Application Brief

Anritsu Advancing beyond

Configuring IC-CAP 2020 for VectorStar Operation

Introduction

Since the introduction of the Anritsu VectorStar Network Analyzer, the Integrated Circuit Characterization & Analysis Program (IC-CAP) has supported all models of the VNA for device modeling and characterization. Beginning with Version 2014, IC-CAP has included VectorStar in the Instrument Library for easy and convenient inclusion of the driver during device analysis.

This document describes the procedure for setting up the IC-CAP software to add a VectorStar network analyzer to the Active Instrument Connections list and the steps to configure the program for operation of the VNA during device measurements.

Note: This procedure works with VectorStar version 2.0 through V2022.6.3 software or later. Menu examples are based on the 2020 Update 2 version of IC-CAP. The procedure assumes a National Instruments GPIB interface is used.

Setting Up VectorStar for IC-CAP Compatibility

1. Verify the VectorStar system (Utilities/System/Remote Interface) is set to Native mode.
2. If the VectorStar system is an ME7838xx broadband system perform the following, otherwise skip to step #3.
   a. Configure VectorStar Preset for SavedSetup.
   b. Setup the ME7838xx for broadband 3739C sweep.
   c. Set appropriate configuration (e.g., power, frequency range, IFBW, etc.).
   d. Save setup as a *.cha file.
   e. Go to Utilities/System/Setup/Preset Setup/Select Saved Setup File and select the appropriate *.cha file. Then select Saved Setup.
   f. This ensures that a preset will return VectorStar to a broadband configuration.
3. Activate the National Instruments “Add GPIB Hardware” program. Note: The GPIB name for your setup (e.g. GPIB0). Select Cancel to exit the program. Alternatively, run NI Max and check under device interface.

Configuring IC-CAP for VectorStar Operation

4. From IC-CAP Main window, click the GPIB button.
5. Confirm that Available Connections is active.
6. If the GPIB Interface window does not list the available connection perform the following:
   a. Select the “Edit Available Connections” button
   b. In the Add GPIB interface window enter the GPIB Name you recorded from the NI program in step 1 (e.g. GPIB0).
7. Confirm VectorStar is included in the Active Instrument Connections window.

8. If VectorStar is not listed in the Active Instrument Connections window perform the following:
   a. Select the “Rebuild Active Instrument List” button. This will connect VectorStar to IC-CAP.

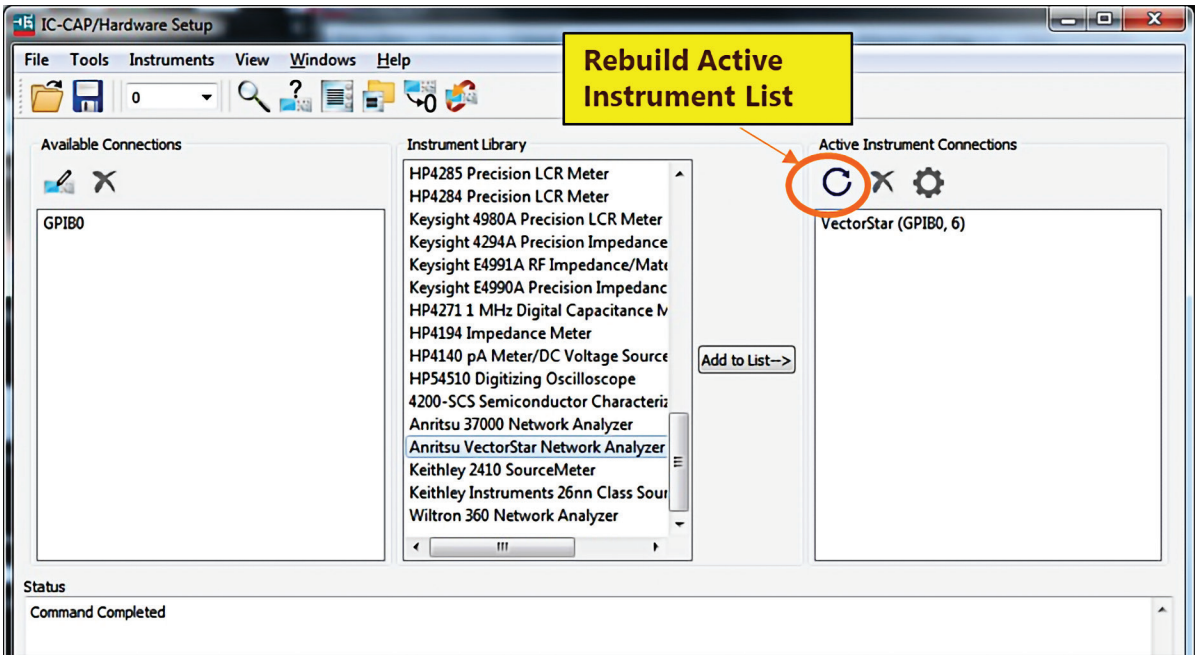

Figure 1. GPIB Hardware Setup Panel

9. Verify the dialog box contains the correct information.
10. Verify IC-CAP is connected to the VectorStar system by selecting the magnifier button (Display All Devices Found on the Bus). The status box should confirm it found a device at address 6.
11. Confirm the drop down address box located in the menu bar is set at the proper address for the VNA, then select the instrument icon question mark button (Display the ID of the Device at the set Address). The status box should display the Output Identify string of the VectorStar system.
12. Exit the IC-CAP Hardware Setup panel.

IC-CAP Operation

13. The IC-CAP Main panel is blank until a *.mdl file is opened. The *.mdl file contains the model extraction parameters as well as the instrument parameters and control.

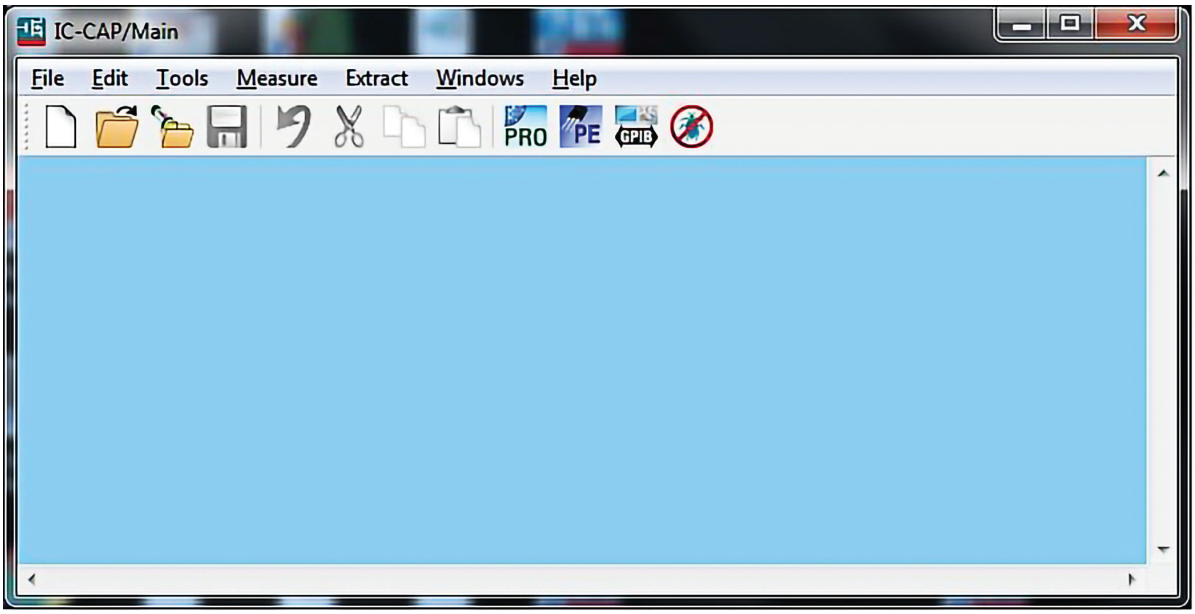

Figure 2. IC-CAP Main Panel Screen

14. To verify VNA connections and IC-CAP operation, open one of the example modules included in IC-CAP. These test modules can be used to provide an indication of basic functionality. They will need to be modified for the VectorStar model being used.
    a. Open the example module by selecting: File / Examples / Model_Files / Misc / sys_test.mdl

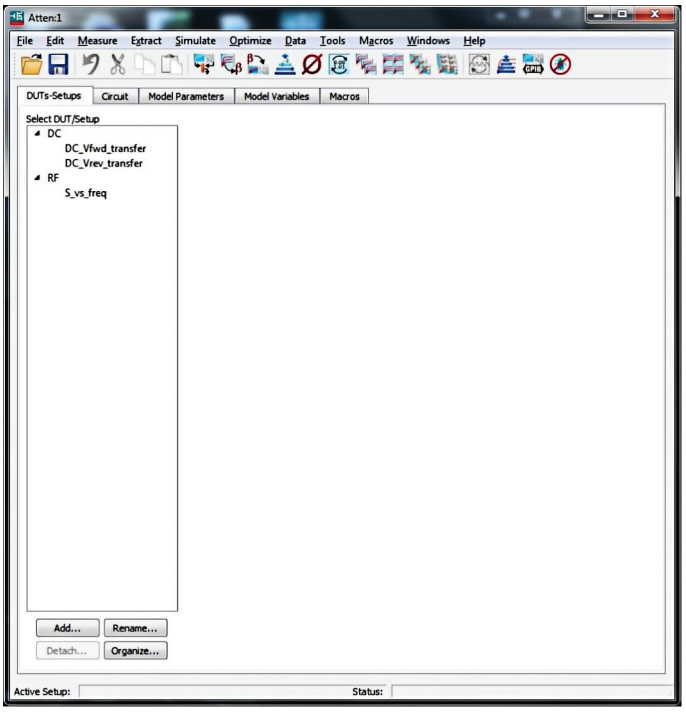

Figure 3. Startup sys_test.mdl Screen

b. Select the Model Variables tab. The Model Variables panel will be set for the default parameters entered when the panel was developed.

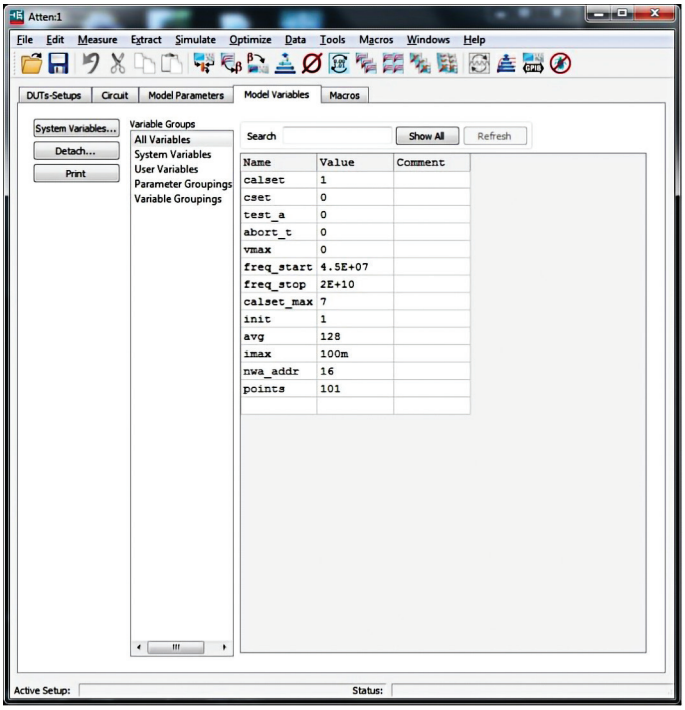

Figure 4. Default Model Variables Start Up Screen

c. Note the parameter settings. Some of the settings pertain to the VNA while others are related to the system configuration for the model.

d. Adjust the VNA specific parameters to the desired setting. The internal calibration of the VectorStar system and this panel must agree.

a. Set ‘freq_start’ to VNA calibrated start frequency (VectorStar default 70 kHz)

b. Set ‘freq_stop’ to VNA calibrated stop frequency (VectorStar default depends on model)

c. Set ‘avg’ to 1

d. Set ‘nwa_addr’ to VNA GPIB address (default is 6 for VectorStar)

e. Set ‘points’ to VNA calibrated points (VectorStar default 201)

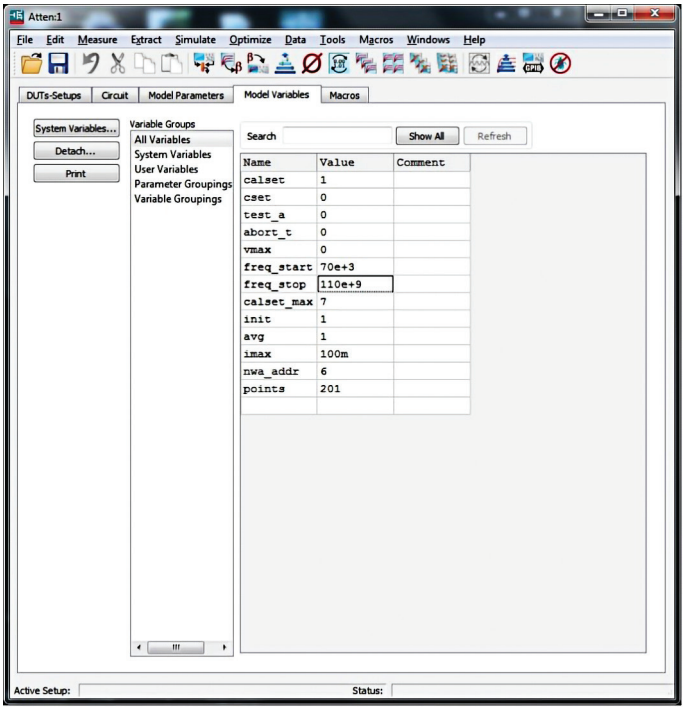

Figure 5. Reconfigured Model Variables Panel for VectorStar ME7838xx Operation

d. If not already performed, calibrate the VectorStar system to these settings.

14. Finalize the IC-CAP configuration for the sys_test.mdl file by selecting the DUTs-Setups tab and clicking the RF / S_vs_freq selection.

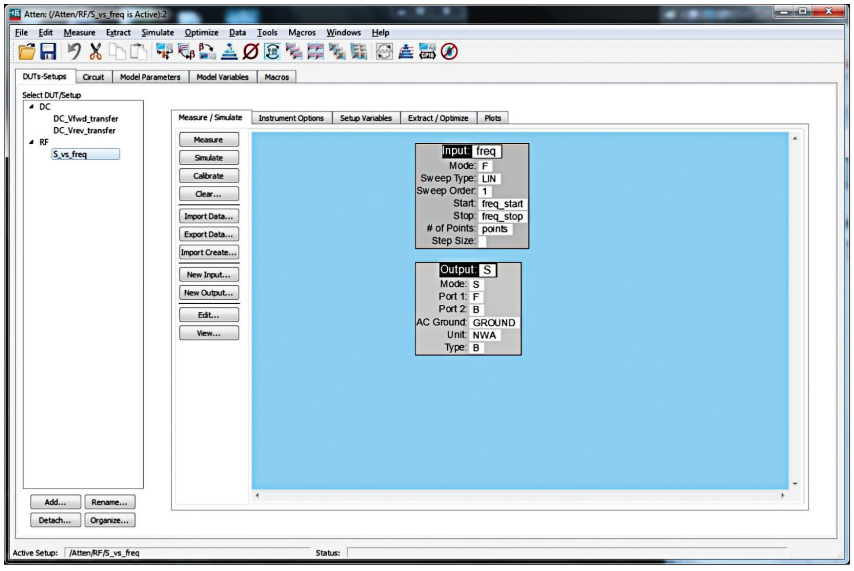

Figure 6. Default S_vs_freq Start Screen

Select the Instrument Options tab. These are the default parameters for the VectorStar driver.

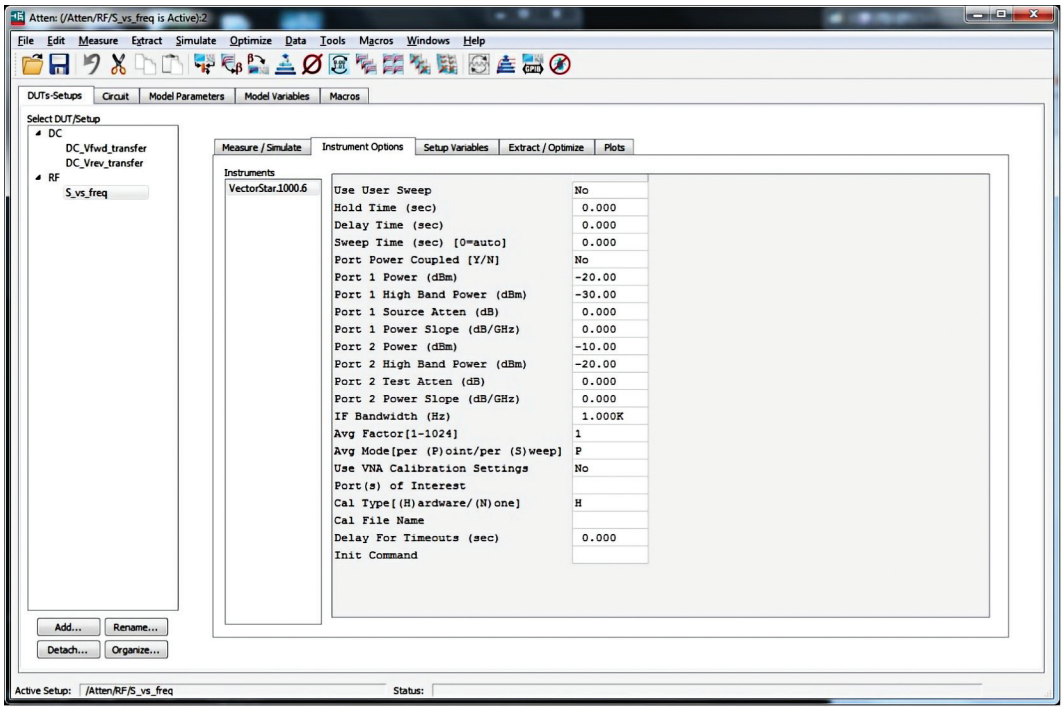

Figure 7. Default Instrument Options Panel

Modify the entries for the VNA settings so that it reflects the calibration state of the VectorStar VNA for parameters such as power, IF Bandwidth and averaging. Other parameters are set depending on the goal of the DUT measurements. See appendix for more details on configuration alternatives for the Instrument Options panel.

15. Select the Measure/Simulate tab.
16. Select Measure. The program will go through a set of measurements.
17. To confirm the measurement, select the Plots panel, select one of the S Parameters and click the Display Plot button. To display the s2p file, select View.

Summary

The VectorStar IC-CAP driver is designed to provide operation of the VectorStar VNA for modeling and characterization of devices using the IC-CAP device characterization program. All VectorStar frequency models are supported and include 2 and 4-port versions with frequencies starting at 70 kHz and single sweep coverage up to 70 GHz for baseband models and 110, 125, 145 and 220 GHz for the broadband models.

Appendix

Anritsu VectorStar Network Analyzer IC-CAP Driver

IC-CAP supports the Anritsu VectorStar Series vector network analyzers grouped as the Anritsu VectorStar. The following table lists each analyzer and frequency range:

Table 1: Supported VectorStar Series Vector Network Analyzers

Model	Low Frequency (w/opt 70)	High Frequency
MS4642x	70 kHz	20 GHz
MS4644x	70 kHz	40 GHz
MS4645x	70 kHz	50 GHz
MS4647x	70 kHz	70 GHz
ME7838Ex	70 kHz	110 GHz
ME7838Ax	70 kHz	125 GHz
ME7838Dx	70 kHz	145 GHz
ME7838Gx	70 kHz	220 GHz

The Anritsu VectorStar can be added to the active instrument list by issuing the Rebuild command from the Hardware Setup window. If VectorStar is manually added to the active instrument list using the Add to List button, IC-CAP verifies that the instrument is available on the bus when either the Measure or Calibrate command is first issued.

IC-CAP assigns the following name to this unit: NWA Network Analyzer Unit

This driver supports Frequency mode with sweep types of Linear, Log, List, Segment, and Constant:

- Linear sweep mode provides specifying of start/stop frequencies, number of points, and step size.
- Log sweep mode provides specifying of start/stop frequencies, and points per decade.
- List sweep mode provides specifying up to 100 individual frequencies.
- Segment sweep mode allows defining the start/stop frequency of up to 9 contiguous segments and the number of points per segment. (same number for all defined segments)
- Constant mode provides measurement of 1 individual frequency.

Table 2 describes the VectorStar options and their default values, where applicable.

A self-test function is provided for this instrument.

Calibration

The IC-CAP Calibrate command loads the Setup information into the VectorStar prior to calibrating. When running a measurement after calibration, the calibration set must match the valid IC-CAP Setup configuration.

Only hardware calibration is supported. The calibration must be either manually executed or executed using dedicated calibration software and saved in a directory in the VectorStar. The calibration file must have extension .cha.

Note: You can save and recall .chx calibration files, but not all settings are recalled; for example the attenuator settings (if installed) are not part of the instrument state saved to a .chx file. Consult the VectorStar Calibration and Measurement Guide for more information.

After a broadband calibration, the VectorStar can perform a spot measurement of swept calibrated data. This capability allows a CON frequency INPUT defined in an IC-CAP setup to be used with a broadband calibration. The requested frequency points must be a subset of the frequency sweep currently set up on the instrument. If the requested frequency point is not part of the instrument sweep, IC-CAP will issue an error message.

To measure calibrated data, set the instrument option Cal Type to H (Hardware) and specify a file name with a .cha extension in the Instrument Option field Cal/State File Name. You must include the path to directory to which you save the .cha file. You can set the system variable, VECTORSTAR_CAL_FILE_PATH and then specify the .cha filename in the Option field. IC-CAP will concatenate the two when loading the file during measurement.

Table 2: VectorStar in 4 Port Configuration Options Option Description

Use User Sweep	Yes = use user sweep No = use instrument's internal sweep / Default = No
Hold Time	Time, in seconds, the instrument waits before each sweep to allow for DC settling / Default = 0
Delay Time	Time the instrument waits before setting each frequency in user sweep mode / Default = 0
Sweep Time	Time the instrument takes for each sweep 0 = Auto / Default = 0
Port Power Coupled	Yes = Coupled mode No = Non-Coupled mode / Default = Yes When ports are coupled, the Port 1 Power value is used for both Port 1 and 2. Port 2 Power is ignored. Attenuators are also coupled so that Port 1 Source Atten is used for both ports and Port 2 Source Atten is ignored
Port 1 Power	Defines the source Power for Port 1, 2, 3 and 4 when ports are coupled or the source power for Port 1 when ports are uncoupled Default value depends on model and installed options: MS4647A with options 51, 61, or 62 = -10 dBm All other MS4647As = -3 dBm MS4642A and MS4644A = +5 dBm
Port 1 High Band Power	For broadband systems (ME7838xx), power above 54 GHz will be set separately
Port 1, 2 Source Atten	0 to 60 dB in 10 dB increments / Default = 0 Only used if Opt 61 or 62 is installed
Port 1, 2 Test Atten	0 to 60 dB in 10 dB increments / Default = 0 Only used if Opt 62 is installed

Port 1 Power Slope	Can be any value between -1E3 to 1E3 dB/GHz Default = 0 When ports are coupled, the Port 1 Power Slope value is used for both Port 1 and 2. Port 2 Power Slope is ignored
Port 2 Power	Defines the source power for Port 2 when ports are uncoupled. This option field is ignored when ports are coupled
Port 2 High Band Power	For broadband systems (ME7838xx), power above 54 GHz will be set separately
Port 3, 4 Source Atten	0 to 60 dB in 10 dB increments Default = 0 Only used if Opt 61 or 62 is installed
Port 3, 4 Test Atten	0 to 60 dB in 10 dB increments Default = 0 Only used if Opt 62 is installed
Port 2 Power Slope	Can be any value between -1E3 to 1E3 dB/GHz Default = 0 When ports are coupled, the Port 1 Power Slope value is used for both Port 1 and 2. Port 2 Power Slope is ignored
Port 3 Power	Defines the source power for Port 3 when ports are uncoupled. This option field is ignored when ports are coupled
Port 3 High Band Power	For broadband systems (ME7838xx), power above 54 GHz will be set separately
Port 3 Power Slope	Can be any value between -1E3 to 1E3 dB/GHz Default = 0 When ports are coupled, the Port 1 Power Slope value is used for both Port 1 and 2. Port 2 Power Slope is ignored
Port 4 Power	Defines the source power for Port 4 when ports are uncoupled. This option field is ignored when ports are coupled
Port 4 High Band Power	For broadband systems (ME7838xx), power above 54 GHz will be set separately
IF Bandwidth	Possible Values: 1, 3, 10, 30, 100, 300 Hz; 1, 3, 10, 30, 100, 300 kHz; and 1 MHz Default = 1000 Hz Note: If an invalid value is specified, the system will automatically select the closest IF bandwidth from the possible values
Avg Factor	Number of averages per measurement. [1-1024] Default = 1
Avg Mode	Set per point (P) or per sweep (S)
Use VNA Calibration Settings	[Yes/No] This setting can be set to Yes only if a calibration file is available and Calibration Type is set to H (Hardware) Default = No When set to Yes, IC-CAP loads the calibration and runs the measurement without further initializing the instrument (i.e., without downloading the current Instrument Table settings). Make sure the requested sweep setting is consistent with the calibration settings as IC-CAP attempts to run the measurement without performing any frequency range checking. Also note that when this option is set to Yes, the driver responds as if MEASURE_FAST=Yes (i.e., calibration is loaded only when the measurement is first run or after errors or warnings occur)

Port(s) of Interest	Provides the ability to specify the number of ports that will be active during the measurement. Thus, a 2-port VectorStar can be configured as a 1-port system or a 4-port system can be configured as a 2-port or 3-port system. When the active port number is identified the associated displayed traces will also be affected. If nothing is entered, all 4 ports will be swept Note: If the RF Cal in ON, VectorStar will sweep the RF calibration related ports even if there are no Ports of Interest
Cal Type[H/N]	H = Hardware calibration. N = No calibration Default = N
Cal File Name	Name of .cha file (cal file and instrument state) to be used Must provide complete path to file unless VECTORSTAR_CAL_FILE_PATH system variable is set Default = none If no file name is provided IC-CAP will use the current active instrument state for the measurement
Delay for Timeouts	For long-running measurements (that use a high number of averages, for example) use this option to avoid measurement timeouts. Default = 0
Init Command	Command field to set the instrument to a mode not supported by the option table. Command is sent at the end of instrument initialization for each measurement. Normal C escape characters such as \n (new line) are available. Default = none

Technical Notes

Additional System Variables:

VECTORSTAR_FMIN	The driver determines the minimum frequency of the instrument during rebuild from the VectorStar ID string This variable can be set if IC-CAP is unable to determine the low frequency correctly
VECTORSTAR_FMAX	The driver determines the maximum frequency of the instrument during rebuild from the VectorStar ID string This variable can be set if IC-CAP is unable to determine the high frequency correctly
SUPPRESS_NWA_RESET	During rebuild or a first session measurement, after finding the instrument on the bus, the driver will perform a *RST. Use this variable if you do not want IC-CAP to reset the VectorStar
RESET_HOLD	After making a measurement, the driver will leave the VectorStar in HOLD mode (default). Use this variable you do not want to leave the VectorStar in HOLD
CAL_LOAD_TIMEOUT	Use the variable if the default timeout for the driver to wait for a cal file to load is not sufficient

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