file must be place in a special file directory on the USB stick./FORCE3/SWEEPS/...
The name of the file must specify the sweep number to be loaded. SWEEP015.SCI will load Flash sweep number 15 into the memory.
Multiple sweep numbers can be loaded into the Force III unit using the USB Flash memory mode.

First Generate Sweep with Flash Sweep ver 3.15 or newer

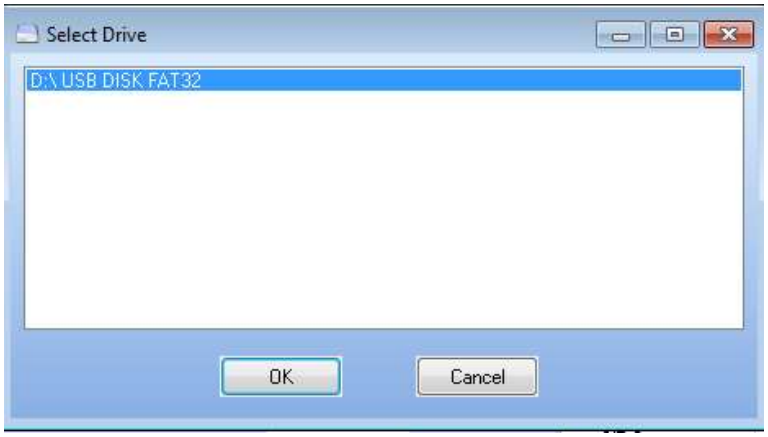


After computing the sweep, save the data to the USB drive.
Plug in USB drive to the computer
Go to the File Menu –"Save to USB Flash" option

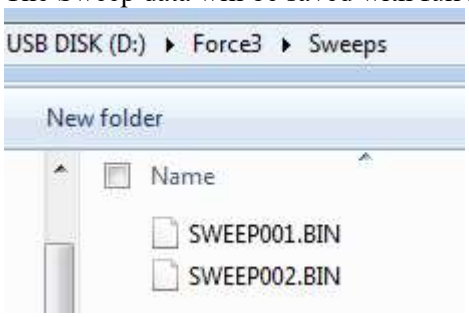
Select sweep number to use



Select USB drive
Click on the Drive in the list and Press OK



The Sweep data will be saved with full resolution to the USB drive in *.BIN format

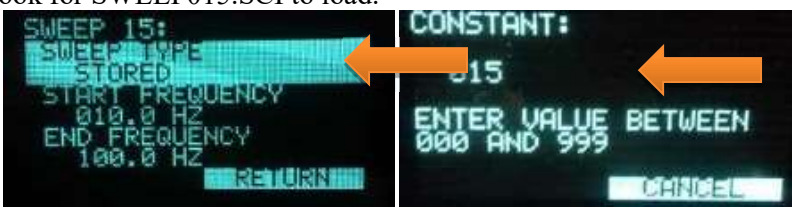


Warning: Saving the data in SCI format does not have full resolution and the Sweep Checksum will not Match. Using the "Save Signal" option in Flash Sweep saves the data in the lower resolution*.SCI format.

Insert to F3 USB flash memory with your custom stored sweep on it in the folder: /FORCE3/SWEEPS/, and the sweeps should automatically upload to the F3 units.

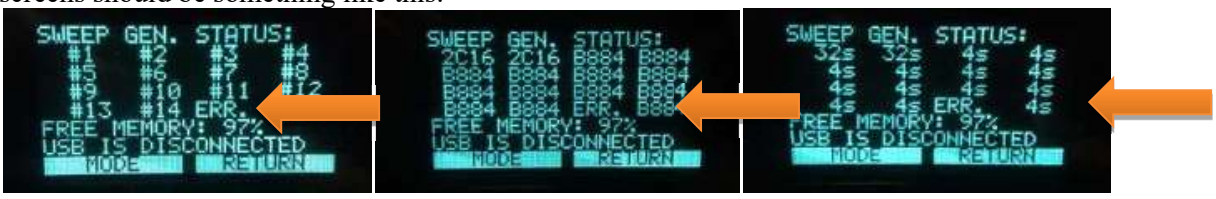
4.2.3 Viewing Sweep memory Status on F3 menus

In our example, we placed SWEEP015.SCI on the USB memory.
This simple example explains how to load single stored sweep to F3 sweep generator's memory. Loading multiple sweeps is the same procedure, just repeated on several sweeps. Typically sweep generator's memory is loaded with standard sweeps. Example below explains main two steps for loading stored sweep.
1) Selecting sweep in F3 memory and modifying it for the load of stored sweep. In this step, we selected sweep number 15, made it is type – stored and then made constant equal 15. Constant number tells sweep generator to look for that particular stored sweep number. In our case, sweep generator will look for SWEEP015.SCI to load.



After that step, on the return to Main menu, sweep generator will display a scroll text error for sweep 15, indicating that the stored sweep is not loaded yet, as shown below:

2). Select Status menu and then select Sweep Generator Status. This screen should show an error for the sweep number 15, to indicate that process of loading stored sweep is not finished. These screens should be something like this:



Sweep number screen Sweep Checksum screen Sweep Length screen

To switch between screens, use left soft-key labeled MODE.
Sweep Generator Status will indicate USB connection and will recalculate sweeps in it is memory. Final result should look similar to this:

Again, left soft-key MODE can be used to switch between screens to check on the sweep checksums, sweep length and sweep numbers to verify stored sweep load.

You can see each stored sweep being load in this screen. A line rotate in a sweep position till load is complete, once complete it show check sum, or sweep length, in the appropriate location. After each stored sweep is load you can see how much memory is available for additional sweeps.

4.2.4 FLASH Memory File Format

Internal SCI file format is based on standard ASCII text file. It can be opened with variety of text editors on different operating systems, like UNIX, Macintosh and Microsoft Windows. For example Notepad editor in Microsoft Windows can be used to open this file.
Each file must have a name and file extension to be recognized by Universal Encoder-II or F3 unit. File names must be following this naming convention and to be numbered in the range from **SWEEP001.SCI** to **SWEEP016.SCI**.
Each line of text in the file contains one sample of data. There are 4000 samples per second of sweep, so there will be 4000 lines of text per each second of sweep. Each line of text is terminated with a Carriage Return/Line Feed (0x0D 0x0A pair).
Each text line in this file is organized in this order: Sample number, Current Envelope, and Current Phase followed by the Carriage Return/Line Feed.
The ***Sample number*** is a 32-bit unsigned integer. It is stored in character positions 1 to 7, right justified, in each line. Typically, the sample numbering starts with number 0.
The ***Envelope number*** is a 2's complement 16-bit number, in range from 0 to 32767 (0-100 %). It's stored in character positions 8 to 14, right justified, in the line, after Sample Number and space.
Typically the front and the end of the sweep have a tapered envelope, based on Cosine or Blackman taper. This is done in order to avoid sudden Reaction Mass motion of seismic vibrator.
For low frequency sweeps, it is important to reach at least 10% of amplitude of the envelope during first 2 cycles. This allows control electronics to engage early in phase and force control.
The ***Phase number*** is a 2's complement 16-bit integer that ranges from -32768 to +32767 (-180to +179.9945 degrees). It is stored in character positions 15 to 21, right justified, last in line of text, just before Carriage Return/Line Feed. Since Phase number has signed value, each sample can have positive or negative sing in front of the number. For simplicity, positive sing "+"number can be omitted in the line for positive phase value.
When you calculate the phase, convert it to degrees and make product number is in range -180 and +180 degrees. Then multiply by the constant 65536/360.
It is recommended to use phase value of 0 for the first sample of the custom sweep. This would allow user to modify sweep phase if desired, by changing *Initial Phase* parameter in F3 sweep table.
Phase increments from sample to sample must be always positive. F3 controller does not allow negative phase increments and the sweep would not be process correctly (negative frequency).

SCI file formatting

Gray line below represents character position in the line and shown here for aid purposes.

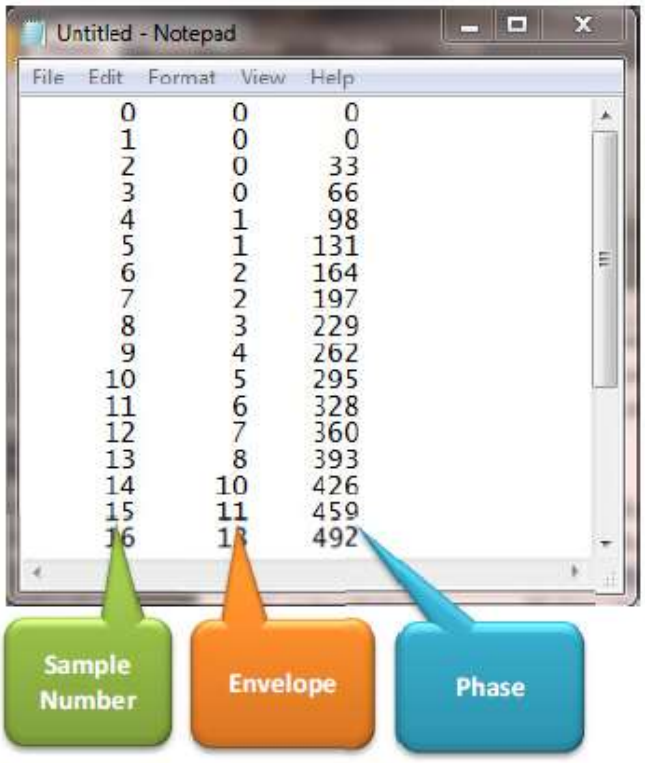
```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
...
      1 2 3 4      3  2  7  6  7          -  1 7 5 3 0D 0A
      1 2 3 5      3  2  7  6  7             2 8 1 0D 0A
      1 2 3 6      3  2  7  6  7          2 3 1 6 0D 0A
      1 2 3 7      3  2  7  6  7          4 3 5 0 0D 0A
...
```

Sample Number

Envelope

Phase

SCI file fragment example



5.0 Force 3 Quality Control

Force-III system has built-in capabilities to record and report information in the following categories:

- PSS Records
- Calibration Records
- Vibrator Start-up Records
- Vibrator Source Signature Records
- Vibrator Signal Records

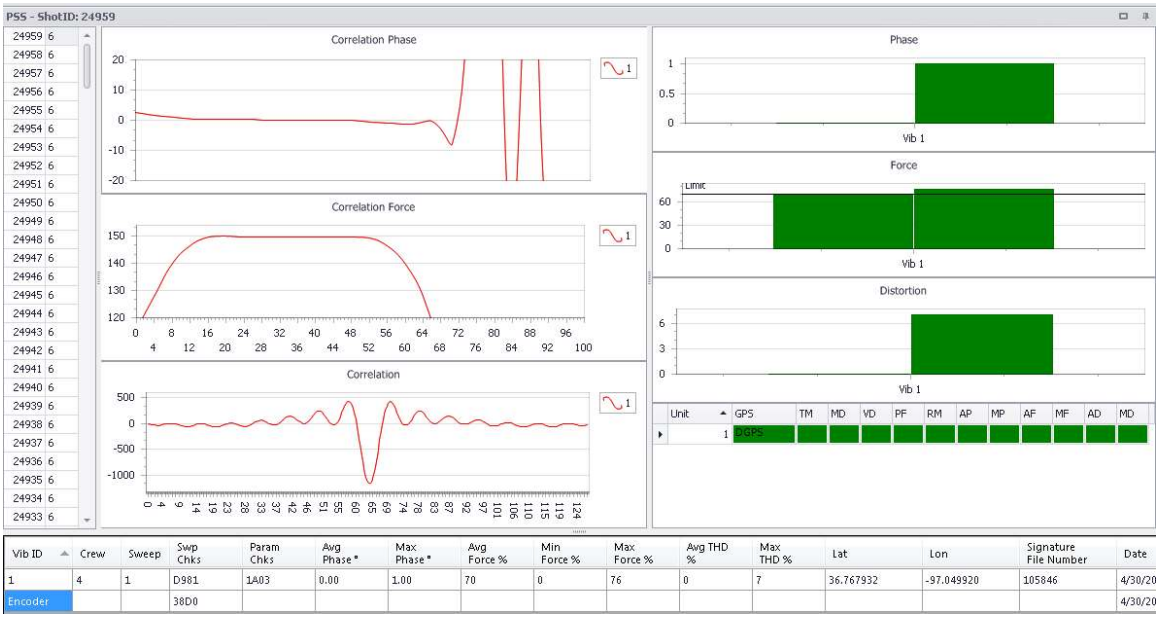
5.1 PSS Data and Stored Records

F3 supports PSS in two different formats – F3 format and A3 format. A3 PSS format is compatible with INOVAVib Pro PSS records.
F3 unit reports real-time and then stores PSS locally in the CF file system, from which any stored PSS record can be retrieved later. F3 CF file system for PSS stores last 65536 of each type, F3 and A3.

The PSS data consists of the cross correlation wavelet and the digital control data.

The cross correlation data uses the Vibrator's Reference signal and the Similarity signal.

The digital values for peak and average phase, force and distortion use the Loop accelerometer signals used by the control system.



Stiffness and Viscosity

The PSS may include Ground Stiffness and Viscosity measurements

These measurements are used to determine the stiffness and viscosity of the ground. These measurement change with frequency. The current firmware only send the average value back during PSS.

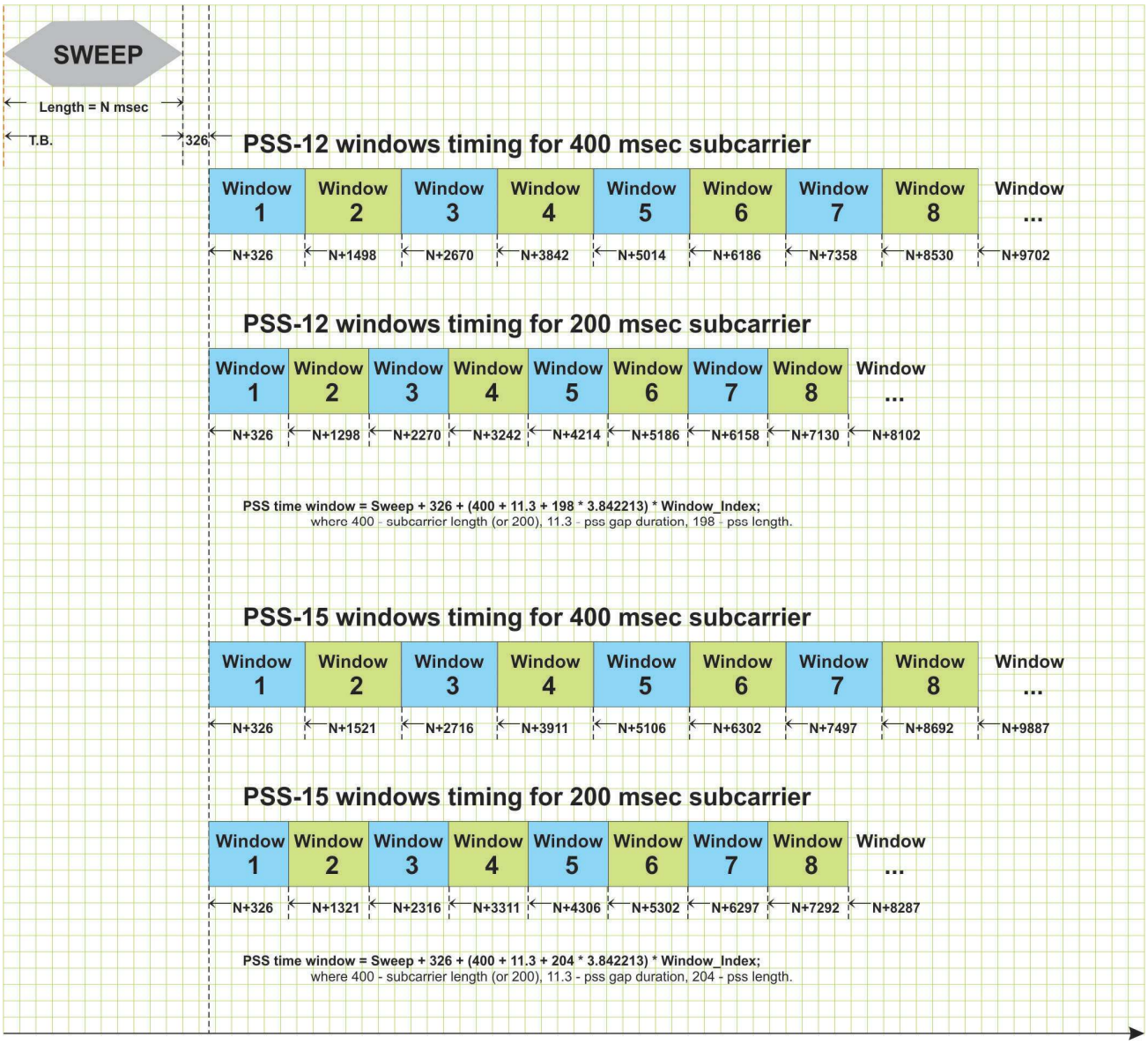
The values are computed using the following equations.

The Stiffness is Ks = fundamental Force/baseplate displacement
The Viscosity is Kv = fundamental Force/baseplate velocity

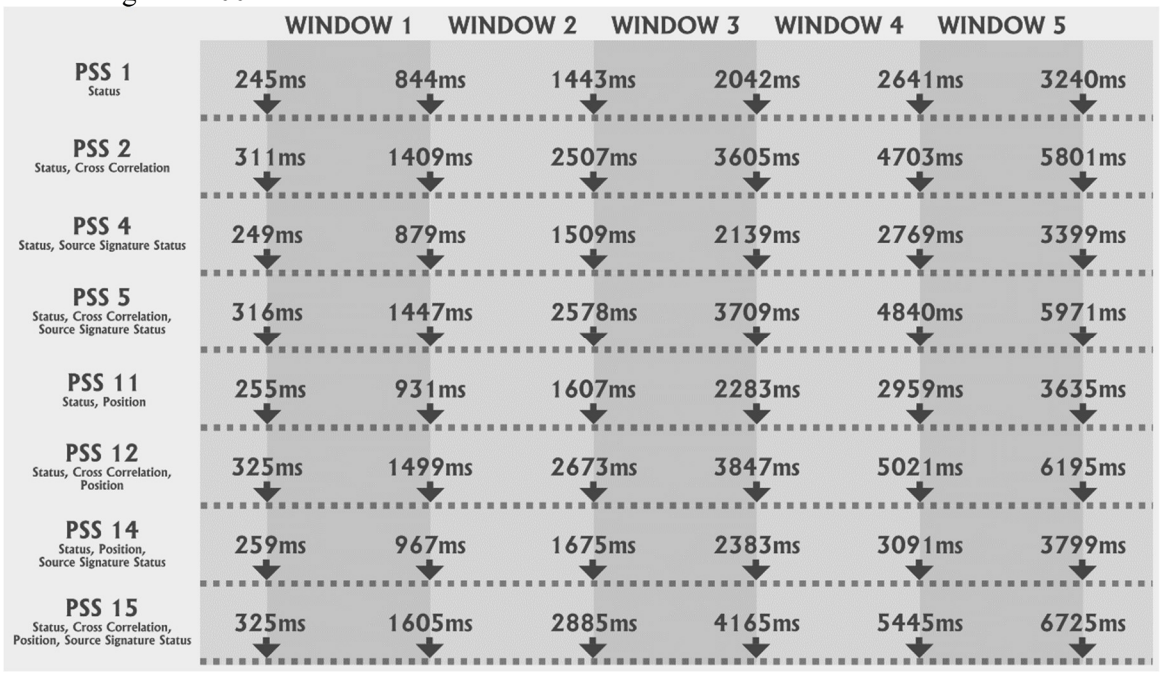
The numbers are scaled down to fit between 0 – 255

5.1.1 Legacy PSS timing diagram

PSS timing chart based on different subcarriers selection and for two popular PSS types.
All timing numbers in milliseconds and measured from the front edge of Time Break signal.
In case there is a need to calculate timing windows for another PSS type or a message, take new message length in bytes, add one byte and use this number in the formula below, in place of PSS length number.
Note: Timing calculation is based on 3123.2 Hz modulation frequency.



PSS timing with 400 msec subcarrier



5.1.2 USB option

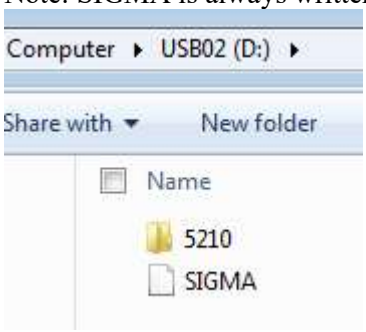
5.1.2.1 USB File Structure

Force 3 / VibProHD
The Force 3 and VibProHD will save data on the external USB drive.

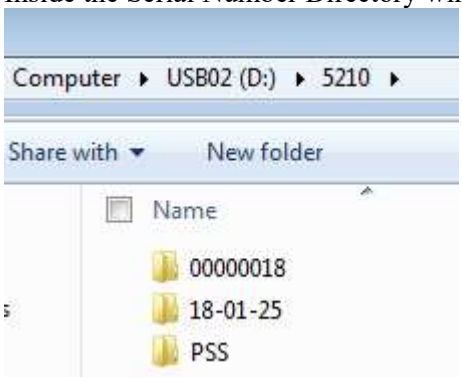
The file structure is

5.1.2.2 USB Root Directory

Shows Unit S/N
Note: SIGMA is always written to the USB stick to identify it as having data



Inside the Serial Number Directory will be three Folders

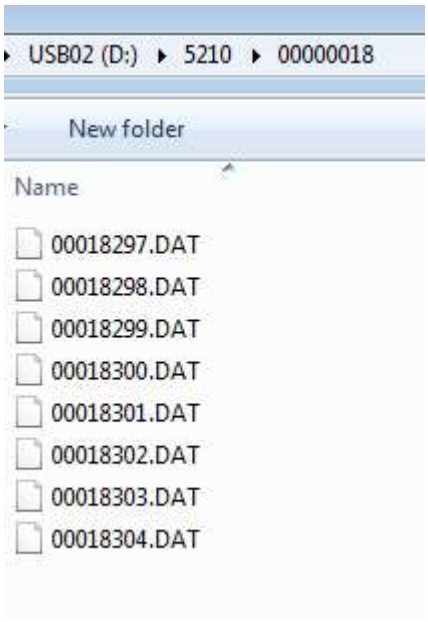


5.1.2.3 USB VSS/Dat File Folder

Vibrator Signature Data - VSS data. This data has been designed to be used in advanced processing techniques of vibroseis data.
These Files contain 3 channels of data

- Reference
- Reaction Mass Force
- Baseplate Force

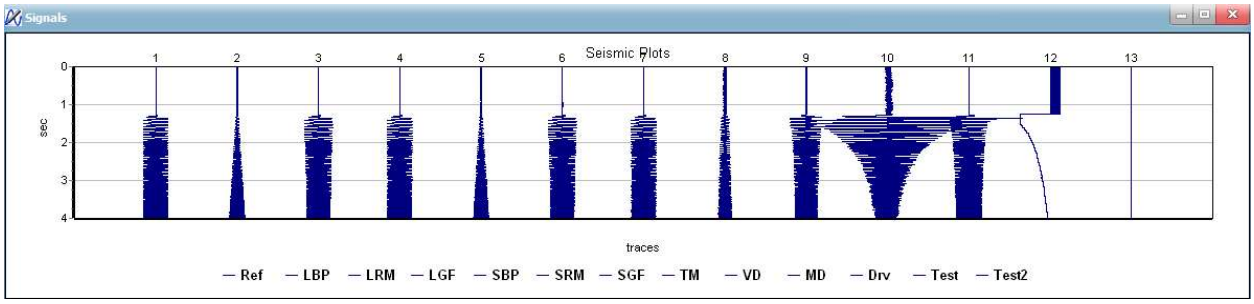
Data Collector 3 software is used to convert these files to standard SEG-Y format and to generate the 4th channel "Estimated Ground Force".
Individual DAT files or SEG-Y files can be viewed using the SrcSig software

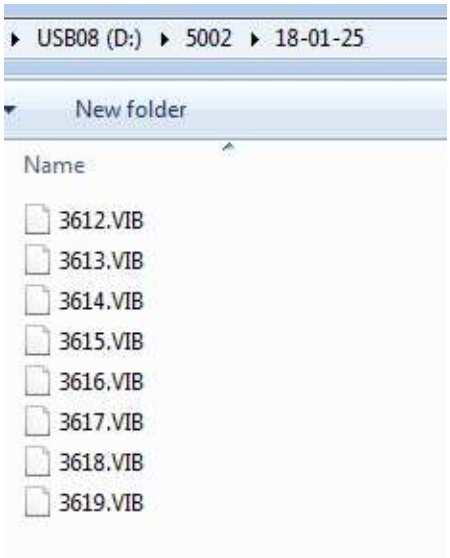


5.1.2.4 USB Vib QC data

Vibrator QC data
These files are only generated if the “Vib Records” are enabled in the Service – Tests – Vib Record On/OFF selection
SrcSig software is used to view these records
The *.Vib files contain 13 traces

- Reference
- Loop BP acc
- Loop RM acc
- Loop GF
- Sim BP acc
- Sim RM acc
- Sim GF
- Torque Motor Current
- Main Valve LVDT (displacement)
- Reaction Mass LVDT (displacement)
- Drive signal
- Test 1 and Test 2 will vary depending on the firmware version

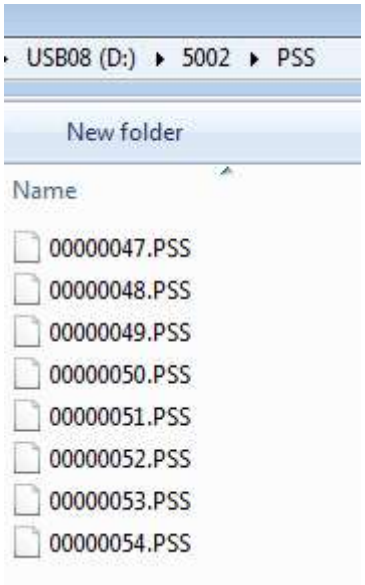




5.1.2.5 USB PSS Folder

The PSS folder will contain the PSS data for this unit.
The PSS data can be read by the SourceLink software. This data can be used in ISS mode. SourceLink can read the data and generate Production Reports based on the GPS time and positions included in the PSS data.
This data includes:

- GPS time of the start
- GPS position
- PSS data
- Unit's internally generated ID (used in ISS mode)



5.1.2.6 USB PSS Folder TXT FILE

The PSS folder will also contain a TXT File for the days production.

This file is automatically saved to the USB stick under the VibNumber/PSS directory

Example would be
D:\5146\PSS\20-10-16.TXT

The log file can also be copied to the USB stick at anytime using the Service Menu – Files- Copy Log to USB

The LOG file is a text file that contains information about the Sweep. This file includes

- Force 3 firmware version
- Force 3 Serial number, Sweep number, Vibrator number and Fleet Number
- Sweep ID
- Sweep Type
- GPS data
- Time Break time
- VSS File Number and sample rate
- Pad Up, Pad down and Time to Pressure Switch ON
- Phase, Force and Distortion for each 0.5 second time window of the sweep

Example below:

% Force III V30.55
% Local Acquisition
% Source Line : N/A
% Station Number: N/A
% Source Index : 1
% Sweep# : 1
% Serial Number : 5146
% Vibe Number : 15
% Fleet Number : N/A
% Sweep ID : 63
% Shot ID : N/A
% SweepCounter : 0
% Sweep Type : STORED 1 12.000 seconds
% Force : 70
% GGA : $GPGGA,152331.00,3646.07273,N,09703.00671,W,2,11,0.84,309.9,M,-26.3,M,,0000*64
% GSA : $GPGSA,A,3,20,15,23,25,29,05,51,13,02,26,18,,1.56,0.84,1.31*08
% GST : NO GST
% VTG : NO VTG
% ZDA : NO ZDA
% PTNL(GGK) : NO GGK
% Time Break : 20/10/16 15:23:31.976000 [55411976000 microsec]

% VSS File Number : 19855
% VSS Sample Interval : 2.00 msec
% time end of prev sweep to up : N/A
% pad up : 20/10/16 15:22:59.078
% pad down : 20/10/16 15:23:20.777
% time up to down : 21699 ms
% time down to pressure switch ON : 2128 ms
% time down to ready : 2128 ms
% time down to sweep : 11199 ms
% QC Window : 500 msec

%	Phase				Peak_Force	Target										
%	Valid	Force	Visc	Stif		RM_Force		Limits								
%Time		Dist		MD	VD	TM		Freq		T	M	V	F	R		
0.5	0	0	0	0	0	0	33	2	0	9	8	2	9	0	0	0	0	0
1.0	1	0	11	0	0	0	36	2	0	16	15	3	12	0	0	0	0	0
1.5	1	0	17	0	0	0	38	3	0	22	21	3	16	0	0	0	0	0
2.0	1	1	22	0	0	0	33	3	0	26	25	4	20	0	0	0	0	0
2.5	1	2	26	0	0	0	27	3	0	30	28	5	25	0	0	0	0	0
3.0	1	1	31	1	0	0	21	3	0	38	35	6	32	0	0	0	0	0
3.5	1	1	40	1	0	0	18	3	0	47	45	7	43	0	0	0	0	0
4.0	1	1	63	2	0	0	15	4	0	68	62	10	63	0	0	0	0	0
4.5	1	1	73	2	25	3	10	4	1	74	67	16	70	0	0	0	0	0
5.0	1	0	71	2	20	3	5	3	1	72	61	21	69	0	0	0	0	0
5.5	1	0	71	2	18	4	2	3	1	72	57	27	69	0	0	0	0	0
6.0	1	0	70	2	17	5	2	3	1	72	54	32	70	0	0	0	0	0
6.5	1	0	70	1	16	6	1	3	1	72	52	38	70	0	0	0	0	0
7.0	1	0	70	1	16	6	1	2	1	71	50	43	70	0	0	0	0	0
7.5	1	0	70	1	16	8	1	2	1	72	49	49	70	0	0	0	0	0
8.0	1	0	70	1	16	9	1	2	1	71	48	54	70	0	0	0	0	0
8.5	1	0	70	1	17	10	1	2	1	72	48	60	70	0	0	0	0	0
9.0	1	0	70	0	17	12	1	2	1	71	48	65	70	0	0	0	0	0
9.5	1	0	70	0	18	13	1	3	2	71	48	71	70	0	0	0	0	0
10.0	1	0	70	0	19	16	0	3	2	71	48	76	69	0	0	0	0	0
10.5	1	0	70	0	20	19	1	3	2	71	48	82	69	0	0	0	0	0
11.0	1	0	69	0	22	23	0	3	2	70	47	87	66	0	0	0	0	0
11.5	1	0	66	0	23	27	0	3	2	67	45	91	64	0	0	0	0	0
12.0	0	0	64	0	28	34	0	3	2	64	44	3980	0	0	0	0	0	0

5.2 Vibrator Source Signature Records

VSS record contains True Reference, Reaction Mass Acceleration, Base Plate Acceleration and PSS for each specific sweep. Data are being recorded in 24-bit format and can be exported to SEG-Y or SEG-D records. These records stored in /DAQ3/ catalog.

“Source Signature” software is used to view and record the data in “real time”.

“Data Collector” software is used to download the Vibrator Source signature data.

5.3 Vibrator Signal Records – VIB QC

"Source Signature" software is used to view and record the data in "real time".

Signals being recorded for troubleshooting and they are stored in /FORCE3/RECORDS/.

- True Reference
- Mass Loop Accelerometer
- Mass Sim Accelerometer
- BP Loop Accelerometer
- BP Sim Accelerometer
- Torque Motor
- Valve LVDT
- Mass LVDT
- Drive

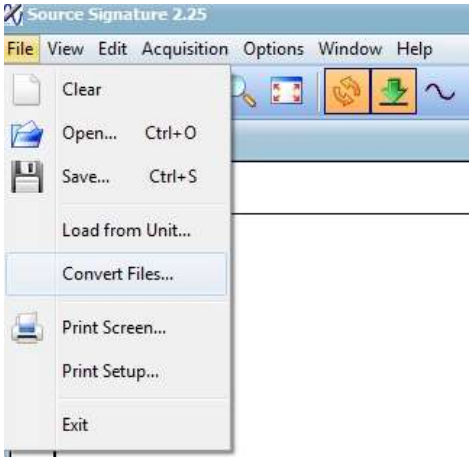
5.3.1 Converting VibQC files to SEG-Y

Requirements:

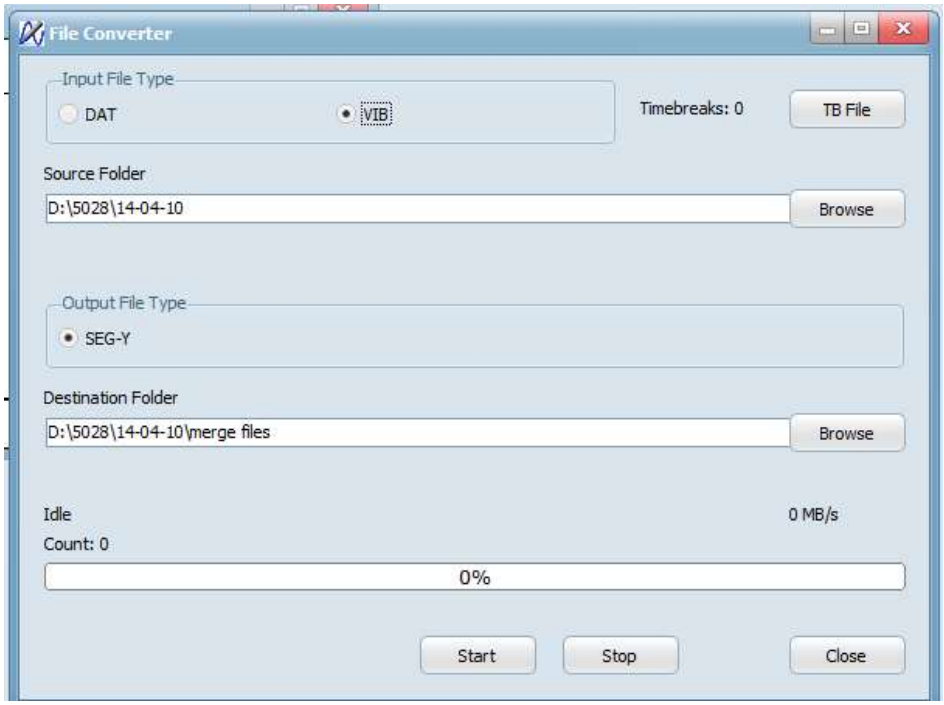
- Source Signature 2.23 or newer.
- Time Break files (Timebreaks.cvs) from SourceLinkReport.
- “VIB” files from F3.

Converting Files:

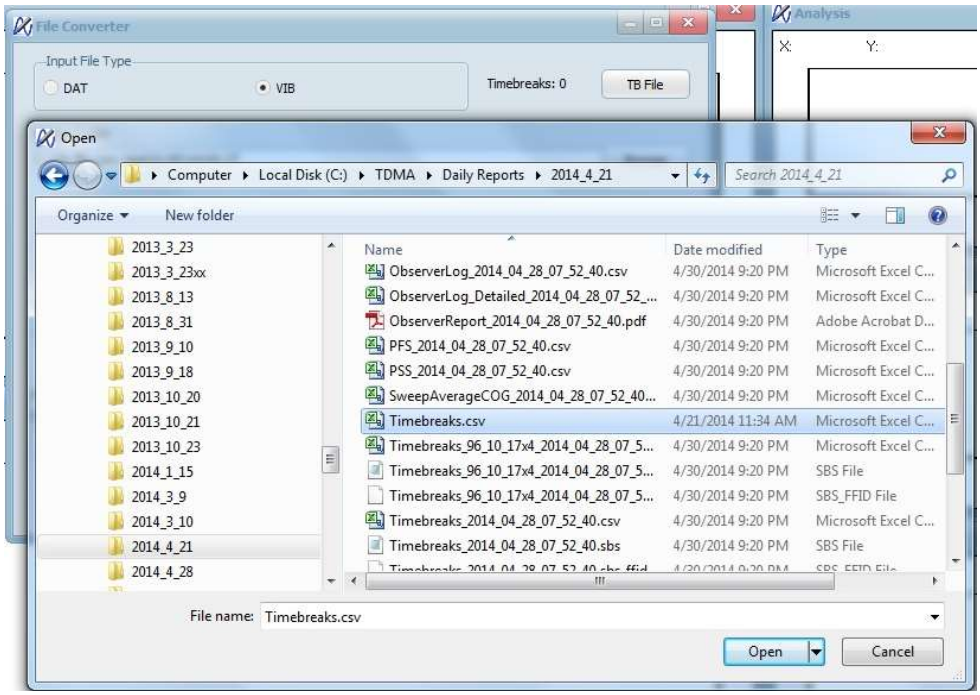
1. Open Source Signature Program.
2. Click on File>Convert Files……

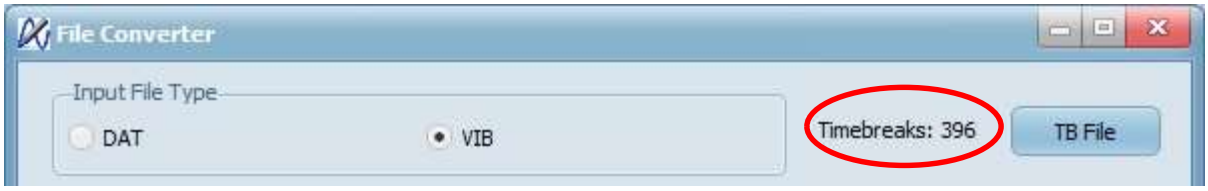


3. Under Input File Type select the correct file type.



4. Make a Daily Report file using SourceLink.
5. Click on TB File button
6. Select the TB break files from SourceLink Reports (Timebreaks.csv).
7. Click Open.

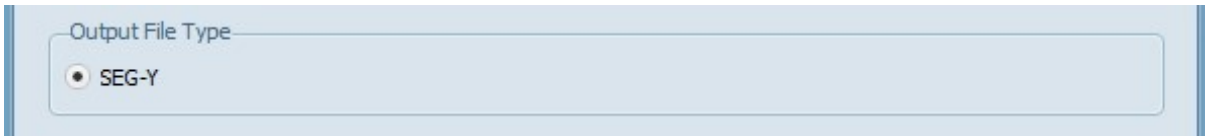




8. Notice next to the TB File button it shows the number of files loaded.

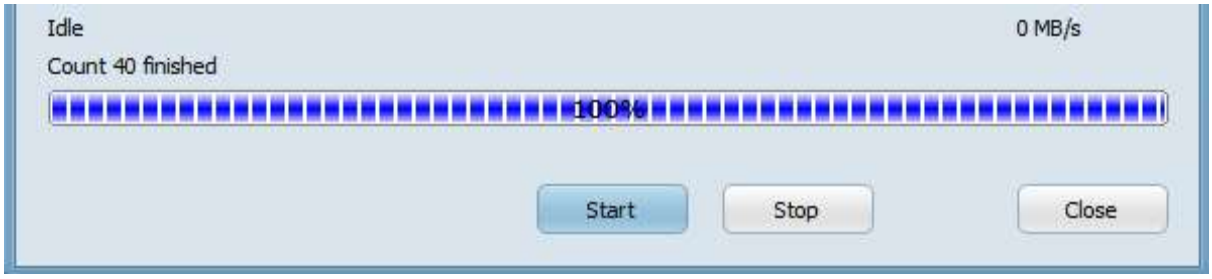
9. Select folder that has the VIB files.

10. Select Output

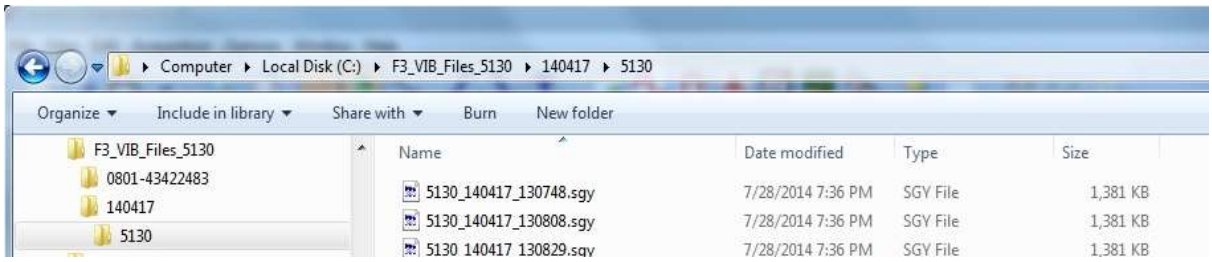


11. Enter a Destination Folder

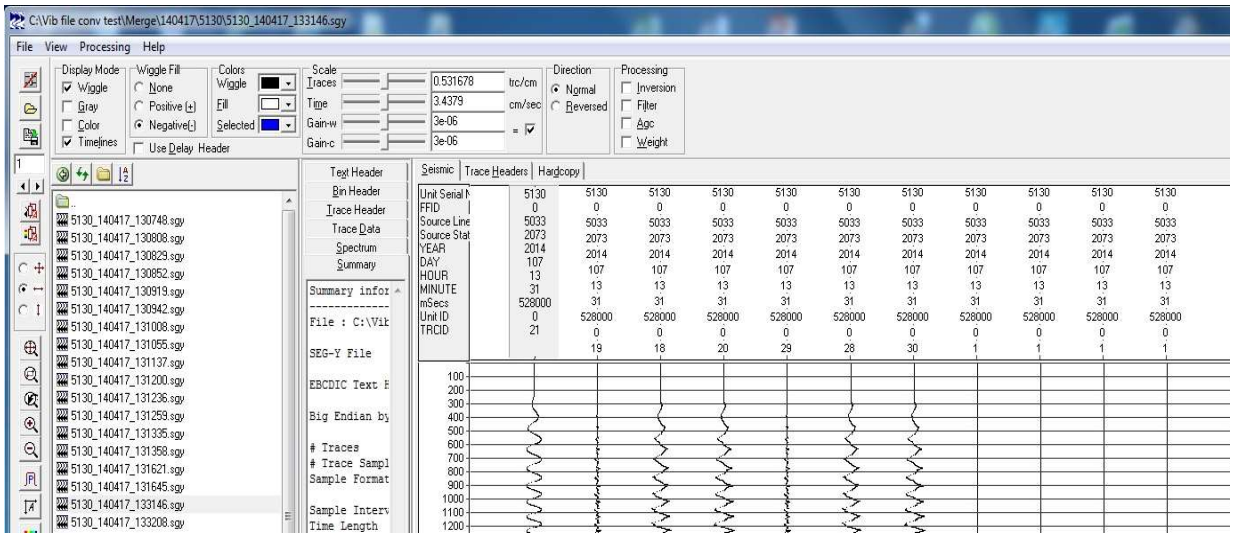
12. Click the “Start” Button.



13. The converted files will be located in the Destination Folder.



14. Once the files are converted the sgy header should have the following information: Unit Number, Line, Station, Julian Date, Time to usec, Trace ID number.


C:\Vib file conv test\Merge\140417\5130\5130_140417_133146.sgy
File View Processing Help
Display Mode
Wiggle
Gray
Color
Timelines
Wiggle Fill
None
Positive (+)
Negative(-)
Use Delay Header
Colors
Wiggle
Fill
Selected
Scale
Traces
Time
Gain-w
Gain-c
0.531678
3.4379
3e-06
3e-06
trc/cm
cm/sec
Direction
Normal
Reversed
Processing
Inversion
Filter
Agc
Weight
5130_140417_130748.sgy
5130_140417_130808.sgy
5130_140417_130829.sgy
5130_140417_130852.sgy
5130_140417_130919.sgy
5130_140417_130942.sgy
5130_140417_131008.sgy
5130_140417_131055.sgy
5130_140417_131137.sgy
5130_140417_131200.sgy
5130_140417_131236.sgy
5130_140417_131259.sgy
5130_140417_131335.sgy
5130_140417_131358.sgy
5130_140417_131621.sgy
5130_140417_131645.sgy
5130_140417_133146.sgy
5130_140417_133208.sgy
Text Header
Bin Header
Trace Header
Trace Data
Spectrum
Summary
Seismic
Trace Headers
Hardcopy
Summary infor
File : C:\Vib
SEG-Y File
EBCDIC Text H
Big Endian by
Traces
Trace Sampl
Sample Format
Sample Interv
Time Length
FFID
Source Line
Source Stat
YEAR
DAY
HOUR
MINUTE
mSecs
Unit ID
TRCID
100
200
300
400
500
600
700
800
900
1000
1100
1200

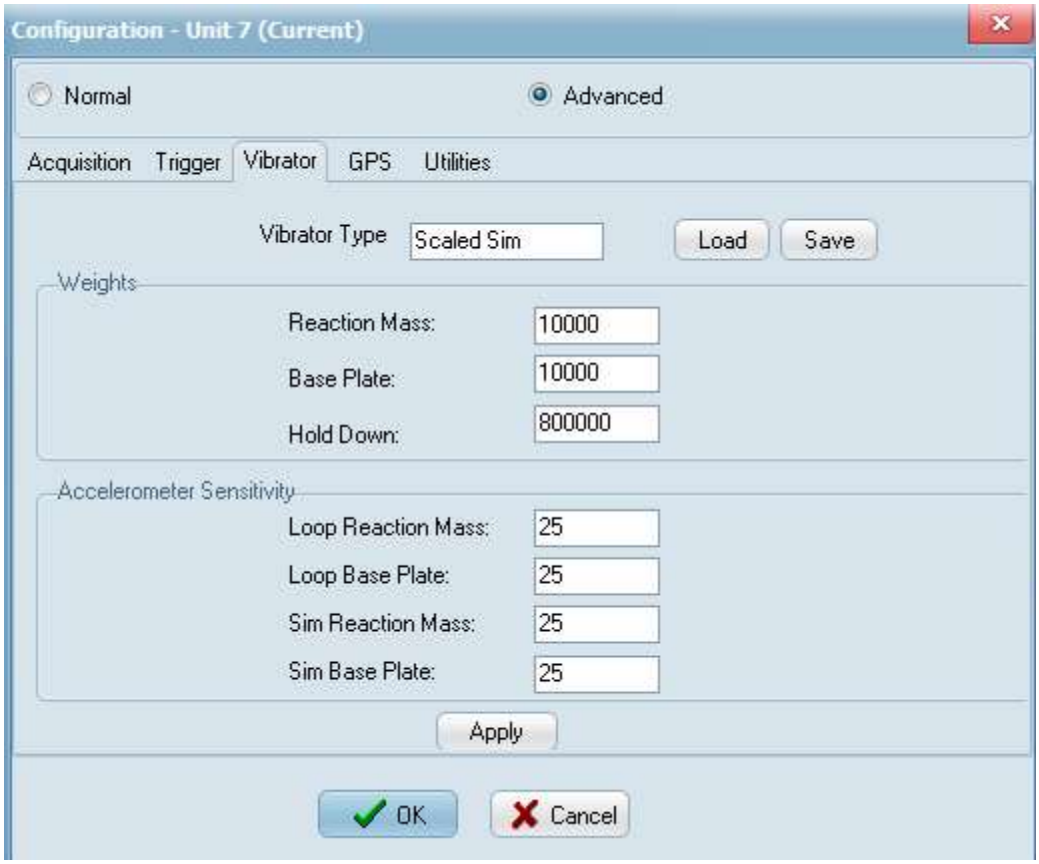
5.4 Scaled Similarity System

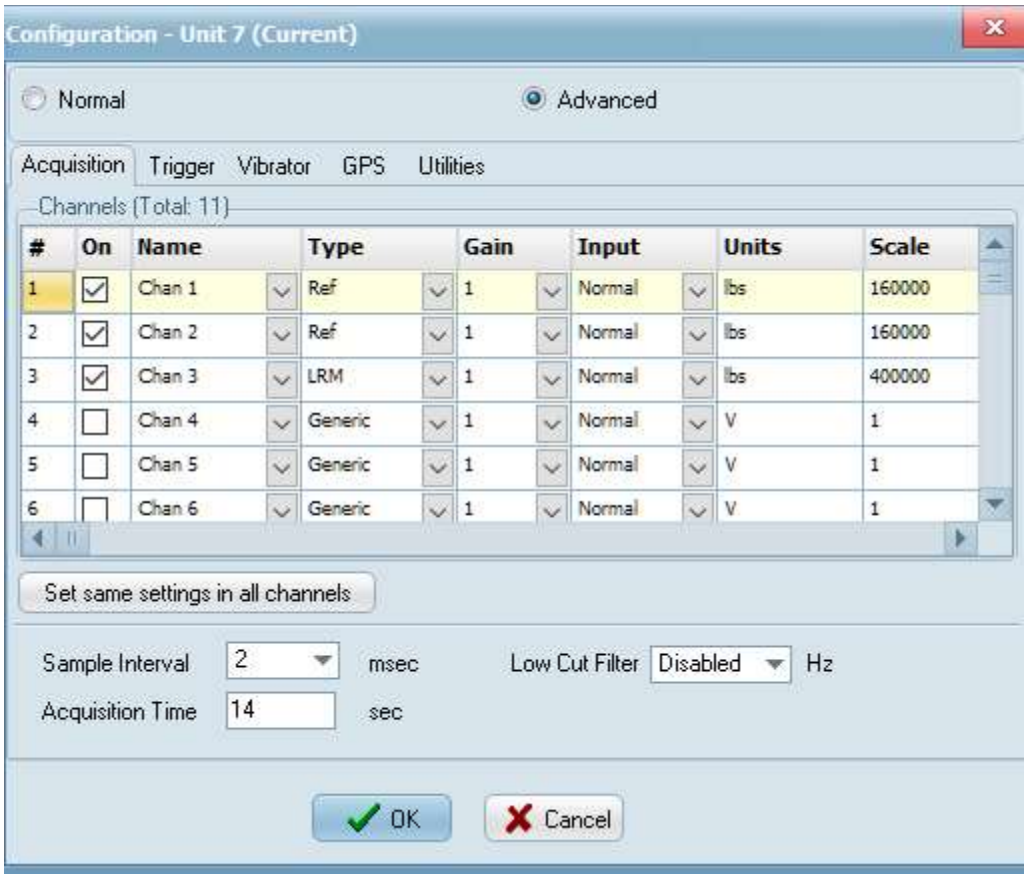
Build-in Scaled Similarity System is designed to provide real-time scaled to vibrator weights signals for recording on external recording equipment. Signals are scaled not to exceed most of recording instruments input dynamic range and according to the Specifications in this manual.

Scaled Similarity Reference	1 V peak-peak (± 0.5 V)
Scaled Time Break	0.3 V peak-peak (0 to + 0.3 V)
Scaled Similarity G. Force	2.5uV/1 lbf
Scaled Mass Force	2.5uV/1 lbf
Scaled Base Plate Force	2.5uV/1 lbf

These signals can be connected to the Bird Dog VibQC system or another Independent Test system. To scale this data to pounds of Force with the independent systems, do NOT re-enter the Vibrator's Baseplate and Reaction Mass Weights. Since this data has already been Scaled to Force Output enter the RM=BP= 10,000 lbs and the accelerometer sensitivity to 25 mV/G to scale these signals to Pounds of Force.

RM weight = 10,000
BP weight = 10,000
Accelerometers sensitivity = 25 mv/G




Configuration - Unit 7 (Current)
Normal
Advanced
Acquisition
Trigger
Vibrator
GPS
Utilities
Channels (Total: 11)
On Name Type Gain Input Units Scale
1 Chan 1 Ref 1 Normal lbs 160000
2 Chan 2 Ref 1 Normal lbs 160000
3 Chan 3 LRM 1 Normal lbs 400000
4 Chan 4 Generic 1 Normal V 1
5 Chan 5 Generic 1 Normal V 1
6 Chan 6 Generic 1 Normal V 1
Set same settings in all channels
Sample Interval 2 msec
Low Cut Filter Disabled Hz
Acquisition Time 14 sec
OK
Cancel

5.4.1 Wireline similarities

UE2

The UE2 has qty=4 Ten pin connectors labeled AUX1- AUX4. This allows the UE2 to output 4 different sweeps for Slip Sweep and other HPV operations.

These aux connectors have differential drivers for the attenuated True Reference signals and Time Break signals for each sweep.

These signals from the AUX connectors can be wired directly to the input of the seismic recorder (Fairfield Nodes or Sercel 428). No attenuator is required.

In addition there is a 24 bit digital Pilot available for each sweep stored in the UE2 memory. This Digital Reference can be used for the correlation if the "Filter response" of the seismic system is matched.

The SSC/I-Seis Sigma recorder and BD3-11 system have an option for "linear phase" filtering. The Sigma or BD3-11 system are used to record the signals from the UE2's aux connector with the Linear phase filtering, the Digital Reference from the UE2 will phase match the Analog Reference signals recorded.

Force3 and VibProHD

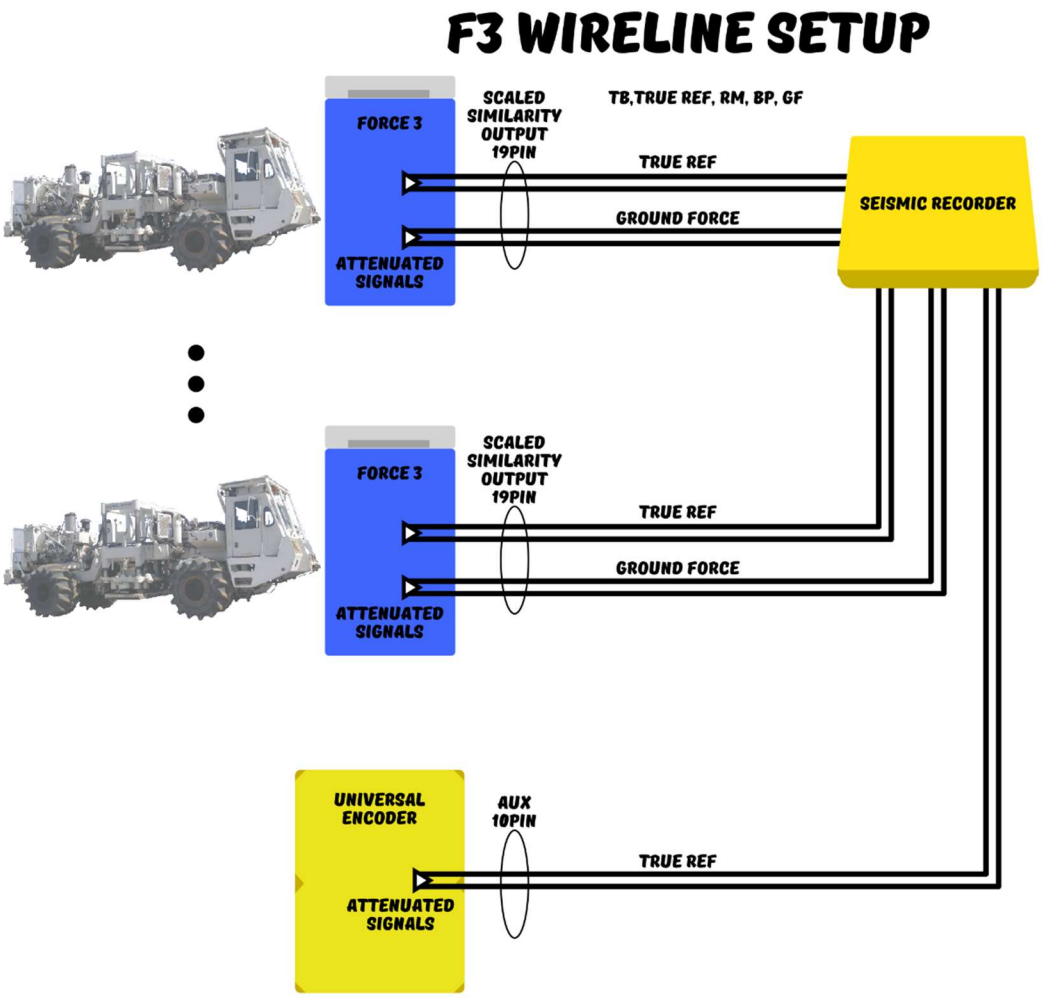
The Force 3 and VibPro HD have a connector labeled Scaled Similarity Output. This connector has been designed to be used for Wireline similarities and recording of the Source signature signals with an external recorder.

All of the signals on the Scaled Similarity Output have been scaled to match the input of most seismic recording systems. No attenuators should be required. Each signal has a differential driver that will match the input requirements for most recording systems.

All of the signals available on the Scaled Similarity Output should be compared with the True Reference Signal from the UE2 system. The following signals are available on the Scaled Similarity connector:

- Scaled Similarity Reference 1 V peak-peak (± 0.5 V)
- Scaled Time Break 0.3 V peak-peak (0 to + 0.3 V)
- Scaled Similarity G. Force 2.5uV/1 lbf
- Scaled Mass Force 2.5uV/1 lbf
- Scaled Base Plate Force 2.5uV/1 lbf

These signals can be wired directly to the seismic recording system



Summary for Force3 and VibProHD

For Wireline Sims we suggest using the Aux Connector from the UE2 for the True Reference Pilot signal and the signals from the Scaled Similarity Output for the Vibrator's Reference and Ground Force signal.

Force 2 and VibPro Wireline Sims (Legacy Mode)

The Force2 and VibPro Legacy Mode Wireline Sims use the “Wireline connector” on the connector Panel. The Wireline Connector provides two signals
Wireline Reference
Wireline Vibrator Output

These two signals are typically 10 or 20 volts Peak to Peak and must be attenuated with external resistor divider before they can be recorded by typical seismic acquisition systems.

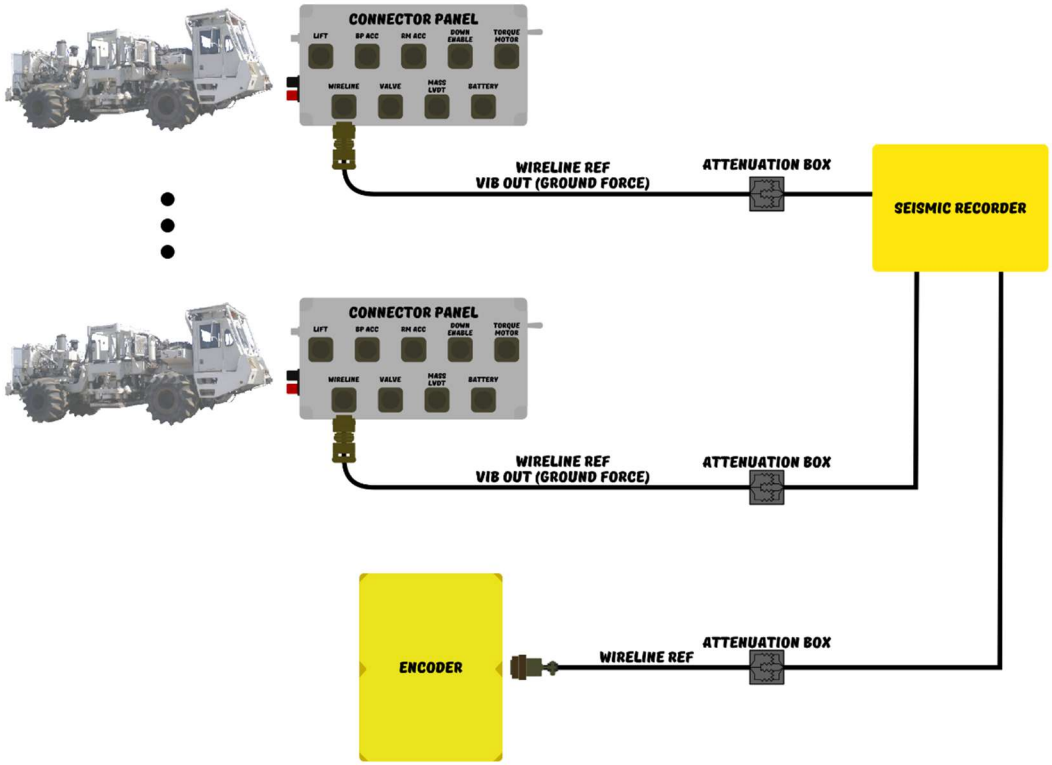
The older Force 2 and VibPro systems do not provide a signal that is "in phase" with the True Reference signal, so the legacy mode with the Wireline Reference signals must be used.

An additional Option is available for the older systems that provides a signal that is ‘in phase” with the True Reference Signal. This option is called the DSSS or VSSS systems. .ere is an additional box that can be added to the Force 2 and VibPro units to provide a scaled vibrator output that is in phase with the True Reference signal. These boxes are called Pelton DSSS (Distributed Similarity System) and SSC VSSS (Vibrator Similarity System). These boxes have internal resistors that must be set to match the Reaction Mass and Baseplate weight of the unit.

Wireline Reference and Wireline connector

The Pelton and SSC connector panels provide a 4 pin connector labeled "Wireline"
This connector provides a 10 - 20 volt peak to peak signal for the Wireline Reference and Wireline Vibrator Output.
These Signals must be attenuated before they can be recorded by the Seismic Recording system.
The Wireline signals from the Vibrator must be compared against the Wireline Reference from the Encoder.
The Wireline Reference is delayed from the True Reference Pilot by 2.77 milliseconds.
The Wireline connector has been available on the Pelton connector panels since the introduction of the Pelton Advance II in 1985.
Many recorders and seismic auditors expect to perform Wireline Similarities in this fashion.
The Force3 and VibPro HD still have this option available for "Legacy Mode" compatibility

LEGACY WIRELINE SETUP



5.4.2 F3 Polarity conventions

The Force 3 complies with the latest SEG polarity convention of 1993

The following definitions are used by the SEG polarity standard

Ground Force
The force applied by the vibrator to the earth, usually considered to be the dynamic alternating component of the total ground force.
For a P-wave vibrator in operating, but quiescent attitude, the ***GROUND FORCE*** *is a positive compression bias created by the Hold Down Force. In vibrating mode, the oscillating driven Ground Force alternates about the bias to result in alternately more or less compressive force than the bias.*

Weighted Sum Signal
The weighted sum of two accelerometer signals, the first accelerometer being mounted to the reaction mass and the other being mounted to the baseplate assembly. The positive weightings applied to the accelerometer signals before summing are proportion to the values of mass of the assemblies to which they are respectively attached.
The ***WEIGHTED-SUM SIGNAL*** *is useful for approximating the value of the alternating component of the GROUND FORCE. Using the polarity convention for the detectors described in this paper, a negative lobe on the weighted –sum signals corresponds to positive downward compressive ground force.*

Summary

The SEG polarity standard recommends testing the "crew" polarity and documenting the polarity accurately. The SEG Polarity does not specify a certain crew polarity, but does require that the crew polarity be determined and recorded.

After 20 years, the following is typical of what the client requires for crew polarity.

Geophone – Tap on top of Geophone- Motion Down – should produce positive voltage.

Accelerometers mounted on Vibrator – Tap on top of Accelerometer – Motion down – should produce positive voltage

Weighted Sum computed with above polarities should be in phase with the reference signal used for the Pilot signal (correlation operation).

Weighted Sum – 0 degrees -- Reference

Ground Force signal should be 180 degrees out of phase with the Reference signals. The Ground Force can be approximated by the accelerometers if the accelerometers are polarized so positive voltage is produce by upward motion.

Ground Force– 180 degrees -- Reference

Most of the Signals on the Force III are defined as "Ground Force" Signals. When not reversed these "Ground Force" Signals are 180 degrees out of phase with the "Reference" signals as suggested by the SEG convention.

The 19 pin VSSS connector provides signals that can be polarized for either “Ground Force” or “Weighted Sum”

Scaled Similarity System 19-pin connector

REFERENCE and GROUND FORCE 180 degrees out of phase

Reference “+” = pin F
Reference “-“= pin E
Ground Force “+” = pin P
Ground Force “-“= pin R

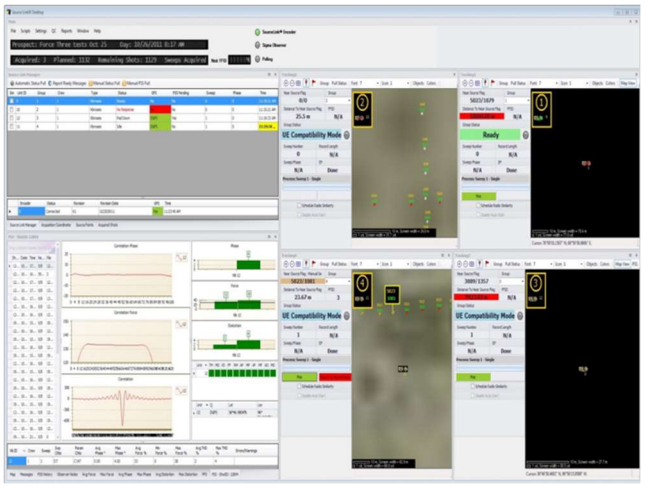
REFERENCE and Weighted Sum 0 degrees out of phase

Reference “+” = pin F
Reference “-“= pin E
Weighted Sum “+” = pin R
Weighted Sum “-“= pin P

5.5 Force 3 Software

SSC Software

5.5.1 SourceLink software Requires license to fire shots
Central Control software for the Force 3 system.



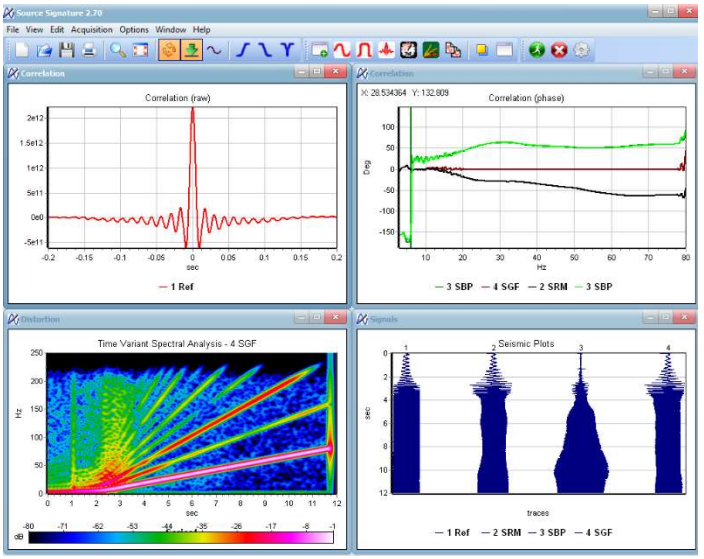
Controls all aspects of the production for some Nodal Recording systems. SourcePoints are loaded and each shot point can be shot from the Central Controls system
Allows operation of Advanced High Production Vibroseis Modes like

- Slip Sweep
- ISS
- DSS – Distance Separated Sweeps
- Combinations of Slip Sweep and DSS

All PSS data is retrieved and plotted on the screen
Radio Sims are performed and plotted
Source Times and position reports are generated. These are used by many of the Nodal Systems for acquiring and processing the Shot Records.
Save and Load projects – Generates production reports. Loads SPS files and converts to SEG-P1
Loads and Saves operational parameters for the Force3, BB3 and RTM3. Also downloads data and uploads source points.

5.5.2 SrcSig

Vibrator QC program



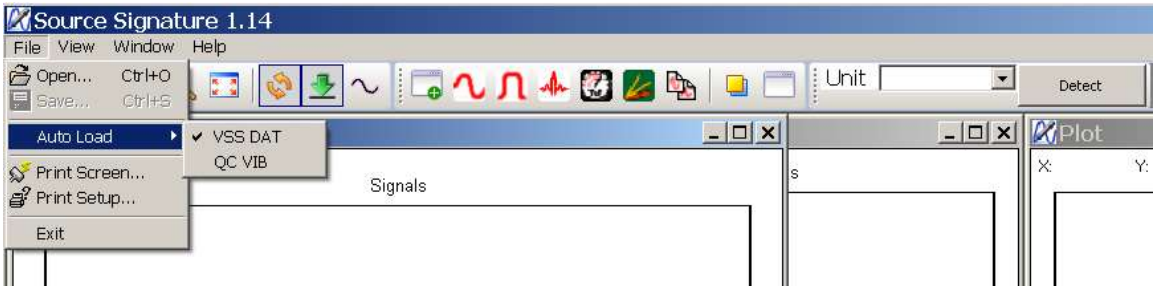
Loads the vibrator signals from the Force 3 or Bird Dog system. Displays the following QC plots

- Raw wiggle traces (time domain plot)
- Phase Plot (typically Reference vs. Ground force)
- Fundamental Force Output
- Peak Force output
- Distortion
- Etc.

Can load data directly from the Force 3 unit

Saves data to SEG-Y files
Loads SEG-Y or SEG-D files
Can load multiple files and combine them
Real Time QC of the Vibrator signals – Loads both VSS and VibQC data

SrcSig can be connected directly to the F3 unit and the VSS or VibQC data can be viewed and analyzed.
Connect Ethernet Cable from computer to the F3 unit
Be sure the IP address of your computer is set correctly (normally it is set to fixed IP address of 10.0.0.101.)
Start the SrcSig software.

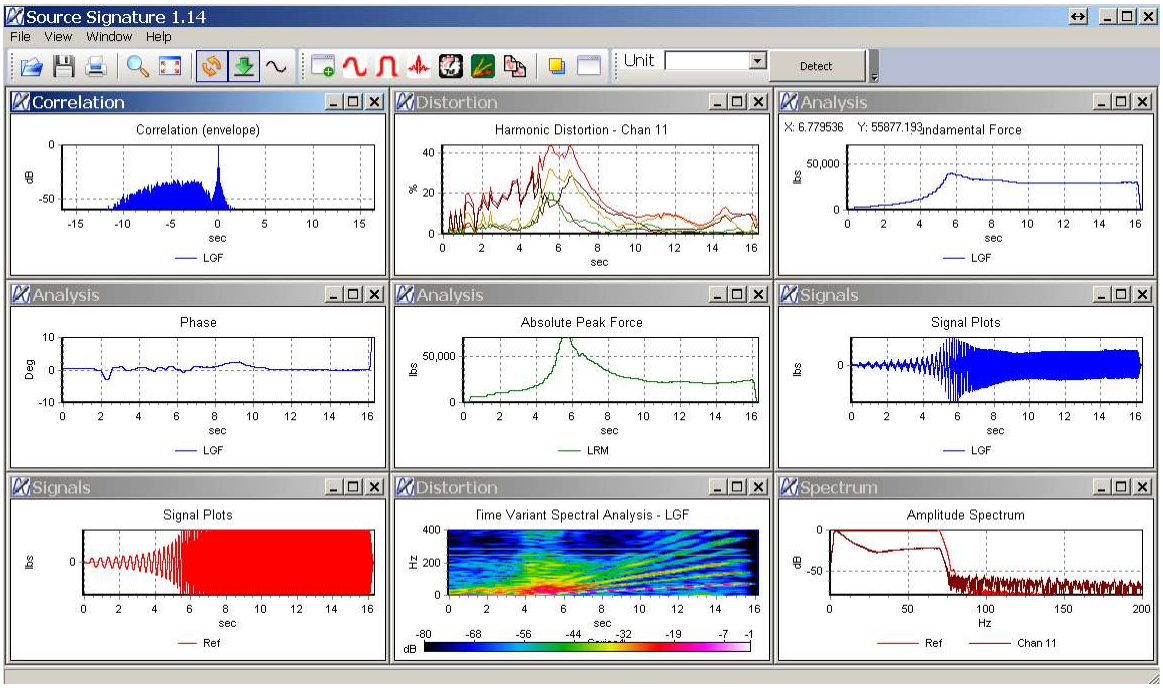


The F3 serial number should appear has a Detected Unit.

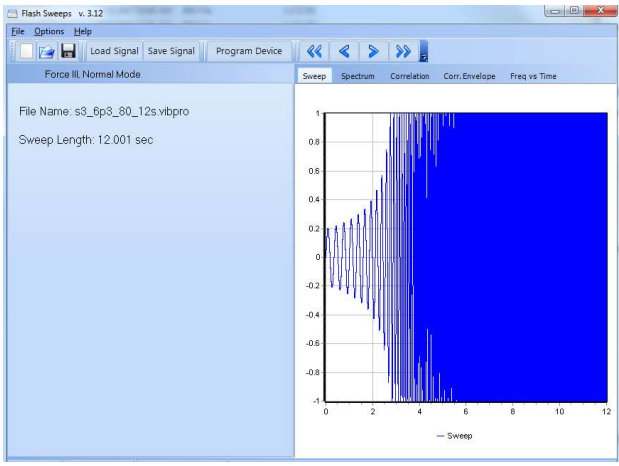
Go to File – Auto Load and select either VSS DAT to view the 3 channels from the VSS recorder, or select the QC Vib to view all of the control signals from the Vib.

When QC Vib is selected the Vib Record option in the TEST menu of the Force III must be set to "ON"

Run a sweep and the data will automatically be uploaded to the computer when the sweep is finished.

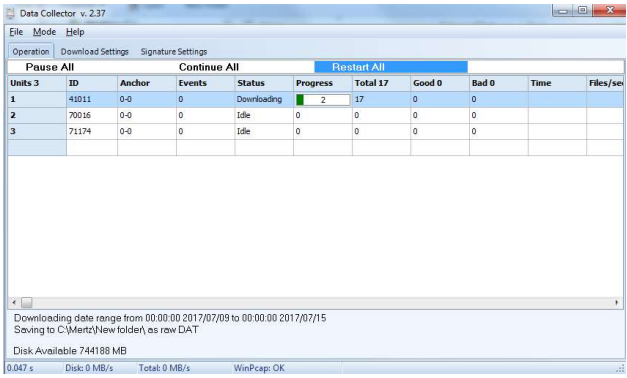


5.5.3 Flash Sweep



Sweep Design and Analysis program
Load non-linear sweeps to the memory on the Force 3 system
Must use this program for the Maximum Displacement Sweeps
View and analyze the data
Save the Data directly to the Force 3 via Ethernet or WiFi connection
Save the data to a USB memory stick. The USB sticks can be used to upload the data to the Force 3 system

5.5.4 Data Collector 2



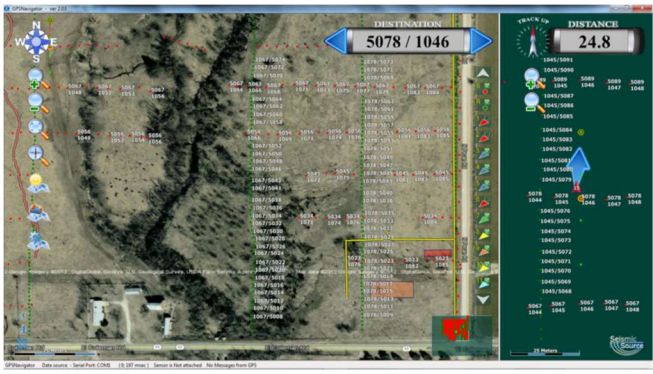
Can connect directly to the Force 3 Ethernet port or via WiFi
Download all the stored Vibrator Signature Files
Can be Saved to SEG-Y or DAT file format
Can load Source Positions, Near Flags can be added to the SEG-Y header and the Report Files

5.5.5 Data Collector 3

Can connect directly to the Force 3 Ethernet port or via WiFi
Download all the stored Vibrator Signature Files
Can be Saved to SEG-Y file format
Can load the saved VSS data file from the Force 3's USB sticks

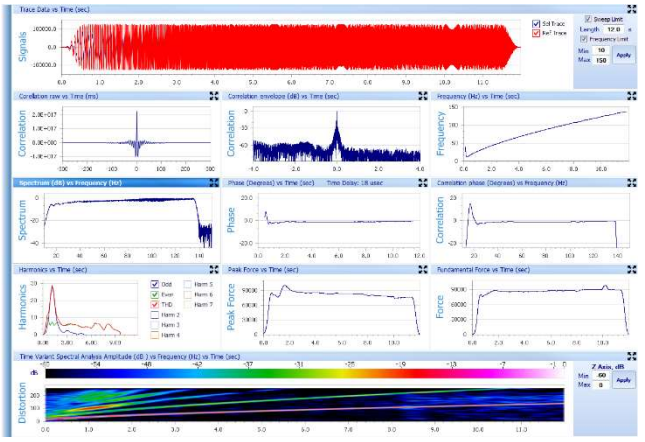
5.5.6 Navigation Software – requires license

Receives GPS positions for the Force 3 units via WiFi or Ethernet
Shows position of vibrator on the screen
Shows source points – distance to Source Points
Keep out areas etc..



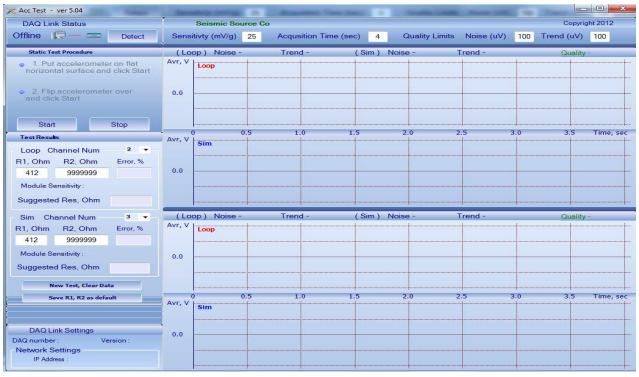
5.5.7 VibTest Software- requires license

Vibrator Quality control program
Generates standard reports
Analyze Wireline sims from 3rd party systems- Reads SEG-D and SEG-Y files



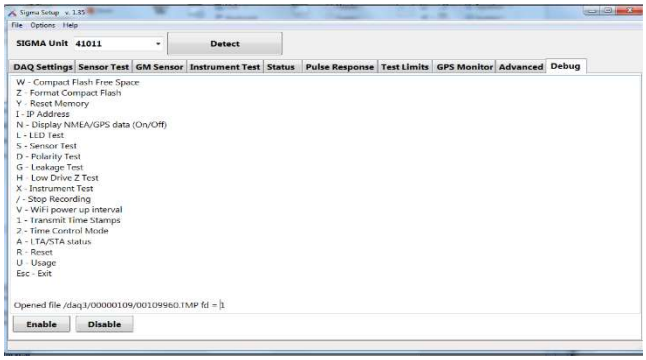
5.5.8 Acc Test –

Used with the BD3-11 system
Test M5 or M6 accelerometers



5.5.9 Sigma Setup

Software used to diagnose issues with the Force 3 system
Allows viewing status of the central control system
Debug windows shows details of various operations
Troubleshooting tool. Not used for general operation

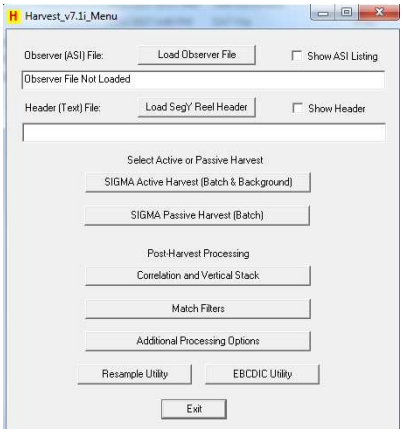


5.5.10 DAQFlash

Used to upgrade the Firmware on the Force 3 units
Firmware can be loaded via Ethernet Cable or DAQFlash can write special file for the USB memory sticks and firmware can be loaded using the USB memory option

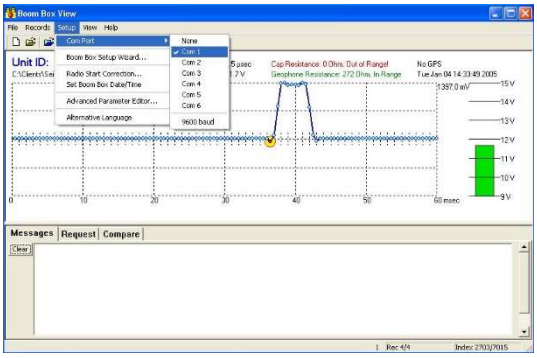
5.5.11 Harvest

Can be used to combine multiple days of Vibrator QC data
SIF file from SourceLink can be used to generate SEG-Y data with all the Vibrator Source Signature data from all the vibrators
Resample Data option
SEG-Y to SEG-D conversion



5.5.12 BBview and RTM software

Program used to setup RTM and BB units
Will not work with newer BoomBox3 and RTM3 units

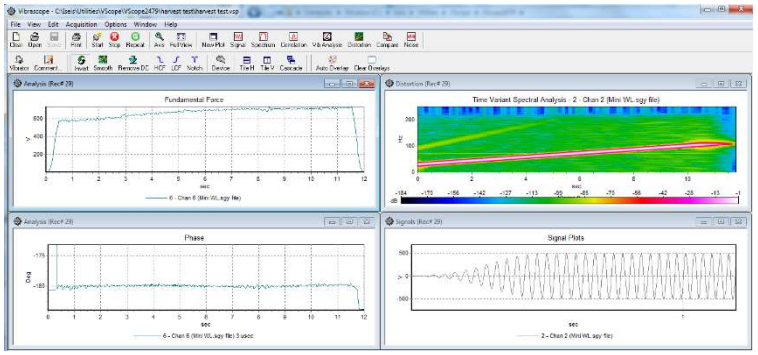


5.5.13 Source Control

Simple easy to use Force 3 control software
Load and verify Sweeps and Keyboard parameters
Start different vibrators and sweeps via radio start codes
Run and evaluate Radio sims
View PSS data

5.5.14 Vscope

Older Vibrator QC program with similar features as SrcSig
Vscope should not be used with the Force 3 System.
Many of the signals will be clipped when viewing with Vscope



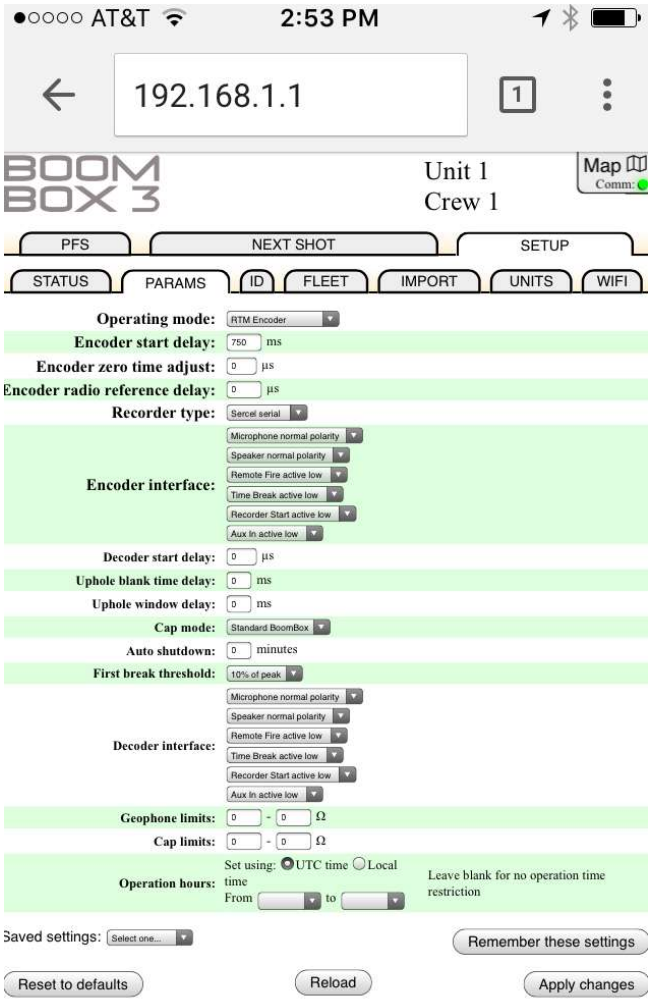
5.5.15 GPS Tracker software **- requires license**

Track All Vehicles on any Seismic Crew
Specifically Designed for Seismic Industry
Loads Standard Surveying Files (SP1)
GeoFencing with Buffer Zones
Multiple Layers
Alerts for unauthorized movement
Monitor from anywhere – Reports Automatically sent to the "Cloud"

5.5.16 BoomBox-3, RTM-3 and WTB-3 Browser

Web Browser is used to setup BB3, RTM3, and WTB3 units
Most computers, cell phones and tablets can be used
BB3 and RTM3 use the web browser based Interface. The web browser interface can:

- Change BB3 and RTM3 parameters.
- Load Source Points
- Download QC log
- Check shot data plot



5.6 Source Signature System – DAT file and VSS analysis

The FORCE-III units have a built-in Scaled Similarity System and Source Signature Recorder. This system uses 32-bit A to D convertors to provide a low noise and high-resolution recording of the vibrator's performance. After the data has been downloading using the "Data Collector" software, the following signals are recorded:

- Trace 1: Reference Signal – (Pilot signal)
- Trace 2: Reaction Mass Force signal
- Trace 3: Base Plate Force signal
- Trace 4: Ground Force approximation using the weighted sum method.

Also recorded in the header

- GPS position
- Time of start – nanosecond resolution
- Selected Flag or Near Flag – Nearest source point
- Shot ID/File Number

The DAT files or VSS files from each sweep are automatically saved by the Force 3 on the internal CF card and on the optional USB stick if it is installed.

5.6.1 VSS Quality control

On a typical crew, thousands of VSS files can be generated. It is important to have a good quality control procedure to assure all the VSS files are collected and the Vibrator system is working properly.

The Force 3 VSS system uses the "Sim" accelerometers, while the Force 3 control system uses the "Loop" accelerometers. Any single failure in a Loop or Sim accelerometer will result in bad VSS files.

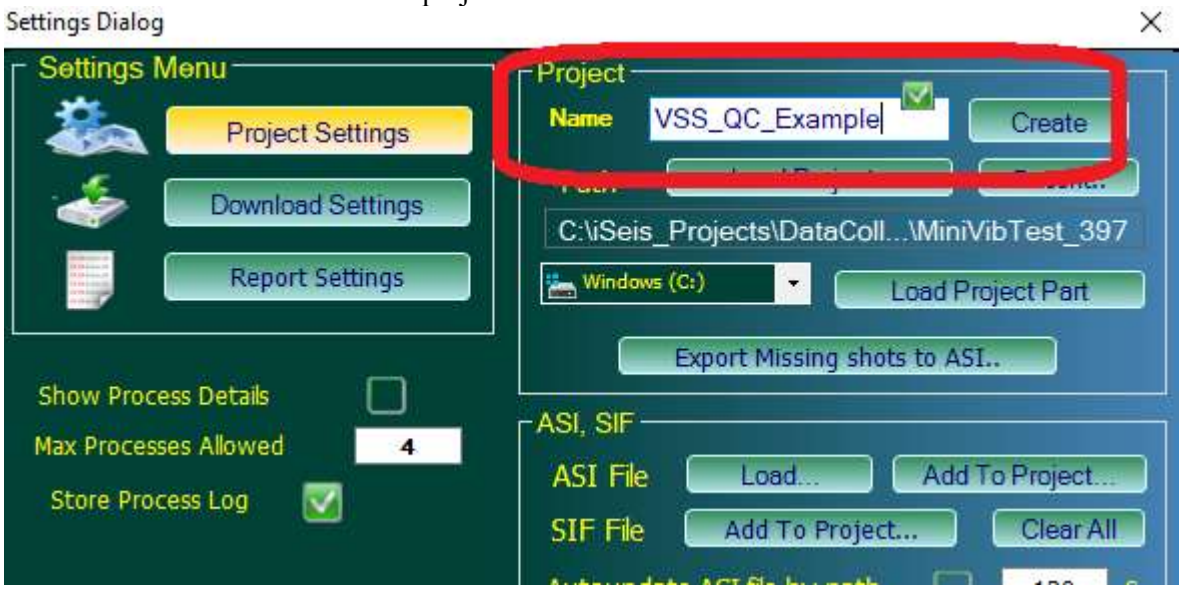
The following Procedure should be performed:

1) Data Collector 3
    a. Load the ASI and SIF files
    b. Download the data from the Vibs and Encoder using the ASI and SIF files
        i. The computer can be connected directly to the Force 3 to download.
        ii. Or the USB sticks from the Vibrator Can be inserted into the computer.
    c. Report is generated to show how many files are downloaded from each vibrator and how many are missing based on the SIF files.
2) Harvest (optional)
    a. If multiple vibrators are used in a group, then Harvest can be used to combine the data from the multiple vibs
    b. Harvest will also combine the Encoder Reference.
    c. Load the ASI and SIF into Harvest and generate the Shot Records.
    d. Report will be generated showing how many files are missing from each unit.
3) VibTest – VSS Report
    a. The VSS report can be generated from any of the following:
    b. Raw Dat files from the Force 3 USB sticks
    c. SEG-Y files from the Data Collector Program
    d. VibTest will analyze all the Records for Phase, Force and Distortion and generate Graphs.

5.6.2 VSS QC Example

5.6.2.1 Data Collector

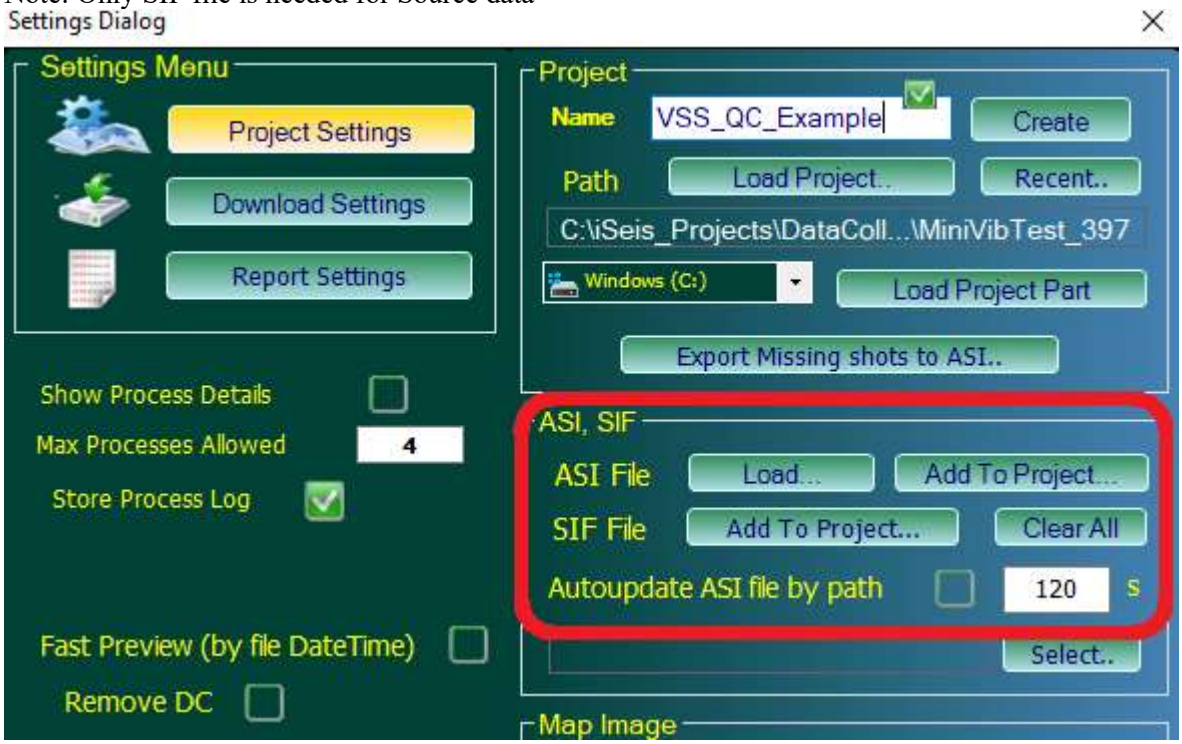
Start Data Collector and Enter new project name. Press Create



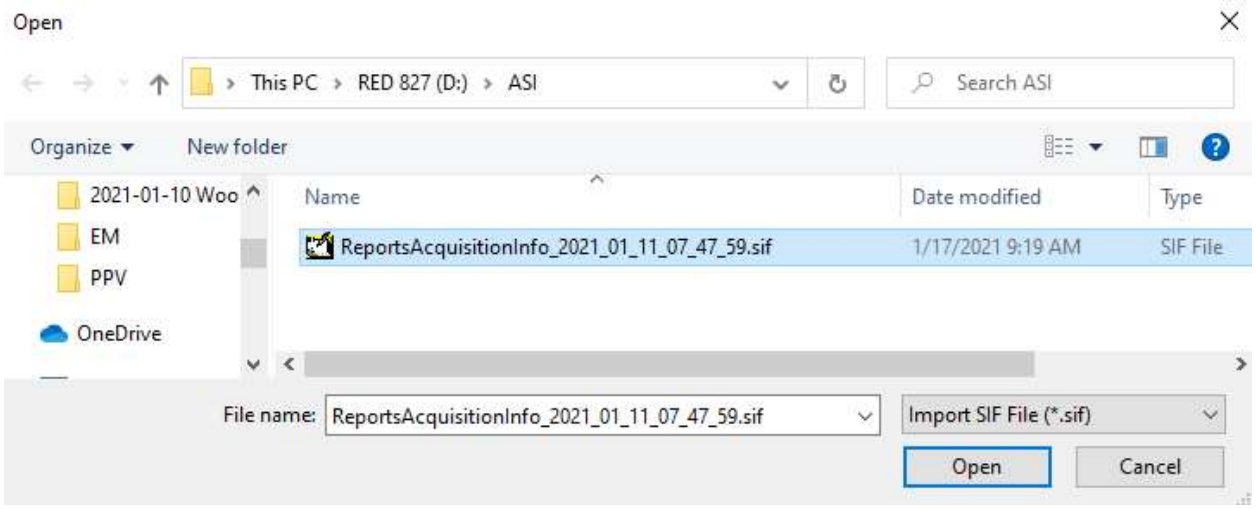
Load SIF files

The ASI and SIF are generated by SourceLink and contain the Vibrator Sweeps that were used for production. Using the ASI and SIF files will only download the production sweeps. Any warmup or tests sweeps will not be downloaded.

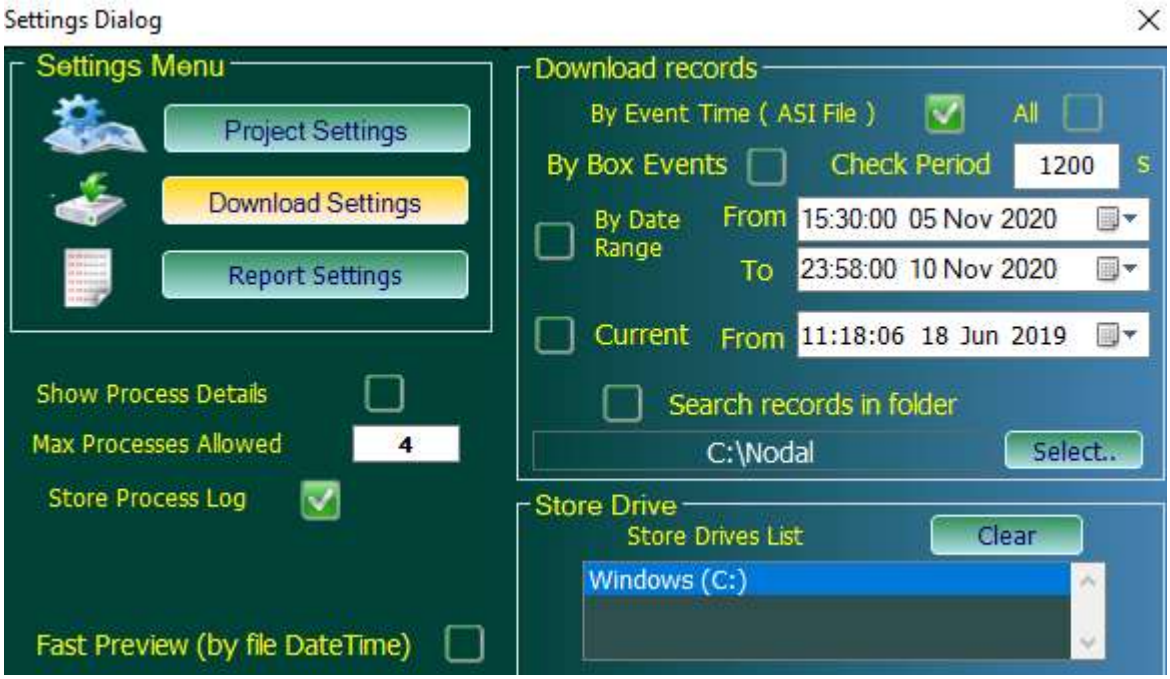
Note: Only SIF file is needed for Source data



Load the SIF (Source Information File)

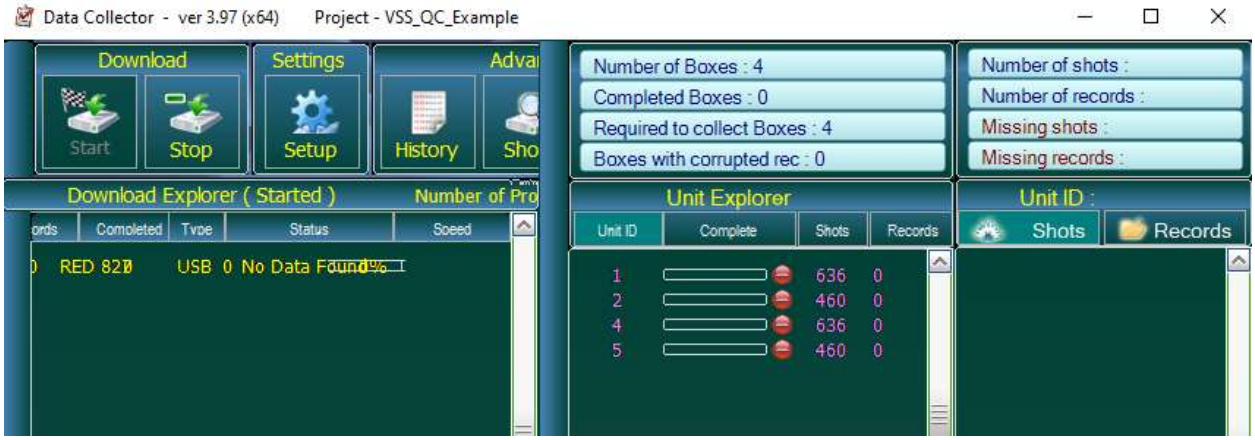

Open
This PC
RED 827 (D:)
ASI
Search ASI
Organize
New folder
2021-01-10 Woo
EM
PPV
OneDrive
Name
Date modified
Type
ReportsAcquisitionInfo_2021_01_11_07_47_59.sif
1/17/2021 9:19 AM
SIF File
File name:
ReportsAcquisitionInfo_2021_01_11_07_47_59.sif
Import SIF File (*.sif)
Open
Cancel

Go to the “Download Settings”
Select by Event Time (ASI File)



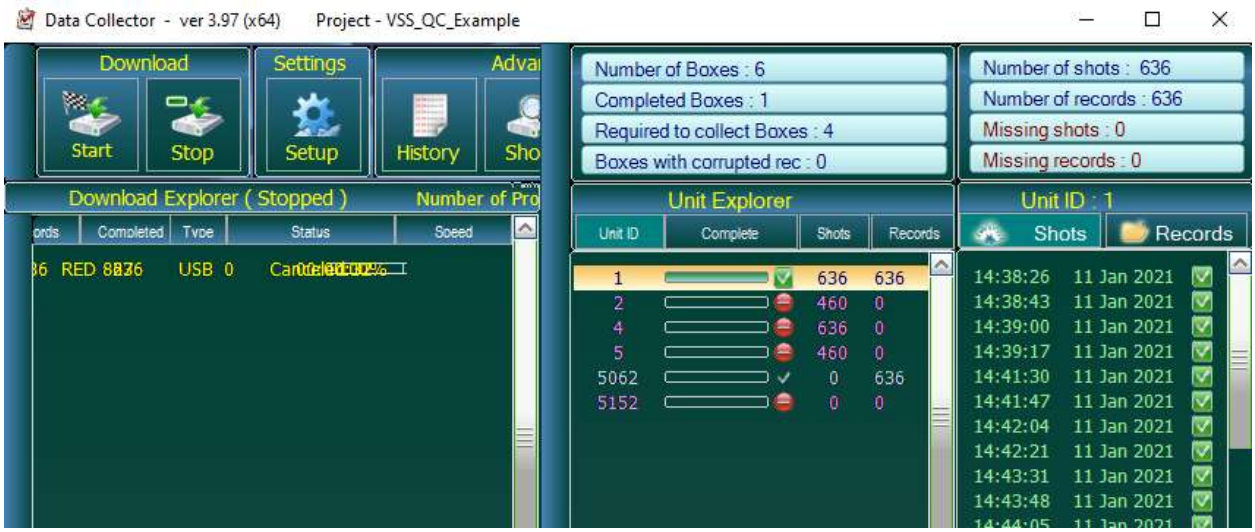
Make sure there is a Drive Selected in the “Store Drive” List

Go to main Window.
Unit Explorer will show each vibrator Number and the Number of sweeps that was included in the SIF file.
The example below shows 4 different vibrator units.
Unit 1 and 4 were in one group and shook 636 times.
Unit 2 and 5 were in another group and shook 460 times.



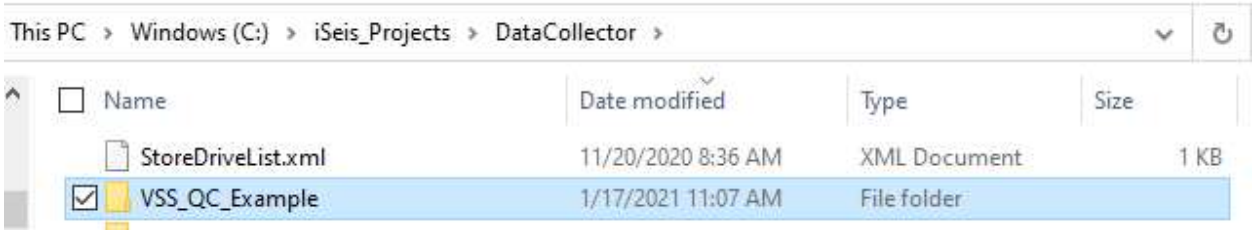
Press start and insert a USB stick from the Vibrator.
The data will download.

The records to be downloaded are shown. The  icon shows that the record has been found and is waiting to be downloaded. The serial number for each vibrator is shown

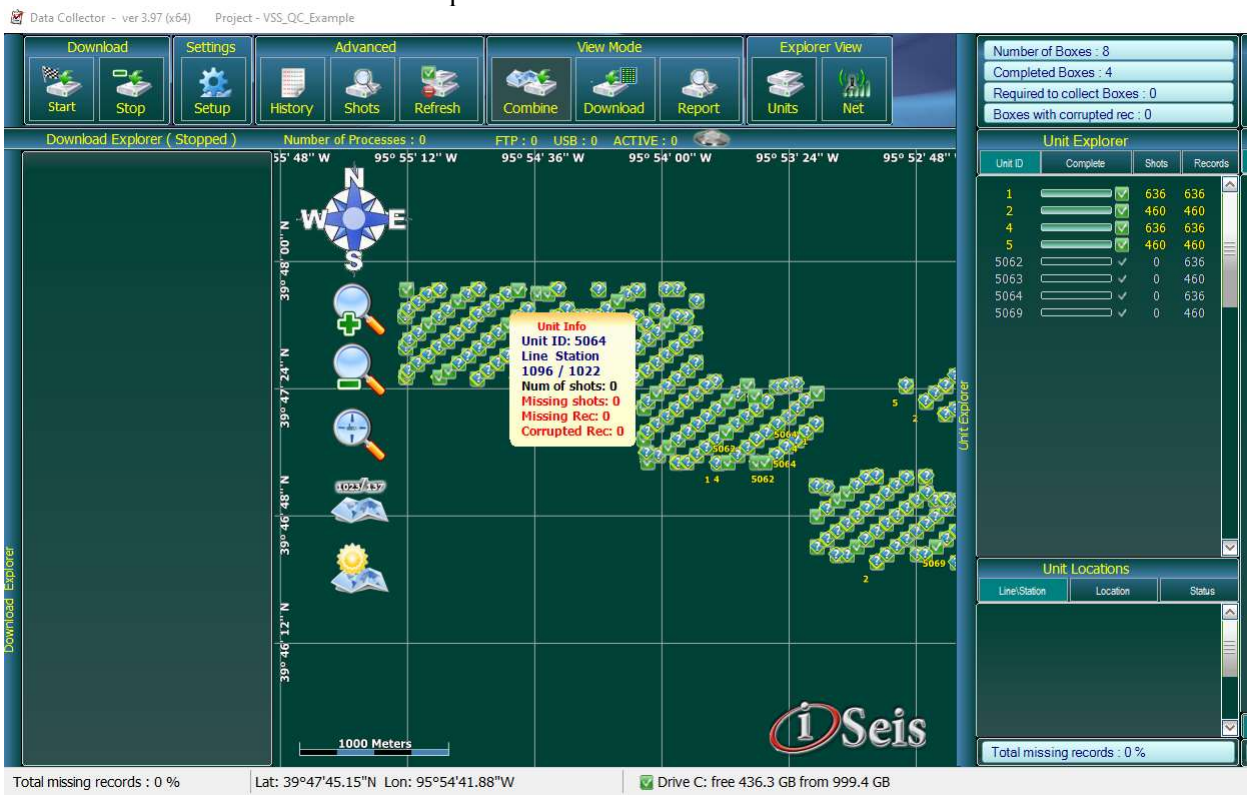


A check mark will appear, and the records found will be displayed.

Once all the data has been downloaded. The time of any missing records can be displayed.
Go to the Project folder in the iSeis_Projects/DataCollector folder and the report file can be viewed.



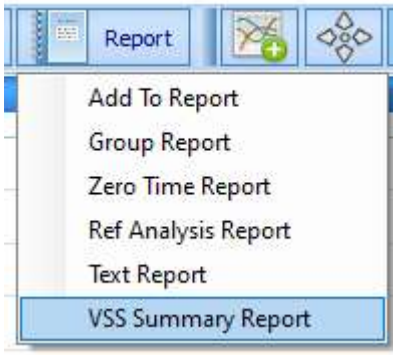
Once the data has been loaded the Map can be used to view the data



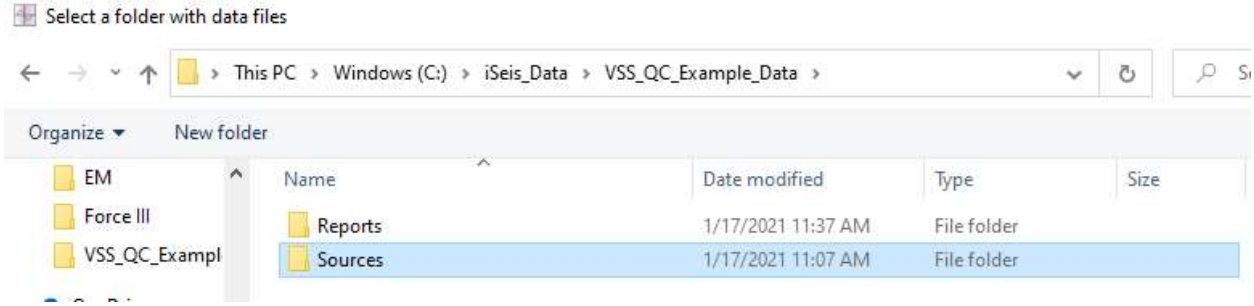
The summary of each vibrator download is shown.

5.6.2.2 VibTest

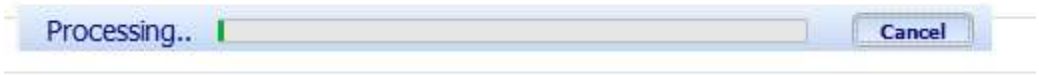
The VibTest program can analyze the data collected by the Data Collector program.
Start Vib Test and load a record into the program from analysis.
Setup all X and Y axis.
The go to the report section and select “VSS Summary Report”



The downloaded data from the Data Collector program can be analyzed.
Select the Sources subdirectory in the Project directory in the iSeis_Data subdirectory.



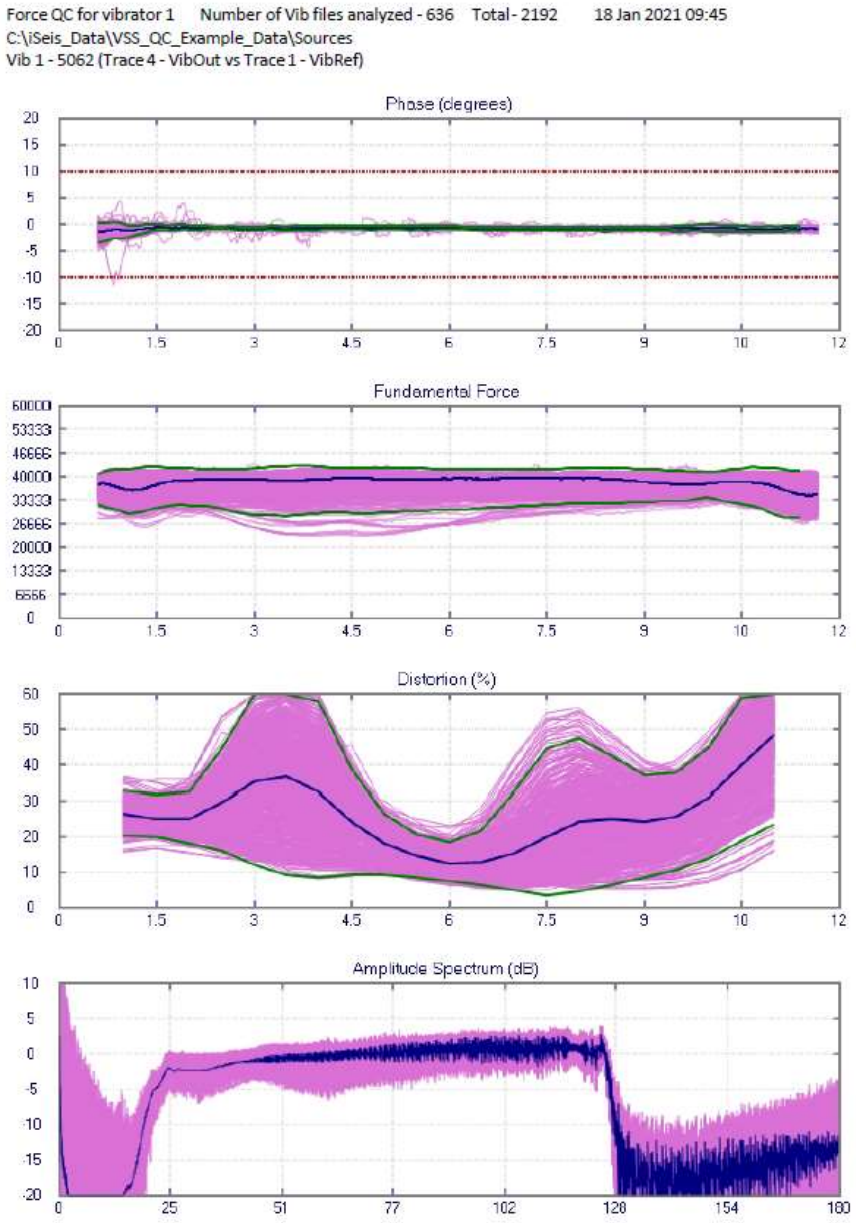
Once Selected Press Select and the VibTest program will process all the source files found in this directory.



Once processing is completed the VSS summary report will be displayed

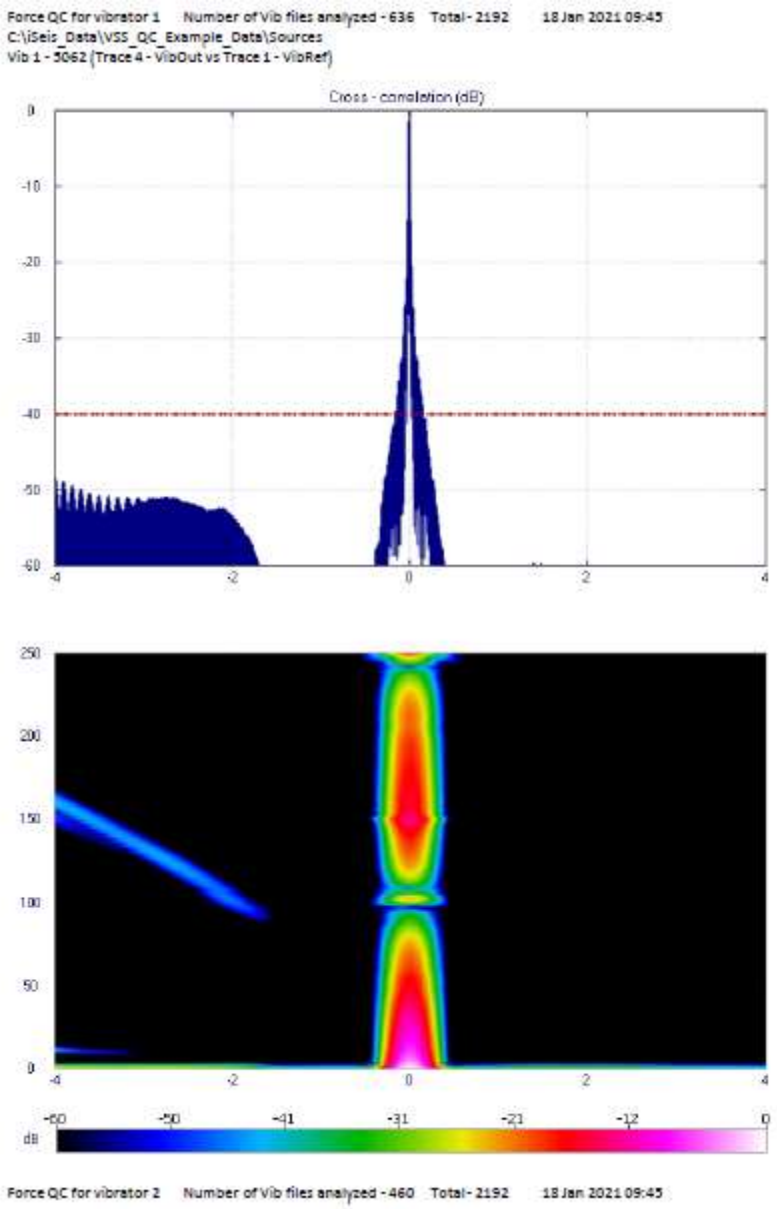
5.6.2.3 VSS summary Report

The VSS summary report analyzes all the sweeps for each vibrator number. The Text shows the number of sweeps analyzed for each vibrator number.
Reports for Each Vibrator Number are shown.
The Phase, Distortion, and Amplitude Spectrum overlays the results for all the sweeps. The Dark Blue Line is the average, the Green Lines are the 90%



The Cross Correlation for each sweep is stacked and the result is shown.
The top plot shows the summed cross correlation envelope. In the Example below the Noise in negative time shows how the harmonics will correlate in the seismic record.
The bottom Plot is a time variant harmonic distortion plot of the Stacked Cross- Correlation wavelet. This plot also analyzes the distortion. It also shows the effect of the distortion on the

seismic data. This plot shows the time the distortion will appear and the amplitude and frequency of the distortion.



6.0 F3 Options

6.1 GPS data

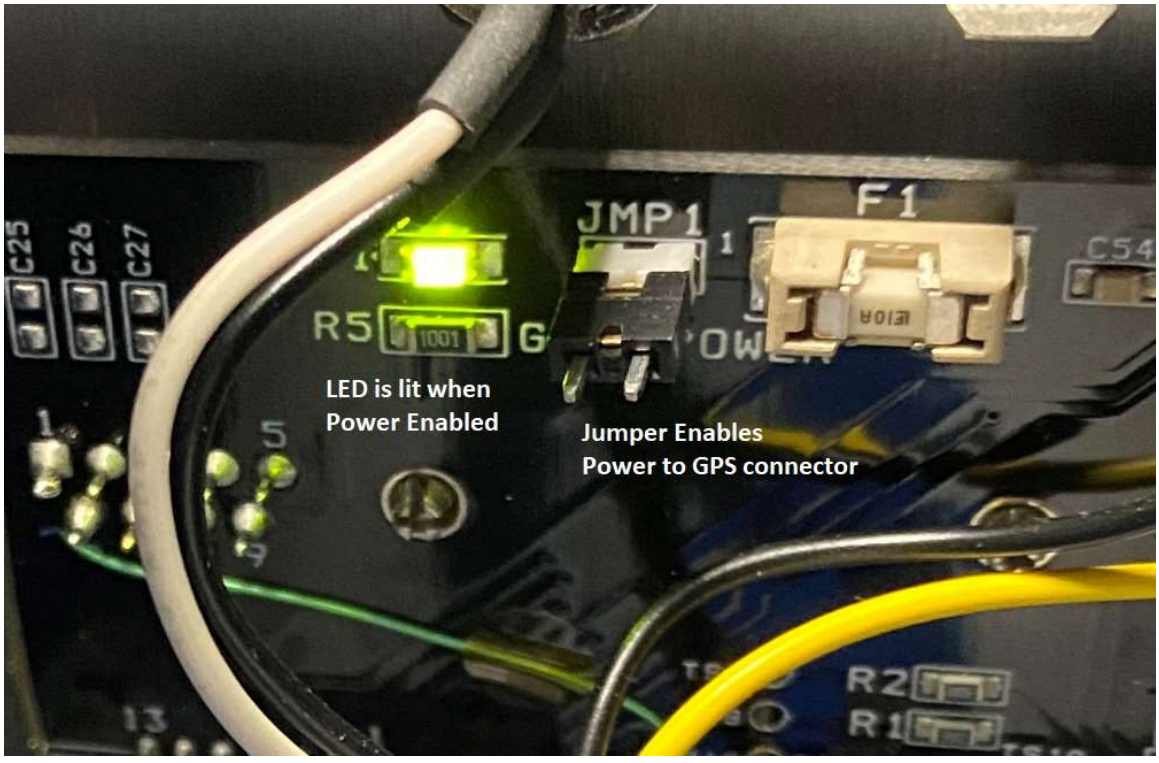
An accurate GPS is connected to the GPS -9 pin D-sub connector. The GPS is used to provide accurate timing to the Force 3 system.

Battery power +12 volt can be provided on the 9 pin connector. This will power the Seismic Source GPS receiver.

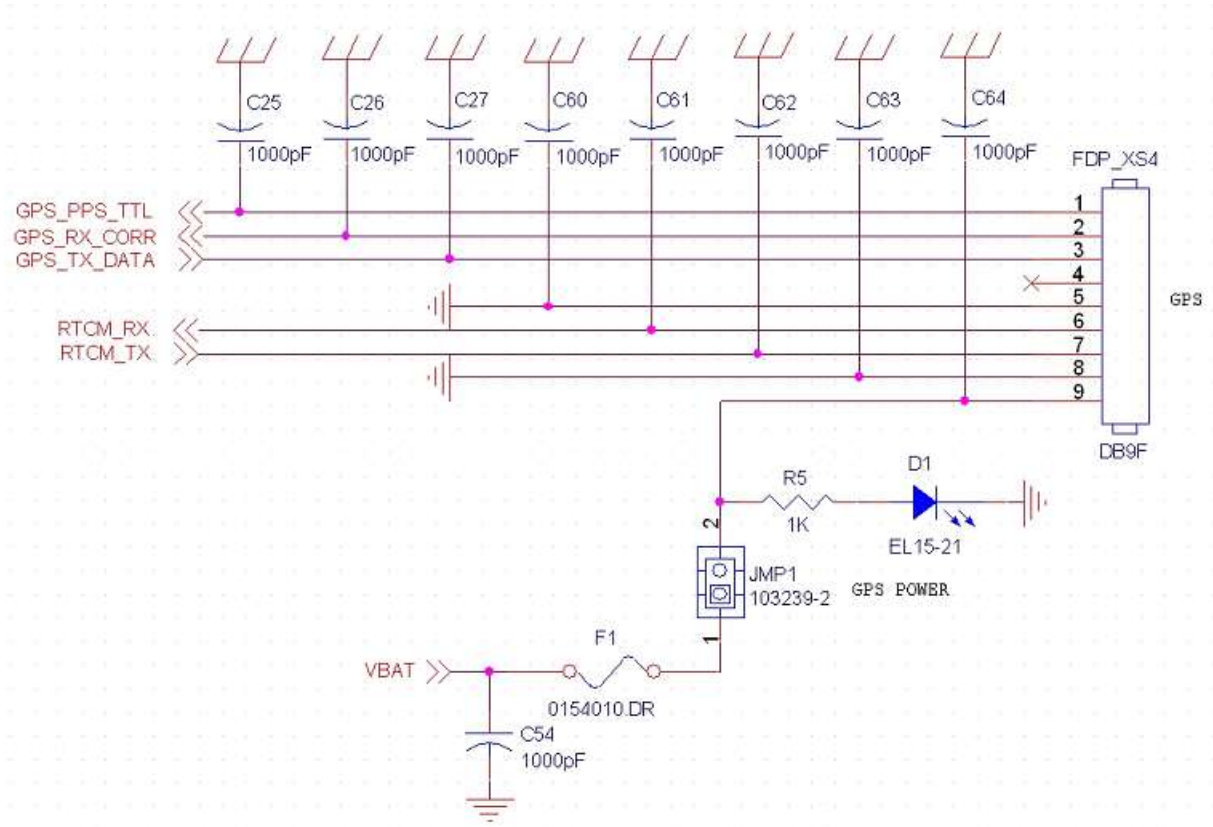
Jumper JMP1 Enables the power out (pin 9 - + battery and pin 5 is GND) of the 9 pin GPS D sub connector. When the Power is enabled the GREEN LED will be lit. See picture below.

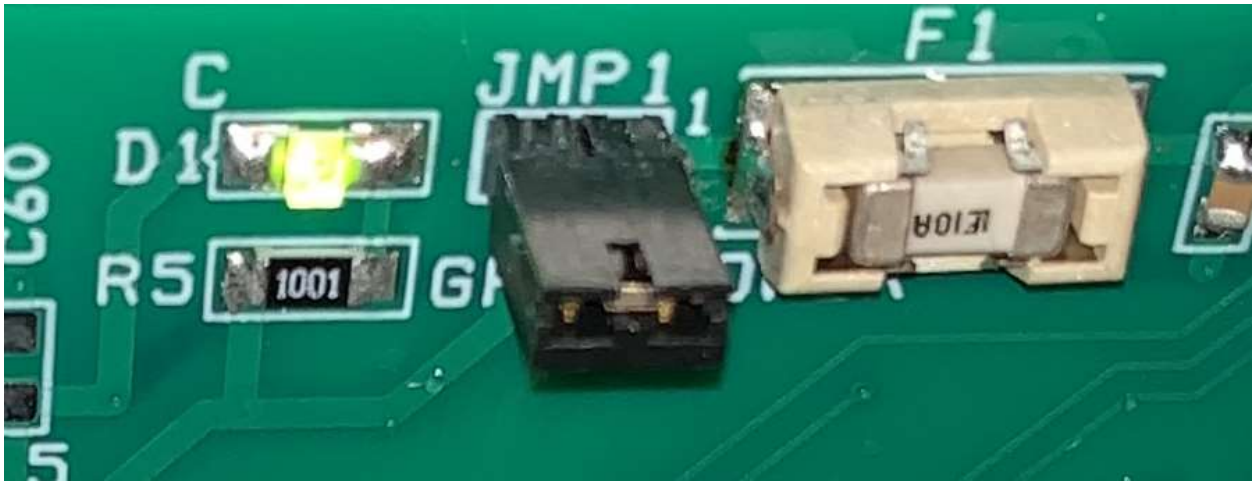
The Force 3 units are shipped with the Power Disabled.

This jumper is on the inside of the Force 3 behind the 9 pin GPS D-sub connector.



The F1 fuse is on the upper middle of the Data Panel Board. JMP1 is just left of the F1 fuse.





Above the LED, D1, is illuminated when JMP1 is connected.

F3 controller is setup to receive external GPS strings at 19200 baud rate, in format as defined in NMEA 0183 standard and supports following messages:
GPGGA – used for timing, position, elevation
GPGSA – used for DOPs
GPRMC – used for timing, navigation

Force III firmware 14.50 and later also supports all $Gx prefix. (Includes Glonass support)

For detailed documentation of GPS strings format please refer to GPS receiver documentation and NMEA 0183. All other message types are being ignored by F3 unit and can be turned off.
F3 controller is also capable to provide power to external Receiver through 9-pin DSUB connector "GPS" on Data Panel of F3 unit. For more detailed information on the connector pin-out please refer to Connector chapter at the end of this manual.
Pulse per Second (PPS) setup
F3 expects PPS pulse to be **positive**, **low going high**. Duration of PPS pulse is typically set to 1 millisecond.

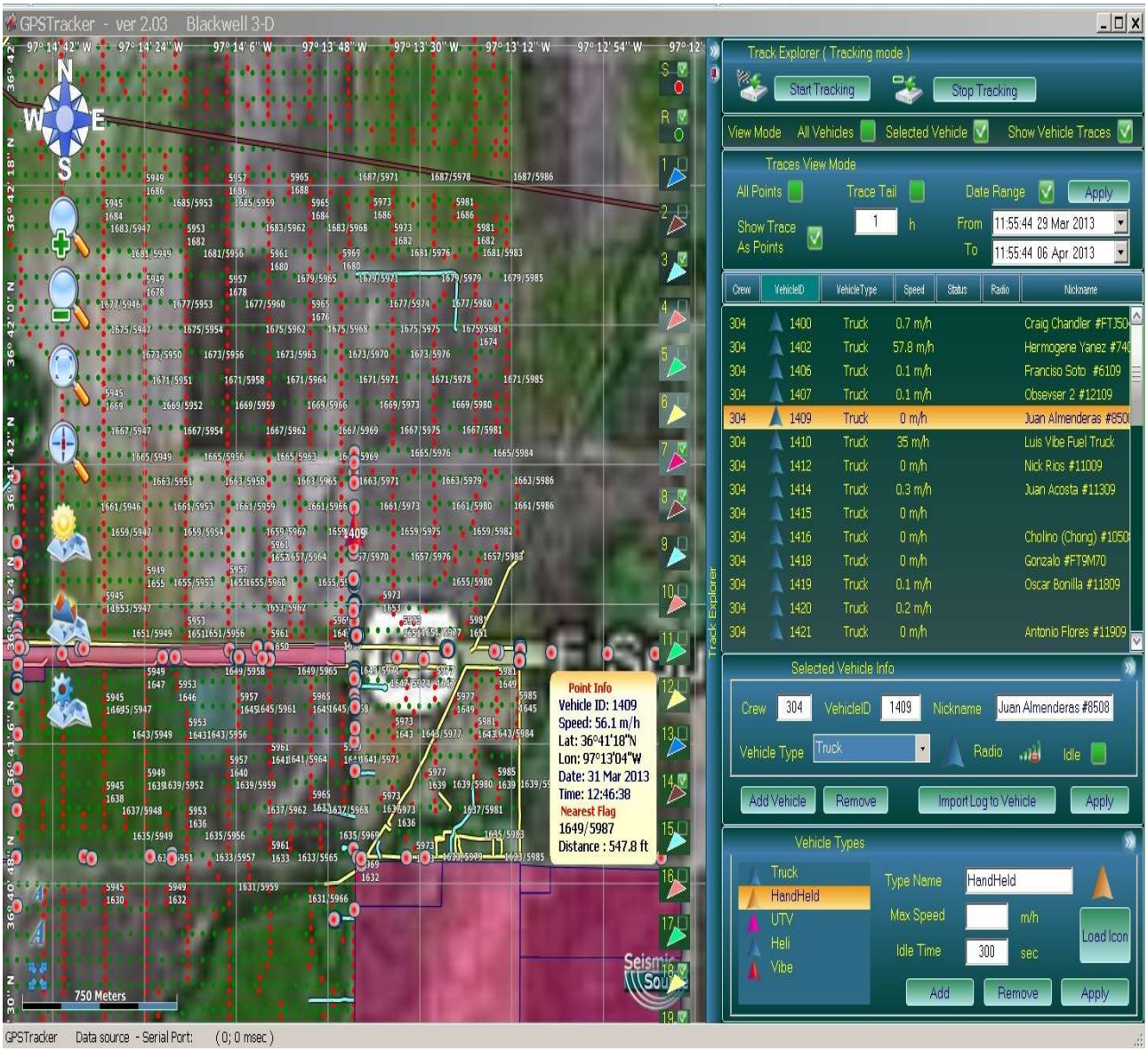
Warning: If wrong (negative) PPS polarity is used, F3 adjusts its clock to a following edge of PPS and this will introduce the delay in the system clock and affects Start-on-Time Start Codes. The delay in this case will be equal to duration of PPS pulse.
Elevation
F3 unit reports elevation back to recorder, based on ***signed sum***(H+N or Ellipsoidal height, h) of the following fields from GPGGA message:
Altitude of antenna above/below sea level, in meters (H – Orthometric height)
Height of geoid (mean sea level) above WGS84 ellipsoid (N – Geoidal separation)

6.2 Navigation and Tracking Option

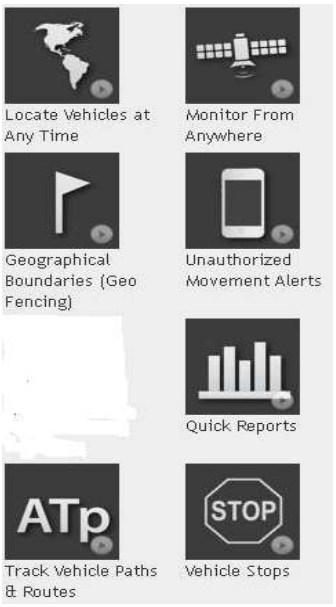
A Separate Tablet computer and Wi-Fi unit can be added for a complete Vibrator Navigation package.

GPS Tracker & Navigator Software

Real Time display and History of all Vehicles and Personnel on Crew Safety Reports and Legal documentation
Built around Google Earth – Data Reports free to everyone



GPS Tracker software



Specifically Designed for Seismic Industry
Loads Standard Seismic Surveying files (SEG P1)
GeoFencing with Buffer Zone
Vehicle Paths and Routes
Multiple Layers – Easily selected for display
Alerts for unauthorized movement or Vehicle stops
GPS Tracker software can capture data from multiple Tracker locations.

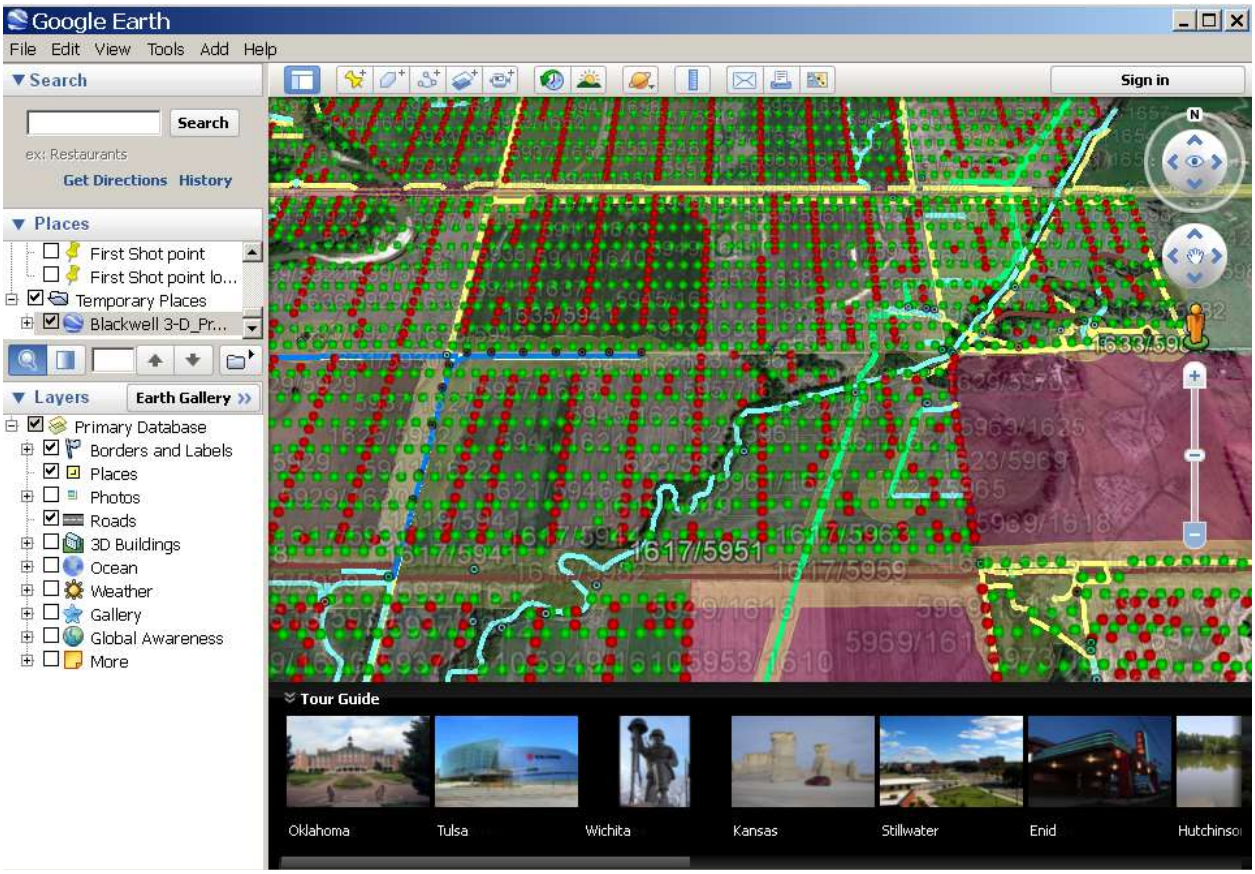
- Seismic Recorder
- Coordinator
- Crew Office
- Data can be combined from all locations for comprehensive reports

Monitor Data From anywhere – Reports automatically sent to FTP server

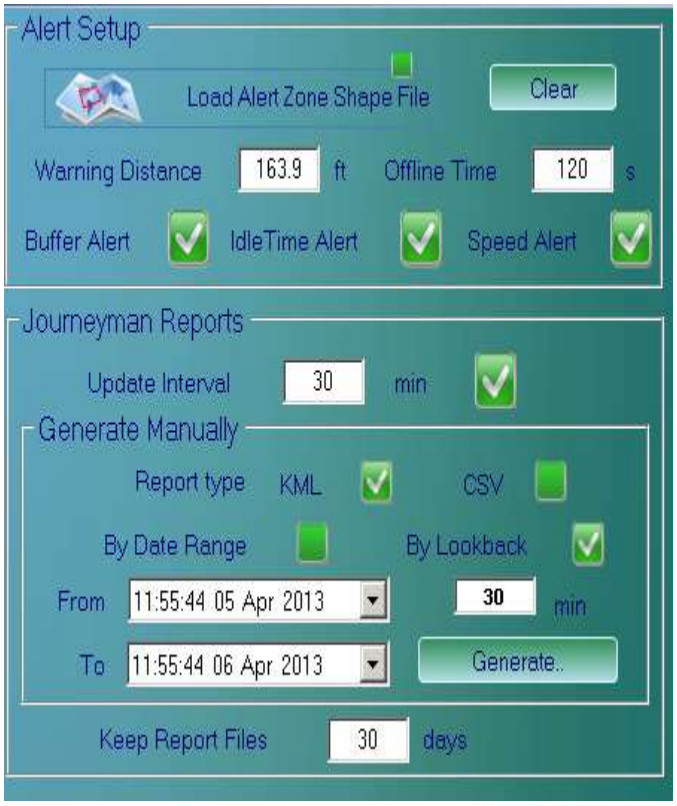

GPSTracker - ver 2.03 Blackwell 3-D
Point Info
Vehicle ID: 1418
Speed: 0 m/h
Lat: 36°39'58"N
Lon: 97°16'26"W
Date: 29 Mar 2013
Time: 13:57:18
Nearest Flag
1601/5890
Distance : 66.2 ft
350 Meters
Seismic Source

Input and GeoReference standard shape files on Import –
Global Mapper – built in
Maps and Graphics

- Import Shape files
- Import Google Earth background maps
- Import standard Survey SP1 files – Source and Receiver Flags
- Create custom Shape files



Alerts and Journeyman Reports



- Set any shape file as an Alert
  - Warning Buffers
  - Hazards
  - Restricted Areas
  - Speed Warning
  - Idle Alerts –
  - Alerts can be setup different for each unit being tracked

- Journeyman Report
  - Near Source or Receiver Flag
  - Journeyman report creation on Time interval (30 minute default)
    - Vehicle ID #
    - Vehicle type (handheld, Jug truck, Pickup truck, Helicopter etc.)
    - Nickname
    - Lat long position
    - Near Flag
    - Date and time
    - Any Alert during the time interval

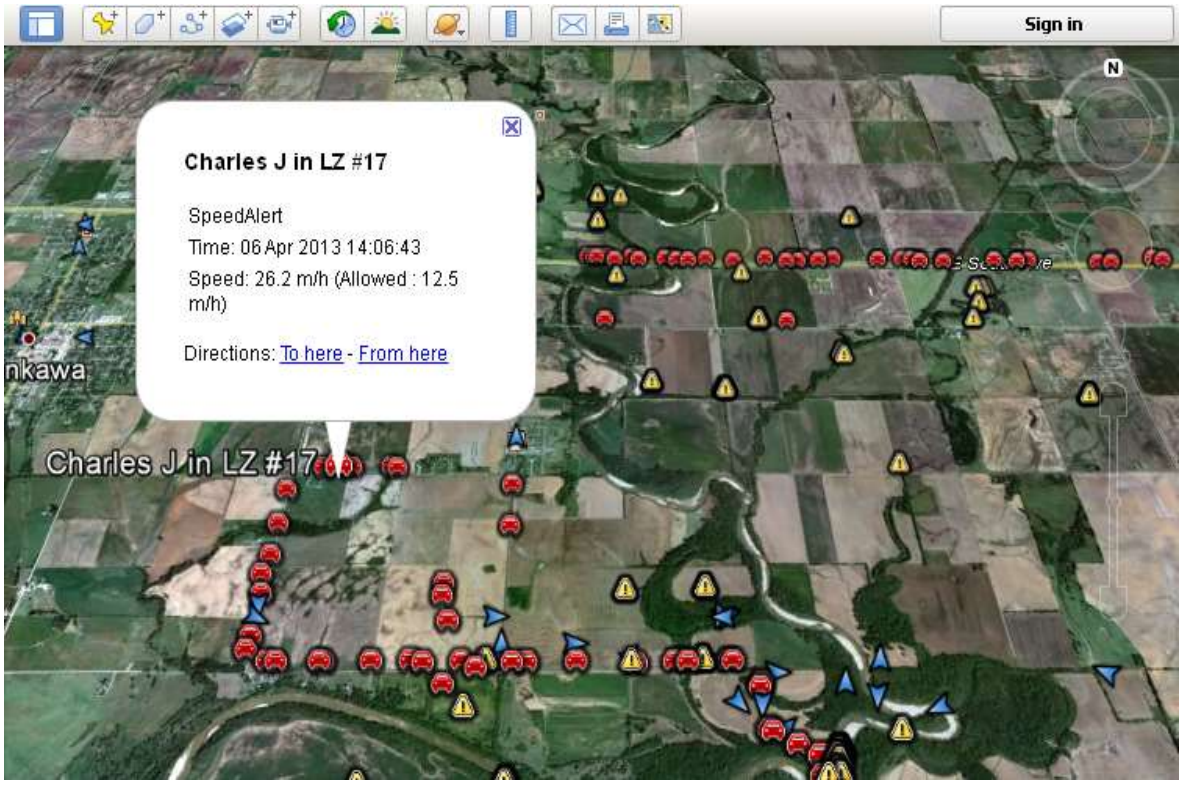
1	Journeyman Report			Saturday Mar 30 2013 12:22 PM									
2	Vehicle Type	Unit ID	Nickname	Last Reported Time	Latitude	Longitude	Nearest Flag	Distance	Zone Alert	Buffer Alert	Offline Alert	Speed Alert	Idle Alert
3	Truck	1400	Craig Chandler #FTJ504	3/29/2013 22:28	36°41'42"N	97°17'05"W	1665/5875	662.5 ft					
4	Truck	1402		3/29/2013 0:04	36°41'42"N	97°15'56"W	1665/5905	98.2 ft					
5	Truck	1406		3/29/2013 0:04	36°41'41"N	97°17'03"W	1663/5875	524.9 ft					
6	Truck	1407	Obsevser 2 #12109	3/29/2013 0:04	36°41'42"N	97°15'56"W	1665/5905	84.0 ft					
7	Truck	1409		3/29/2013 0:04	36°43'49"N	97°03'57"W	1795/6034	38164.5 ft					
8	Truck	1412	Nick Rios #11009	3/29/2013 23:30	36°43'53"N	97°03'57"W	1795/6034	38135.8 ft					

Vehicle Types

- Unlimited number of Vehicle types can be setup – handheld, UTV, Helicopter, VibroseisTrucks,and Pickup Trucks etc.
- Max Speed and idle time can be set for each vehicle type

Kml /Kmz Report

- Standard Google Earth Report
- Generated on local PC
- Send Reports to remote FTP server
- Crew operation is easily monitored from office
- Alert Only Reports Can be Generated
    - Can set time window – example 1 hour, 1 day, 1 month, etc...
        - Shows typical alerts
        - Speeding
        - Idle time
        - No permit area

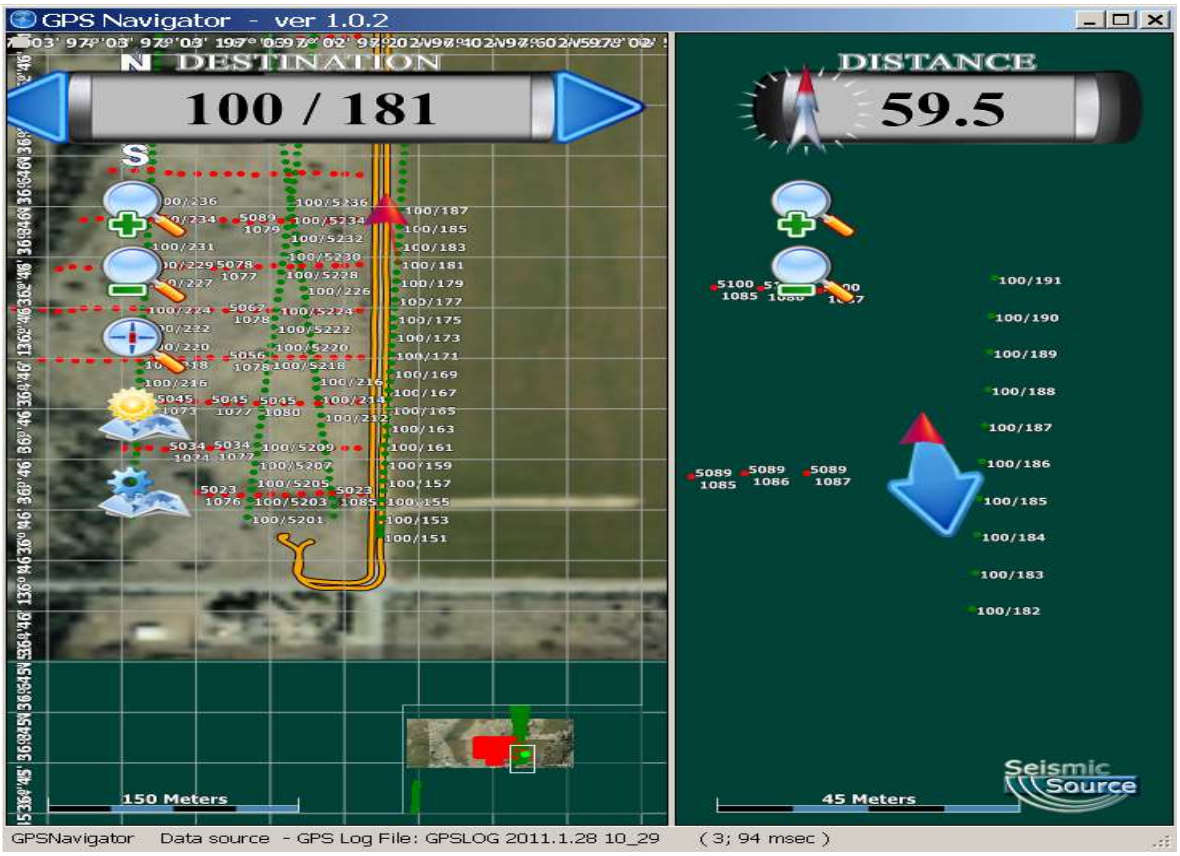


Real Time Viewing
Can view history of each vehicle or all vehicles

GPS Navigator Software

Uses same database as GPS Tracker software
Common layers and Geodetic support as GPS Tracker
Designed for Use with Force III and SourceLink software
Vibrator navigation – Displays all Vibrators in Group – Display source Points that I have been completed

- Dual Screen support for "zoomed" view and complete view of prospect
- Source and Receiver FLAGS can be loaded into the MAP package using standard formats.

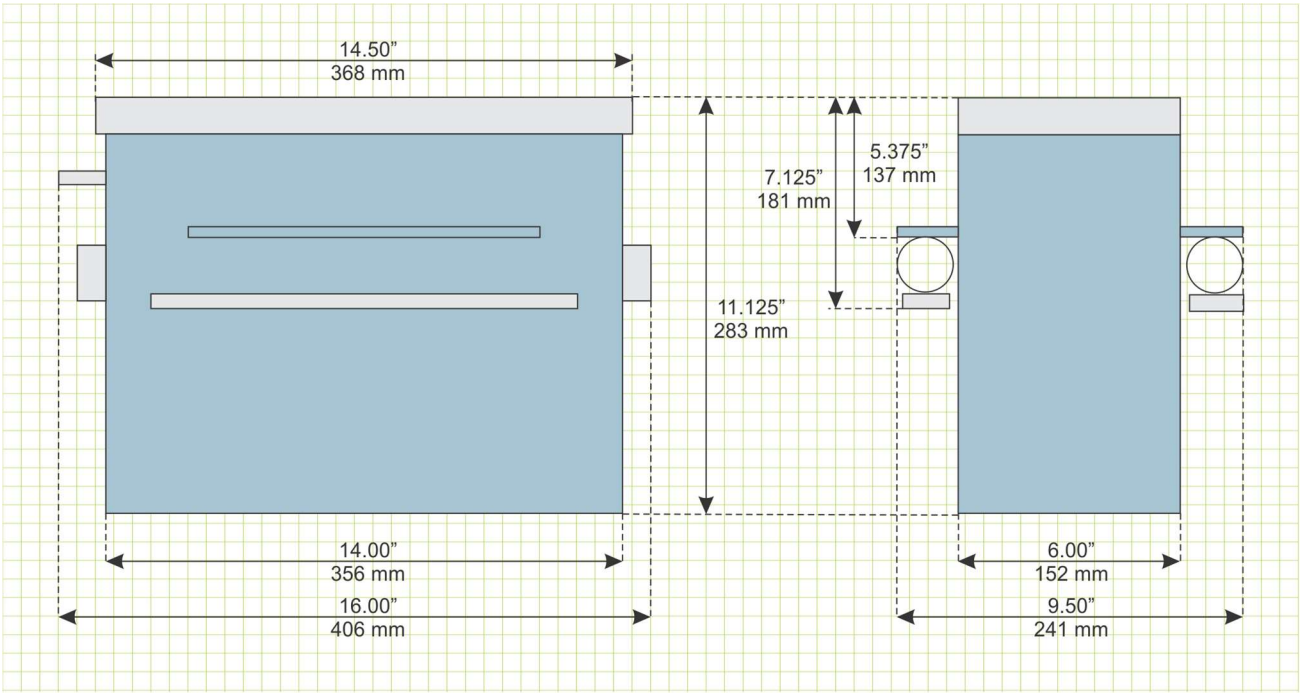


- Source Flags are easily selected as waypoints
- Next Flag and previous Flag selected by single keystroke
- Real-time display of Bearing and Distance to next waypoint
- Multiple map layers can easily be enabled or disabled
- Keep out zones can be displayed on Map
- Optimized for use with Touch Screen
- Routes and trails can be recorded and loaded for "drive around" guidance
- External Compass option for reliable direction information
- Google Earth Support for quick downloads of background maps
- Display of Vibrator Group information

Installation

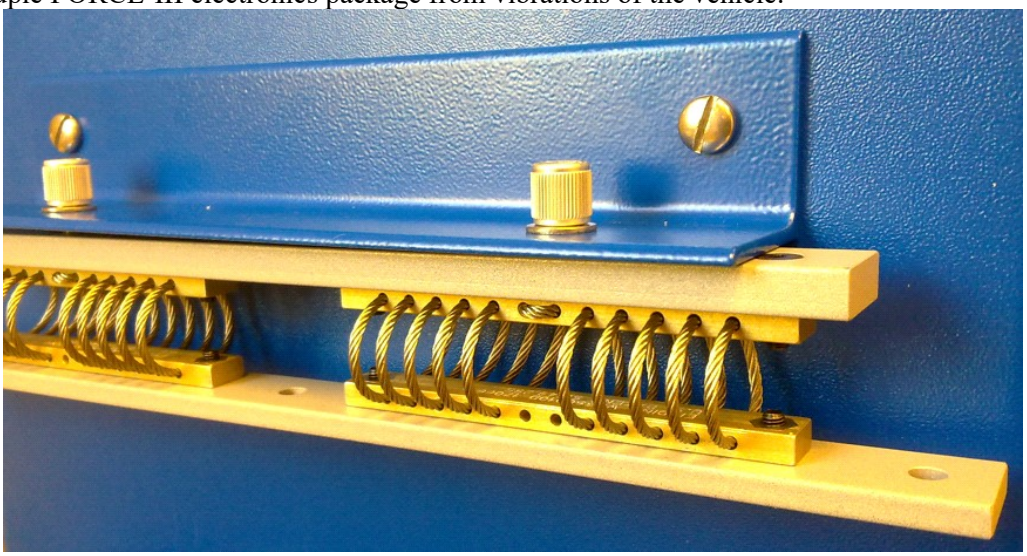
Controller's dimensions

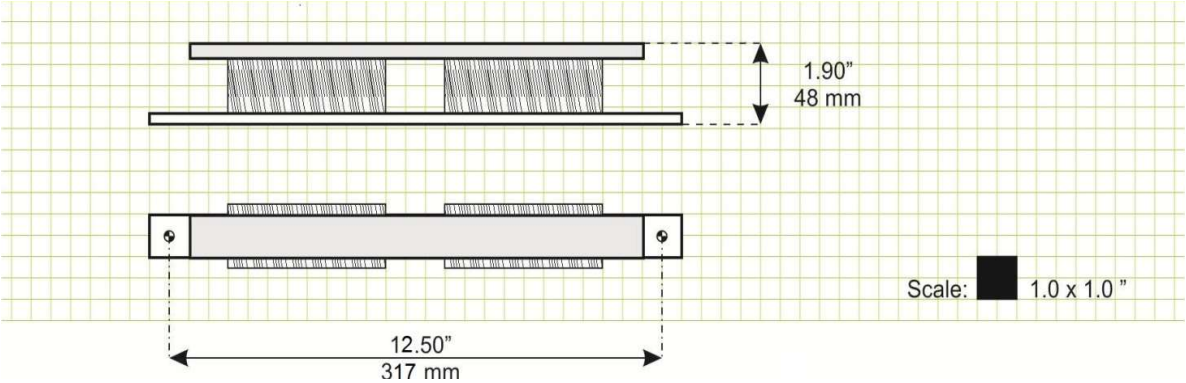
FORCE-III controller's dimensions for mechanical installation are shown here. The drawing below includes dimensions of shock mount assembly and the bracket for it. Additional space should be considered for the cable connections on the front and back of the unit.



Shock Mount Assembly Mounting dimensions

The part shown below is Shock Mount Assembly (FGF3150-1).Two of them must be used to decouple FORCE-III electronics package from vibrations of the vehicle.



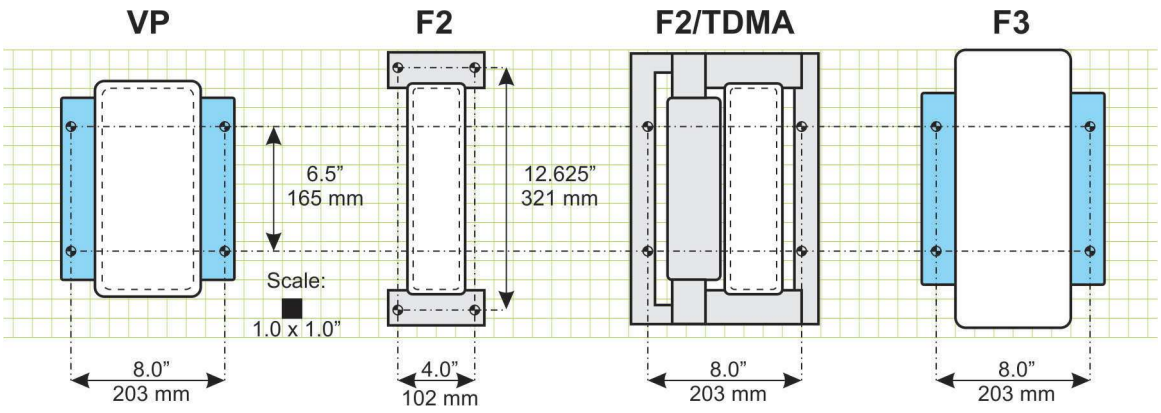


Mounting dimensions

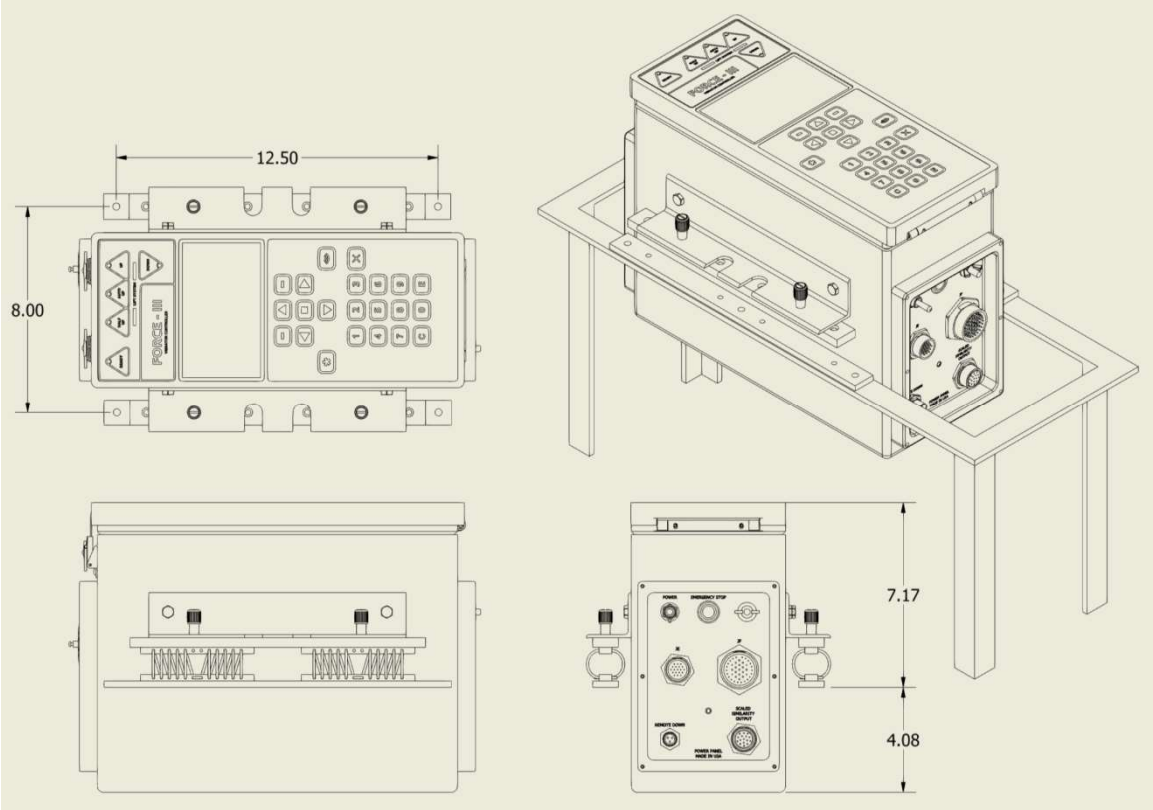
Vibrator Electronics L-Bracket Mounting dimensions

The top view drawing below shows different vibrator electronics packages and L-bracket mounting dimensions for comparison and installation. L-bracket captive screw thread size is 1/4-28.

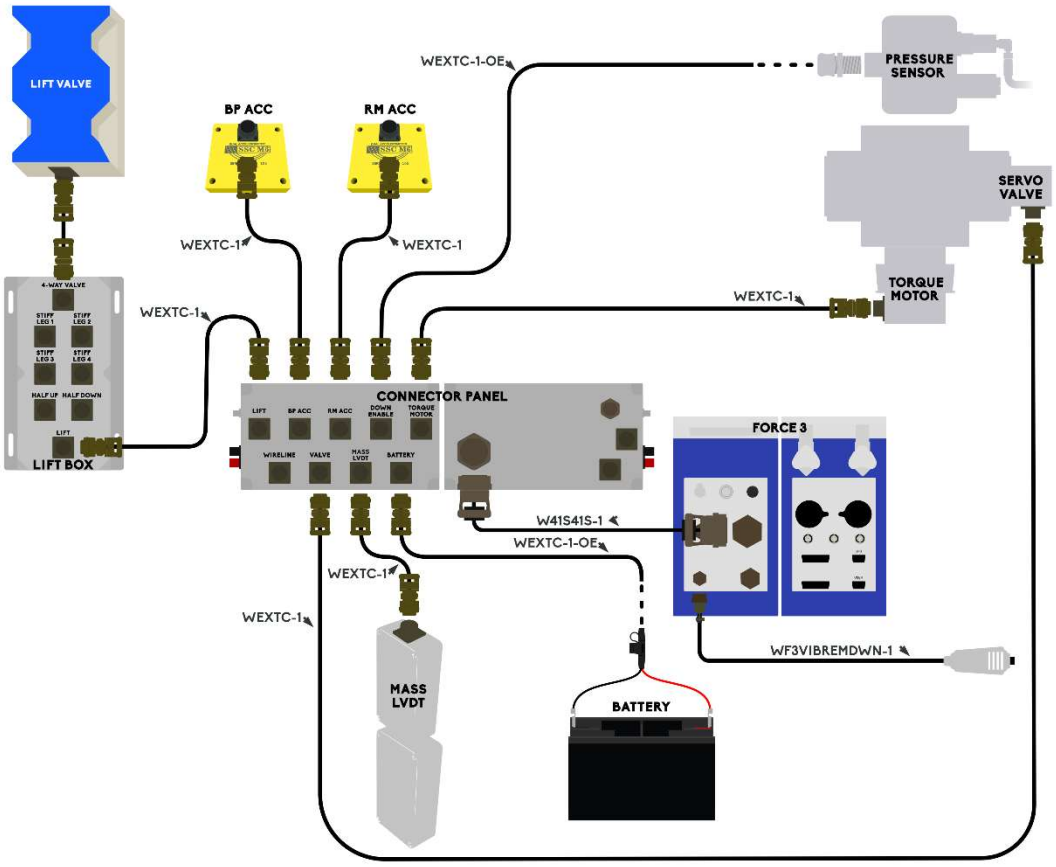
Various legacy packages top views are shown below for dimension comparison.



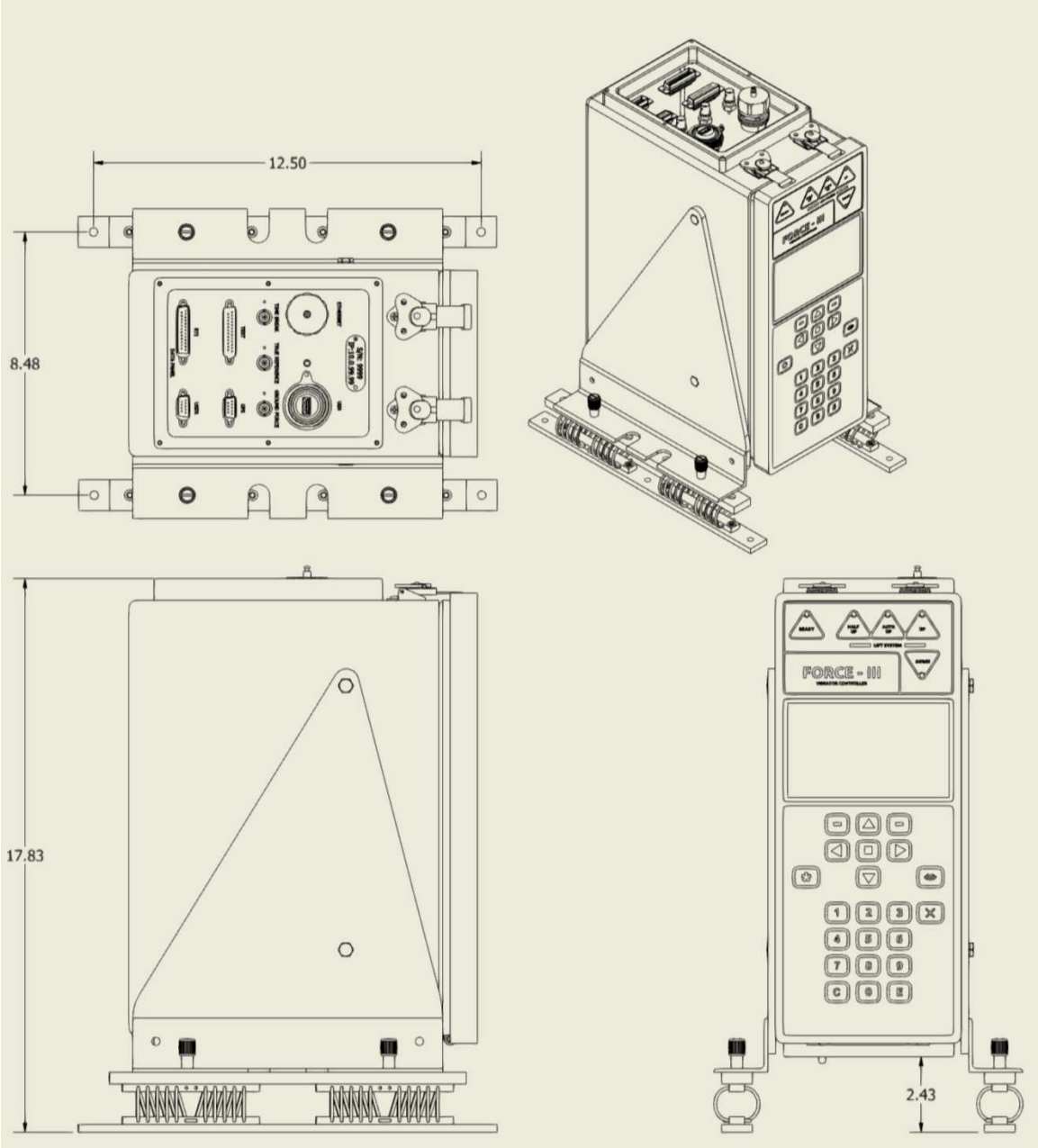
Force 3 Decoder Mounting



F3 Standard Decoder Connections
Vibrator Wiring



F3 Encoder Mounting



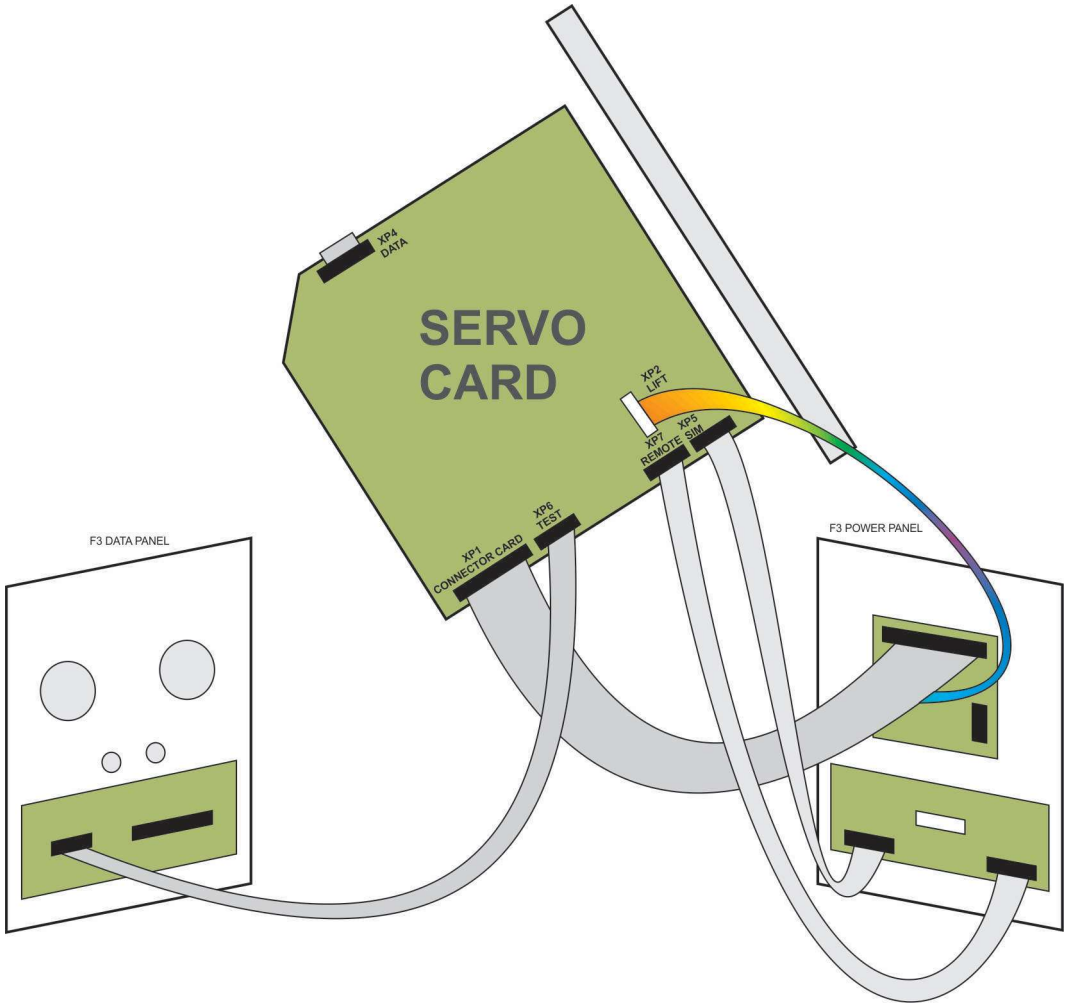
References

Internal cable connections

Servo Card Cables (Unit's right side)

Consist of cables:

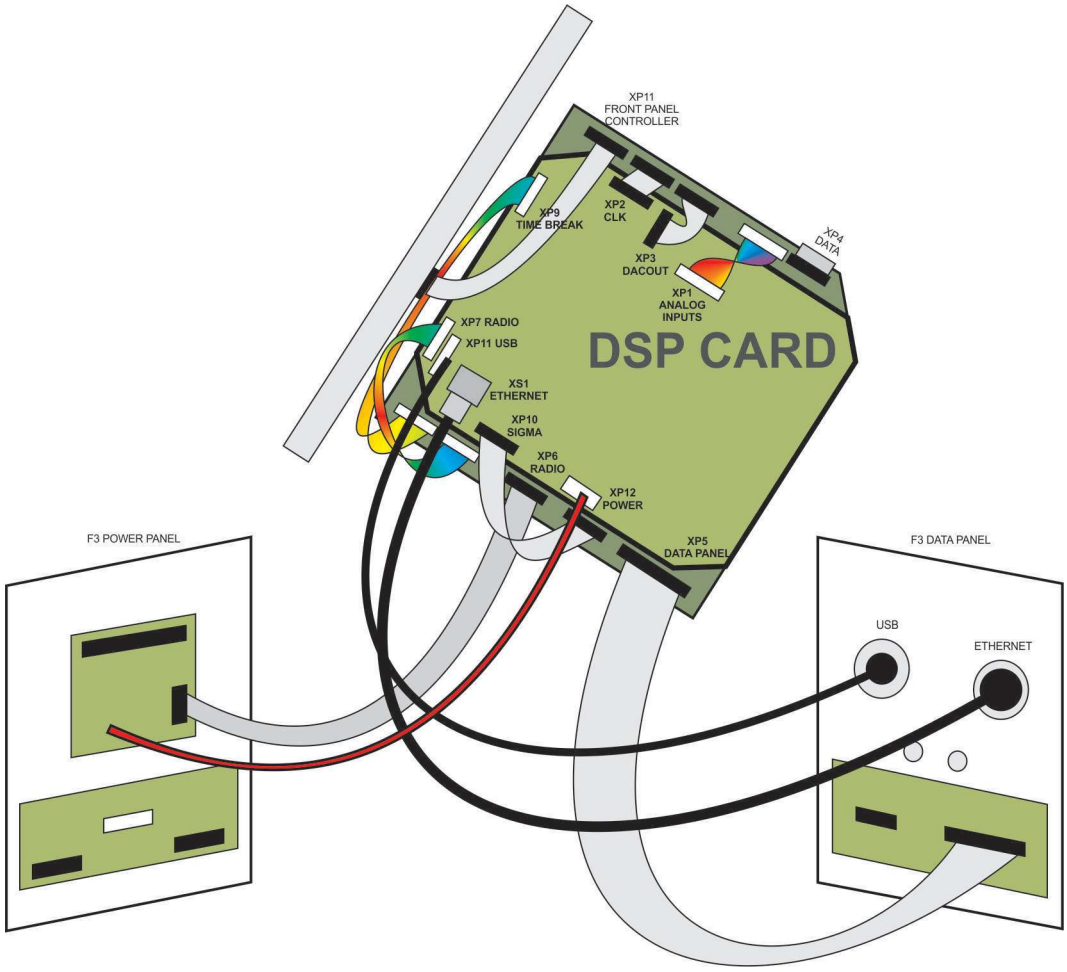
- XP1 41-PIN CONNECTOR CARD
- XP2 LIFT
- XP4 DATA (shared on both sides)
- XP5 SIMILARITIES
- XP6 TEST
- XP7 REMOTE



DSP Card Cables (Unit's left side)

Consist of cables:

- XP1 ANALOG INPUTS
- XS1 ETHERNET
- XP2 CLK
- XP4 DATA (shared on both sides)
- XP5 DATA PANEL
- XP6 RADIO
- XP7 RADIO
- XP9 TIME BREAK
- XP10 SIGMA
- XP11 USB



8 Specifications and Options

8.1 Options

8.2 Force III Specifications

Phase control:

- Phase Loop Gain 0-999%
- Predictive Phase Gain 0-100%
- Phase Control Type: Cycle, Sample, Adaptive
- Similarities Signal: Reference, Sim G/F, Sim B/P, Sim R/M, Loop G/F, Loop B/P, Loop R/M

Force control:

- Force Loop Gain: 0-255%
- High Force Output: 0-100%
- Low Force Output: 0-100%
- Test Drive Attenuation: 0-255
- Predictive Force Gain 0-100%
- Test Force Preset: 0-500%

Control limits:

- Maximum Torque Motor Current Limit: 0-200 mA peak-peak, where 0 indicates no limit
- Maximum Valve Displacement Limit: 0-100% , where 0 indicates no limit
- Maximum Mass Displacement Limit: 0-100% , where 0 indicates no limit
- Peak Force Limit: 0-200% of Peak Force, where 0 indicates no limit
- Reaction Mass Force Limit: 0-200% of Peak Force, where 0 indicates no limit

Vibrator:

- Mass Offset: 0-100%
- Accelerometer Sensitivity: mV/g
- Test Mass Feedback 000-255
- Test Valve Feedback 000-255

Weights:

- Reaction Mass Weight: 1-65535 lbs. or kg
- Base Plate Weight: 1-65535 lbs. or kg
- Hold Down Weight 0-655350 lbs. or kg

Note: Mass conversion rates: 1lb = 0.45359 kg or 1 kg = 2.20 lb.
Force conversion rates: 1lbf = 4.448 N or 1 N = 0.2248

Radio:

- Start Code: 0-3
- Crew Number: 1-255
- PSS Type 1,2,4,5,11,12,14,15
- Decoder Radio Delay: +/- 0-4000 usec
- Microphone Polarity: Normal or Reversed
- Speaker Polarity: Normal or Reversed
- Subcarrier Size: 400, 200, 150, 125, 100 msec

Report Control:

- Auto Pad Up Counter: 1-100
- Auto Pad Up Delay: 0-65000 msec

Advanced Control:

- Phase Preset: 0-359 deg.
- Initial Advance: 0-45 msec
- Harmonics Cut-off Frequency: 0-999 Hz

Hardware Setup:

- Time Break Active: High/Low
- VSS Sample Rate 8, 4, 2, 1, 0.5, 0.25 msec
- VSS Low Cut Filter ON/OFF

Errors and Warnings Indication (in PSS – Post Sweep Service or Post Sweep Report):

- Battery Warning
- Power Supply Warning
- +30VDC Warning
- -30VDC Warning
- +15VDC Warning
- -15VDC Warning
- +5VDC Warning
- Accelerometer Warning
- Accelerometer Mass Similarities Bias Warning
- Accelerometer Mass Loop Bias Warning
- Accelerometer BP Similarities Bias Warning
- Accelerometer BP Loop Bias Warning
- Valve Excitation Warning
- Mass Excitation Warning
- Lift Error
- Not Ready for VP Error
- Sweep Aborted Error

Specifications

- Standard sweeps 16
- Sweep types 6
- Linked sweeps 16
- Stored sweeps 16

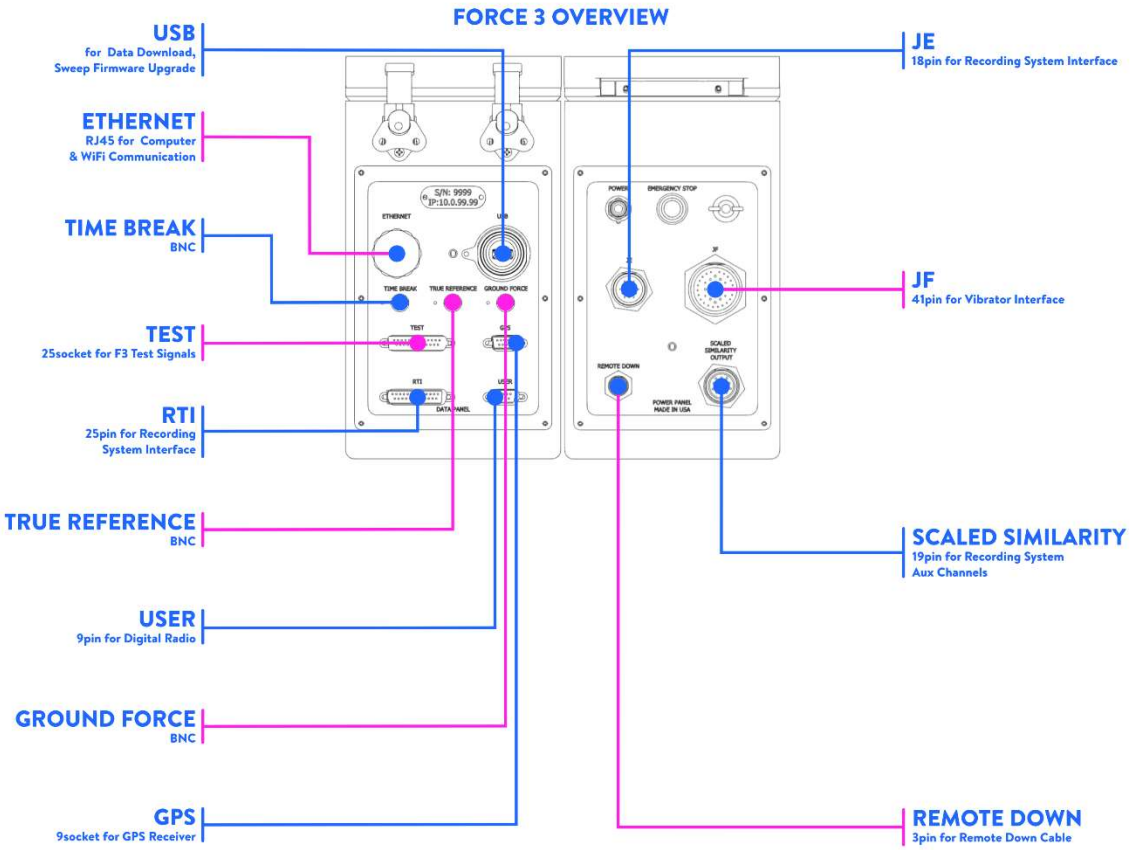
- Input voltage 11 – 26 VDC
- Overall dimensions 16.00 x 11.125 x 9.50” (406 x 283 x 241 mm)

- True Reference 24-bit digital, 16-bit analog (10 V peak-peak, ± 5.0 V)
- Time Break 0 to 5V (positive or negative polarity)

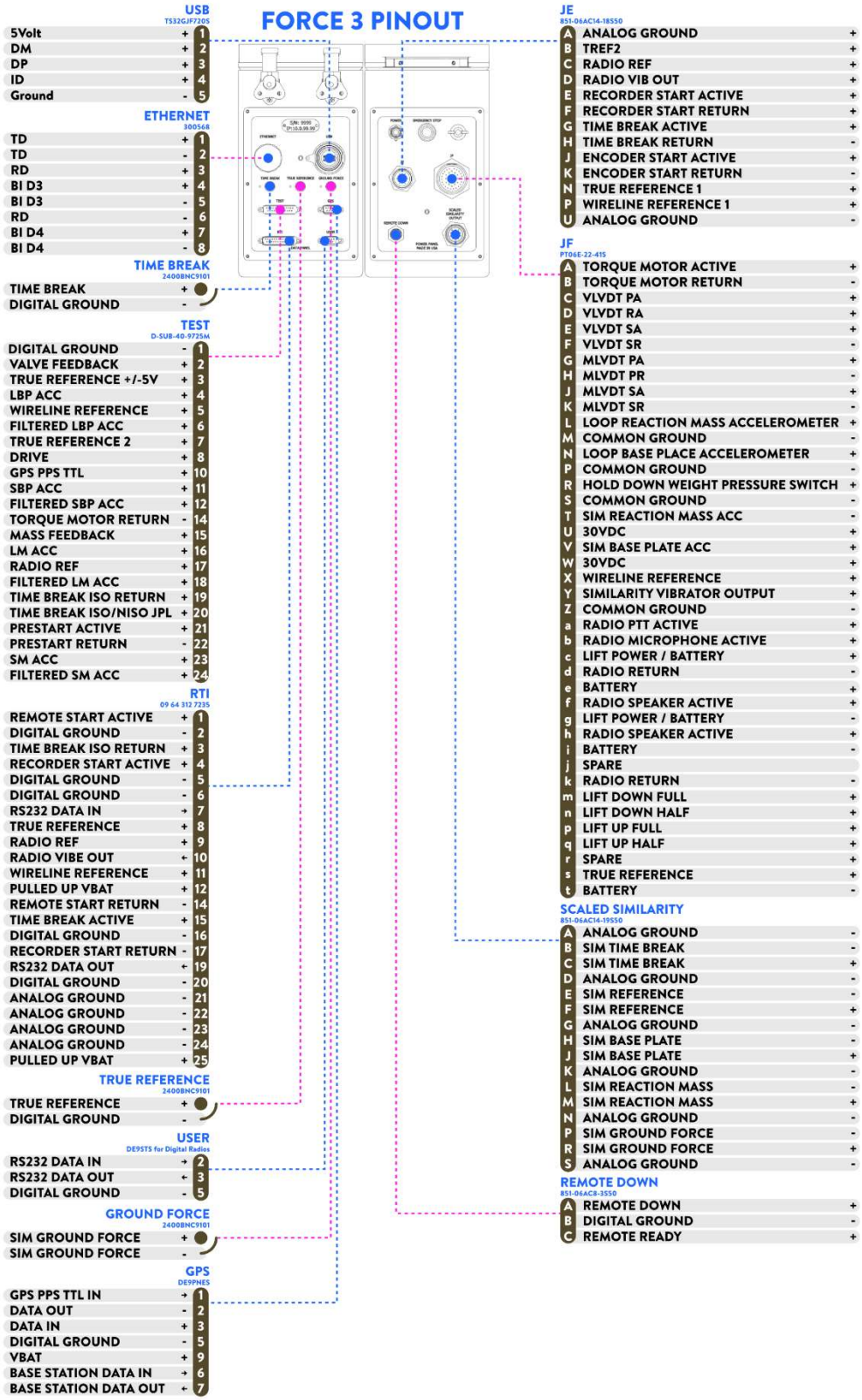
- Scaled Similarity Reference 1 V peak-peak (± 0.5 V)
- Scaled Time Break 0.3 V peak-peak (0 to + 0.3 V)
- Scaled Similarity G. Force 2.4 uV/1 lbf (or 2.4 uV/Kg in Metric)
- Scaled Mass Force 2.4 uV/1 lbf (or 2.4 uV/Kg in Metric)
- Scaled Base Plate Force 2.4 uV/1 lbf (or 2.4 uV/Kg in Metric)

9 Schematics

Force 3 Overview



Force 3 connector pinout



9.1 Front Data Panel

FORCE-III Front Data Panel is located on front side of the unit and contains following elements:

- DATA A connector for Ethernet connectivity
- DATA B connector for external USB memory
- 25-pin TEST connector for Vibrator Quality Control
- 9-pin GPS connector for external GPS
- 25-pin RTI connector for basic Recording Truck Interface functionality
- 9-pin USER connector for additional RS-232 port

DATA A connector

Standard Ethernet RJ-45 connector and pin out.

DATA B connector

Standard USB-A connector and pin out.

9.2 TEST connector 25-pin Female DSUB

TEST		
Pin Number	Signal direction	Signal description
1	Output	Common (DCOM). Non-isolated return
2	Output	Valve Feedback
3	Output	True Reference(±5 V)
4	Output	Loop Base Plate Accelerometer
5	Output	Wire line Reference
6	Output	Filtered Loop Base Plate Accelerometer
7	Output	TREF2
8	Output	Drive
9	Output	Spare
10	Output	GPS_PPS_TTL
11	Output	Similarity Base Plate Accelerometer
12	Output	Filtered Similarity Base Plate Accelerometer
13	Output	Spare
14	Output	TM_R
15	Output	Mass Feedback
16	Output	Loop Mass Accelerometer
17	Output	Vib Out
18	Output	Filtered Loop Mass Accelerometer
19	Output	ISO Return (For TB ISO selection)
20 21	Output Input	Time Break 5V – (Signal Polarity is software selection) (ISO/Non-ISO selected by Jumper JP1) PRESTART-A
22	Input	PRESTART-B
23	Output	SMACC_AT - Similarity Mass Accelerometer
24	Output	Filtered Similarity Mass Accelerometer
25	Output	Filtered Similarity Base Plate Accelerometer

Note: JP1 is located on the top of F3 Frame board, between FRB_XP1 and FRB_XP3 connectors.

9.3 GPS connector 9-pin Female DSUB

GPS		
Pin Number	Signal direction	Signal description
1	Input	GPS PPS
2	Output	data GPS TX – Transmit to GPS RX232 data
3	Input	GPS RX – Receiving from GPS RS232
4		Spare
5	Output	Common (DCOM)
6		Spare
7		Spare
8		Spare
9	Output	Battery Positive (Fused 2A). Can be 12VDC or 24VDC

9.4 RTI connector 25-pin Male DSUB

RTI		
Pin Number	Signal direction	Signal description
1	Input	Start From Recorder Active.
2	Output	Common (DCOM). Non-isolated return
3	Output	Time Break To Recorder Return. ISO return if JP1* in 1-2 position.
4	Output	Start To Recorder Active. Isolated if JP1 in 1-2* position.
5	Output	Common (DCOM). Non-isolated return
6	Output	Common (DCOM). Non-isolated return
7	Input	RS232 Data In
8	Output	True Reference
9	Output	Vibrator Output
10	Output	Radio Vibrator Output
11	Output	Wire Line Reference
12	Output	+5 VDC
13	Input	SERVO_PS_OFF – to turn Servo Card power off
14	Input	Start From Recorder Return
15	Output	Time Break to Recorder Active
16	Output	Common (DCOM). Non-isolated return
17	Output	Start To Recorder Return
18	Output	Dynamite Reference Pulses
19	Output	RS232 Data Out
20	Output	Common (DCOM). Non-isolated return
21	Output	Common (ACOM). Non-isolated return
22	Output	Common (ACOM). Non-isolated return
23	Output	Common (ACOM). Non-isolated return
24	Output	Common (ACOM). Non-isolated return
25	Output	Common (ACOM). Non-isolated return

Note: JP1 is located on the top of F3 Frame board, between FRB_XP1 and FRB_XP3 connectors.

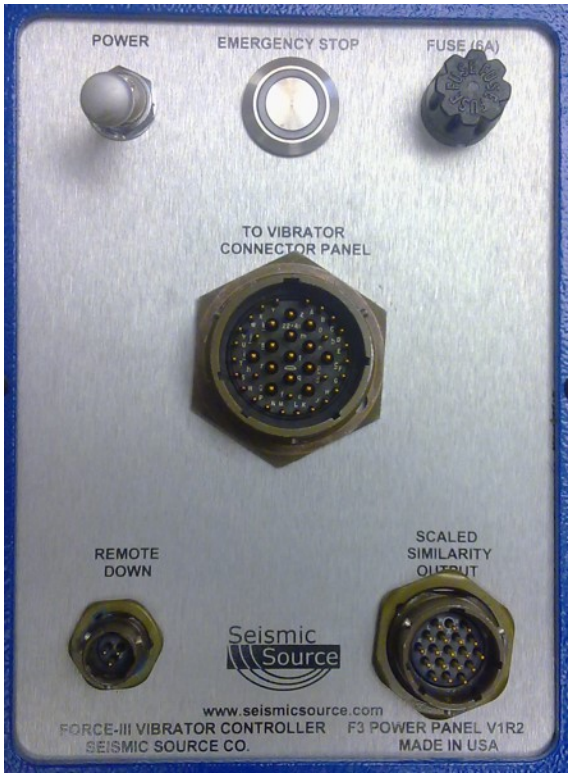
9.5 USER connector 9-pin Male DSUB

USER		
Pin Number	Signal direction	Signal description
1		
2		
3		
4		
5		
6		
7		
8		
9		

9.6 Rear Power Panel

FORCE-III Rear Panel is located on the back side of the unit and contains following elements:

- Power On/Off switch
- Emergency Stop button
- Fuse holder and 6A Fuse
- 41-pin connector to Vibrator Connector Panel
- 3-pin connector for Remote Down and/or Ready extension cable and buttons
- 19-pin connector for Scaled Similarity System (Wire Line Similarity)



9.7 Vibrator Connector Panel 41-pin connector

TO VIBRATOR CONNECTOR PANEL		
Pin Number	Signal direction	Signal description
A	Output	TMA - Torque Motor Active
B	Output	TMR - Torque Motor Return
C	Output	VEXT2, VLVDT_PA
D	Output	Common (ACOM), VLVDT_PR
E	Output	VLVDT_SA
F	Output	VLVDT_SR
G	Output	MEXT3, MLVDT_PA
H	Output	Common (ACOM), MLVDT_PS
J	Output	MLVDT_SA
K	Output	MLVDT_SR
L	Input	LMACC – Loop Reaction Mass Accelerometer
M	Output	Common (ACOM)
N	Input	LBPACC – Loop Base Plate Accelerometer
P	Output	Common (ACOM)
R	Input	DOWN_ENB, XD–Hold Down Weight Pressure Switch
S	Output	Common (ACOM)
T	Input	Battery Negative
U	Output	+30 VDC
V	Input	SBPACC – Similarity Base Plate Accelerometer
W	Output	+30 VDC
X	Output	WLREF – Wire Line Reference
Y	Output	SVOUT –Similarity Vibrator Output
Z	Output	Common (ACOM)
/a	Output	PTT_A – Radio PTT Active
/b	Output	MIC_A – Radio Microphone Active
/c	Input	Battery Positive
/d	Input	RADIO_RET – Radio Return
/e	Input	Battery Positive
/f	Input	SPKR_A – Radio Speaker Active
/g	Input	Battery Negative
/h	Input	SPKR_R – Radio Speaker Return
/i	Input	Battery Negative
/j	Input/Output	Spare
/k	Input	RADIO_R – Radio Return
/m	Output	DOWN_FULL – Lift Down Full
/n	Output	DOWN_HALF – Lift Down Half
/p	Output	UP_FULL – Lift Up Full
/q	Output	UP_HALF – Lift Up Half
/r	Input/Output	Spare
/s	Output	TREF – True Reference
/t	Input	Battery Negative

9.8 Remote Down 3-pin connector

REMOTE DOWN		
Pin Number	Signal direction	Signal description
A	Input	Remote Down. LOW when active.
B	Output	Common (DCOM)
C	Input	Remote Ready. LOW when active.

9.9 Scaled Similarity System 19-pin connector

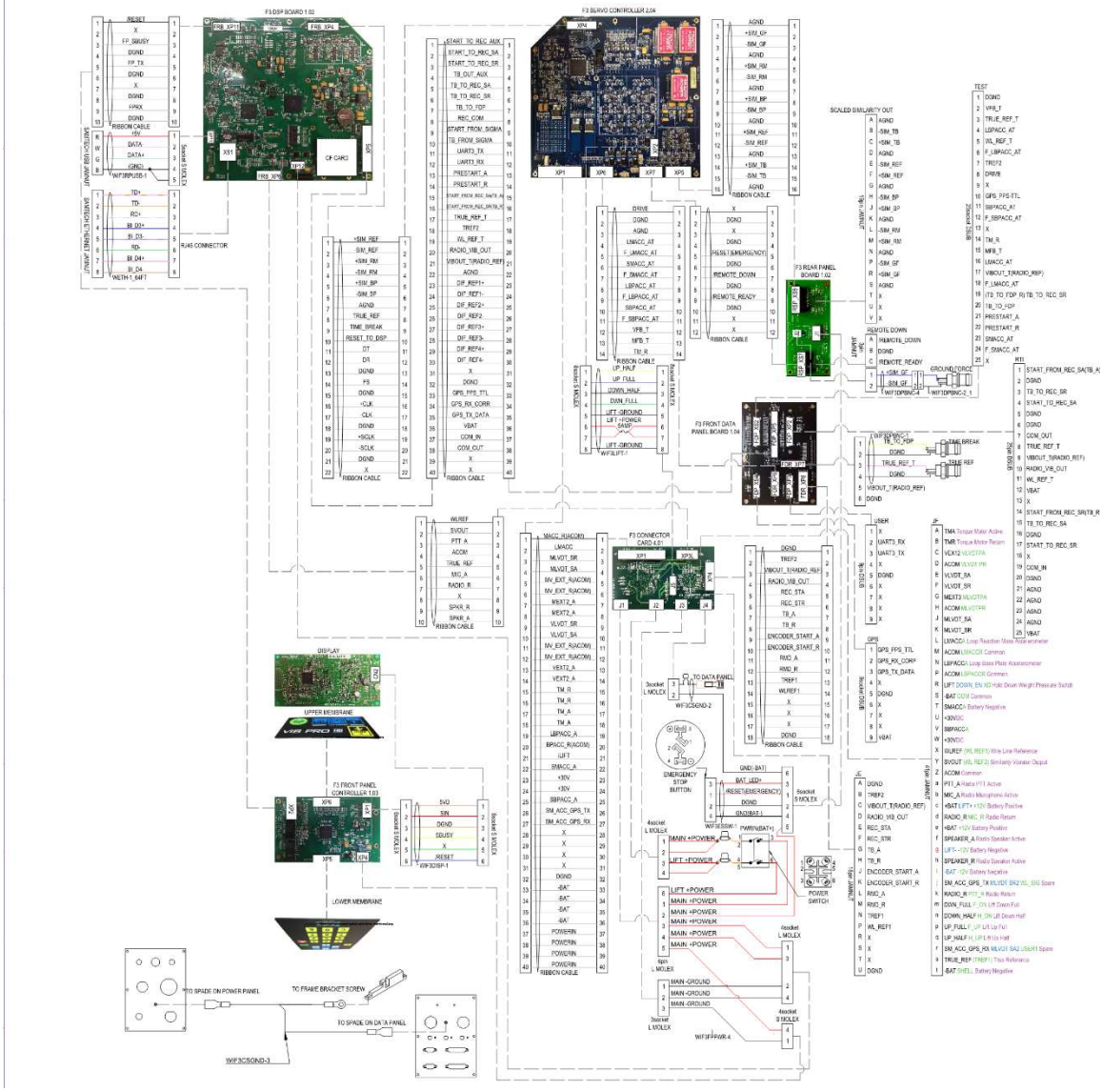
SCALED SIMILARITY SYSTEM		
Pin Number	Signal direction	Signal description
A	Output	Common (ACOM)
B	Output	Time Break Differential Negative
C	Output	Time Break Differential Positive
D	Output	Common (ACOM)
E	Output	Similarities Reference Differential Negative
F	Output	Similarities Reference Differential Positive
G	Output	Common (ACOM)
H	Output	Similarities Base Plate Force Differential Positive
J	Output	Similarities Base Plate Force Differential Negative
K	Output	Common (ACOM)
L	Output	Similarities Reaction Mass Force Differential Positive
M	Output	Similarities Reaction Mass Force Differential Negative
N	Output	Common (ACOM)
P	Output	Similarities Ground Force Differential Positive
R	Output	Similarities Ground Force Differential Negative
S	Output	Common (ACOM)
T	Output	Spare
U	Output	Spare
V	Output	Spare

Similarity Reference Differential Negative and Positive (pins E and F) output +/- 0.5 volts (1 volt Peak to Peak).

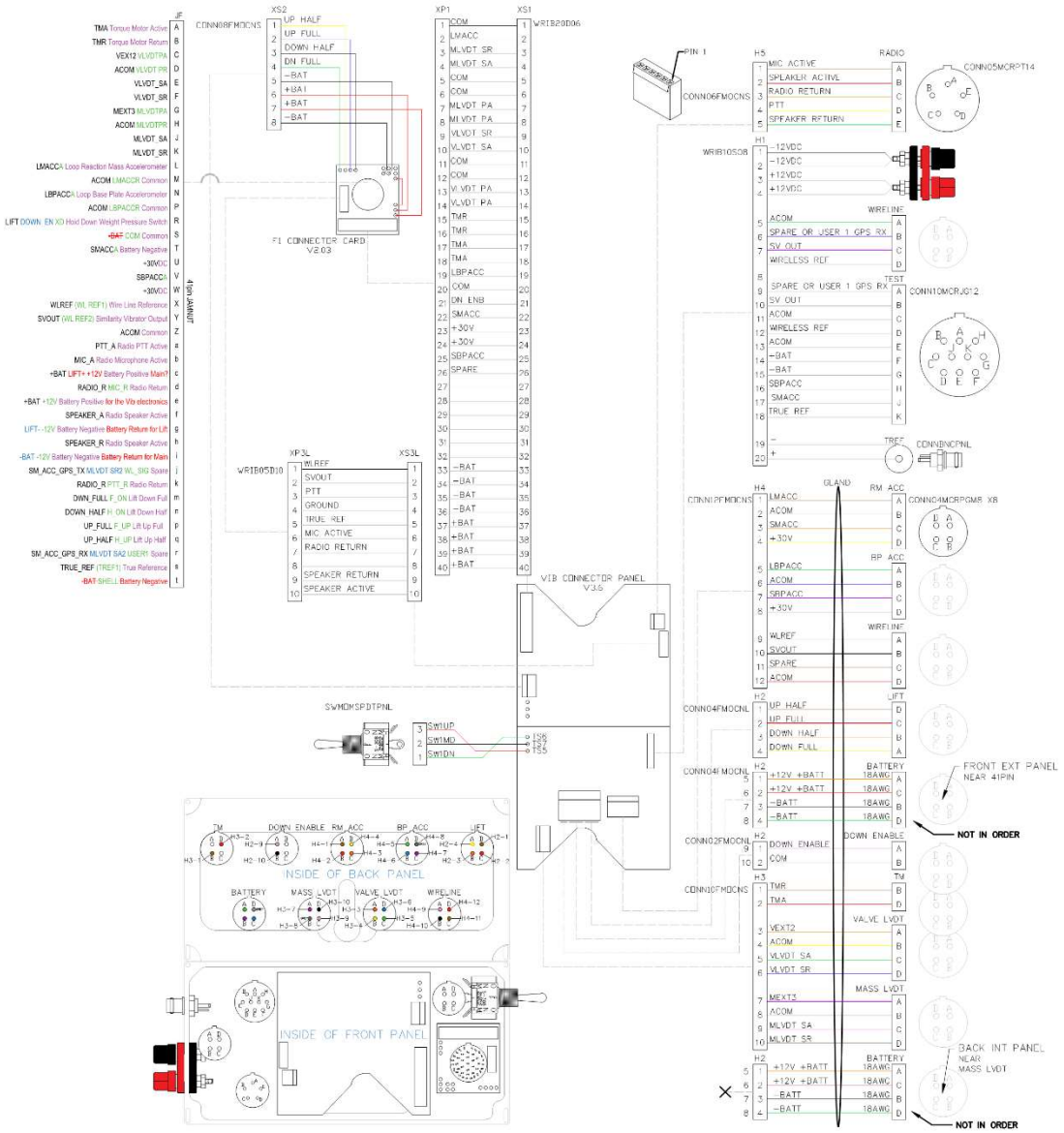
Scaled Similarity Reference 1 V peak-peak (± 0.5 V)
Scaled Time Break 0.3 V peak-peak (0 to + 0.3 V)
Scaled Similarity G. Force 2.5uV/1 lbf
Scaled Mass Force 2.5uV/1 lbf
Scaled Base Plate Force 2.5uV/1 lbf

9.10 F3 Internal Wiring

NUMBER	TITLE	NOTES	AUTHOR	DATE	APPROVED BY
...	F3 AND VPHD FINISHED GOOD	...	Christopher D.	1-14-19	REV 6
Revised JF Signal Names including original except g and i which were dangerously wrong, F3Connector Card Schematic, JF Assembly-2 Cable Schematic, John's Table from Nov 18, 2021 email.			AUTHOR Christopher D.	DATE 11-19-2021	



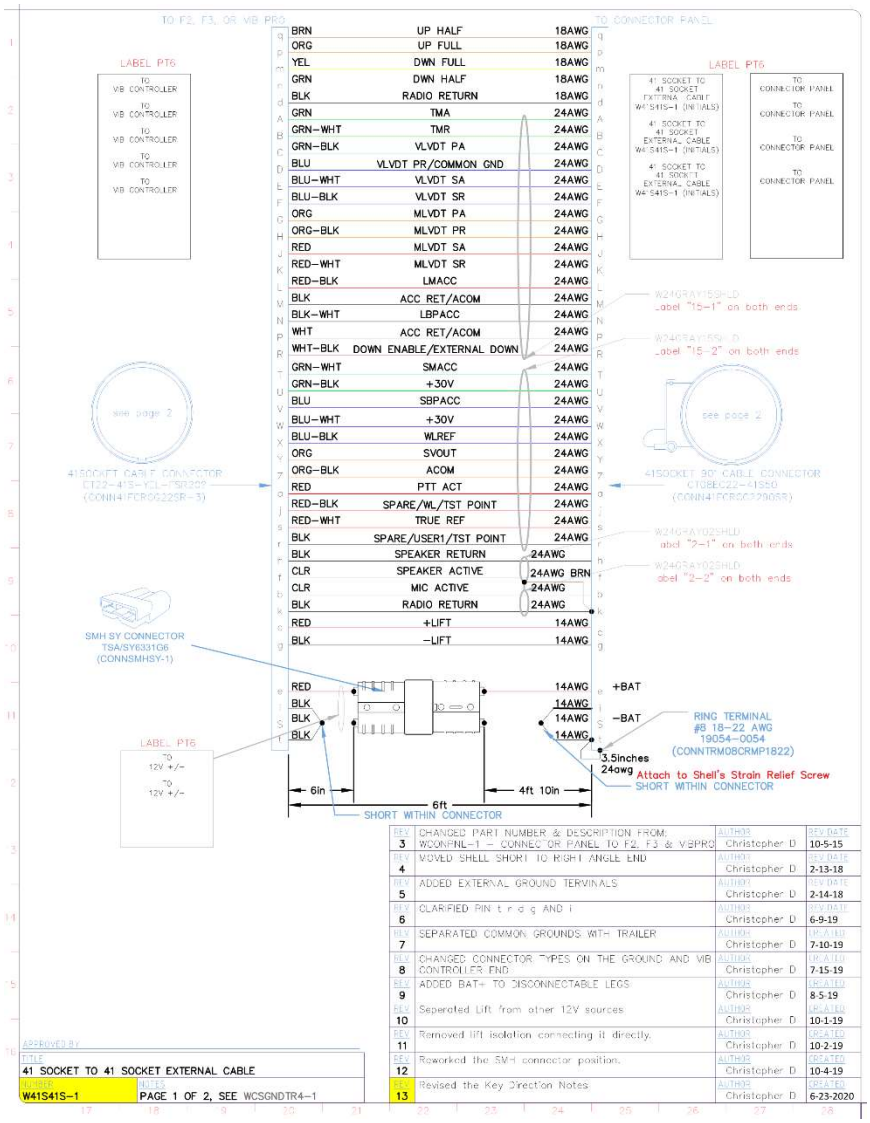
9.11 F3 Vibrator wiring



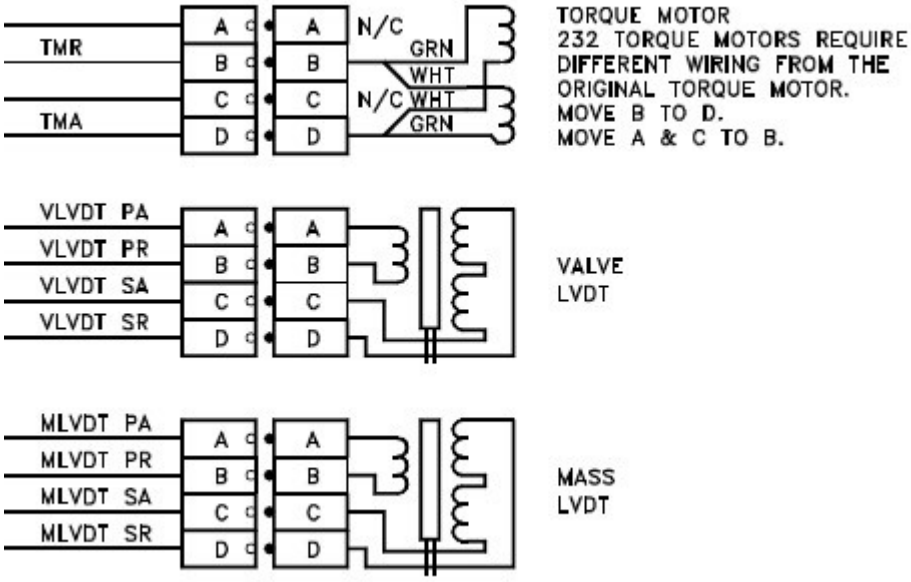
SSC CONNECTOR PANEL SYSTEM

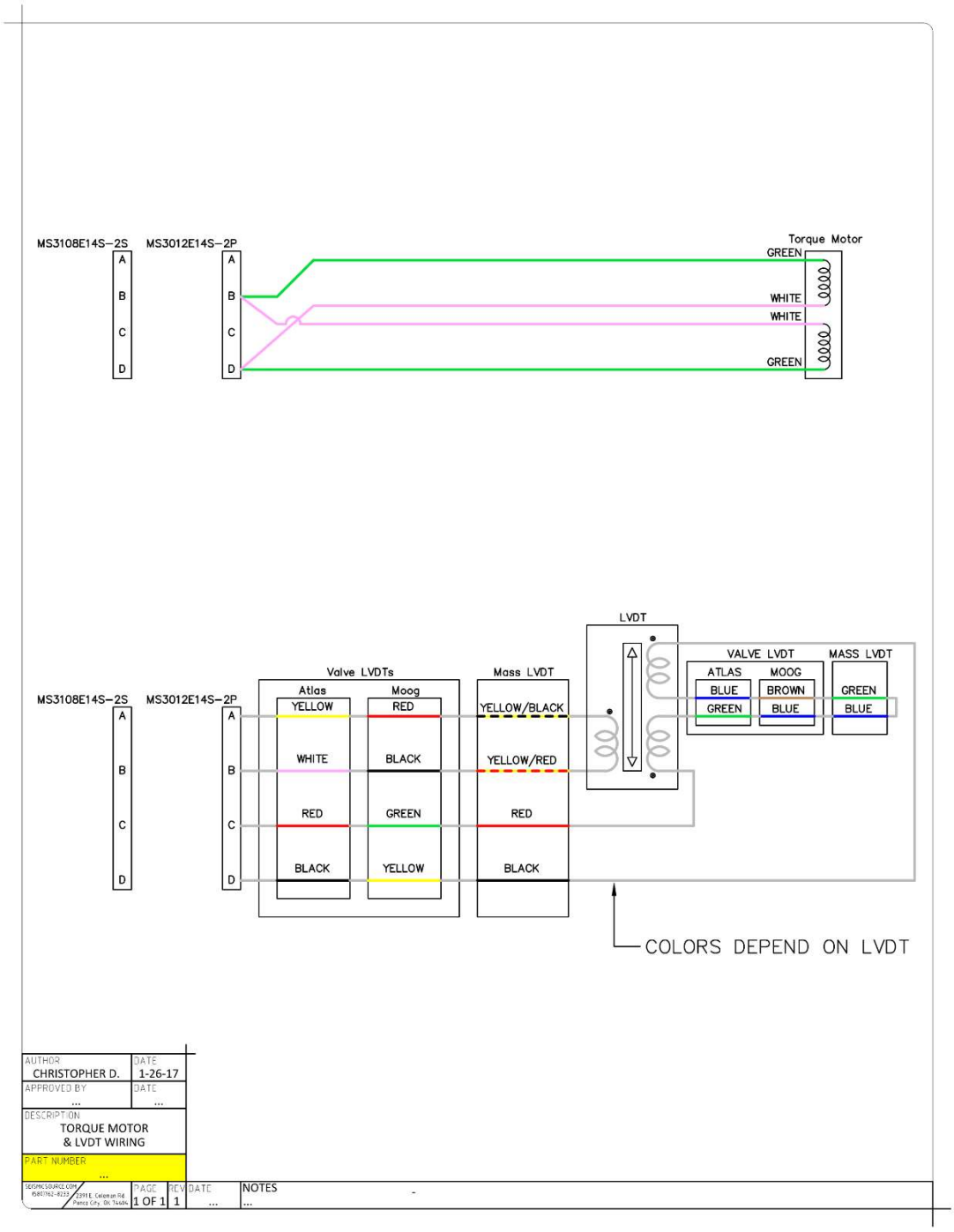
(FSCONPNL-1)

EXTERNAL CABLE SCHEMATICS

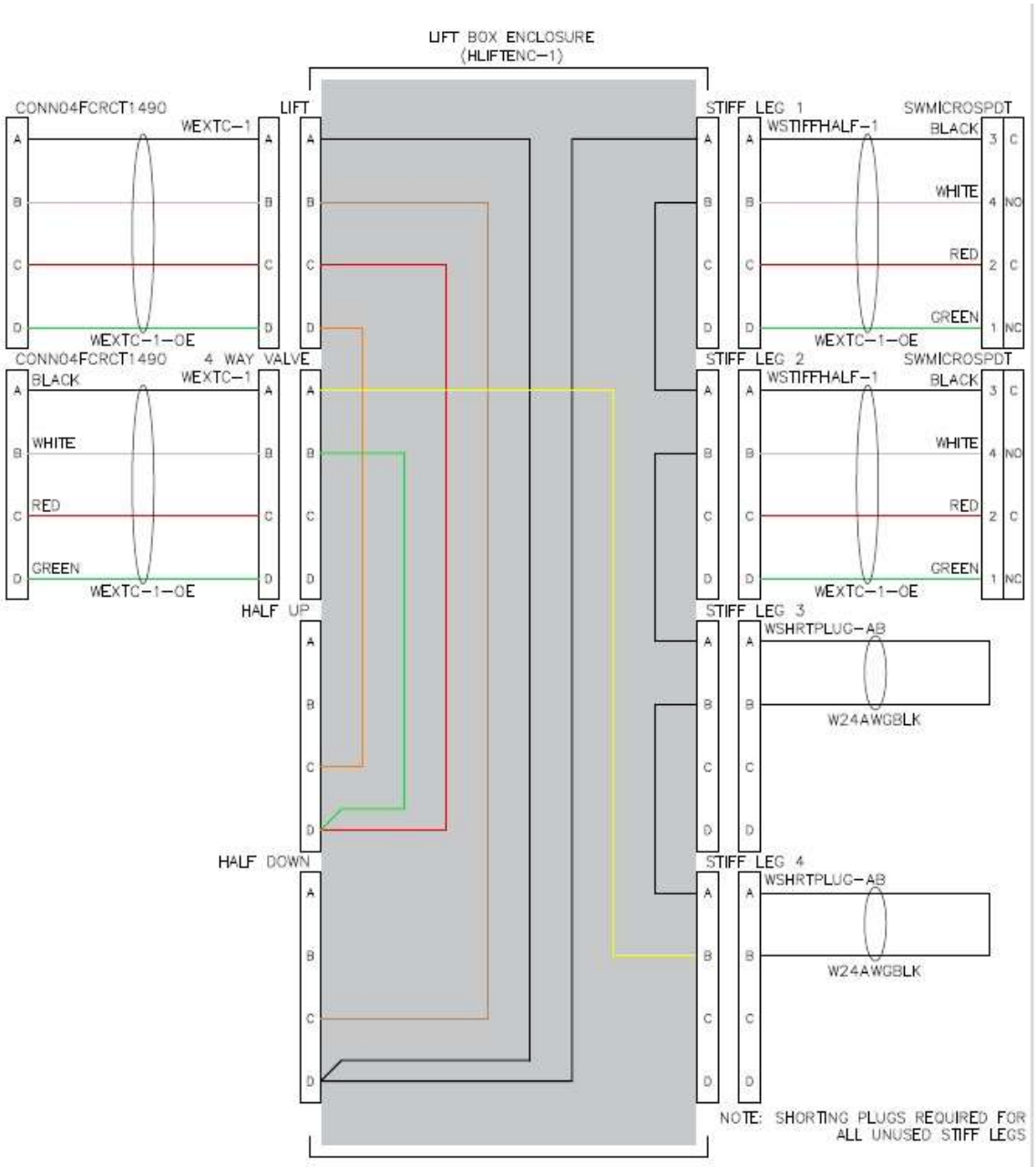


9.11 LVDT wiring

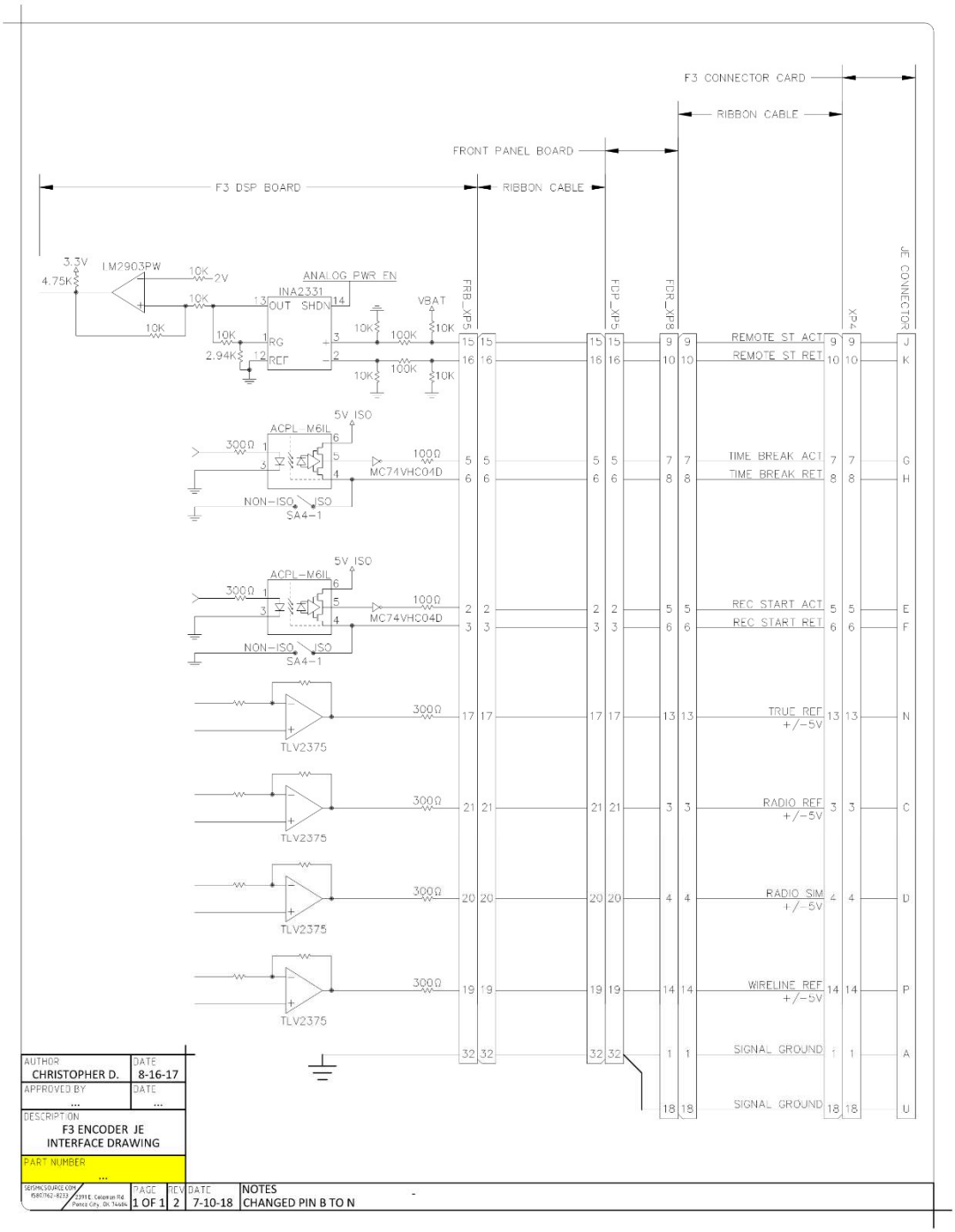



MS3108E14S-2S
MS3012E14S-2P
A
B
C
D
Torque Motor
GREEN
WHITE
WHITE
GREEN
LVDT
Valve LVDTs
Atlas
Moog
Mass LVDT
YELLOW
RED
YELLOW/BLACK
WHITE
BLACK
YELLOW/RED
RED
GREEN
RED
BLACK
YELLOW
BLACK
VALVE LVDT
MASS LVDT
ATLAS
MOOG
BLUE
BROWN
GREEN
GREEN
BLUE
BLUE
COLORS DEPEND ON LVDT
AUTHOR
CHRISTOPHER D.
DATE
1-26-17
APPROVED BY
DATE
DESCRIPTION
TORQUE MOTOR
& LVDT WIRING
PART NUMBER
PAGE
1 OF 1
REV
1
DATE
NOTES

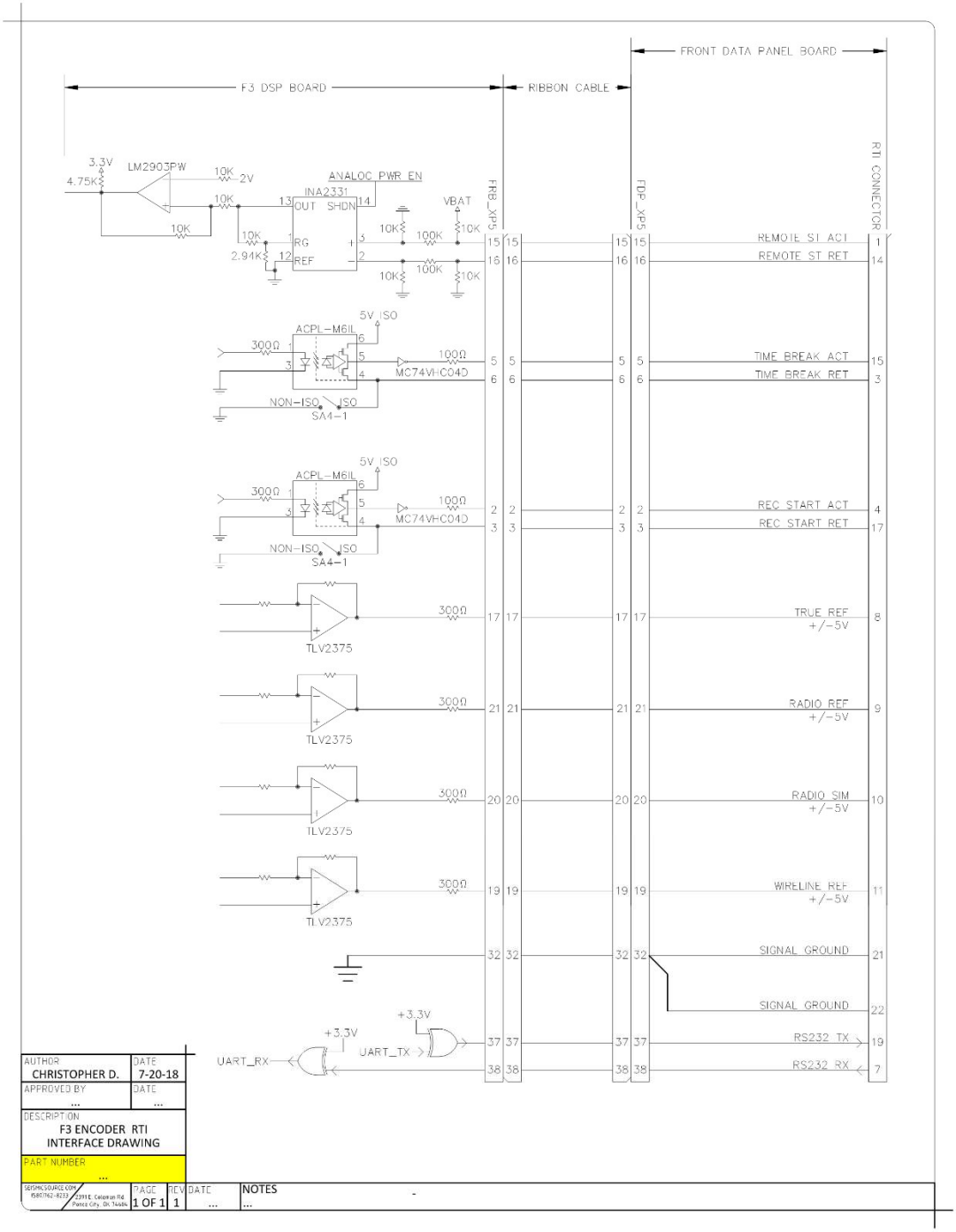
9.12 F3 Lift Box wiring

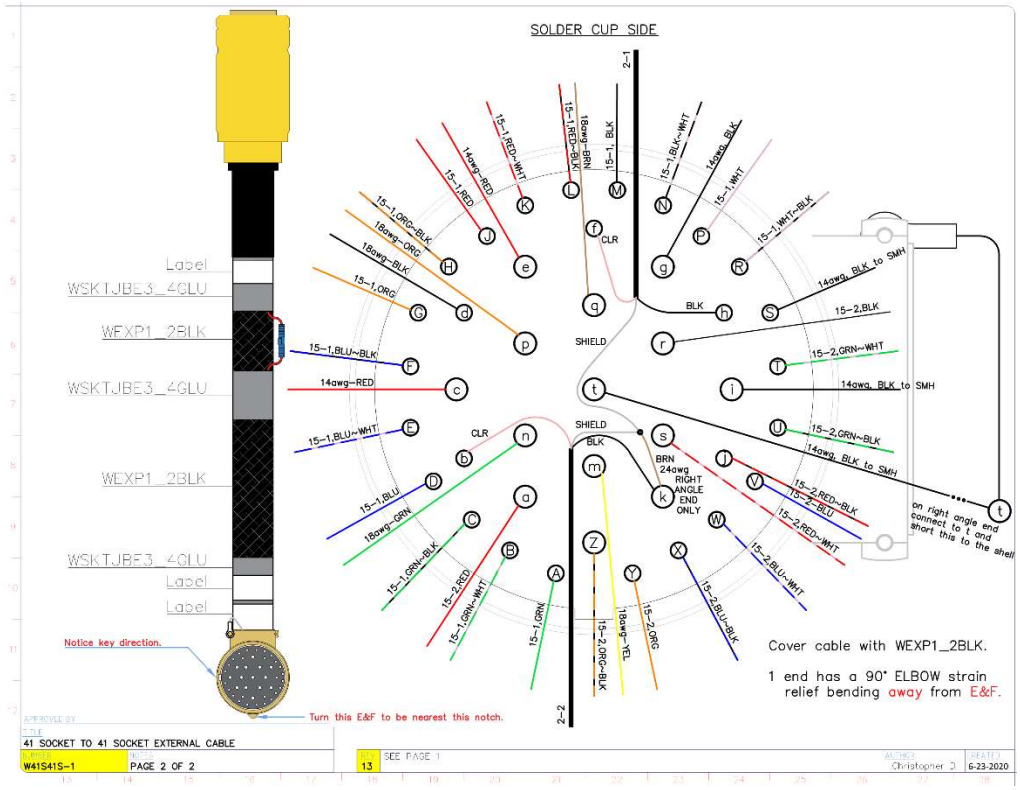


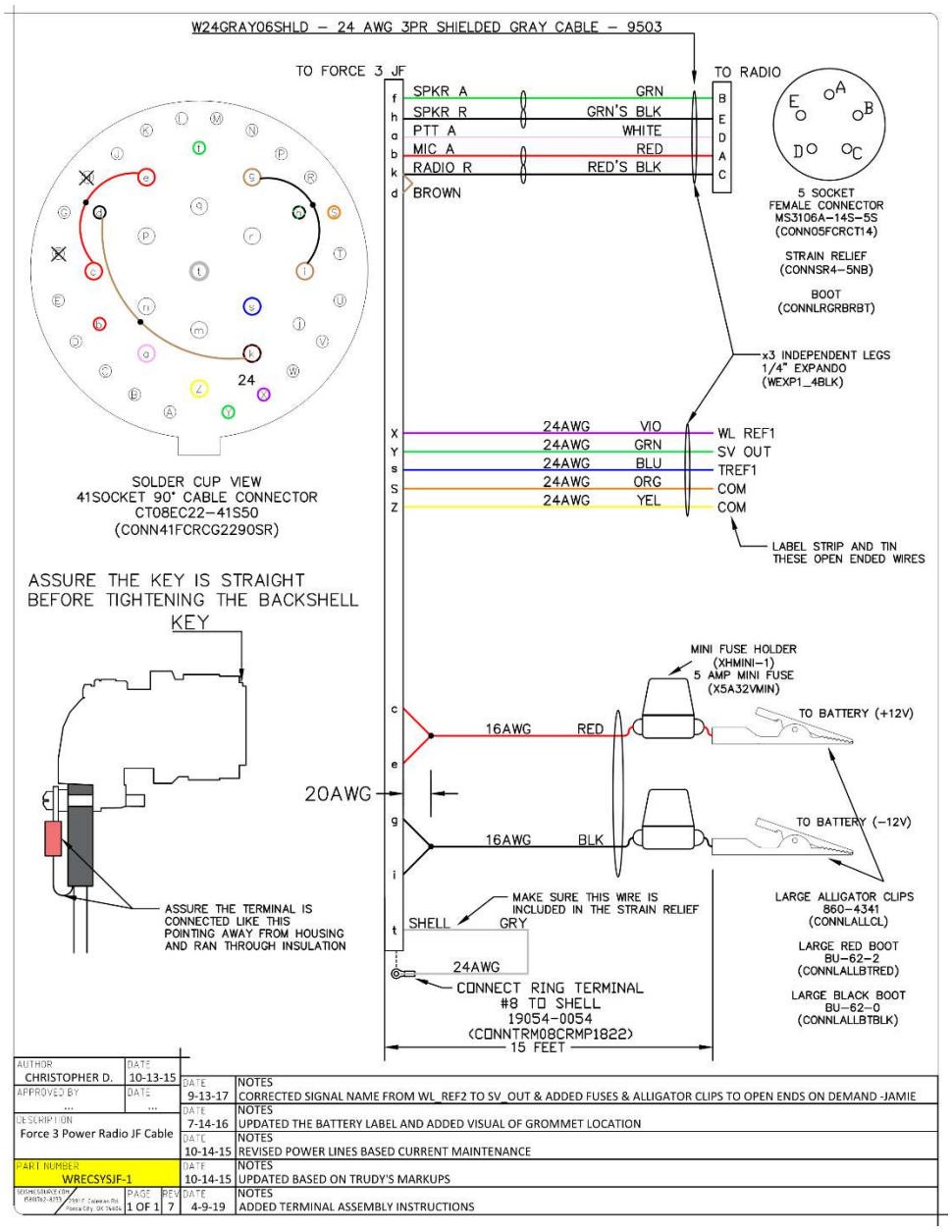
9.12 F3 – JE connector

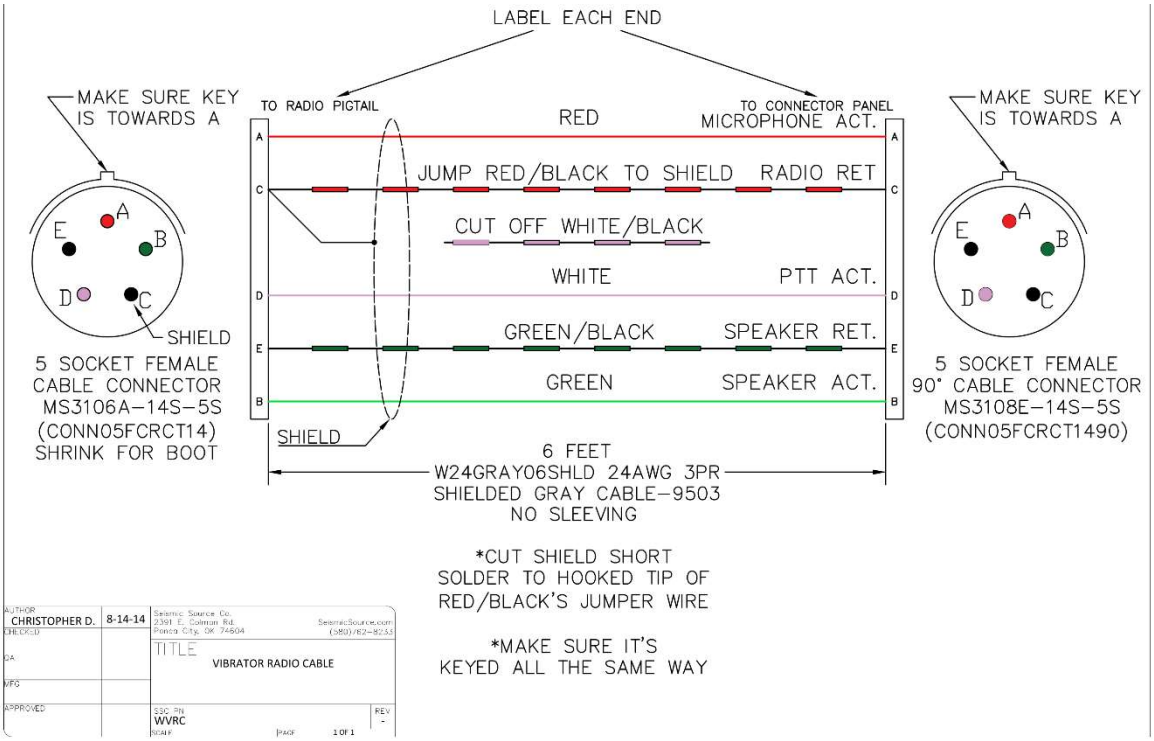


9.13 F3-25 pin RTI connector




SOLDER CUP SIDE
Label
WSKTJBE3_4GLU
WEXP1_2BLK
WSKTJBE3_4GLU
WEXP1_2BLK
WSKTJBE3_4GLU
Label
Label
Notice key direction.
Turn this E&F to be nearest this notch.
Cover cable with WEXP1_2BLK.
1 end has a 90° ELBOW strain relief bending away from E&F.
41 SOCKET TO 41 SOCKET EXTERNAL CABLE
W41S41S-1
PAGE 2 OF 2
13
SEE PAGE 1
Christopher D
6-23-2020


W24GRAY06SHLD – 24 AWG 3PR SHIELDED GRAY CABLE – 9503
TO FORCE 3 JF
TO RADIO
SPKR A GRN
SPKR R GRN'S BLK
PTT A WHITE
MIC A RED
RADIO R RED'S BLK
BROWN
5 SOCKET FEMALE CONNECTOR MS3106A-14S-5S (CONN05FCRCT14)
STRAIN RELIEF (CONNSR4-5NB)
BOOT (CONNLRGRBRBT)
x3 INDEPENDENT LEGS 1/4" EXPANDO (WEXP1_4BLK)
24AWG VIO WL REF1
24AWG GRN SV OUT
24AWG BLU TREF1
24AWG ORG COM
24AWG YEL COM
LABEL STRIP AND TIN THESE OPEN ENDED WIRES
SOLDER CUP VIEW
41SOCKET 90° CABLE CONNECTOR
CT08EC22-41S50
(CONN41FCRCG2290SR)
ASSURE THE KEY IS STRAIGHT BEFORE TIGHTENING THE BACKSHELL
KEY
ASSURE THE TERMINAL IS CONNECTED LIKE THIS POINTING AWAY FROM HOUSING AND RAN THROUGH INSULATION
20AWG
MINI FUSE HOLDER (XHMINI-1)
5 AMP MINI FUSE (X5A32VMIN)
16AWG RED
TO BATTERY (+12V)
16AWG BLK
TO BATTERY (-12V)
LARGE ALLIGATOR CLIPS 860-4341 (CONNLALLCL)
LARGE RED BOOT BU-62-2 (CONNLALLBTRED)
LARGE BLACK BOOT BU-62-0 (CONNLALLBTBLK)
MAKE SURE THIS WIRE IS INCLUDED IN THE STRAIN RELIEF
SHELL GRY
24AWG
CONNECT RING TERMINAL #8 TO SHELL 19054-0054 (CONNTRM08CRMP1822)
15 FEET
AUTHOR CHRISTOPHER D. DATE 10-13-15
APPROVED BY DATE
DESCRIPTION Force 3 Power Radio JF Cable
PART NUMBER WRECSYSJF-1
PAGE 1 OF 1
REV 7
DATE 9-13-17 NOTES CORRECTED SIGNAL NAME FROM WL_REF2 TO SV_OUT & ADDED FUSES & ALLIGATOR CLIPS TO OPEN ENDS ON DEMAND -JAMIE
DATE 7-14-16 NOTES UPDATED THE BATTERY LABEL AND ADDED VISUAL OF GROMMET LOCATION
DATE 10-14-15 NOTES REVISED POWER LINES BASED CURRENT MAINTENANCE
DATE 10-14-15 NOTES UPDATED BASED ON TRUDY'S MARKUPS
DATE 4-9-19 NOTES ADDED TERMINAL ASSEMBLY INSTRUCTIONS


LABEL EACH END
MAKE SURE KEY IS TOWARDS A
TO RADIO PIGTAIL
TO CONNECTOR PANEL
RED
MICROPHONE ACT.
JUMP RED/BLACK TO SHIELD
RADIO RET
CUT OFF WHITE/BLACK
WHITE
PTT ACT.
GREEN/BLACK
SPEAKER RET.
GREEN
SPEAKER ACT.
SHIELD
A
B
C
D
E
5 SOCKET FEMALE
CABLE CONNECTOR
MS3106A-14S-5S
(CONN05FCRCT14)
SHRINK FOR BOOT
5 SOCKET FEMALE
90° CABLE CONNECTOR
MS3108E-14S-5S
(CONN05FCRCT1490)
6 FEET
W24GRAY06SHLD 24AWG 3PR
SHIELDED GRAY CABLE-9503
NO SLEEVING
*CUT SHIELD SHORT
SOLDER TO HOOKED TIP OF
RED/BLACK'S JUMPER WIRE
*MAKE SURE IT'S
KEYED ALL THE SAME WAY
AUTHOR
CHRISTOPHER D.
8-14-14
CHECKED
QA
MFG
APPROVED
Seismic Source Co.
2391 E. Colman Rd.
Ponca City, OK 74604
SeismicSource.com
(580)762-2553
TITLE
VIBRATOR RADIO CABLE
SSC PN
WVRC
REV
-
SCALE
PAGE
1 OF 1

VIB CONTROL CABLE SET

(STWVIBCTRL)

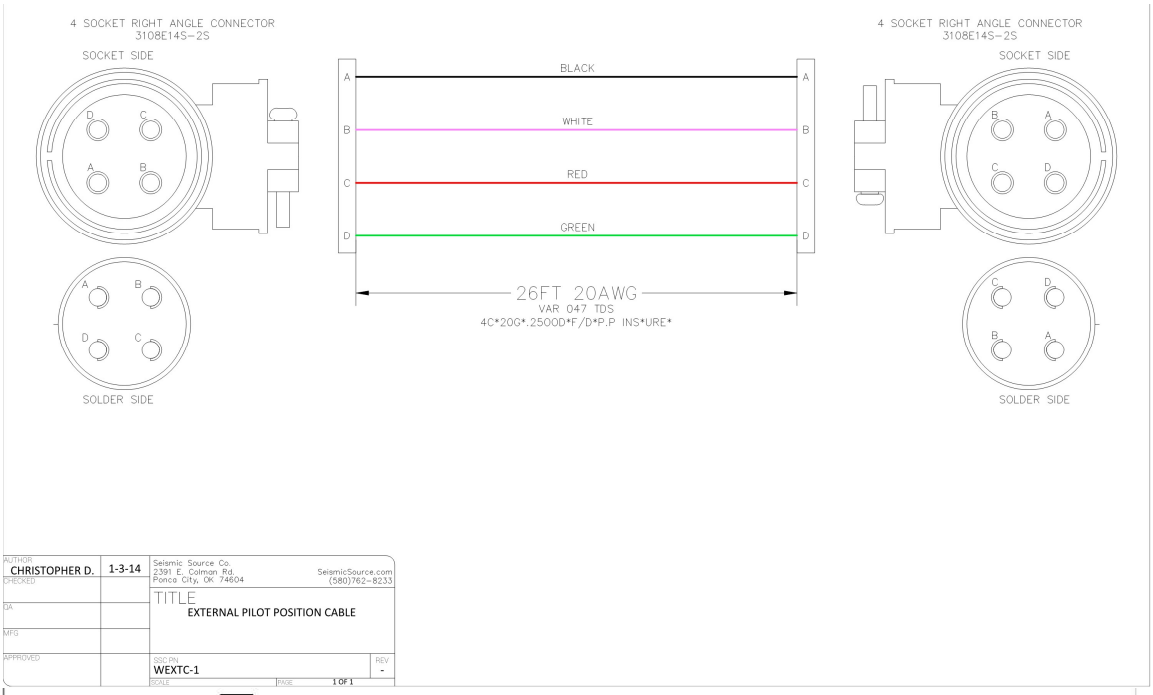
BILL OF MATERIAL

WEXTC-1	B	EXTERNAL VIB CABLE
WEXTC-1-OE	M	EXTERNAL VIB CABLE - OPEN ENDED (SSC)

VIB CONTROL CABLE SET

(STWVIBCTRL)

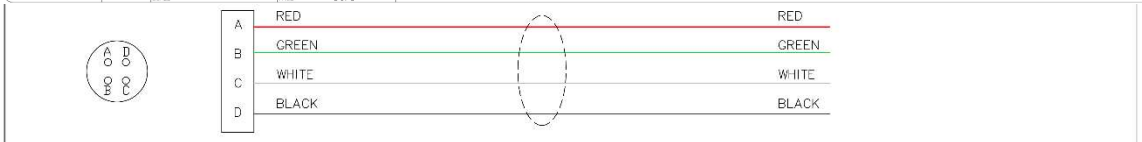
EXTERNAL CABLE SCHEMATICS



CHRISTOPHER D. | 1-3-14 | Seismic Source Co. 2391 E. Colman Rd. Ponca City, OK 74604 | SeismicSource.com (580)762-8233

TITLE: EXTERNAL PILOT POSITION CABLE

SSC P/N: WEXTC-1 | REV: - | SCALE | PAGE 1 OF 1



MS3108E-14S-2S 4-SOCKET 90° CABLE CONNECTOR (CONN04FCRCT1490)

9503 - 6-COND 24 AWG CABLE (W24GRAY06SHLD)

DRAWN D. WESTBERG | 05/22/2012 | CHECKED | DA | MFG | APPROVED | PART #

Seismic Source Co. 2391 E. Coleman Rd. Ponca City, OK 74604 (580)762-8233 www.seismicsource.com

TITLE: EXTERNAL VIB CABLE OPEN ENDED

SIZE B | DWG NO WEXTC-1-OE | REV - | SCALE | SHEET 1 OF 1

BILL OF MATERIALS

QTY	PART #	DESC:
2	CONN04FCRCT1490	4-SOCKET 90° CABLE CONNECTOR
TBD	W24GRAY06SHLD	6-COND. 24 AWG CABLE
2 IN.	WSKTUBE3_32	3/32" SHRINK TUBE
TBD	WEXP1_4	1/4" EXPANDABLE SLEEVING