

Introduction

Using the TSERVER server application provided with TimeLab, phase noise and stability measurements with the PhaseStation 53100A can be configured, initiated, and recorded under the control of a remote Telnet client or other ASCII terminal application. This application note describes how to run TSERVER and how to access the services it provides. Compatibility with industry-standard phase noise test instrumentation is also demonstrated.

Launching TSERVER

TSERVE.EXE is a Windows console application. It is installed as part of the standard TimeLab software package, and is suitable for use with any 32-bit or 64-bit Windows PC that is capable of running 53100A acquisitions in the full TimeLab GUI. Since TSERVER does not display graphics, provide extensive user interaction, or work with large data files, most dual-core PCs should be capable of running it reliably.

TSERVE can be launched from a Windows desktop shortcut or run manually at a command prompt ("DOS box.") Particularly during the familiarization process, you may find it easier to work with TSERVER at the command prompt. After you've determined what options and parameters are needed in your application, you can create a batch file or shortcut to launch TSERVER with the same parameters.

Unless you specified a different location during installation, you can find the program by opening a command prompt and changing the current directory to **c:\Program Files\Miles Design\TimeLab**. To do this, select *Start → Run* in Windows and enter *cmd* as the name of the program to run. Once the DOS box appears, you can drag its lower edge to expand the window to a more comfortable size. Then, enter the commands

```
cd "\program files\miles design\timelab"
```

```
tserve /?
```

As shown in Figure 1 below, the */?* option causes TSERVER to display a brief list of the command-line options available in the current release. (Throughout this document, black on white text indicates typed commands.)

```
Administrator: MS-DOS Prompt
C:\Program Files\Miles Design\TimeLab>tserve /?

53100A console server V1.12 of Apr 21 2022      Miles Design LLC
Press ESC to terminate, SCROLL LOCK to view traffic  john@miles.io
/? for help

Usage: tserve[64] [optional arguments]

Optional arguments:
    /serial:<sernum>                Default: Any
    /logfile:<filename>             Default: server.log
    /data_port:<portnum>            Default: 1298
    /cmd_port:<portnum>             Default: 1299
    /file:<filename>                 Default: None
    /msglvl:<0-7>                   Default: 4
    /model:<name>                   Default: Microchip 53100A
    /phaserate:<1, 10, 100, 1000>   Default: 100
    /phasedec:<factor>              Default: 2
    /timerec:<secs>                 Default: 10000
    /inputfreq:<MHz> (0=auto)       Default: 0
    /referencefreq:<MHz> (0=auto)   Default: 0
    /roundfreq:<MHz>               Default: 0.1
    /ch:<chanexpr>                 Default: 3-1
    /title:<string>                 Default: (Serial #)
    /chart:<secs>                   Default: 600
    /dateformat:<1,2,3>             Default: 1
    /timeformat:<12,24>             Default: 24
    /smooth:<0,1,2>                Default: 2
    /spur_dB:<dB>                  Default: 6
    /spur_Hz:<Hz>                  Default: 0
    /format:<P, F, TSC>             Default: TSC
    /timestamp:<s, MJD, UNIX>       Default: None
    /sep:<ASCII code>               Default: ,
    /duration:<secs> (0=indefinite) Default: 0
    /am:<true,false>               Default: True
    /warn                           Default: True
    /notify                         Default: True
    /noprompt                       Default: True
    /overlap                        Default: True
    /start                          Default: True
    /wait                           Default: True
    /update                         Default: True

C:\Program Files\Miles Design\TimeLab>
```

Figure 1

Note that both 32-bit and native 64-bit versions are installed on 64-bit Windows PCs. These can be launched by running TSERVER or TSERVER64, respectively. There is no functional difference between the 32-bit and 64-bit executables, but TSERVER64 may provide more reliable acquisition on slower systems due to its use of 64-bit processing.

TSERVE command line options and defaults

When TSERVER or TSERVER64 is launched without any command-line arguments, the program will listen for Telnet connections at port 1299.¹ Once a measurement has begun, ASCII phase data will be transmitted to any client(s) connected to port 1298. Parameters appropriate for emulation of the industry-standard Symmetricom/Microsemi 5115A/5120A/5125A test sets will be used by default. In this mode of operation, TSERVER will transmit phase data samples in the TSC format, which consists of negative time interval values in seconds multiplied by the nominal input frequency. This default behavior can be modified with various command-line options, described below in alphabetical order.

¹ Although the command port is referred to as a "Telnet" port in this document, no Telnet-specific codes or protocol elements are required. Most ASCII terminals and other communications applications should be usable with TSERVER.

/am:<true | false>

By default, TSERVER performs AM noise measurements as well as phase noise measurements, as in the TimeLab GUI application. AM measurements can be disabled to reduce CPU workload by specifying `/am:false` on the command line. The **show amspectrum** and **show amspurs** commands will display the error message *AM measurements are not enabled* in this case.

/ch:<chanexpr>

Specifies the channel configuration to be used for stability measurements.

By default, the channel expression is **3-1**, indicating that a DUT connected to the 53100A's channel 3 input (or the DUT input splitter that drives it) should be measured using the reference connected to the channel 1 input or REFERENCE input splitter. It is possible to return data for up to 4 channel pairs, sampled simultaneously. For example, data for a three-cornered hat measurement of oscillators connected to channels 1, 2, and 3 could be obtained by specifying `/ch:1-2,2-3,3-1` on the command line as shown in Figure 2 below.

```
C:\dev\timeLab>mc_tserve64 /start /format:P /ch:1-2,2-3,3-1

53100A console server V1.10 (beta) of Apr  6 2022      Miles Design LLC
/? for help, ESC to terminate                        john@miles.io

[4/6/2022 4:39:35 AM] -----
[4/6/2022 4:39:35 AM] Opened logfile C:\dev\timeLab\server.log
[4/6/2022 4:39:35 AM] -----

[4/6/2022 4:39:35 AM] Initializing host JMCORE64, address 192.168.1.200:1298
[4/6/2022 4:39:35 AM] Initializing host JMCORE64, address 192.168.1.200:1299
[4/6/2022 4:39:35 AM] Stability channel 1: 1-2
[4/6/2022 4:39:35 AM] Stability channel 2: 2-3
[4/6/2022 4:39:35 AM] Stability channel 3: 3-1
[4/6/2022 4:39:35 AM] Initializing . . .
[4/6/2022 4:39:36 AM] Initializing channels
[4/6/2022 4:39:41 AM] Preparing acquisition . . .
[4/6/2022 4:39:41 AM] Acquisition in progress
[4/6/2022 4:39:41 AM] Measurement 1 of 3: DUT channel J1, reference channel J2
[4/6/2022 4:39:41 AM]   Input frequency   = 100 MHz
[4/6/2022 4:39:41 AM]   Input amplitude  = 14.0 dBm
[4/6/2022 4:39:41 AM]   Reference frequency = 12 MHz
[4/6/2022 4:39:41 AM]   Reference amplitude = 6.0 dBm
[4/6/2022 4:39:41 AM]   Sample rate      = 100.0 Hz
[4/6/2022 4:39:41 AM]   ENBW             = 50.0 Hz
[4/6/2022 4:39:41 AM] Measurement 2 of 3: DUT channel J2, reference channel J3
[4/6/2022 4:39:41 AM]   Input frequency   = 12 MHz
[4/6/2022 4:39:41 AM]   Input amplitude  = 6.0 dBm
[4/6/2022 4:39:41 AM]   Reference frequency = 11.1 MHz
[4/6/2022 4:39:41 AM]   Reference amplitude = 11.0 dBm
[4/6/2022 4:39:41 AM]   Sample rate      = 100.0 Hz
[4/6/2022 4:39:41 AM]   ENBW             = 50.0 Hz
[4/6/2022 4:39:41 AM] Measurement 3 of 3: DUT channel J3, reference channel J1
[4/6/2022 4:39:41 AM]   Input frequency   = 11.1 MHz
[4/6/2022 4:39:41 AM]   Input amplitude  = 11.0 dBm
[4/6/2022 4:39:41 AM]   Reference frequency = 100 MHz
[4/6/2022 4:39:41 AM]   Reference amplitude = 14.0 dBm
[4/6/2022 4:39:41 AM]   Sample rate      = 100.0 Hz
[4/6/2022 4:39:41 AM]   ENBW             = 50.0 Hz
[4/6/2022 4:39:41 AM] Acquiring data from Microchip 53100A serial #58526.447544
-0.0000000000616601 -0.0169955038459082 0.0170720601778488
-0.0000000000627916 -0.0175784630806108 0.0176576453543472
-0.0000000000640644 -0.0181614223159031 0.0182432305315798
-0.0000000000653570 -0.0187443815505592 0.0188288157081933
-0.0000000000664523 -0.0193273407847281 0.0194144008841192
-0.0000000000677004 -0.0199103000193194 0.0199999860606230
-0.0000000000690095 -0.0204932592542420 0.0205855712375208
-0.0000000000698884 -0.0210762184897989 0.0211711564146236
-0.0000000000708728 -0.0216591777237902 0.0217567415902597
-0.0000000000714601 -0.0222421369586700 0.0223423267663895
-0.0000000000720035 -0.0228250961934905 0.0229279119424156
-0.0000000000724804 -0.0233632124106504 0.0234684521052806
[4/6/2022 4:40:02 AM] Manual shutdown requested
[4/6/2022 4:40:02 AM] Acquisition terminated at 2113 points
[4/6/2022 4:40:02 AM] Acquisition complete
```

Figure 2

In Figure 2, the */start* option has been used to initiate a measurement in the absence of any remote client connections, */ch:1-2,2-3,3-1* is used to request separate measurements of three channel pairs, and */format:P* requests phase-difference data in seconds. The Scroll Lock key has been pressed to display a subset of the outgoing data in the server console. Each column represents the phase slope over time that corresponds to the frequency of the DUT channels (1, 2, and 3 respectively) measured against the reference sources on channels 2, 3, and 1.

Phase noise and AM noise measurements in TSERVER are always performed using the default channel configuration for noise measurements in TimeLab; specifically, the DUT that drives channels 3 and 4 through an internal or external splitter is cross-correlated against the single or dual reference(s) present at channels 1 and 2.

/chart:<secs>

Specifies the maximum length of the data record returned by TSERVER in response to the **show phasediff** and **show freqdiff** commands.

By default, these commands will return the most recent 600 seconds of data. Values between 10 and 86400 seconds are accepted.

/cmd_port:<port #>

Specifies the TCP/IP port to be used for command input from a Telnet client or other ASCII terminal program.

The default port for Telnet command access is 1299. If the port number is 0, no command port will be opened, and TSERVER's Telnet server functionality will not be available.

Up to three clients at a time may log on to the command port. Note that each client can control the measurement independently; TSERVER does not attempt to arbitrate or otherwise manage control authority between clients. To allow remote clients to initiate and control PhaseStation 53100A measurements made by TSERVER, you may need to configure your firewall or NAT gateway to open the specified command port. Instructions for doing so can be obtained from the equipment manufacturer.

/data_port:<port #>

After a measurement has been initiated through the use of the */start* command-line option or the **start** Telnet command, TSERVER will begin broadcasting a continuous stream of frequency or phase-difference data on this TCP/IP port.

The stream consists of a series of double-precision real values in standard ASCII. Data is provided at the rate given by the */phaserate* and */phasedec* parameters (100 per second by default), using the format specified by the */format* parameter. One reading per line is emitted, with each line terminated with a CR+LF pair. Optionally, each reading may be prefixed by a timestamp; see the */timestamp* and */sep* options for further information.

The default port for phase/frequency data streaming is 1298. If the port number is 0, TSERVER will not attempt to open a streaming data output port.

Up to eight clients at a time may receive data via the streaming port. TSERVER ignores any commands or other input received. To allow remote clients to receive data from TSERVER, you may need to configure your firewall or NAT gateway to open the specified data port. Instructions for doing so can be obtained from the equipment manufacturer.

/dateformat:<1,2,3>

Sets the format used by the **show date** command.

- 1** = dd (abbreviated name of month) yyyy
- 2** = mm/dd/yyyy
- 3** = dd/mm/yyyy

The default date format is 1.

/duration:<seconds>

Specifying a nonzero duration with this option will cause TSERVER to exit after the specified number of seconds.

/file:<filename>

Specifies the name of an optional ASCII text file to which streaming phase-difference or frequency readings will be written. If the specified file already exists, it will be overwritten. Typically the file is shared with other applications that can access it in read-only mode while it's being written by TSERVER.

The data written to the file may be 'followed' from within TimeLab by selecting **Acquire→Acquire from live ASCII file**. You can also monitor the data written to the file with a command such as `tail -f <filename>` from Cygwin. Finally, pressing the **Scroll Lock** key will cause TSERVER to display the lines written to the file on the stdout device (i.e., the DOS console itself) at a maximum rate of 10 readings per second.

Example: `tserve64 /data_port:0 /cmd_port:0 /start /format:P /file:%HOMEPATH%\Documents\mydata.txt`

The command above writes a continuous stream of phase-difference readings to the file **mydata.txt** in the current user's Documents folder. No TCP/IP ports are opened for either data streaming or command input. You can then use TimeLab or another application to 'follow' the file. Even if the acquisition fails or otherwise encounters problems, you can use the appropriate **File→Import** option to bring the data into TimeLab at any time.

In addition to specifying the output file on the TSERVER command line, connected Telnet clients can also open and close the output file remotely with the **open** and **close** commands.

/format:<P, F, TSC>

Specifies the type of measurement data that will be broadcast via the TCP/IP data port and/or logged to the specified file.

TSERVE writes Symmetricom 51XXA-style phase-difference data by default (*/format:TSC*). This format consists of phase-difference values that have been inverted and multiplied by the input frequency. You can also generate conventional (unscaled) phase differences with */format:P* or absolute frequency readings with */format:F*.

Optionally, any warning or error messages can be forwarded to the connected TimeLab client(s) by TSERVER for display in the status line. This capability requires the use of the */notify* option on the TSERVER command line. If */notify* is not used, data sent to the TCP/IP streaming clients and/or shared file will always consist of numeric readings in the specified format.

/inputfreq:<MHz>

By default, the DUT and reference input frequencies are measured at acquisition startup time and rounded to the nearest 100 kHz. These nominal frequencies are reported by the **show inputs** command and used as the basis for phase-difference readings. If either frequency does not accurately reflect the nominal frequency of the corresponding input source, the discrepancy will appear as a nonzero slope in successive phase-difference readings. If the phase slope is due to insufficient DUT frequency precision, the */inputfreq* option can be used to specify the precise DUT input frequency to be used instead of the estimated value. Alternatively, */roundfreq* can be used to force the nominal input frequency to be logged at higher precision.

For example, if a DUT with a nominal frequency of 10.23 MHz is being measured and it is desirable to minimize the slope of the phase-difference readings, either */inputfreq:10.23* or */roundfreq:0.01* could be used.

Note that the accuracy of the absolute frequency readings obtained with the */format:F* switch depends only on the reference source, regardless of the nominal input frequency reported by **show inputs**. Consequently, it is unaffected by the */inputfreq* or */roundfreq* options. As a result, the */inputfreq* and */roundfreq* options are not required in most TSERVER measurements. However, note that if the nominal reference frequency is not a multiple of 100 kHz, it is necessary to use */referencefreq* to avoid inaccurate results regardless of the selected output format. See the */referencefreq* option for more information.

/logfile:<filename>

Specifies the pathname for a logfile which will record status, warning, and error messages. If the */logfile* parameter contains an absolute path specification, the log file is placed at that location. Otherwise, if */logfile* specifies a filename by itself, the log file is placed in the user's Documents directory. The location of the log file is displayed when TSERVER is launched.

The default logfile name used when no */logfile* parameter is provided is **server.log**.

/model:<name>

Specifies the instrument name that will be returned by the **show version** command. The instrument name is also used to present a logon banner ("Welcome to the ____") when a new connection is made to the Telnet command port.

The default model name is *Microchip 53100A*. The specified model name has no effect on any aspect of operation except as described above. A different model name may be required for compatibility with legacy software that expects to communicate with (e.g.) a Symmetricom 5125A:

Example: `tserve64 /model:"Symmetricom 5125A" /start`

/msglvl:<0-7>

Specifies the "verbosity" of informational, warning, and error messages that TSERVER will display on the server console. */msglvl:0* will display all available status messages and notices including internal driver diagnostics, while */msglvl:7* will display only fatal error messages. The default message level is 4.

Messages displayed at the server console are also written to the logfile. See the */logfile* option for more information.

/noprompt

By default, clients attached to the Telnet command port will receive a command prompt containing the TSERVER host IP address. Issuing the **prompt off** command or specifying the */noprompt* argument on the TSERVER command line will prevent the prompt from being displayed.

/notify

Optionally, any warning or error messages that occur during data acquisition can be forwarded to clients via the TCP/IP data port used for phase/frequency streaming. To enable this capability, include the */notify* option on the TSERVER command line.

If */notify* is not used, data sent to the TCP/IP streaming clients and/or shared file will always consist of numeric readings in the specified format.

/overlap

For maximum reliability on slower host PCs, overlapped FFT processing during phase noise measurement is turned off by default in TSERVER. Specifying the */overlap* option can significantly improve the speed required for low-noise measurements to converge, at the risk of possible data overruns.

Specifying the */overlap* option on the TSERVER command line is equivalent to checking the *Overlapped acquisition* checkbox in the *Additional options* page of the 53100A acquisition dialog.

/phasedec

/phaserate

These options determine the default sample rate for frequency and phase-difference data streamed to TCP/IP clients connected to the data port.

When a client initially establishes a Telnet connection to the TSERVER command port, it inherits various global settings including the */phaserate* parameter. In this case, the */phaserate* parameter becomes the **phaserate** value for measurements initiated by that client. This value can be displayed with the **show phaserate** command or modified with the **set phaserate** command at any time prior to starting a measurement. Using either of these techniques, you can set the phase rate to 1 reading per second to conserve network bandwidth and/or disk space for use with extremely stable sources. Conversely, measurements of drift-prone sources may require phase data rates of 100 or 1000 readings per second to avoid acquisition failures.

The choice of phase data rate also determines the baseband measurement bandwidth for frequency and phase stability. In TSERVER, the equivalent noise bandwidth (ENBW) is half of the */phaserate* interval, or 50 Hz by default. (Note that the PhaseStation 53100A driver limits the minimum bandwidth to 5 Hz, even when */phaserate:1* is used.)

The */phasedec* parameter provides some additional flexibility by allowing you to specify a larger-than-normal decimation ratio for the post-detection phase data. Its default value is 2, corresponding to the default *Output decimation* property on the *Additional options* page of the PhaseStation 53100A acquisition dialog. The nominal phase rate options of 1, 10, 100, and 1000 readings per second are based on the default */phasedec* value of 2. Setting */phasedec* to larger values reduces the overall rate at which frequency and phase-difference data is streamed to TSERVER clients and any output file specified with the */file* parameter, and also determines the tau0 interval for the **show adev** command. Regardless of any changes to */phasedec*, the equivalent noise bandwidth is still determined by the **phaserate** value that was in effect when the measurement began.

If not overridden by a command-line argument, the */phaserate* value defaults to 100 samples per second. Note that some legacy Symmetricom/Microsemi 51XXA applications may require a phase data rate of 1000 samples per second. Unlike these test sets, any changes made to parameters such as **phaserate**, **tau0**, and **referencefreq** will not affect either queried or streamed data from the measurement in progress. As a result, the data rate must either be set from the command line when TSERVER is started, or by issuing a **set phaserate** command prior to the **start** command.

/referencefreq:<MHz>

At measurement startup time, TSERVER estimates the frequency of the signal at the 53100A's REFERENCE input by rounding it to the nearest 100 kHz. This provides an authoritative basis for calculation of the applied DUT input frequency, assuming that the reference frequency is indeed a multiple of 100 kHz. If this is not the case, you should use the */referencefreq* option to specify the nominal reference frequency explicitly.

For example, if a 10.5 MHz oscillator is used as a reference source, the */referencefreq* parameter does not need to be specified. However, if a 10.23 MHz oscillator is used as the reference, it is necessary to specify */referencefreq:10.23* to avoid inaccurate results.

The nominal reference frequency can be changed by remote clients with **set referencefreq**. Whether it is measured or specified, the reference frequency is inherited by Telnet command clients at connection time and used as the **referencefreq** parameter during subsequent measurements. Any changes made with **set referencefreq** while a measurement is in progress will have no effect on frequency-count or streamed frequency/phase-difference readings reported during the current measurement.

/roundfreq:<MHz>

By default, the DUT and reference input frequencies are measured at acquisition startup time and rounded to the nearest 100 kHz. These nominal frequencies are reported by the **show inputs** command and used as the basis for phase-difference readings. If either frequency does not accurately reflect the nominal frequency of the corresponding input source, the discrepancy will appear as a nonzero slope in successive phase-difference readings. If the phase slope is due to insufficient DUT frequency precision, the */roundfreq* option can be used to force the nominal input frequency to be logged at higher precision. Alternatively, */inputfreq* can be used to specify the precise DUT input frequency to be used instead of the estimated value.

For example, if a DUT with a nominal frequency of 10.23 MHz is being measured and it is desirable to minimize the slope of the phase-difference readings, either */inputfreq:10.23* or */roundfreq:0.01* could be used. The **show inputs** command will report an input frequency of 10.23 MHz in either case.

Note that the accuracy of the absolute frequency readings obtained with the */format:F* switch depends only on the reference source, regardless of the nominal input frequency reported by **show inputs**. Consequently, it is unaffected by the */inputfreq* or */roundfreq* options. As a result, the */inputfreq* and */roundfreq* options are not required in most TSERVER measurements. However, note that if the nominal reference frequency is not a multiple of 100 kHz, it is necessary to use */referencefreq* to avoid inaccurate results regardless of the selected output format. There is no corresponding way to increase the reference frequency's rounding precision; the nominal reference frequency must be specified explicitly with */referencefreq* if 100-kHz precision is insufficient.

/ sep:<character>

/ timestamp:<s, MJD, UNIX>

These related options cause TSERVER to add a timestamp to each phase-difference or frequency reading that is written to a shared file or streamed to network clients.

By default, no timestamps are emitted. When */timestamp:MJD* is specified, the Modified Julian Date (MJD) associated with each phase-difference or frequency value will be written as the first numeric field on each line, followed by a space character (ASCII 32), then the measurement value itself. MJD timestamps are generated with six digits of decimal precision, resulting in roughly 10 unique MJD values per second.

You can also use */timestamp:s* to emit a simple numeric timestamp at one-microsecond precision. These timestamps begin at 0.000000 for the first reading acquired. Finally, */timestamp:UNIX* can be used to request numeric timestamps at one-millisecond precision relative to the standard Unix epoch (January 1st, 1970 at 00:00:00 UTC.)

In all cases, the difference between successive timestamps will be equal to the reciprocal of the */phaserate* parameter, whose default is 100 readings per second, scaled further by any specified */phasedec* ratio beyond its default value of 2:1. Refer to the description of the */phaserate* parameter for more information.

The `/sep` option may be used to specify an additional separator character that will appear before the space between the timestamp and measurement value. If the client requires comma-separated values, for example, `/sep;`, would be useful. Any nonzero numeric value used as the `/sep` argument is treated as an ASCII code; e.g. `/sep:9` generates a tab character.

Example: `tserve64 /start /phaserate:1000 /phasedec:200 /format:F /timestamp:s /sep;`

```

C:\Program Files\Miles Design\TimeLab\tserve64.exe
53100A console server V1.00 of Oct 22 2019
Press ESC to terminate
Miles Design LLC
john@miles.io

[10/22/2019 9:48:16 PM] -----
[10/22/2019 9:48:16 PM] Opened logfile C:\Users\john\Documents\server.log
[10/22/2019 9:48:16 PM] -----
[10/22/2019 9:48:16 PM] Initializing host JMCORE64, address 192.168.1.200:1298
[10/22/2019 9:48:16 PM] Initializing host JMCORE64, address 192.168.1.200:1299
[10/22/2019 9:48:16 PM] Loaded driver (Jackson Labs PhaseStation ...)
[10/22/2019 9:48:16 PM] Initializing channels
[10/22/2019 9:48:21 PM] Preparing acquisition . . .
[10/22/2019 9:48:21 PM] Acquisition in progress
[10/22/2019 9:48:21 PM] Input frequency = 10.1 MHz
[10/22/2019 9:48:21 PM] Input amplitude = 9.0 dBm
[10/22/2019 9:48:21 PM] Reference frequency = 10 MHz
[10/22/2019 9:48:21 PM] Reference amplitude = 5.0 dBm
[10/22/2019 9:48:21 PM] Sample rate = 10.0 Hz
[10/22/2019 9:48:21 PM] ENBW = 500.0 Hz
[10/22/2019 9:48:21 PM] Acquiring data from PhaseStation serial #58526.447544
0.100000, 10123455.9900418613106012
0.200000, 10123455.9900453537702560
0.400000, 10123455.9900770755545616
0.600000, 10123455.9900992810726166
0.800000, 10123455.9903018996119499
0.900000, 10123455.990275456387663
[10/22/2019 9:48:22 PM] Manual shutdown requested
[10/22/2019 9:48:22 PM] Acquisition complete
[10/22/2019 9:48:23 PM] Terminating, please wait . . .
[10/22/2019 9:48:23 PM] Terminated connection to 58526.447544, exit code 5

```

Figure 3

Note that without the `/phasedec:200` parameter, the timestamps shown in green in Figure 3 above would have advanced at the rate of 0.001 second per reading rather than 0.1 second. This effect would be apparent to any connected streaming-data clients but would not necessarily be visible in the server console, since the readings obtained with the Scroll Lock monitor function are limited to 10 readings per second.

`/serial:<sernum>`

When more than one 53100A is connected to the server PC, you may need to use the `/serial` option to associate a given TSERVER instance with a specific instrument. Each instance of TSERVER supports only one acquisition at a time, but you can launch as many instances as desired.

Example: `tserve64 /serial:55908.304876 /cmd_port:1234 /data_port:1235`

The command above will launch an instance of TSERVER for use with the 53100A whose serial number is 55908.304876. To avoid addressing conflicts, each TSERVER instance must specify unique TCP/IP ports for command and data traffic.

`/smooth:<0,1,2>`

The `/smooth` option determines the filtering operations applied to phase noise data returned by the **show spectrum** command.

- 0** = No smoothing or spur suppression
- 1** = Spurs are removed from the trace but no smoothing is applied
- 2** = Spurs are removed from the trace and smoothing is applied (default)

In most cases the smoothing parameter should be left at its default value of 2. Spurs that are present in the phase noise spectrum have undergone the same 1-Hz normalization process as the noise data itself, so they will rarely appear at their true amplitudes. Use the **show spurs** command to retrieve the offsets and amplitudes of detected spurs.

/spur_dB:<dB>

This parameter corresponds to the *Spur threshold* field in the *Additional options* page of the PhaseStation 53100A acquisition dialog. It determines the amplitude above the local average phase noise level at which a discrete spectral line is recognized as a coherent spur. The default spur detection threshold is 6.0 dB.

/spur_Hz:<Hz>

This parameter corresponds to the *Spur min offset* field in the *Additional options* page of the PhaseStation 53100A acquisition dialog. Spurs with offset frequencies below this value in Hz will not be removed from the plot or added to the spur chart. This may be helpful when one or more spurs close to the carrier are being erroneously flagged. The default minimum spur offset is 0 Hz, which disables the feature.

/start

Causes TSERVER to begin an acquisition immediately after launch.

If */start* is not specified on the command line, no measurement will begin until a client logs onto the Telnet command port and issues a **start** command.

/timeformat:<12,24>

Sets the format used by the **show time** command. */timeformat:12* specifies 12-hour time while */timeformat:24* specifies 24-hour time.

/timestamp:<s, MJD, UNIX>

See */sep*.

/title:<string>

Establishes the title text returned by the **show title** command.

By default, the title is the reserved string **(Serial #)**, which causes the serial number of the connected instrument to be returned by **show title**. Refer to the **show title** command description for more information.

/update

The */update* function is useful in scenarios where **TSERVE[64].EXE** may need to be recompiled, upgraded, or otherwise replaced over a network without manual intervention at the server console. When */update* is present on the command line, TSERVE will periodically check for the presence of a file called **TSERVE[64].EX1** in the same directory as the executable. If **TSERVE[64].EX1** is ever found, the program will terminate with exit(2), reporting the message "Server terminated due to release of new version."

This feature depends on the use of a batch file or script to launch **TSERVE[64].EXE**. Upon detecting exit code 2, the batch file or script should overwrite the program executable with a copy of **TSERVE[64].EX1**, then delete the **TSERVE[64].EX1** file and relaunch the new **TSERVE[64].EXE** process with the same set of command-line parameters. When any other exit code is returned by the program, the batch file or script can exit normally or take other actions.

As an example, **TSC.BAT** is provided in the TimeLab installation directory to demonstrate the use of the */update* and */model* options. Any additional command-line options specified by the user are passed along to the program as well. **TSC.BAT** appears below in its entirety.

```
@echo off

rem
rem Batch file to emulate a Symmetricon 5125A with the PhaseStation 53100A
rem

:start

rem
rem If tserve64.ex1 exists in the directory, rename it to tserve64.exe and run it
rem (passing any command-line arguments that were originally used with tsc.bat)
rem

if not exist tserve64.ex1 goto serve
copy tserve64.ex1 tserve64.exe >nul
del tserve64.ex1
:serve
if not exist tserve64.exe goto bail

tserve64 /model:"Symmetricon 5125A" /update %*

rem
rem If stream server exits with code 2, it means that the /autoupdate option
rem detected a new copy of tserve64.ex1 in the directory. Go back and launch
rem the new version without any manual intervention
rem

if errorlevel 2 goto start
:bail
```

/wait

If the */wait* option is specified on the TSERVE command line, the program will prompt for a keypress before terminating, except when the */update* mechanism has been triggered by the appearance of a newer executable version. See the description of the */update* option below for more information.

Typically the */wait* option is used to keep Windows from discarding useful status or error information by closing the console window immediately upon termination. It is not necessary when TSERVER is launched directly at an MS-DOS prompt, but may be helpful when launching from a desktop shortcut.

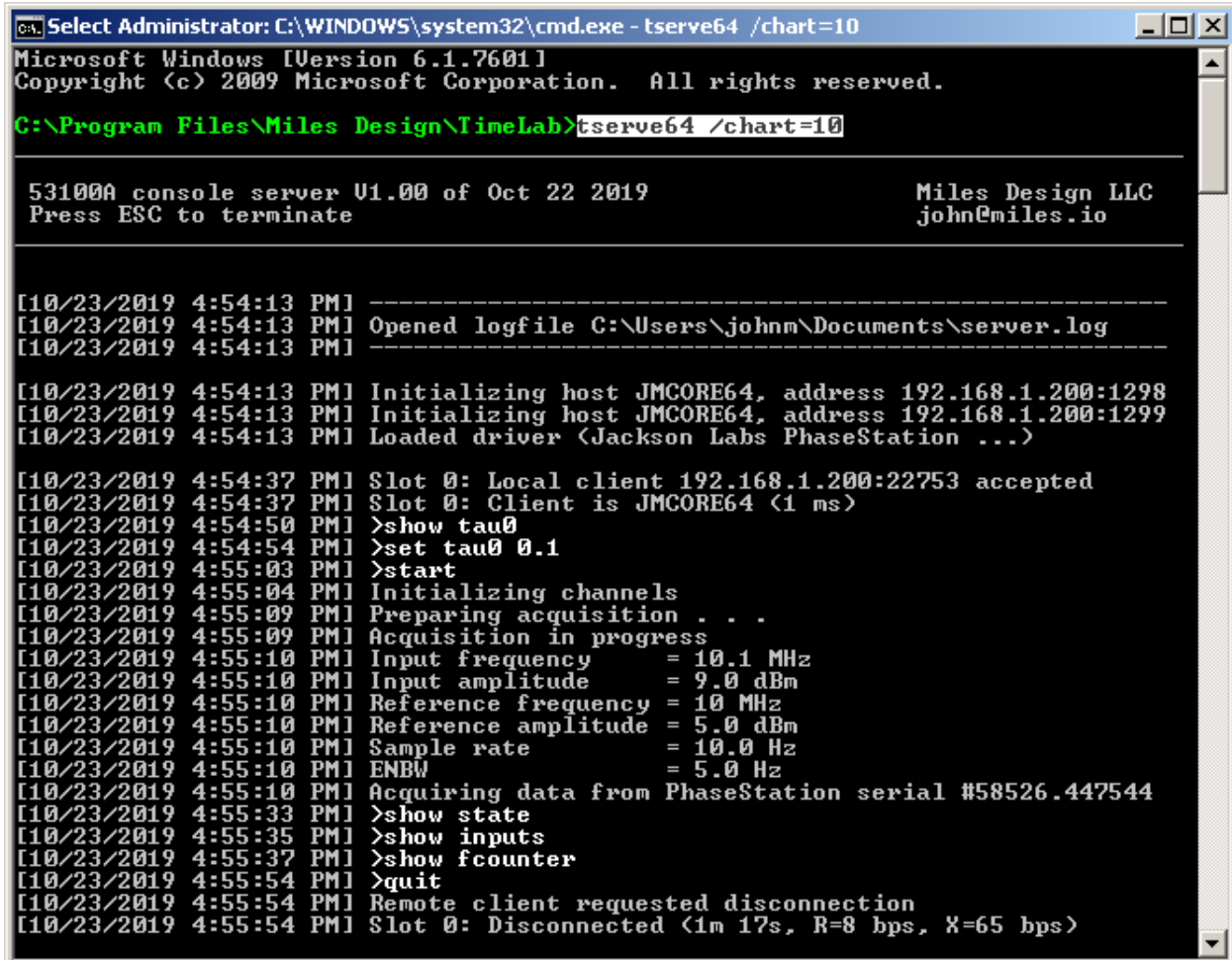
/warn

By default, a TSERVER-hosted measurement will stop if any significant changes in signal amplitude or frequency are observed at either the DUT or REFERENCE input ports. Using the */warn* option will allow the measurement to continue running when non-fatal anomalies are encountered. This option is equivalent to unchecking the *All warnings fatal* option in the *Additional options* page of the PhaseStation 53100A acquisition dialog.

When a measurement stops due to an error condition, any streaming data connections will remain open, and any Telnet or terminal clients will remain connected. Clients attached to the command port can query the status of the measurement with the **show state** and **show message** commands, while clients connected to the streaming data port will receive error and warning messages if the */notify* option was specified on the TSERVER command line.

TSERVE remote commands

A variety of commands and queries may be issued by a Telnet or other ASCII terminal client connected to the TSERVER command port. These commands will appear in the console TTY display as shown in Figure 4 below, and will also be written to the server log file.



```
C:\WINDOWS\system32\cmd.exe - tserve64 /chart=10
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Program Files\Miles Design\TimeLab>tserve64 /chart=10

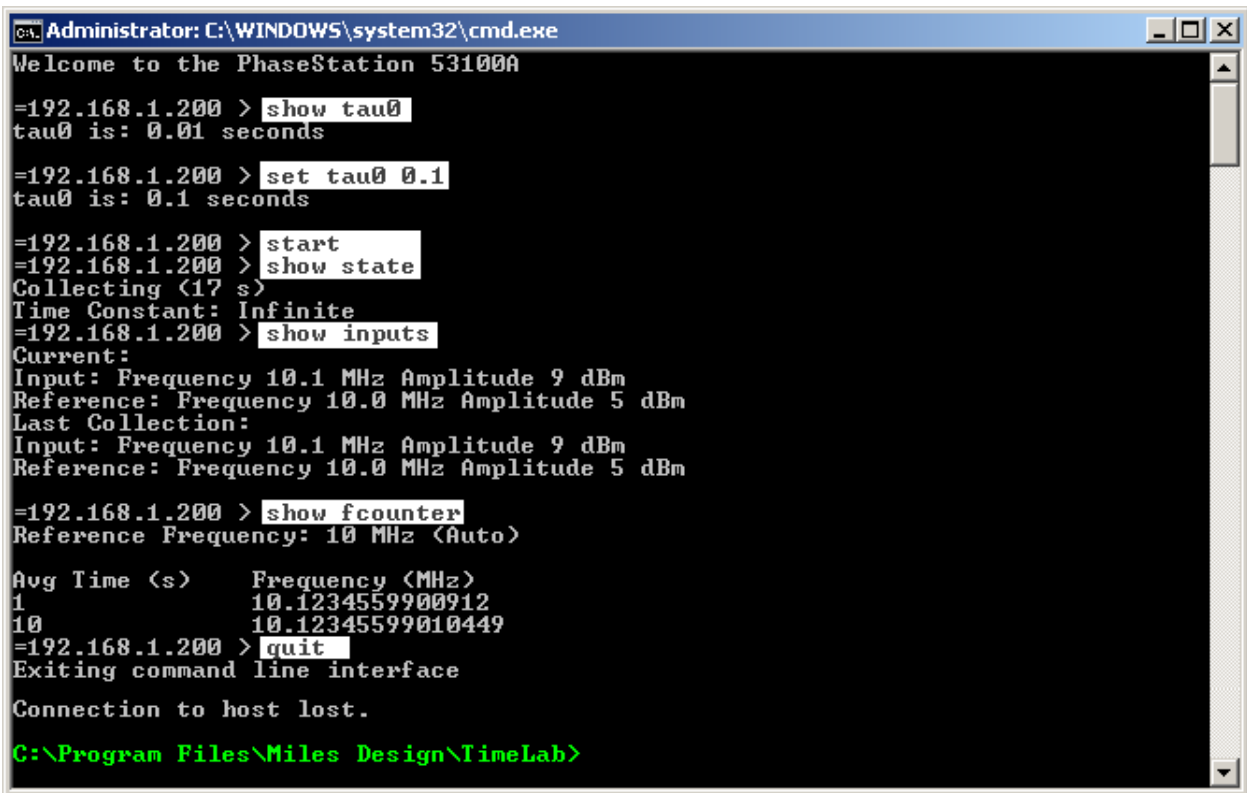
53100A console server V1.00 of Oct 22 2019                               Miles Design LLC
Press ESC to terminate                                                john@miles.io

[10/23/2019 4:54:13 PM] -----
[10/23/2019 4:54:13 PM] Opened logfile C:\Users\johnm\Documents\server.log
[10/23/2019 4:54:13 PM] -----
[10/23/2019 4:54:13 PM] Initializing host JMCORE64, address 192.168.1.200:1298
[10/23/2019 4:54:13 PM] Initializing host JMCORE64, address 192.168.1.200:1299
[10/23/2019 4:54:13 PM] Loaded driver (Jackson Labs PhaseStation ...)
[10/23/2019 4:54:37 PM] Slot 0: Local client 192.168.1.200:22753 accepted
[10/23/2019 4:54:37 PM] Slot 0: Client is JMCORE64 (1 ms)
[10/23/2019 4:54:50 PM] >show tau0
[10/23/2019 4:54:54 PM] >set tau0 0.1
[10/23/2019 4:55:03 PM] >start
[10/23/2019 4:55:04 PM] Initializing channels
[10/23/2019 4:55:09 PM] Preparing acquisition . . .
[10/23/2019 4:55:09 PM] Acquisition in progress
[10/23/2019 4:55:10 PM] Input frequency      = 10.1 MHz
[10/23/2019 4:55:10 PM] Input amplitude       = 9.0 dBm
[10/23/2019 4:55:10 PM] Reference frequency   = 10 MHz
[10/23/2019 4:55:10 PM] Reference amplitude    = 5.0 dBm
[10/23/2019 4:55:10 PM] Sample rate          = 10.0 Hz
[10/23/2019 4:55:10 PM] ENBW                  = 5.0 Hz
[10/23/2019 4:55:10 PM] Acquiring data from PhaseStation serial #58526.447544
[10/23/2019 4:55:33 PM] >show state
[10/23/2019 4:55:35 PM] >show inputs
[10/23/2019 4:55:37 PM] >show fcounter
[10/23/2019 4:55:54 PM] >quit
[10/23/2019 4:55:54 PM] Remote client requested disconnection
[10/23/2019 4:55:54 PM] Slot 0: Disconnected (1m 17s, R=8 hps, X=65 hps)
```

Figure 4

The TSERVER example session shown above was launched from an MS-DOS prompt. (Black-on-white characters indicate text entered by the user at the prompt.) The 64-bit version of TSERVER was run by typing **tserve64**, followed by the **/chart=10** command-line option.

Shortly after the server was started, a connection was established from another DOS box on the same PC as shown in Figure 5 below, using the command **telnet 192.168.1.200 1299**:



```
Administrator: C:\WINDOWS\system32\cmd.exe
Welcome to the PhaseStation 53100A

=192.168.1.200 > show tau0
tau0 is: 0.01 seconds

=192.168.1.200 > set tau0 0.1
tau0 is: 0.1 seconds

=192.168.1.200 > start
=192.168.1.200 > show state
Collecting (17 s)
Time Constant: Infinite
=192.168.1.200 > show inputs
Current:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm
Last Collection:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm

=192.168.1.200 > show fcounter
Reference Frequency: 10 MHz (Auto)

Avg Time (s)      Frequency (MHz)
1                10.1234559900912
10               10.12345599010449
=192.168.1.200 > quit
Exiting command line interface
Connection to host lost.

C:\Program Files\Miles Design\TimeLab>
```

Figure 5

In this example, several different commands and queries were transmitted to TSERVER from the Telnet client application, including the **start** command to begin data acquisition. These user-entered commands appear in black-on-white text in the Telnet client window and are displayed in bold white text at the server console. After the user issued the final **quit** command at 4:55:54 PM, the Telnet session ended. The server (and the measurement acquisition) continued to run, awaiting further connections.

An alphabetical list of supported commands and queries appears below. Except as noted, TSERVER's remote command syntax is compatible with the Microsemi/Symmetricom/TSC 5125A and other phase noise test sets in the 51XXA series. Applications and test scripts written for these instruments should run on a PhaseStation 53100A with little or no adaptation.

Note that multiple commands may be entered on one line by separating them with semicolons.

beep

Plays a sound on the TSERVER host PC.

close

Closes the output stream data file most recently opened with the **open** command or */file:* command-line option.

exit

See **quit**.

help [<command>]

Returns a list of commands with brief usage information. If a command name is specified, only the help text for that command is returned.

history

Returns a list of previously-entered commands.

logout

See **quit**.

measurelinear

Computes the slope and intercept coefficients of the current phase-difference chart. After a **measurelinear** command has been issued, a subsequent **removelinear on** command will cause the linear trendline to be removed from the chart data returned by **show phasediff**.

If **measurelinear** is executed while **removelinear on** is in effect, the stored coefficients will be updated for use by subsequent **show phasediff** commands. It is not necessary to use **removelinear off** before issuing a **measurelinear** command.

open <filename>

Opens an ASCII text file to which streaming phase-difference or frequency readings will be written. If the specified file already exists, it will be overwritten. Typically the file is shared with other applications that can access it in read-only mode while it's being written by TSERVER.

The data written to the file may be 'followed' from within TimeLab by selecting **Acquire→Acquire from live ASCII file**. You can also monitor the data written to the file with a command such as *tail -f <filename>* from Cygwin. Finally, pressing the **Scroll Lock** key will cause TSERVER to display the lines written to the file on the stdout device (i.e., the DOS console itself) at a maximum rate of 10 readings per second.

Example: *tserve64 /data_port:0 /cmd_port:0 /start /format:P /file:%HOMEPATH%\Documents\mydata.txt*

The command above writes a continuous stream of phase-difference readings to the file **mydata.txt** in the current user's Documents folder. No TCP/IP ports are opened for either data streaming or command input. You can then use TimeLab or another application to 'follow' the file. Even if the acquisition fails or otherwise encounters problems, you can use the appropriate **File→Import** option to bring the data into TimeLab at any time.

The output file may be flushed and closed at any time by issuing a **close** command or by **opening** a different file. In addition to the **open** command, a stream output file can also be opened at TSERVER startup time by specifying the */file: <filename>* command-line option.

pause <chart>

pause phasediff and **pause freq** will inhibit updates to the phase difference and frequency difference charts, respectively. Updates may be resumed with **resume phasediff** or **resume freq**. (The inconsistent chart nomenclature is required for compatibility with the TSC 51XXA command language.)

prompt <on | off>

The **prompt off** and **prompt on** commands will disable and enable the Telnet command prompt, respectively. The prompt is enabled by default. **prompt off** is equivalent to the */noprompt* command-line option.

quit

Closes the Telnet connection. The TSERVER server will continue running, as will any measurement in progress.

removelinear <on | off>

When **removelinear on** is in effect, the linear trendline most recently measured by the **measurelinear** command will be removed from subsequent phase-difference charts returned by the **show phasediff** command. Use **removelinear off** to disable linear-trend subtraction.

reset

restorefactorydefaults

When the Telnet server thread is created by TSERVER at startup time, copies of the default values for the **phaserate**, **tau0**, **referencefreq**, **inputfreq**, **prompt**, **dateformat**, **timeformat**, and **title** properties are associated with the server instance, taking into account any changes made to the program defaults at the TSERVER command line. These properties subsequently apply to any measurements initiated by either Telnet clients or by a */start* parameter on the TSERVER command line. Clients may alter these server property values by issuing the appropriate **set** commands. Changes made to the server property values will apply to acquisitions that are subsequently initiated by that client or any others.

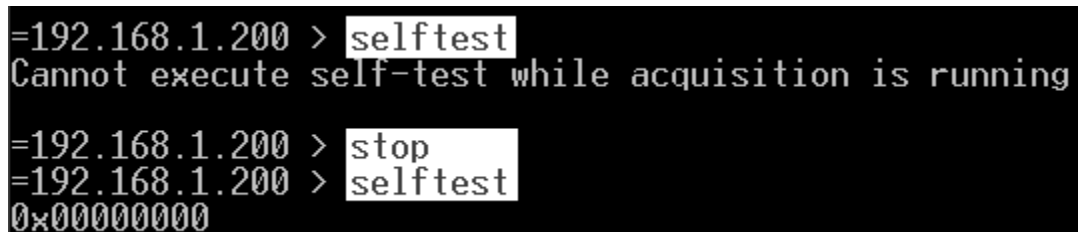
Issuing a **reset** or **restorefactorydefaults** command will immediately stop any measurement in progress. TSERVER will continue running and any clients will remain connected, but the server default properties will be restored to the program default or command-line values, just as if TSERVER had been terminated and restarted. The **reset** and **restorefactorydefaults** commands behave identically.

resume <chart>

See **pause**.

selftest

Executes a built-in self test (BIST) routine on the PhaseStation. As shown below (Figure 6), the **selftest** command is available only when no measurement is currently in progress.



```
=192.168.1.200 > selftest
Cannot execute self-test while acquisition is running

=192.168.1.200 > stop
=192.168.1.200 > selftest
0x00000000
```

Figure 6

selftest returns a 32-bit hexadecimal number whose individual bits represent various fault indications. A result of 0x00000000 indicates that no issues were found. Nonzero bits are interpreted as follows:

const U32 BIST_OK	= 0x00000000;	// All bits clear = no faults detected
const U32 BIST_POCXO_COLD	= 0x00000001;	// Clock OCXO not warmed up (< 68C)
const U32 BIST_POCXO_HOT	= 0x00000002;	// Clock OCXO over max temperature (75C)
const U32 BIST_POCXO_UNLOCKED	= 0x00000004;	// ADC clock PLL unlocked
const U32 BIST_FPGA_HOT	= 0x00000008;	// FPGA over max temperature (100C)
const U32 BIST_FPGA_COLD	= 0x00000010;	// FPGA under min temperature (0C)
const U32 BIST_PREREG_OVERVOLT	= 0x00000020;	// Controller input voltage > 13.9V
const U32 BIST_PREREG_UNDERVOLT	= 0x00000040;	// Controller input voltage < 13.2V
const U32 BIST_POWER_HIGH	= 0x00000080;	// Controller input power > 15W
const U32 BIST_POWER_LOW	= 0x00000100;	// Controller input power < 11W
const U32 BIST_1P0_OVERVOLT	= 0x00000200;	// 1.0V bus > 1.05V
const U32 BIST_1P0_UNDERVOLT	= 0x00000400;	// 1.0V bus < 0.95V
const U32 BIST_1P8_OVERVOLT	= 0x00000800;	// 1.8V bus > 1.89V
const U32 BIST_1P8_UNDERVOLT	= 0x00001000;	// 1.8V bus < 1.71V
const U32 BIST_PSRAM_FAULT	= 0x00002000;	// PSRAM FIFO could not be enabled
const U32 BIST_FPGA_UNCONFIGURED	= 0x00004000;	// FPGA could not be configured
const U32 BIST_BULK_READ_ERROR	= 0x00008000;	// Couldn't stream input data
const U32 BIST_CH0_PRN_FAULT	= 0x00010000;	// Invalid data read from ADC channel 0 (J3)
const U32 BIST_CH1_PRN_FAULT	= 0x00020000;	// Invalid data read from ADC channel 1 (J1)
const U32 BIST_CH2_PRN_FAULT	= 0x00040000;	// Invalid data read from ADC channel 2 (J4)
const U32 BIST_CH3_PRN_FAULT	= 0x00080000;	// Invalid data read from ADC channel 3 (J2)
const U32 BIST_MB_NOT_FOUND	= 0x04000000;	// Main board disconnected
const U32 BIST_FPAN_NOT_FOUND	= 0x08000000;	// Front panel disconnected
const U32 BIST_AUTH_FAILURE	= 0x10000000;	// Authentication failure
const U32 BIST_DEVICE_IN_USE	= 0x20000000;	// Device is currently in use
const U32 BIST_USB_ERROR	= 0x40000000;	// Non-fatal USB communication error(s) occurred
const U32 BIST_CONNECT_FAILURE	= 0x80000000;	// Failed to connect to device

It is normal for bit 1 to be set (0x00000001) if the **selftest** command is issued immediately after power-up while the front-panel STATUS indicator is still blue.

set <...>

When the Telnet server thread is created by TSERVER at startup time, copies of the default values for the **phaserate**, **tau0**, **referencefreq**, **prompt**, **dateformat**, **timeformat**, and **title** properties are associated with the server, taking into account any changes made to the program defaults at the TSERVER command line. These properties subsequently apply to any measurements initiated by either Telnet clients or by a */start* parameter on the TSERVER command line. Clients may alter these server property values by issuing the appropriate **set** commands. Changes made to the server property values will apply to acquisitions that are subsequently initiated by that client or any others.

The following **set** commands are supported by TSERVER:

- **set dateformat <1|2|3>**

Sets the date format used by the **show date** command.

- 1 dd (abbreviated name of month) yyyy
- 2 mm/dd/yyyy
- 3 dd/mm/yyyy

The default date format is 1, unless overridden by the */dateformat* command-line parameter.

- **set phaserate <rate>**

See the description of the */phaserate* command-line parameter for more information.

- **set referencefreq <auto|MHz>**

See the description of the */referencefreq* command-line parameter for more information.

- **set inputfreq <auto|MHz>**

See the description of the */inputfreq* command-line parameter for more information.

- **set tau0 <value>**

Sets the tau-zero period for the **show adev** command in seconds. Values of 0.001, 0.01, 0.1, and 1 second are supported.

Note that changing the **tau0** value will recompute the **phaserate** property, and vice versa. See the description of the */phaserate* command-line parameter for more information. As with **phaserate**, changes to **tau0** are scaled by the */phasedec* parameter if a non-default value is provided on the command line.

- **set timeformat <24|12>**

Sets the time format used by the **show date** command. The default time format is 24, unless overridden by the */timeformat* command-line parameter.

- **set title <title>**

Establishes the title text returned by the **show title** command. Unless changed by the */title* command-line parameter, the default title is the reserved string **(Serial #)**. When **show title** is issued during a measurement, the reserved string will be replaced by the serial number of the connected instrument. Other title strings will be reported verbatim.

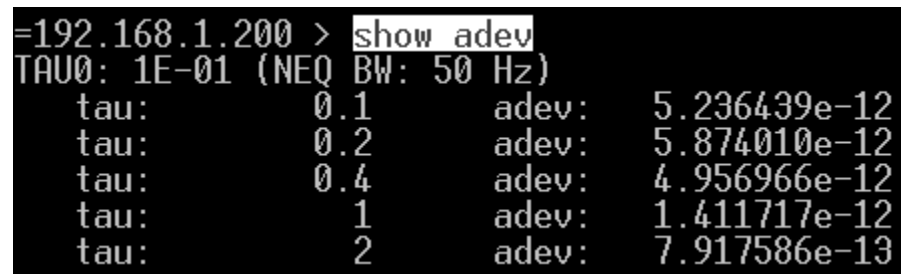
Titles containing spaces must be enclosed in double quotes (" "). See the **show title** command description below for more information.

show <...>

The **show** command queries the current value of a property or the results of the current measurement in progress. The following **show** queries are supported by TSERVER:

- **show adev**

Returns the current Allan deviation chart, as shown in the example below (Figure 7):



tau:	0.1	adev:	5.236439e-12
tau:	0.2	adev:	5.874010e-12
tau:	0.4	adev:	4.956966e-12
tau:	1	adev:	1.411717e-12
tau:	2	adev:	7.917586e-13

Figure 7

- **show amspectrum**

- **show amspurs**

These commands function identically to **show spectrum** and **show spurs**, but for the AM noise rather than phase noise. See **show spectrum** and **show spurs** for more information.

If */am:false* was specified on the TSERVER command line, these commands will return an error message indicating that no AM measurement data is available.

- **show date**

Returns the current date/time information as reported by the TSERVER host OS, as shown in the example below (Figure 8):

```
=192.168.1.200 > show date  
Current date and time: 23 Oct 2019 20:45:53
```

Figure 8

The date and time formats are determined by the **dateformat** and **timeformat** properties, respectively.

- **show dateformat**

- **show timeformat**

Both of these commands return the date and time formats, as established by the **dateformat** and **timeformat** properties (Figure 9):

```
=192.168.1.200 > show dateformat  
Current date format: Verbose  
Current time format: 24 hour
```

Figure 9

- **show fcounter**

Returns the current reference frequency and frequency count chart at all available averaging times up to 1000 seconds (Figure 10):

```
=192.168.1.200 > show fcounter  
Reference Frequency: 10 MHz (Auto)  
  
Avg Time (s)      Frequency (MHz)  
1                 10.1234559900888  
10                10.12345599010810  
100               10.123455990105819
```

Figure 10

The display precision is 13 digits to the right of the decimal point for 1-second averaging times at all DUT input frequencies. At DUT input frequencies of 5 MHz and above, 15 digits are displayed for averaging times longer than 10 seconds. 14 digits are displayed under all other conditions.

As with the TSC 51XXA phase noise test sets, accurate frequency counts with reference frequencies other than multiples of 100 kHz require the actual reference frequency to be specified. This can be done by a Telnet client with the **set referencefreq** command, or by using the */referencefreq* command-line option on the server.

Unlike the 51XXA instruments, **set referencefreq** must be issued before the measurement begins in order to provide correct frequency counts. Any changes made during the measurement will not take effect until the next measurement begins.

- **show freqdiff**
- **show freq**

Returns the current frequency difference chart (Figure 11). Both forms (**freqdiff** and **freq**) are accepted.

```
=192.168.1.200 > show inputs
Current:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm
Last Collection:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm

=192.168.1.200 > show fcounter
Reference Frequency: 10 MHz (Auto)

Avg Time (s)    Frequency (MHz)
1               10.1234559901065
10              10.12345599010392
100             10.123455990105908
=192.168.1.200 > show freqdiff
Frequency
2.3223752573466871e-03
2.3223752564676126e-03
2.3223752578431789e-03
2.3223752585423973e-03
2.3223752580092683e-03
2.3223752564336397e-03
2.3223752582799406e-03
2.3223752583785284e-03
2.3223752587122615e-03
```

Figure 11

The values reported by this command comprise a historical “strip chart” record of the frequency of the signal at the DUT input jack, assuming that the reference frequency is either a multiple of 100 kHz or has been set correctly with either **set referencefreq** or **/referencefreq**. These DUT frequency readings are returned in the form of fractional frequency differences relative to the rounded input frequency reported by **show inputs**. Entries for the past $n-1$ seconds are displayed, ordered by age (oldest to newest), where n defaults to 600 seconds. The value of n can be configured through the use of the **/chart** command-line parameter.

In the example above, the DUT signal was generated by a DDS synthesizer tuned to a nominal frequency of 10.123456 MHz. This value will be reported by the **show inputs** query as 10.1 MHz unless */inputfreq*, */roundfreq*, or **set inputfreq** has been used to establish a more precise nominal DUT input frequency. The readings from **show fcounter** are more accurate as well as more precise than **show inputs**, displaying consistent error that reveals the synthesizer's limited tuning precision. Multiplying 10.1 MHz by one of the reported frequency difference readings near 2.322...E-3 and adding the result back to 10.1 MHz yields a similarly-precise absolute frequency count.

- **show inputs**
Returns amplitude readings and rounded or specified frequency readings for the signals at the 53100A's REFERENCE and DUT input ports, as shown in Figure 11 above.

Unlike the TSC 51XXA implementation of this command, both the 'Current' and 'Last Collection' values reflect the state of the measurement in progress. If no measurement is running at the time **show inputs** is issued, the message *No measurement in progress* will be returned.
- **show inputfreq**
Returns the nominal DUT input frequency used for phase-difference calculations and the **show inputs** command. See the description of the */inputfreq* command-line parameter for more information.
- **show ipn**
Returns a chart showing integrated phase noise in units of radians over various portions of the Fourier spectrum, with and without the influence of coherent spurs.

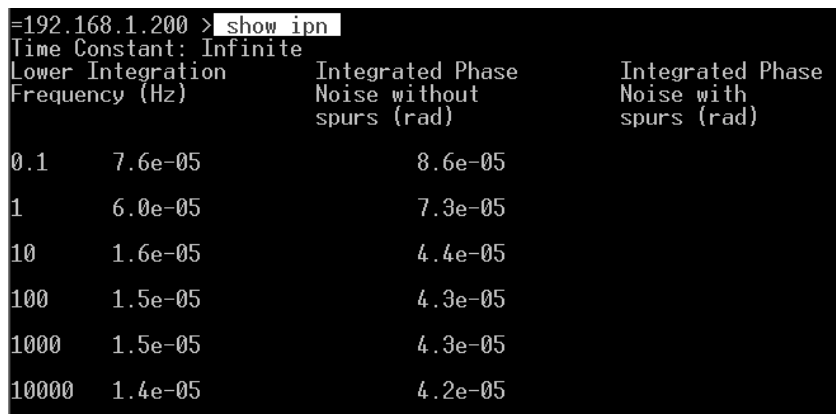


Figure 12

Each row in the chart reports the jitter at limits of integration between the given offset shown at left and the maximum offset supported by the PhaseStation hardware, normally 1 MHz. Lower integration limits from 0.01 Hz to 10000 Hz are supported. In the example shown above (Figure 12), the measurement has been running long enough to provide data at a minimum lower integration limit of 0.1 Hz.

Columns are tab-separated for compatibility with TSC 51XXA applications.

- **show message**

Returns the most recent error or warning message from the PhaseStation hardware driver (Figure 13).

```
=192.168.1.200 > show message
USB connection lost
```

Figure 13

- **show phasediff**

Returns the current phase difference chart (Figure 14).

```
=192.168.1.200 > show inputs
Current:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm
Last Collection:
Input: Frequency 10.1 MHz Amplitude 9 dBm
Reference: Frequency 10.0 MHz Amplitude 5 dBm

=192.168.1.200 > show fcounter
Reference Frequency: 10 MHz (Auto)

Avg Time (s)    Frequency (MHz)
1               10.1234559901202
10              10.12345599010774
100             10.123455990105990

=192.168.1.200 > show phasediff
Phase Difference (s)
4.4101906150355252e-02
4.6424281404940718e-02
4.8746656662802354e-02
5.1069031922492659e-02
5.3391407181225030e-02
5.5713782437155149e-02
```

Figure 14

The values reported by this command comprise a historical “strip chart” record of the difference in phase between the nominal DUT input frequency reported by **show inputs** and the actual frequency at the DUT input jack, assuming that the reference frequency is either a multiple of 100 kHz or has been set correctly with either **set referencefreq** or **/referencefreq**. Entries for the past *n* seconds are displayed, ordered by age (oldest to newest), where *n* defaults to 600 seconds. The value of *n* can be configured through the use of the **/chart** command-line parameter.

The phase difference chart's overall slope is a representation of the fractional difference between the nominal and actual frequencies. In the example above, as in the earlier **show freqdiff** example, the reported DUT input frequency is 10.1 MHz while the actual frequency from the test source is just under 10.123456 MHz. The readings above advance by about 2.322 milliseconds per second, corresponding to the fractional frequency differences returned by the **show freqdiff** command. Continuing the example, if the nominal input frequency had been specified with **set inputfreq 10.123456**, **/inputfreq:10.123456**, or **/roundfreq:0.000001**, the slope of the phase differences would be almost zero.

See the **measurelinear** and **removelinear** commands for information on calculating and removing the linear trend from the phase-difference chart.

- **show phaserate**
Returns the phase data rate set by the **/phaserate** command-line parameter or the most recent **set phaserate** command. See the description of the **/phaserate** command-line parameter for more information.
- **show referencefreq**
Returns the reference frequency used for frequency counter and phase/frequency difference calculations. See the description of the **/referencefreq** command-line parameter for more information.
- **show spectrum**
Returns a list of offset frequencies and dBc/Hz values corresponding to the phase noise spectrum in the measurement in progress (Figure 15):

```
=192.168.1.200 > show spectrum
Time Constant: Infinite
Frequency (Hz)  Power Spectral Density (dBc/Hz)
19.895         -130.572329
19.953         -130.578253
20.010         -130.588895
20.068         -130.603304
20.126         -130.620726
20.184         -130.640562
```

Figure 15

Following the PSD data, the current instrument noise floor estimate will be returned (Figure 16):

Noise Floor	
Frequency (Hz)	PSD
20.000	-135.240870
37.661	-137.191687
75.000	-140.679948
133.872	-145.450762

Figure 16

If no measurement is currently in progress, the **show spectrum** query will have no effect.

- **show spurs**

Returns a list of identified coherent spurs in the phase noise spectrum (Figure 17).

```
=192.168.1.200 > show spurs
```

Spur	Frequency (Hz)	Power (dBc)
0	60	-106.8
1	120	-120.1
2	180	-114.1
3	310	-117.5
4	710	-119.4
5	2630	-115.0
6	10420	-124.4
7	40290	-123.3
8	76020	-126.5
9	171360	-93.3
10	283160	-113.3
11	341500	-96.7
12	511640	-101.8
13	535940	-117.0
14	681780	-107.0

Figure 17

All identified spurs are removed from the PSD plot returned by **show spectrum**. Spurs that are not classified as instrument artifacts will appear in the table returned by **show spurs** at their correct (i.e., non-normalized) amplitudes in dBc.

See the descriptions of the `/spur_Hz` and `/spur_dB` command-line parameters for more information.

- **show state**

Returns the current measurement status and elapsed time (Figure 18).

Ready	No measurement has been started
Initializing	The measurement has not yet begun to return data
Collecting	The measurement is currently in progress

```
=192.168.1.200 > show state  
Collecting (14m 6s)  
Time Constant: Infinite
```

Figure 18

Since TSERVER does not support the **timeconstant** property from the TSC 51XXA command language, **show state** will always report **Time Constant: Infinite**.

- **show tau0**

Returns the current tau0 property value.

- **show timeformat**

See **show dateformat**.

- **show title**

Returns the title most recently set by the **set title** command or the */title* command-line option. As shown in Figure 19 below, the **show title** query response depends on the measurement state as well as the title text itself.

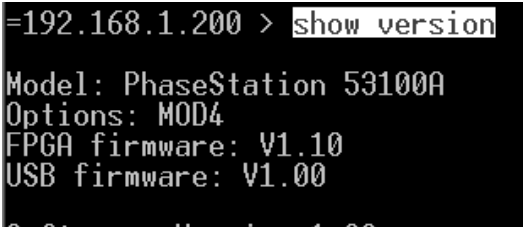
```
=192.168.1.200 > show title  
(Serial #)  
  
=192.168.1.200 > start  
=192.168.1.200 > show title  
58526.447544  
  
=192.168.1.200 > set title "Example title text"  
Subtitle has been set to:  
Example title text  
  
=192.168.1.200 > show title  
Example title text  
  
=192.168.1.200 > set title "{Serial #}"  
Subtitle has been set to:  
(Serial #)  
  
=192.168.1.200 > show title  
58526.447544
```

Figure 19

The default title text is the reserved string (**Serial #**). If a **show title** query is issued during a measurement and the default title has not been changed, the reserved string will be replaced with the serial number of the PhaseStation that is running the measurement.

- **show version**

Returns software and hardware version information (Figure 20).



```
=192.168.1.200 > show version  
Model: PhaseStation 53100A  
Options: MOD4  
FPGA firmware: V1.10  
USB firmware: V1.00
```

Figure 20

shutdown

This command can be used to request immediate shutdown of the TSERVER server process, disconnecting all connected clients. To disconnect the current client without exiting TSERVER, use the **quit** command instead.

start stop

These commands can be used by any connected client to initiate a new measurement or terminate one that is already in progress.

In many applications, it may be more convenient to start a measurement at the time TSERVER is launched and allow it to run until the server itself is stopped. This can be accomplished with the */start* command-line parameter. Other command-line parameters can be used in lieu of the **set <property>** commands when necessary.

The above approach is analogous to pressing the START button on a physical test set. Streaming clients can connect to the data port and acquire data from the PhaseStation 53100A without the need for any Telnet clients or other terminal applications to connect to the command port.

Compatibility notes

- The following 51XXA commands and queries are not supported by TSERVER:

*button <number>
print [<options>]
show mac*

*calinputs
set print <options>
show printformats*

*control <take | yield>
set timeconstant <value>
show printoptions*

show screens

- As discussed elsewhere, commands such as **set referencefreq** that affect both current and subsequent measurements on the Symmetricom/Microsemi 51XXA phase noise test sets will affect only subsequent measurements in TSERVER.
- The **show inputs** command returns both “Current” and “Last Collection” values on the 51XXA test sets. These values are not correctly maintained by the 51XXA test set firmware under certain conditions, such as when the previous input signals are disconnected and different ones reconnected. TSERVER does not attempt to emulate the 51XXA’s behavior in this regard. Instead, both the “Current” and “Last Collection” values reflect the rounded frequency and amplitude estimates for the measurement currently in progress. If no measurement is currently being performed, the message *No measurement in progress* is returned to the client.
- The streaming phase-difference values returned by TSERVER are based on the rounded or specified input frequency reported by the **show inputs** query. This is also true of the **show phasediff** and **show freqdiff** chart entries. On the 51XXA test sets, however, these values are referred to a more precise internal frequency measurement that is not made available to remote-access clients. Consequently, only the **show fcounter** command can be used to obtain accurate frequency counts on the 51XXA test sets, while TimeLab’s own frequency count chart in the [Measurement→Frequency difference \(f\)](#) view can be used with phase data from TSERVER if the correct rounded input frequency is entered in the acquisition dialog.
- On the 51XXA test sets, the **show adev** command returns separate Allan deviation charts for all supported t_0 intervals. TSERVER returns data only for the t_0 interval corresponding to the most recent **set phaserate** or **set tau0** commands.
- The default **phaserate** for the 51XXA test sets is 1000 samples per second. TSERVER’s default **phaserate** is 100 samples per second, unless changed with the */phaserate* command-line option.
- The 51XXA test sets transmit measurement-related error messages to the Telnet client asynchronously, sometimes waiting until the next character arrives from the remote client before sending the message. As a rule, TSERVER transmits text on the Telnet command port only in response to specific commands. The **show message** command is provided to allow the remote user or application to determine if the most recent measurement encountered an error or warning condition. An empty string indicates that no errors or warnings have occurred.

Measurement example: Phase data streaming

When using software that was originally written to capture phase data from the Symmetricom / Microsemi 5115A/5120A/5125A and compatible instruments, you will normally want to allow TSERVER to use its default */port* value (1298) and default */format* value (TSC). However, when using TimeLab's [Acquire→Acquire from TCP/IP streaming server](#) option, only the phase-difference data format (*/format:P*) is supported.

Example: `tserve64 /data_port:1234/phaserate:100/phasedec:20/format:P /start`

As an example, the command above will begin capturing phase-difference data at a rate of 100 samples per second as soon as TSERVER is launched. If desired, Telnet commands may be issued via port 1299 as usual, but this isn't required since the */start* option has been specified on the TSERVER command line.

Figure 21

Internally, the data will be captured at 200 samples per second with a noise-equivalent bandwidth of 50 Hz. Phase data would normally be recorded with 2:1 decimation after detection, for a final data rate of 100 samples per second. However, the use of the */phasedec:20* option results in a final data rate of only 10 samples per second. This is the rate at which the phase-difference readings associated with */format:P* will be streamed from port 1234.

You can receive the streaming phase data on any machine that can access the server on your network, including the server PC itself. Either [Acquire→Symmetricom 5115A / 5120A / 5125A \(Frequency stability\)](#) or the more general [Acquire→Acquire from TCP/IP streaming server](#) option can be used to retrieve phase data from TSERVER. In Figure 21 above, the latter has been selected. The Input Frequency field in the acquisition dialog has been populated with the 100-kHz rounded value that would be reported by the **show inputs** command, while Sample Rate is set to the final data rate of 10 samples per second. With an Output Decimation value of 1, no additional decimation will be performed by TimeLab.

TimeLab can receive data concurrently from multiple instruments. When the PhaseStation 53100A measurement described above was run alongside a Symmetricom 5125A test set connected to the same signal sources, the result shown in Figure 22 was obtained:

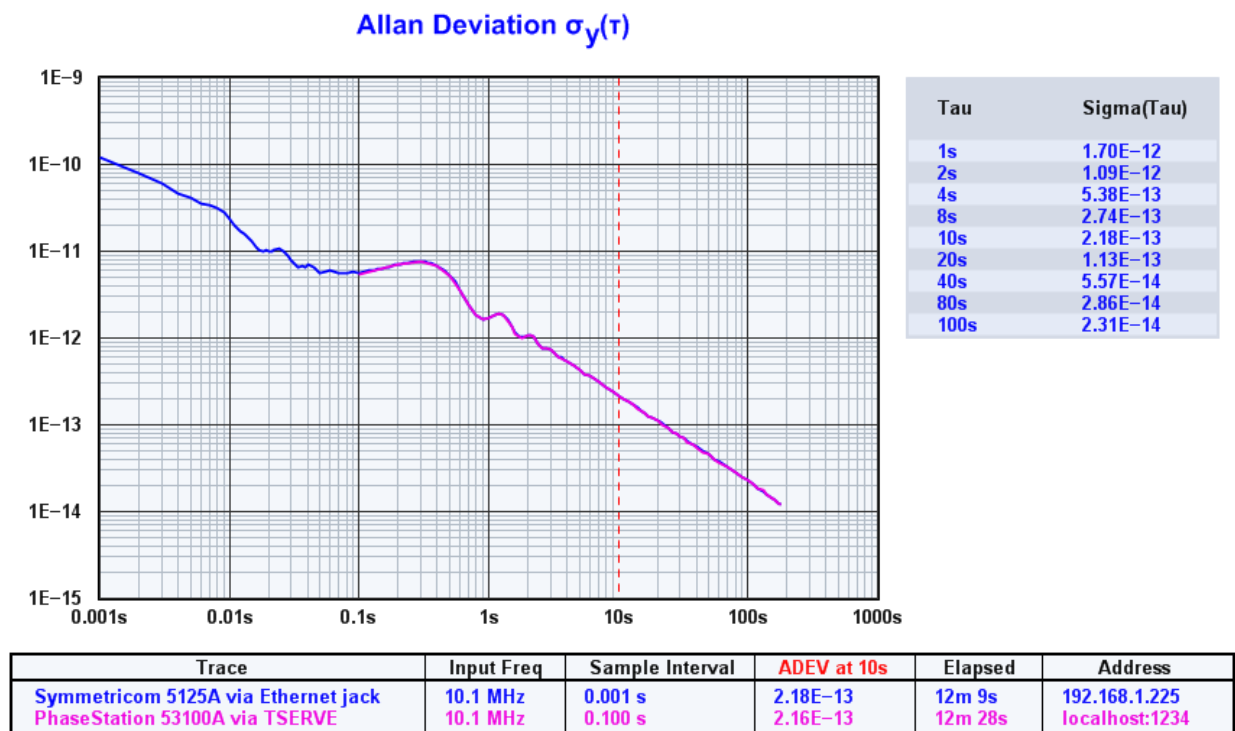


Figure 22

For this exercise, the Symmetricom 5125A’s **phaserate** property was left at its default value of 1000 samples per second. Consequently, its Allan deviation trace begins at $t_0=0.001$ second, while the PhaseStation measurement begins at $t_0=0.1$ second. The results are otherwise virtually identical.

Measurement example: Phase noise plot acquisition

TimeLab can also retrieve and display phase noise data from both the PhaseStation 53100A and Symmetricom 51XXA test sets through the use of the [Acquire→Symmetricom 5115A / 5120A / 5125A \(Phase noise\)](#) acquisition option. Unlike the streaming phase data acquisition process, obtaining phase noise data from either TSERVER or an actual 51XXA test set requires the program to connect to the Telnet command port.

Figure 23

Because TimeLab can obtain most of the required measurement parameters and properties directly from the server, relatively few configuration steps are needed in the 51XXA phase noise acquisition dialog. It's necessary only to ensure that the correct IP address and optional port number are specified, in this case either **192.168.1.200** as used above in Figure 23, or the equivalent **localhost** alias used earlier for phase data capture. No port number is required as long as the default command port assignment (1299) has not been changed with the `/cmd_port` command-line parameter.

For convenience, the phase noise acquisition dialog offers four general-purpose command buttons that are predefined with useful defaults that allow front-panel control commands to be transmitted to an actual TSC 51XXA phase noise test set. (Only the **start** and **stop** buttons are supported by TSERVER.)

Figure 24 shows the phase noise plots that were simultaneously measured during the one-hour streaming data acquisition in the previous example.

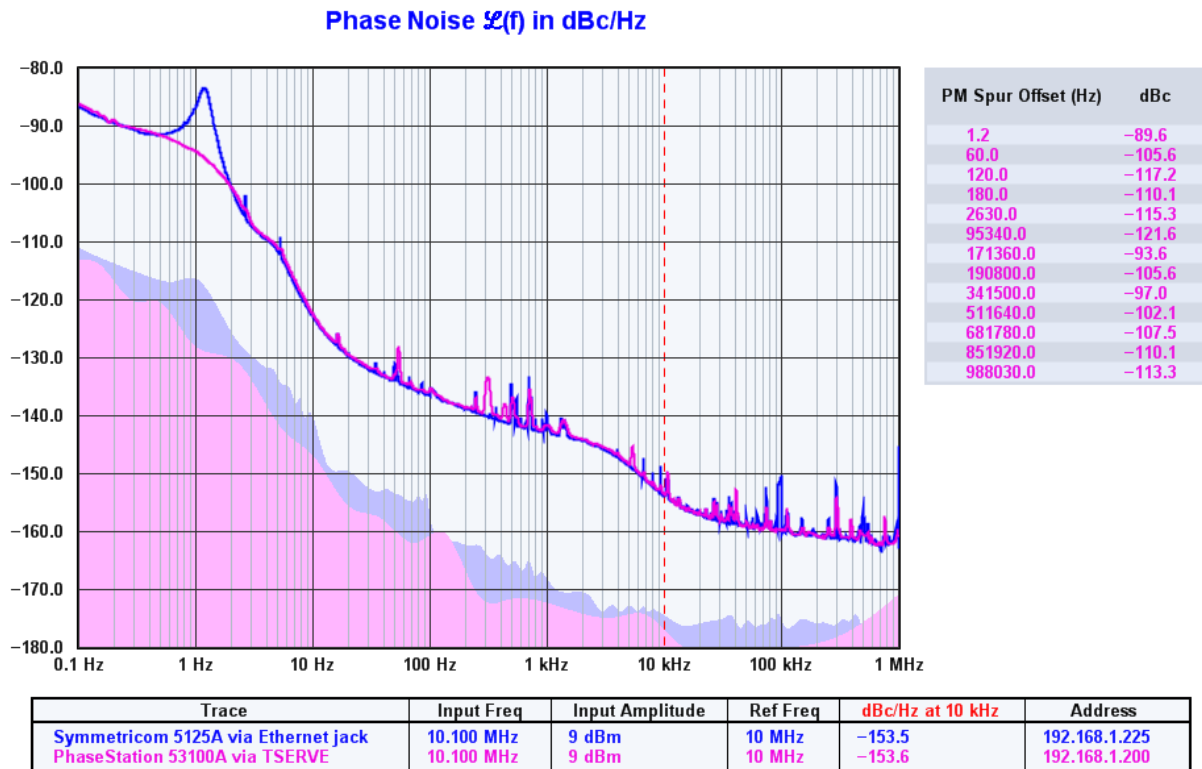


Figure 24

Once again, the results match closely. The most notable difference is that the PhaseStation has classified the sharp peak near 1.2 Hz as a spur, removing it from the plot and adding it to the spur chart at right. Adding `/spur_Hz=2` to the TSERVER command line would have resulted in an even-closer match by forcing the PhaseStation's spur-detection routine to disregard the peak.

Conclusion

This application note has described the TSERVER console server application, documenting the available command-line options and Telnet commands. Compatibility with the Symmetricom/Microsemi 51XXA line of phase noise test sets has also been addressed. Two measurement examples were shown, demonstrating comparable results when both the PhaseStation 53100A and Symmetricom 5125A were remotely configured to perform the same phase noise and frequency-stability measurements.