

ADVENT INSTRUMENTS INC.

**CAS2200 CAS EVALUATION SYSTEM**

***User Guide  
&  
Reference  
Manual***

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## ■ Overview

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## ■ Section 1

## Installation & Setup

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### *Before You Begin*

#### **Verifying the System Requirements**

The CAS2200 CAS Detector Evaluation System requires the following minimum system setup for the target computer.

- Intel 486DX33 PC computer
- VGA type monitor
- Microsoft Windows 3.1, 3.11, or Windows 95 operating system
- Eight Megabytes of RAM
- One full length 16 bit ISA expansion slot

#### **Backup the Software**

Make a backup copy of the software disk before beginning the software installation. Keep the original disk in a safe location.

## Installing the Telephone Signal Processing Card

Before installing the Telephone Signal Processing Card (TSPC), verify that the correct base I/O address is set. The base I/O address used is determined by the settings of two jumpers shown in figure 1. The factory default settings includes both jumpers, as shown below, for a base I/O address of 0x0380. This address should be free of conflict from most other peripheral cards; however, in case of conflict, change the jumpers to select an alternate base I/O address. The CAS2200 program will automatically scan all four possible base I/O address for a TSPC. Note, that the TSPC is designed to avoid interrupt and DMA channel conflicts, and as such, these parameters do not need to be configured. The only possible conflict between peripheral cards is with the base I/O address selected.

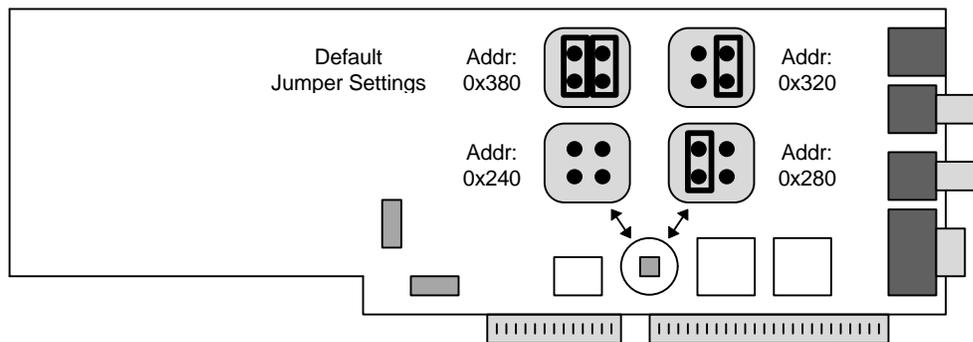


Figure 1. Verifying Base I/O Address

To install the TSPC:

1. Turn off the computer, including all external peripherals
2. Leave the power cable connected to a grounded outlet, so that the system is grounded
3. Remove the cover from the computer
4. Locate an unused 16 bit ISA expansion slot in your system
5. Insert the TPSC into the expansion slot
6. Replace the cover from the computer

---

**Note:** The TSPC can create high voltages. Ensure adequate space between the TSPC and other adjacent peripheral cards in the computer. Also, always re-attach the cover to the computer before turning it on in order to insure that no contact can be made to the high voltage portions of the TSPC.

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## *Installing the Windows Software*

To install the software package, turn on the system and launch either the Windows 3.1, 3.11, or 95 operating system. Insert the floppy disk into the 3.5 Disc Drive (usually drive A:). For users of Windows 3.1 or 3.11, from the Windows program manager, select menu command [FILE] [RUN]. Type "A:\setup" and press ENTER. For users of Windows 95, press the START button, followed by the RUN selection. Then type "A:\setup" and press ENTER.

The setup program will extract all the necessary files and install them into the directory you select. The default directory is set to "C:\AI\CAS2200"; however, alternate directories may be chosen.

The Setup program will automatically create both a program group and program icon within the Windows program manager

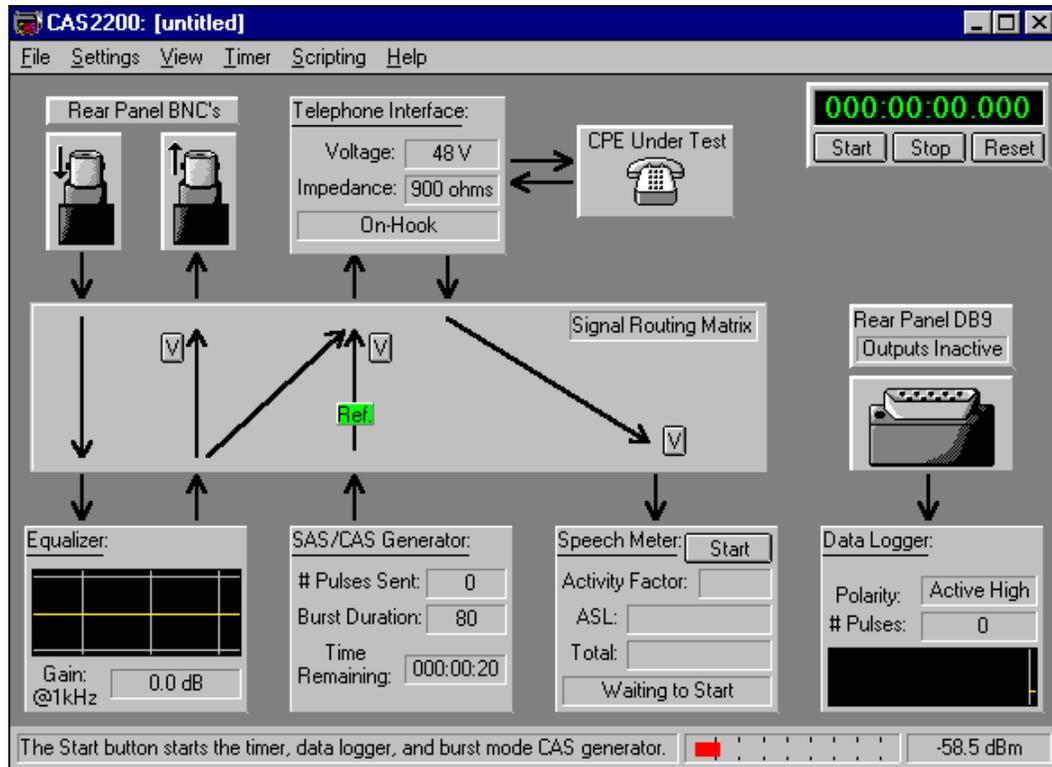
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Note: The software does not require any modifications to the AUTOEXEC.bat or CONFIG.sys files. However, the WIN.ini file is modified to contain certain program initialization values.

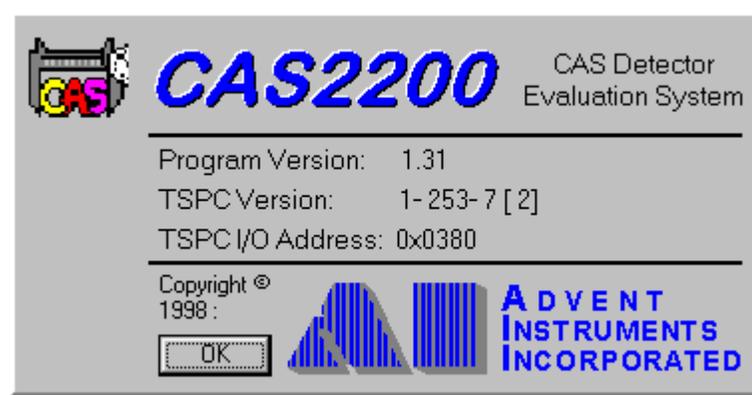
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## Testing the Installation

Once you have finished installing the hardware and software, you can verify the correct setup by launching the CAS2200 program from the Windows Program Manager. Once the program has finished loading itself in the system, the screen should display the following.



To verify the software version and the TSPC version codes, select the HELP menu by either clicking on HELP or pressing ALT-H. Select the "ABOUT CAS2200" option within the HELP menu. The following window will appear until you press the OK button.



The window will display the software version code, TSPC product, revision, and option codes, and the TSPC base I/O address being used. If any problems are

encountered in the use of this product, include the above information in any correspondence with technical support.



## ■ Section 2

## Getting Started

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### ***Background Information***

The CAS2200 program is designed to help simplify the complex testing required to quantify the CAS tone detector performance in Caller ID with Call Waiting devices. The performance of the CAS detector is both critical to the operation of the telephone device, and unfortunately, not trivial to determine. An improperly functioning CAS detector can miss Caller ID transmissions, and perhaps more importantly, interrupt the speech on a seemingly random basis. To facilitate the determination of the CAS detectors performance, Bellcore has published a document, SR-TSV-002476, which outlines a procedure for testing a CPE's CAS detector. From the data collected in the tests, whether or not the performance meets Bellcore's recommendation is extracted. Unfortunately, the test procedure is quite complex and requires a sophisticated test setup. This program brings together all of the basic instruments required to perform the Bellcore tests and extract the performance results of a CPE's CAS detector, all under a simple to use Windows graphical interface. However, it is nevertheless important that the user be familiar with the Bellcore testing procedures in order to use the program properly.

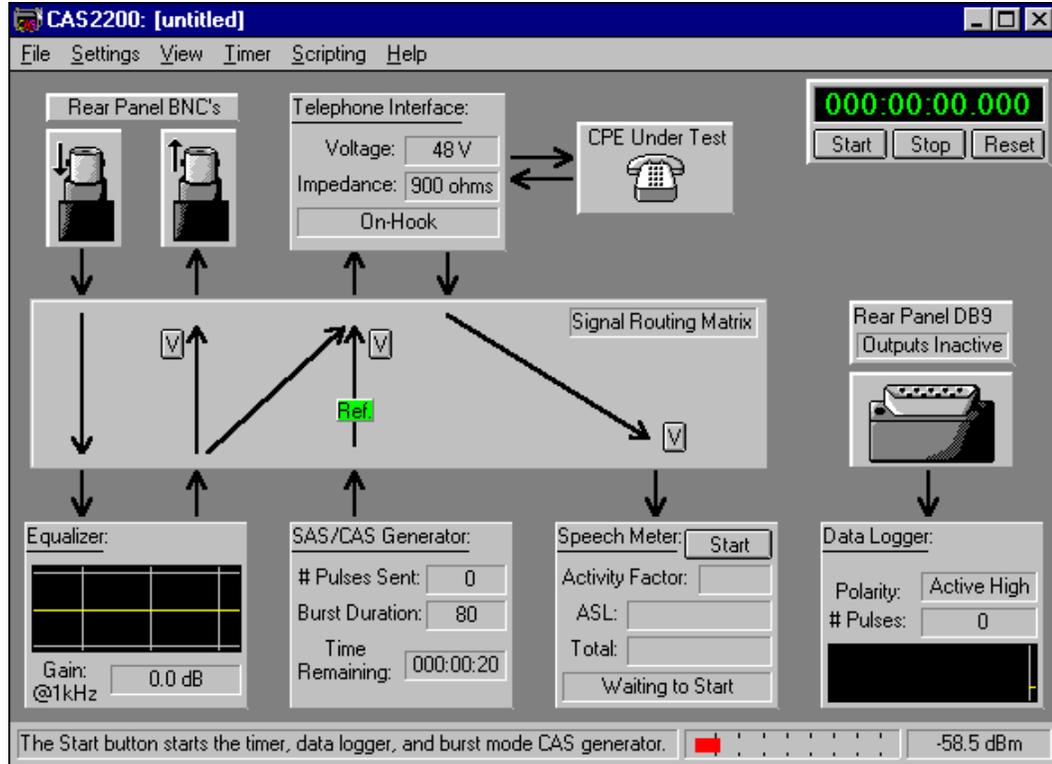
The recommended Bellcore test procedures in SR-TSV-002476 can be broken down into three basic tests. They are:

- i) Signal recognition tests without speech present,
- ii) Talkdown tests - missed signals in the presence of speech, and
- iii) Talkoff tests - false detection caused by speech.

The Signal Recognition tests determines the CAS detection success rate under several possible central office and loop conditions. These include varying the CAS tone frequencies, levels, and duration over a specified range. No speech is present for these tests, unlike for the Talkdown and Talkoff tests. The basis of the Talkdown test is to add speech to the CAS tone and determine how many CAS bursts were missed by the detector. The fewer the CAS bursts missed by the detector, the better the detectors performance is, in terms of Talkdown . The final class of tests, termed Talkoff, are used to ascertain how often the CAS detector will falsely detect a CAS tone due to the presence of speech. The Talkoff performance is stated as the average number of hours between false detections of a CAS tone. The larger the number of hours between false detects, the better the detector's talkoff performance.

## Getting Started

Once the program has started, it checks for the proper hardware components installed in the computer. If the software is unable to locate the required hardware, a message will be issued to the user. Assuming the proper hardware is installed, the program will display the main window, similar to the following:



This window shows all of the main components of the hardware setup and the signal flow and connections between them. These include a programmable telephone interface to the device under test, a signal equalizer for adjusting the frequency response of signals, a programmable CAS tone generator, an active speech level meter, and a data logger that records and time stamps the CAS detector's output. A flexible signal routing matrix connects all the basic instruments together.

Changing the parameters that control the various components, like the CAS Generator, is done by either selecting the appropriate item from the [SETTINGS] menu, or double-clicking the mouse on the CAS Generator panel. Likewise is done when changing the Telephone Interface, Equalizer, Speech Meter, or the Data Logger settings.



The status bar at the bottom of the window includes a hint line, that displays the function of various controls in the program. Also, a true RMS signal meter in a graphical and numeric form is presented on the status bar. This is useful in setting up the various signal levels for the tests. The graphical display is

calibrated in dBm with 10 dB steps. The units of the numerical display can be changed by double-clicking the mouse on the numerical value.

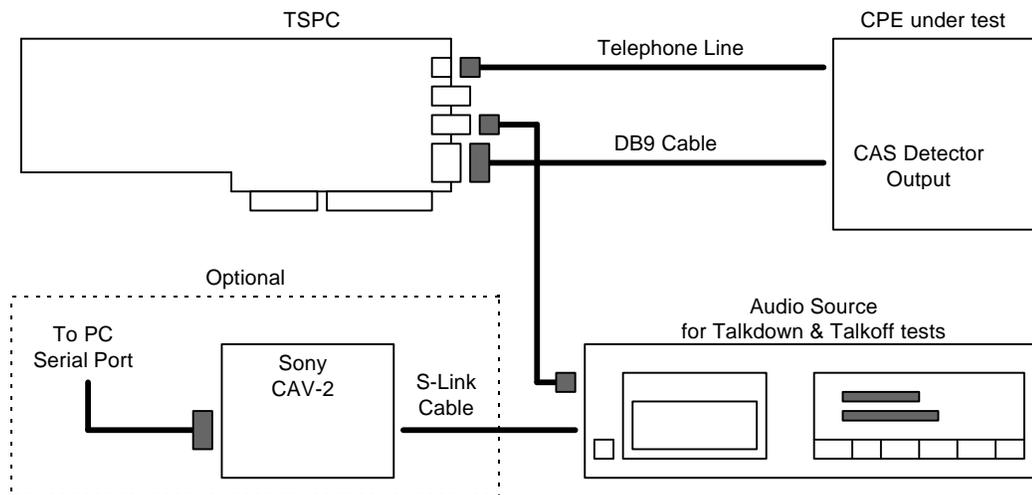


The timer, located in the upper right corner of the main window, is used to control the execution of a test. Pressing the start button will start the timer along with the CAS tone generator and data logger. The CAS tones will be generated as specified, and the data logger will record any activity on the CPE's CAS detector. The Stop button will suspend the test in case changes to the setup are required. The timer can be set to stop automatically when all of the CAS pulses have been sent, or it may be set to run indefinitely. The data logger will time stamp all the CAS pulses detected when the timer is running. Once a test is complete, these time stamps are used for an analysis of the CAS detectors performance. Resetting the timer, sets it back to zero, and clears all the data logged. The system is then ready for another test.

After a test has finished, or even during the test, the actual waveform from the detector can be viewed and analyzed. From this the Talkdown and Talkoff results are calculated. As outlined in the Bellcore testing procedures, once a series of Talkdown and Talkoff test results are available, the data can be entered into the CAS Performance Calculator in order to determine the final detector performance ratings.

## Connecting the CPE

For all of the above tests, the interface to the CPE is very straight forward. The CPE is connected to the telephone interface via the RJ11 jack on the back of the TSPC (Telephone Signal Processing Card). This allows for the CPE to receive the CAS tones in conjunction with speech or other impairments. In cases where an unbalanced signal output is desired without the large DC feeding voltage, the external BNC output connector can be used. This would normally be the case in testing the CAS detector by itself, as opposed to one that is integrated into a CPE.



In order to do any data analysis, the program needs to know if the CAS detector has detected what it considers a valid CAS tone. This information is passed back to the CAS2200 via pin 9 on the rear DB9 connector present on the TSPC. The signal can be either active high or active low, but must be constrained between 0 and 5 volts. The ground connection is located on pin 5, while pin 1 can be used to supply up to 250 mA of current at 5 volts. The following list defines the function for each of the pins on the DB9 connector. For more information on the External Input/Output pins, see section 3-8.

### DB 9 Connector Pin Connections:

- Pin 1: +5V (can draw up to 0.25A from this pin) (internally fused)
- Pin 2: Reserved Output (do not use)
- Pin 3: External Output A ('HC CMOS 5V output)
- Pin 4: External Output B ('HC CMOS 5V output)
- Pin 5: Ground
- Pin 6: Reserved Output (do not use)
- Pin 7: Digital Output Enabled (connect to ground to enable outputs)
- Pin 8: External Input A ('HC CMOS 5V input)
- Pin 9: CAS Detect Input ('HC CMOS 5V input)

## ***Grounding Considerations***

As with any system of instruments and devices, proper grounding is essential in order to minimize circuit hum and interference. It is important to understand the circuit grounds of all the devices in the test setup to ensure their proper connection.

Like most instruments the TSPC's ground point is referenced to the PC's ground, which should be connected to earth ground. The ground conductor on the BNC input and output and the DB9 connector are at earth ground potential, assuming the computer is properly grounded. The tip and ring leads of the telephone interface have a negative potential with respect to ground depending on the programmed line voltage. At the default setting of 48 volts, the voltages present on tip and ring are approximately -52 volts and -4 volts with respect to the computers ground.

Care must be taken with CPE's that do not maintain isolation from the telephone interface. Most Caller ID adjunct units fall into this category. This can cause grounding problems when connecting the ground leads of oscilloscopes or other equipment that is normally earth grounded. Likewise for returning the CAS detector's output signal to the TSPC. In this case, when connecting the ground lead of the DB9 connector to CPE's circuit ground, the telephone interface may become unbalanced. Such a condition will be detected by the TSPC, and the software will report an unbalanced line condition. Various means can be used to resolve this situation by isolating the CAS detector's output signal. These include the use of opto-couplers, relays, and differential amplifiers (with sufficient common mode rejection).

If stand alone CAS detector circuits and IC's are being tested, it may make more sense to use the BNC output as the signal source, instead of the telephone interface. This eliminates the problem of dealing with the high DC voltage present on the telephone line, and provides a single-ended ground referenced output. In this case, isolation would not generally be required for the CAS detector's output signal.

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Note: Disconnecting the earth ground wire from the computer is both an improper and potentially dangerous method of isolating the computer from the remainder of the test setup. The AC isolation achieved is generally poor due to the large parasitic capacitance's to earth ground. An alternative approach may be the use of a UPS. UPS's are an excellent method of achieving near perfect isolation between circuit grounds.

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## ■ Section 3 Setting Up and Using the Program

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This section describes in detail how to setup and use the various program elements. Major topics covered include the following:

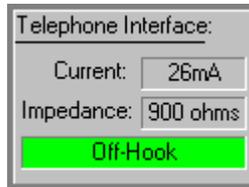
- 1) Setting up the Telephone Interface
- 2) Controlling the Signal Flow and Routing
- 3) Setting the Equalizer Parameters
- 4) Setting the CAS Tone Generator Parameters
- 5) Setting the SAS Tone Generator Parameters
- 6) Setting up the Active Speech Level Meter
- 7) Setting up the Data Logger for Analysis
- 8) Setting the Digital Input/Output Functions



## ■ Section 3-1

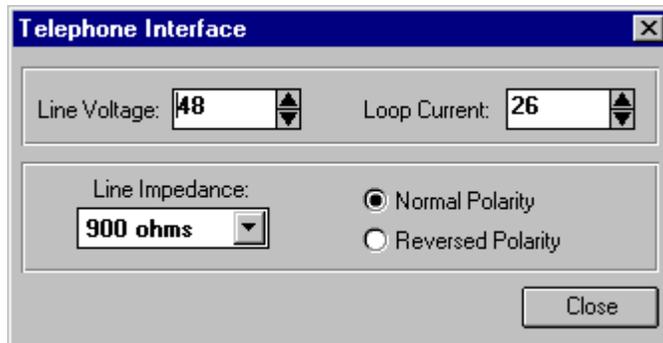
## Telephone Interface

A programmable telephone interface is available for connecting the CPE under test to the system. It allows for adjusting the on-hook line voltage, off-hook loop current, AC source impedance, and voltage/current polarity.



The telephone interface on the main panel will display the hook switch status of the CPE and the setting of key parameters. If the CPE is off-hook, the panel will indicate the loop current setting, or while on-hook the line voltage will be displayed. The selected impedance is also shown in the panel, since this has important implications on the signal levels present on the telephone line. If in the case the current flow between the tip and ring leads is not balanced, the telephone interface panel will display in red background "Unbalanced" in order to alert the user. This can occur with improper grounding of the CPE in relation to the tip and ring leads.

To change any of the telephone interface setups, simply select [SETTINGS] [TELEPHONE INTERFACE] from the menu, or double click the mouse on the telephone interface panel. In either case the following window will be displayed.



The line voltage and loop current settings can be changed by entering a new value or using the spin up/down buttons. The maximum and minimum limits for each value is shown in the hint line when the mouse is positioned over the text area. Changing the impedance is accomplished by simply selecting a value from the drop down list. The AC source impedance can be either 600 ohms real, 900 ohms real, or a complex impedance. The exact complex impedance depends on the options specified when the TSPC was ordered. Finally, the voltage or current polarity can be specified as either normal or reversed. Any changes will take effect when the Close button is pressed.

---

Note: The impedance setting will affect the CAS generator's output level under certain conditions. If the CAS tone is specified in units of "dBm" then the program will deliver that level when the telephone line is terminated into 600 ohms for both source impedances of 600 or 900 ohms. The program will take into account the source impedance and adjust its output level. However in the case when the complex impedance is specified, the program does not compensate for the source impedance, and the output level will match the specified level only on an unterminated telephone line.

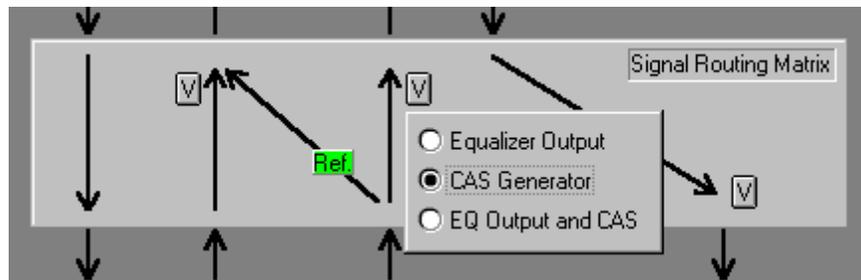
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## ■ Section 3-2 Controlling the Signal Flow

Various different combinations of signal flow can be easily accommodated within the program. The current signal flow is always displayed on the main window as a series of arrows. This gives a visual representation of how the signals are routed from one section of the system to the next.

Normally, the CAS tone generator will send its signal to the telephone interface, for transmission to the CPE under test. Additionally, speech signals are mixed in with the CAS tones for the purpose of Talkdown testing. The speech signal's source is connected to the BNC input connector on the rear of the TSPC. This signal then passes through the equalizer, which can introduce some spectral shaping, and then can be sent to the telephone interface or the BNC output connector. The source of the active speech level meter and the true RMS meter on the status bar can be selected from the telephone interface, or the output of the equalizer.

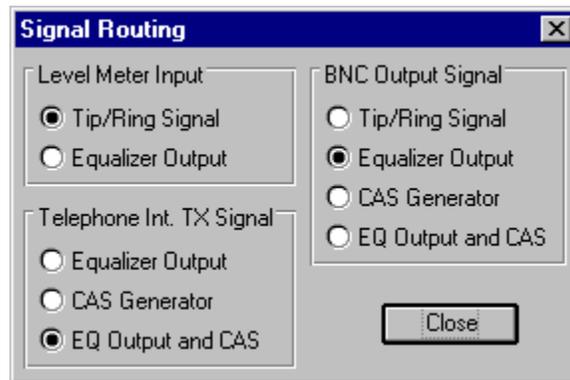
Which signals are routed to the telephone interface can be changed by either selecting the [SETTINGS] [SIGNAL FLOW] item from the menu, or clicking the mouse on the down arrow button. Clicking a down arrow button pops up a selection of the possible combinations for the input to the telephone interface, as shown below:



Similar drop down buttons are present that allow for the changing of the BNC output signal, and the input signal source for the active speech level meter and true RMS meter.

The green "Ref" marker shown above is used to indicate the level reference selection of the CAS tone generator. This marker can appear at the signal path from the CAS generator to the BNC output, or to the telephone interface. See section 3-4 Setting up the CAS Generator for more information on the meaning of the reference marker.

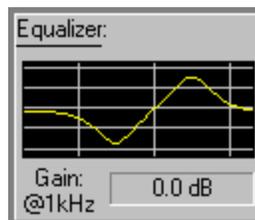
The signal routing can also be changed by selecting the [SETTINGS] [SIGNAL FLOW] command from the menu. This displays the following window:



From here all of the signal routing options are presented, and can be changed by selecting the appropriate option.

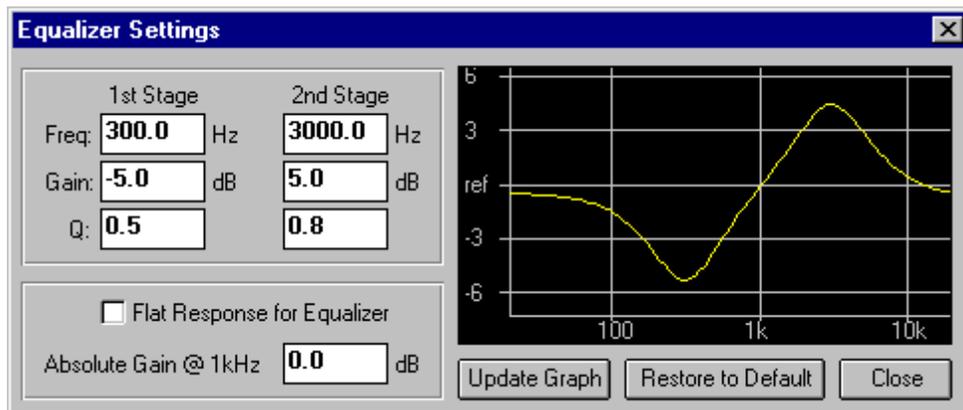
## ■ Section 3-3 Setting the Equalizer Parameters

An equalizer is available for altering the spectral shape of the signals present at the BNC input connector. Along with changing the spectral shape, the equalizer can introduce gain or loss for the signals passing through it. Generally the equalizer will be used to pre-emphasize the high frequency components of the speech signals. This is in order to properly simulate the pre-emphasis that is normally applied by the CPE for near end speech.



The main window displays a small graph that corresponds to the programmed frequency response. The gain, which is always specified at a frequency of 1 kHz is also shown on the panel for reference information.

To change the settings of the equalizer, either select the [SETTINGS] [EQUALIZER] item from the menu, or double click the mouse on the equalizer panel. Either way, the following window will be displayed.



The equalizer consists of two parametric stages in cascade, where each stage has an independent frequency, gain, and Q value. This allows for a fair degree of flexibility in setting the spectral shape. Also, the absolute gain at 1 kHz is specified independently of the parametric stages. Changing the equalizer settings is as simple as altering the value in the appropriate text field. The hint line in the main window will show the maximum and minimum limits for a given parameter if the mouse is positioned over the text field. The stages can be enabled or disabled by clicking the mouse on the "flat response for equalizer" checkbox. Selecting the "Update Graph" button re-draws the frequency response graph if any of the parameters have changed. The response at 1 kHz is always considered the reference point, from which gain or loss can be added. The horizontal lines displayed on the graph represent 3 dB increments in level.

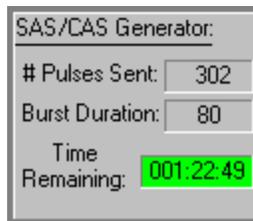
Clicking the "Restore to Default" button resets the parameters of the equalizer back to their default values.

The minimum, maximum, and default values for each parameter is defined as:

| <b>Parameter:</b>      | <b>Minimum<br/>Value</b> | <b>Maximum<br/>Value</b> | <b>Default<br/>Value</b> | <b>Units</b> |
|------------------------|--------------------------|--------------------------|--------------------------|--------------|
| Absolute Gain at 1 kHz | -60.0                    | +20.0                    | 0.0                      | dB           |
| Stage 1 Frequency      | 50.0                     | 10000.0                  | 300.0                    | Hz           |
| Stage 1 Gain           | -12.0                    | +12.0                    | -5.0                     | dB           |
| Stage 1 Q factor       | 0.1                      | 5.0                      | 0.5                      |              |
| Stage 2 Frequency      | 50.0                     | 10000.0                  | 3000.0                   | Hz           |
| Stage 2 Gain           | -12.0                    | +12.0                    | +5.0                     | dB           |
| Stage 2 Q factor       | 0.1                      | 5.0                      | 0.75                     |              |

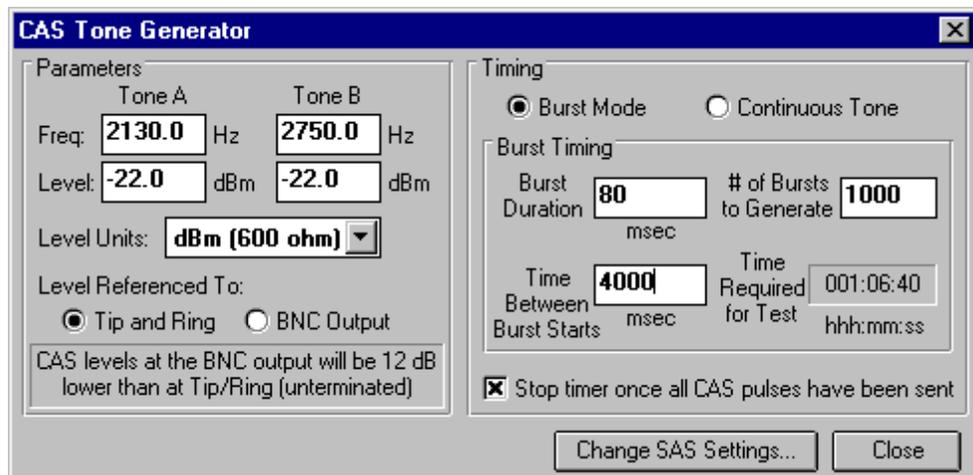
## ■ Section 3-4 Setting Up the CAS Generator

The CAS Tone Generator is responsible for creating the CAS tone bursts for the Signal Recognition and Talkdown tests. Usually, the generated CAS tone is routed to the telephone interface in order to subject the CPE to the CAS tones. The dual tone signal can be programmed to accommodate a wide range of frequencies, levels, and burst duration's. The time between bursts and the number of bursts to generate can also be varied over a wide range.



The CAS Tone Generator panel shown in the main window indicates the number of CAS bursts that have been generated, since the last time the settings have changed, or the timer being reset. The programmed burst duration of the CAS tone is also shown along with the time remaining until all of the bursts have been sent. The timer is used to start and stop the CAS Tone Generator. When the timer start button is pressed, the CAS bursts are generated at the prescribed rate. The background color of the time remaining display will turn to green when the timer is running. Once the programmed number of bursts have been sent, or the timer stop button is pressed, the CAS generator will be shut off and the background color will return to gray.

The settings of the CAS Tone Generator can be changed by selecting the [SETTINGS] [CAS TONE GENERATOR] item in the menu, or double clicking the mouse on the CAS panel in the main window. Either way, the following window will appear, in which the CAS parameters can be adjusted.

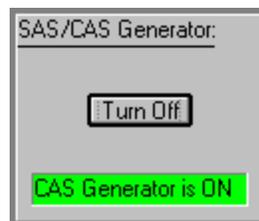


The left side of the window is used to specify the frequencies and levels for the two tones that make up the CAS. The levels can be specified in terms of either dBm or dBV and be referenced to the telephone interface or the BNC output connector. The difference in output signal level between the telephone interface tip and ring leads, when unterminated, and the BNC output is always 12 dB. As such, the CAS generator can adjust its output level to be as specified for the telephone interface or BNC output, but not both. A green "Ref" marker on the signal routing arrows shows which signal path is defined as the reference path for the purposes of the CAS and SAS generator.

In the default case that the level will be referenced to the telephone interface tip and ring leads, the level units are interpreted as follows. If the selected units are dBm, then the setting of the telephone interface AC source impedance will have an effect on the CAS level. The CAS and SAS generator will deliver the level specified when the telephone line is terminated into 600 ohms for both source impedance's of 600 or 900 ohms. The program will take into account the source impedance and adjust its output level. However, if in the case the complex impedance is specified, the program can not compensate for the source impedance, and the output level will match the specified level on an unterminated telephone line. If the level units are specified in terms of dBV, then the AC source impedance setting of the telephone interface has no effect, as the output level will be as specified only for an unterminated telephone line.

If the CAS levels are referenced to the BNC output, it is assumed that a high impedance load is connected to the BNC output connector. The output has a source impedance of 600 ohms, and if loaded into 600 ohms the actual signal level will be reduced by 6 dB.

The right side of the CAS Tone Generator settings window is used to control the mode and timing of the CAS bursts. The mode can either be set as continuous tone or burst mode. If continuous tone is selected, then the generator can be started and stopped manually. The tone generator panel on the main window will change appearance to the following:

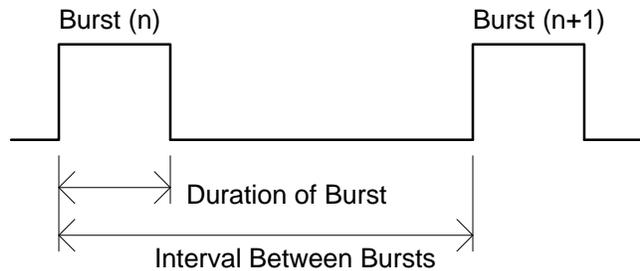


The button toggles the state of the CAS generator. If it is currently on, then clicking the button will disable the tone, while if off, clicking the button will enable the tone. This mode can be useful for checking the levels of the CAS tone, and when probing various points on the CPE under test.

In the burst mode of operation, the tone generator is controlled exclusively by the timer. Starting the timer will enable the tone generator, while resetting the timer will disable the tone generator. Stopping the timer will freeze the status of the tone generator. This means that if the tone generator was producing a CAS tone when the timer stopped, then the CAS tone will continue to be generated until the start or reset buttons are pressed.

For the burst mode of operation, the burst duration, interval between bursts, and number of bursts to generate must be specified between valid limits. The

program will display the calculated length of the test given the interval time between the bursts and the number of bursts to generate. The relationship between the burst duration and burst interval is as follows:



Finally, an option can be specified, that if enabled, will force the timer to stop when all of the CAS bursts have been sent. Thus after the last CAS burst has been generated, the timer will automatically stop and end the test. If this option is disabled then the timer will continue after all of the specified CAS bursts have been sent. This option is enabled or disabled by clicking on the checkbox in the CAS Tone Generator settings window.

The minimum, maximum, and default values for each parameter are defined as:

| <b>Parameter:</b>        | <b>Minimum Value</b> | <b>Maximum Value</b> | <b>Default Value</b> | <b>Units</b> |
|--------------------------|----------------------|----------------------|----------------------|--------------|
| Frequency of Tone A      | 50.0                 | 10000.0              | 2130.0               | Hz           |
| Frequency of Tone B      | 50.0                 | 10000.0              | 2750.0               | Hz           |
| Level of Tone A (dBm)    | -70.0                | 0.0                  | -22.0                | dBm          |
| Level of Tone B (dBm)    | -70.0                | 0.0                  | -22.0                | dBm          |
| Level of Tone A (dBV)    | -70.0                | +6.0                 | n/a                  | dBV          |
| Level of Tone B (dBV)    | -70.0                | +6.0                 | n/a                  | dBV          |
| Tone Burst Duration      | 1.0                  | 1000000.0            | 80.0                 | msec         |
| Tone Burst Interval      | 1.0                  | 1000000.0            | 2000.0               | msec         |
| Number of Bursts to Send | 1.0                  | 100000.0             | 10.0                 |              |



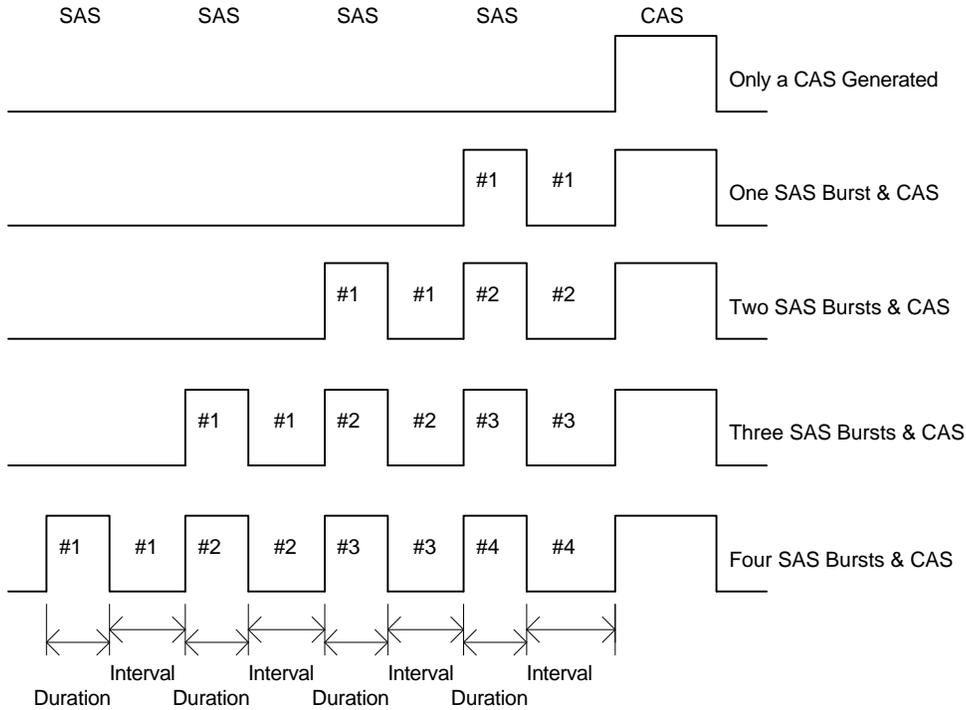
## ■ Section 3-5 Setting up the SAS Generator

A programmable Subscriber Alerting Signal (SAS) can be generated in conjunction with the CAS tone. The SAS tone is normally a 440 Hz tone that lasts for approximately 300 msec; however in some circumstances, it may be broken up into a series of tone bursts. The SAS tone will always precede the CAS tone by some time interval. The frequencies, levels, and timing parameters can all be changed over a wide range in order to properly simulate every possible SAS and CAS tone pattern. All of the SAS tone parameters can be changed by selecting the [SETTINGS] [SAS TONE GENERATOR] command from the menu. This displays the following window, from which changes can be made.

| SAS Tone Generator          |                                     |
|-----------------------------|-------------------------------------|
| <b>Parameters</b>           |                                     |
| Tone A Enabled              | <input checked="" type="checkbox"/> |
| Freq:                       | 440.0 Hz                            |
| Level:                      | -22.0 dBm                           |
| Tone B Enabled              | <input type="checkbox"/>            |
| Freq:                       | 350.0 Hz                            |
| Level:                      | -22.0 dBm                           |
| Level Units:                | dBm (600 ohm)                       |
| <b>Timing</b>               |                                     |
| Number of Tone Bursts:      | one                                 |
| <b>SAS Burst 1 Duration</b> | 300 msec                            |
| <b>SAS Burst 1 Interval</b> | 25 msec                             |
| Duration (msec)             | 300                                 |

The SAS tone can consist of up to two simultaneous tones (Tone A and Tone B); however, normally only Tone A is enabled. Each tone's frequency can range from 50 Hz to 10,000 Hz with the level ranging from 0 to -70 dBm or dBV. The right side of the above window is used to set the timing parameters of the SAS tone. The top drop-down list box is used to select the number of tone bursts that make up the SAS tone. This can range from zero (no SAS tone generated) to four SAS tone bursts. Depending on the selected number of tone bursts, a list of all the burst duration's and intervals is displayed. The duration specifies the amount of time the SAS tone will be generated, while the interval specifies the time delay between the end of the previous SAS tone burst and the next. The last interval time shown specifies the time between the end of the SAS and the beginning of the CAS tone. To change any of the duration or interval times, click the mouse on the selected time. The current time value is displayed in the lower right text box. Simply type in a new value in the range of 0 to 1000 msec and press the ENTER key to accept the new value.

The following diagram shows the relationship between the duration times and the interval time given the number of SAS bursts.



Note that the relationship between the timer and CAS tone generator is unaffected by the number of SAS tone bursts generated or their timing. If the CAS tone generator is set to product a CAS tone burst every four seconds, then the first CAS tone will be generated at a timer value of 0.000 seconds, while the next CAS tone will occur at a timer value of 4.000 seconds, and so on. The settings of the SAS tone generator will have no effect on this timing relationship between the CAS tone and the timer. Since the timer will start counting at the same time as the first CAS tone is generated, this means that the first SAS tone will occur before the timer starts counting. For example, if the duration of all the SAS tone duration's and intervals is 2 seconds, then when pressing the START timer button the timer's start will be delayed by 2 seconds. This is done to keep the relationship between the timer and the CAS generator fixed, which is important in order to properly classify the signals captured by the data logger.

Also, it is possible that the sum of the SAS tone duration and interval times exceeds the interval between CAS tones. In this case the CAS tone will always take precedence and the SAS tone pattern will be truncated to insure that the CAS tone timing matches its set parameters.

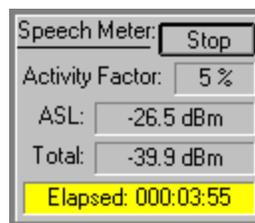
The minimum, maximum, and default values for each parameter are defined as:

| <b>Parameter:</b>     | <b>Minimum<br/>Value</b> | <b>Maximum<br/>Value</b> | <b>Default<br/>Value</b> | <b>Units</b> |
|-----------------------|--------------------------|--------------------------|--------------------------|--------------|
| Frequency of Tone A   | 50.0                     | 10000.0                  | 440.0                    | Hz           |
| Frequency of Tone B   | 50.0                     | 10000.0                  | 350.0                    | Hz           |
| Level of Tone A (dBm) | -70.0                    | 0.0                      | -22.0                    | dBm          |
| Level of Tone B (dBm) | -70.0                    | 0.0                      | -22.0                    | dBm          |
| Number of SAS Bursts  | 0.0                      | 4.0                      | 1.0                      | n/a          |
| Burst #1 Duration     | 0.0                      | 1000.0                   | 300.0                    | msec         |
| Burst #1 Interval     | 0.0                      | 1000.0                   | 25.0                     | msec         |
| Burst #2 Duration     | 0.0                      | 1000.0                   | 0.0                      | msec         |
| Burst #2 Interval     | 0.0                      | 1000.0                   | 0.0                      | msec         |
| Burst #3 Duration     | 0.0                      | 1000.0                   | 0.0                      | msec         |
| Burst #3 Interval     | 0.0                      | 1000.0                   | 0.0                      | msec         |
| Burst #4 Duration     | 0.0                      | 1000.0                   | 0.0                      | msec         |
| Burst #4 Interval     | 0.0                      | 1000.0                   | 0.0                      | msec         |



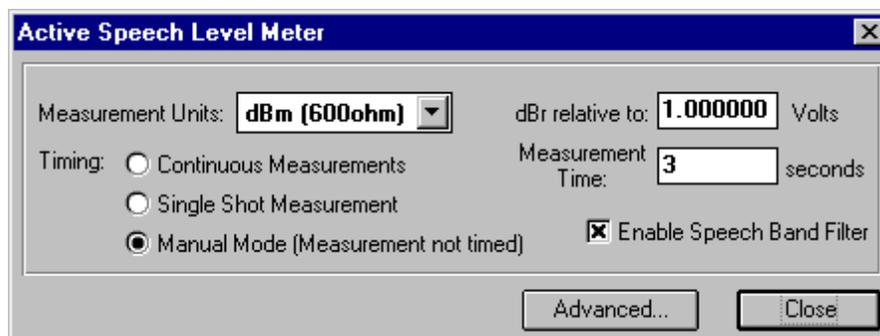
## ■ Section 3-6 Setting up the Speech Meter

When performing the Talkdown and Talkoff tests, it becomes important to determine the speech level that the CAS detector is subjected to. This is the function of the active speech level meter. It will measure signals present at either the tip and ring interface, or at the equalizer output, and return the active speech level (ASL). The measurement method of this level meter is based on Method B of Recommendation P.56 Objective Measurement of Active Speech Level. This document is published in the CCITT Blue Book, Volume V Telephone Transmission Quality, 1989.



The active speech level panel in the main window displays the measurement readings. The meter can operate in one of three different modes, allowing for continuous measurements, timed measurements, or manual measurements. However, in all modes, the panel will display the active speech level (ASL), total signal power (Total), and the activity factor (AF). Also displayed is the current operational status of the meter. If making a timed or manual measurement, it will indicate the elapsed time since the meter has started. Otherwise, if in a continuous measurement mode, it will indicate the time remaining until the measurement is complete.

To change the settings of the active speech level meter, select the [SETTINGS] [SPEECH LEVEL METER] item in the menu bar, or double click the mouse on the meter's panel. In either case, the following window will be displayed.



In the settings window, the measurement units can be selected from a drop down list. The options include the units of dBm, dBV, dBr, and Vrms. Changing this selection will update the ASL panel on the main window with the new units. The dBr unit is relative to a specified RMS voltage level that is also entered in the settings window. This reference value must be in the range of 0 to 10 Vrms.

The true RMS signal meter present on the status bar can also be set to display its result in terms of the same dBr reference value. Changing this meter's units is accomplished by double clicking the mouse on the meter's numeric readout. The dBr reference value can be automatically set by pressing the F9 key. This will take the current reading of the true RMS meter on the status bar, and use that value as the dBr reference. Since the Talkdown tests are based on relative levels between the CAS signal and speech, the CAS signal can be measured by the true RMS meter, then by pressing F9, the active speech level meter will display its results relative to the CAS signal measured. This can simplify the level setup for the Talkdown tests.

The active speech level meter can also be set to operate in one of three different modes. These are continuous measurement, single shot measurement, and manual measurement. In the continuous mode, a measurement time is specified in seconds. Once the measurement time has expired, the meter will return its reading. Another reading will then be automatically initiated. Thus, the meter will be continuously returning measurements at the prescribed rate. In the single shot mode of operation, a measurement time is also set, but the meter must be manually started. This is done by pressing the Start button on the active speech level meter panel. This will start a single measurement that is performed over the specified time interval. Once the time has expired, the measurement will stop. During the measurement, intermediate results will be displayed at a rate of about once per second. Also, the measurement can be prematurely terminated, by pressing the Stop Button. The final measurement mode is manual operation. In this mode, the meter is started and stopped manually by pressing the Start/Stop button. As with the single shot measurement, intermediate readings will be updated at about once per second.

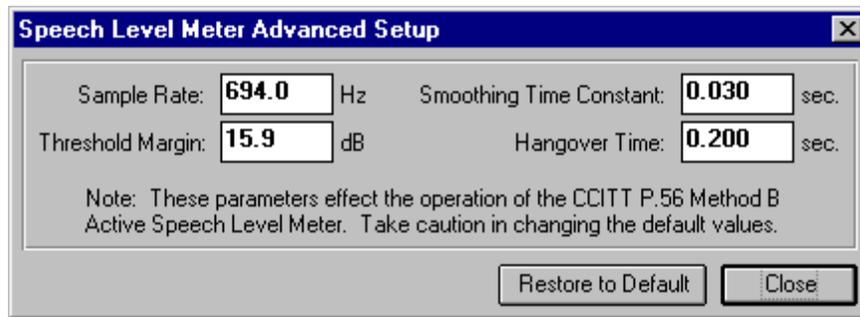
A speech band filter is included as part of the level meter. This filter can be enabled and disabled by clicking the mouse on the checkbox in the settings window. The filter is flat in the passband with the response being down approximately 0.2 dB at 200 Hz and 5500 Hz relative to 1 kHz. Outside the pass band, the response falls at a rate of approximately 18 dB/octave. A table of response values is shown below.

#### Speech Band Filter Response

| Frequency<br>(Hz) | Response<br>(dB) | Frequency<br>(Hz) | Response<br>(dB) |
|-------------------|------------------|-------------------|------------------|
| 10                | -64.8            | 2000              | 0.0              |
| 50                | -22.8            | 4000              | 0.0              |
| 60                | -18.1            | 5500              | -0.2             |
| 100               | -6.0             | 7000              | -1.0             |
| 200               | -0.2             | 10000             | -6.6             |
| 400               | 0.0              | 15000             | -22.9            |
| 1000              | 0.0              | 20000             | -46.7            |

The speech band filter, if enabled, will affect both the active speech level meter, and the true RMS meter present in the status bar of the main window.

The operational measurement parameters of the active speech meter's algorithm can be changed by pressing the Advanced button in the settings window. This will bring up the following window.



These four parameters control key operational aspects of the speech level meter. Care should be taken when changing any of the values to something other than the default settings. If changes have been made, pressing the Restore to Default button will reset the parameters back to their original value.

The minimum, maximum, and default values for each parameter affecting the speech level meter are:

| Parameter:           | Minimum Value | Maximum Value | Default Value | Units |
|----------------------|---------------|---------------|---------------|-------|
| Measurement Time     | 1             | 1,000,000     | 3             | sec   |
| dBr Reference Value  | 0             | 10.0          | 1.0           | Vrms  |
| ASL Sample Rate      | 200.0         | 2000.0        | 694.0         | Hz    |
| ASL Smoothing Time   | 0.001         | 1.000         | 0.030         | sec   |
| ASL Hangover Time    | 0.001         | 1.000         | 0.200         | sec   |
| ASL Threshold Margin | 0.0           | 40.0          | 15.9          | dB    |

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Note: When measuring the speech levels, a sufficient margin should be maintained in order to prevent clipping of the speech signal due to its high peak to mean power ratio. Normally 18 dB is considered sufficient, where the probability of exceeding that value is 0.001. The maximum unclipped tip/ring measurement level of the TSPC is +14 dBm. This would mean the highest speech level that should be measured with the active speech level meter is -4 dBm. This exceeds the maximum speech level used in the Talkdown and Talkoff tests by 3 dB, and thus should not cause any problems.

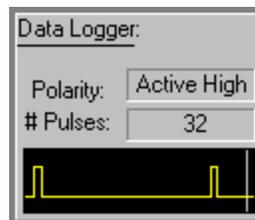
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## ■ Section 3-7 Setting up the Data Logger

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The Data Logger is used for recording and analyzing the CAS pulses returned by the CAS detector on the CPE. This signal is fed back to the TSPC on pin 9 of the DB9 connector at the rear of the TSPC. The signal must be a digital high or low (conforming to standard CMOS logic levels) and constrained between the voltage levels of 0 and 5 volts. Working in conjunction with the timer and CAS tone generator, the data logger records any pulses detected and analyzes the data under various conditions.



The data logger panel presented on the main window displays the set polarity of the received pulses and the number of pulses that have been received by the data logger. For a polarity setting of active high, a pulse is considered as detecting a rising edge that is followed by a falling edge. Likewise for active low signal polarities, a pulse is defined by a falling edge followed by a rising edge. The number of pulses displayed is reset to zero if the timer reset button is pressed. Pressing the timer reset button also clears all of the data logger's recorded pulses. Displayed on the panel is a visual graph showing the last couple of seconds of activity on the input signal. This graph will scroll across as the timer is running, and gives an easy way to verify that pulses are being detected and recorded. The thin vertical line on the right side represents the current time of the timer. The current input reading of the CAS pulse signal is displayed to the right of the vertical line even if the timer is stopped or reset. This way the signal level from the CAS detector can be monitored at all times. The polarity setting of the data logger does not effect the polarity of the graph shown above. The graph always represents the input level at connector as either a logic high or logic low.

Changing the settings of the data logger can be done by either selecting [SETTINGS] [DATA LOGGER] from the menu, or double clicking the data logger panel on the main window. This will display the data logger settings window.

The screenshot shows the 'CAS Pulse Data Logger' window with the following settings:

- Signal Polarity:**  Active High Signal,  Active Low Signal
- Input Signal De-glitching:**  Active, 5 msec.
- Pulse Analysis Criteria:**
  - Measurement Type:**  Signal Recognition / Talkdown / Talkoff,  Talkoff Only
  - Defining a Valid CAS Pulse:** A Valid CAS pulse has a duration between 70 and 90 msec, with signal drop-outs allowed, but not exceeding 10 msec.
  - Signal Recognition/Talkdown Signal Timing:** To be considered a properly received CAS pulse (not missed), it must start 10 msec, +/- 10 msec after the start of the CAS tone.
  - Talkoff Signal Timing:**
    - Reject Talkoff pulses that occur 100 msec after the CAS tone, and
    - Reject Talkoff pulses that occur 100 msec before the CAS tone.
    - If a Talkoff pulse is detected, no further Talkoff pulses will be recognized for 500 msec. Note that this applies for a "Talkoff Only" measurement.

In this window, the various parameters used in analyzing the CAS pulses are defined. Starting at the top of the window, the CAS pulse signal's polarity is defined as either active high or active low. The CAS Pulse Waveform display uses this setting so that when the signal is active or asserted, it will always appear at a high level. Where as, if the signal is de-asserted, it will always appear at a low level. An optional de-glitching algorithm can be enabled or disabled along with specifying a threshold time. When enabled, any positive or negative pulses that are shorter in duration than the threshold time are eliminated. This option should be used if the CAS detect line being monitored contains a large number of glitches. This is because the data logger can only store a finite number of pulses and if a large number of glitches are produced the maximum possible test time is reduced.

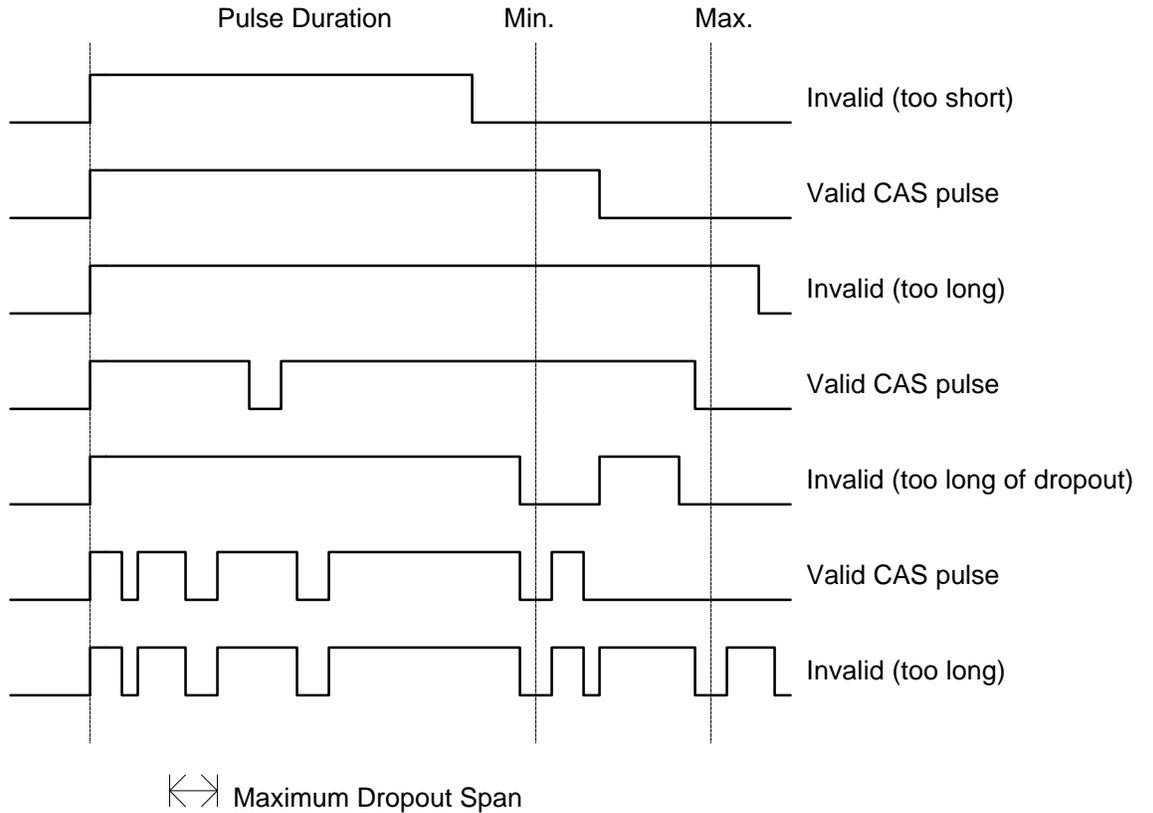
The following sections of the data logger settings window deal with defining the proper criteria for the data analysis. The type of test can be defined as either:

- i) Signal Recognition/Talkdown/Talkoff, or
- ii) Talkoff Only

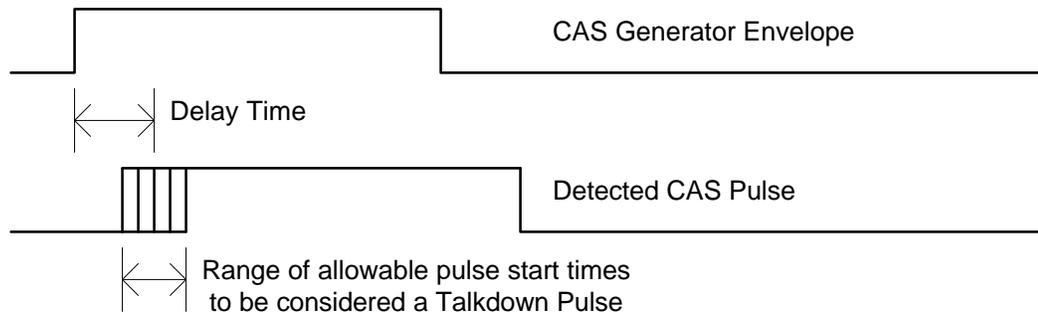
The main difference between the two, is that in the first test, the CAS generator is expected to be operating, and CAS pulses should be detected. In the second test, it is assumed that the CAS generator is disabled, and no CAS pulses are supposed to be detected. The program is required to know if CAS pulses are expected due to the operation of the CAS generator, so that it can qualify the pulses as proper Signal Recognition or Talkdown pulses.

The next section deals with defining what is considered a valid CAS pulse. Not every pulse recorded can be considered a valid CAS pulse. This is because the CPE's microprocessor will generally qualify the output of the CAS detector in

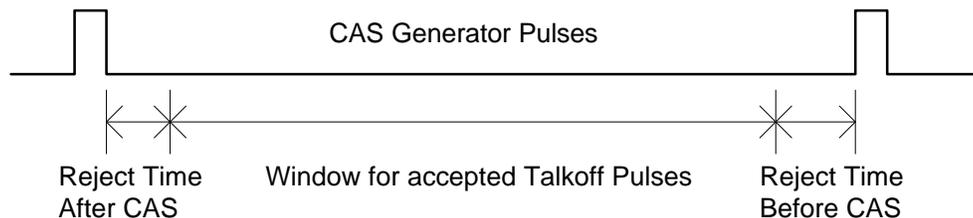
some manner before it considers having received a valid CAS pulse. The settings help to mimic the algorithm that would usually be employed by a CPE's microprocessor in qualifying a CAS pulse. The parameters define a minimum and maximum pulse duration, and maximum drop out time within that pulse duration. Some examples of possible pulse shapes of valid and invalid CAS pulses are given below.



Once the definition for what the CPE's microprocessor will accept as a valid CAS pulse is entered, the valid CAS pulses are classified into different categories depending on the instant of time they were detected. For the Signal Recognition and Talkdown tests, the CAS pulses should occur at or around the same time the CAS generator generates the CAS tone. A time window around the CAS generator is defined and if a valid pulse is detected within that window, it will be considered as a Talkdown pulse. The window is defined as a delay time from the start of the CAS tone, plus or minus a margin of error. Thus a valid Talkdown pulse must start within this time window, otherwise it is not considered a Talkdown pulse.



Valid CAS pulses that occur when no CAS signal is being generated are generally termed as Talkoff pulses. As such, it is possible to combine the testing for Talkdown and Talkoff, since pulses that occur while the CAS generator is active can be considered as Talkdown pulses, and other pulses are the Talkoff pulses. Combining the tests can considerably reduce the amount of testing time required. However, if the tests are combined together, it is important that the detected Talkoff pulses are not a result of the CAS tone generator being active. Two parameters are required to define an additional time window where valid CAS pulses will be considered as Talkoff pulses. This time window maintains a guard time around the CAS tone generator, so that a large degree of confidence exists that the Talkoff pulses detected are not a result of the tone generator. The parameters define a time after the CAS generator has stopped, where any pulses detected will be rejected since they occur too close to the CAS generator interval. Likewise, the second parameter defines a time interval before the CAS generator, where pulses detected will be rejected.



A Talkoff pulse can be qualified in one more additional manner. In the case that a CPE detects a CAS pulse, it will then proceed with the normal sequence of events for receiving a Type II or Caller ID with Call Waiting transmission. If the CAS pulse was due to Talkoff, then the CPE will wait until a prescribed time-out interval before returning to normal operation. In this time where the CPE is waiting for the FSK data, further CAS pulses will most likely be rejected by the microprocessor. If this is the case for the CPE, then a suppression time interval can be defined in which after a Talkoff pulse has been detected, no further Talkoff pulses will be recognized until the suppression time has elapsed. The result is that two closely spaced Talkoff pulses, would be treated as one Talkoff pulse for analysis purposes, since the second pulse would most likely be ignored by the CPE anyway.



This additional Talkoff qualification only applies when the Measurement Type selection has been set to Talkoff Only.

The minimum, maximum, and default values for each parameter affecting the data logger analysis are defined as:

| <b>Parameter:</b>              | <b>Minimum Value</b> | <b>Maximum Value</b> | <b>Default Value</b> | <b>Units</b> |
|--------------------------------|----------------------|----------------------|----------------------|--------------|
| Valid Pulse Min Duration       | 1                    | 20000                | 70                   | msec         |
| Valid Pulse Max Duration       | 1                    | 20000                | 90                   | msec         |
| Drop Out Maximum               | 0                    | 20000                | 5                    | msec         |
| Talkdown Delay Time            | 0                    | 20000                | 10                   | msec         |
| Talkdown Delay Tolerance       | 0                    | 20000                | 10                   | msec         |
| Talkoff Reject Time After CAS  | 0                    | 20000                | 100                  | msec         |
| Talkoff Reject Time Before CAS | 0                    | 20000                | 100                  | msec         |
| Talkoff Suppression Time       | 0                    | 20000                | 500                  | msec         |
| De-glitching Threshold Time    | 0                    | 100                  | 5                    | msec         |

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Note: The Data Logger samples the CAS pulse input at a rate of once every millisecond. As a result, the start time and duration of any pulses are always in terms of milliseconds. However, this also means that pulses shorter than a millisecond may not be captured by the Data Logger.

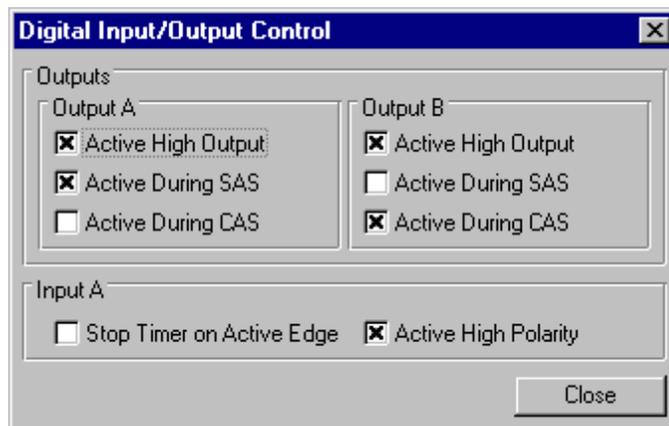
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## ■ Section 3-8 Setting up the Digital I/O

The DB9 pin connector at the rear of the Telephone Signal Processing Card (TSPC) provides access to digital output and input signals that can be used for various functions. Two output signals can be used for monitoring the timing of the CAS and SAS tones, while two input signals are used for detecting the response of the CAS tone detector and forcing a stop to any test in progress.

Changing the default settings for the digital I/O port is done by selecting the [SETTINGS] [DIGITAL I/O FUNCTIONS] menu command. Alternatively, double clicking the mouse on the image of the DB9 connector displays the window controlling the digital I/O functions.

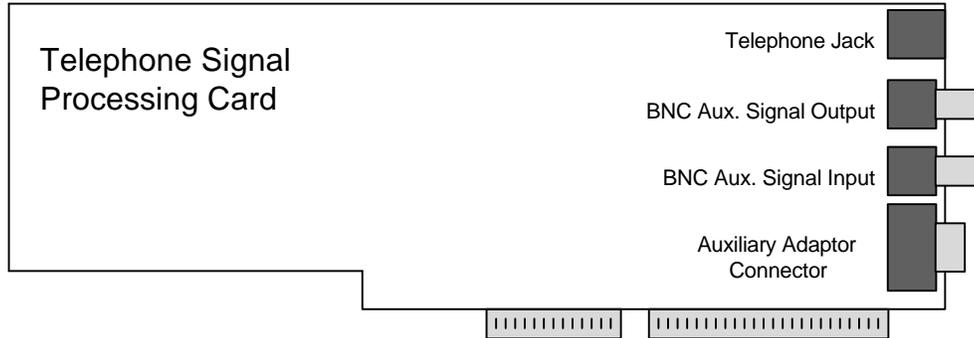


Each digital output (output A and output B) can be independently controlled in terms of their active polarity and under what conditions they will be asserted. For the default settings, both output A and output B are set to active high outputs. Output A will be asserted when the SAS signal is being generated and output B will be asserted when the CAS signal is being sent. These outputs find the most use in synchronizing external test and measurement equipment, or acting as triggers for external equipment.

One of the digital inputs is reserved for recording the signal from the CAS detector, while the second digital input can be used to force a halt to any test in progress. Input A can be set to stop the timer on either a rising or falling edge. If the input is set to an active high polarity, then at its rising edge, any test in progress will be stopped. Likewise, if the input is set to an active low polarity, then at its falling edge, and test in progress will be stopped. In order to properly detect the rising or falling edges, input A must be held at its de-asserted level for a least 300 msec before the transition to the asserted level.

The DB9 female connector that supplies the digital input and output pins is located at the bottom rear of the TSPC card. Along with the digital I/O pins, the

connector provides a +5 Volt output (at 250 mA max), ground pin, and digital output enable pin.



The digital outputs are only active when Pin 7 is connected to ground. This serves as a output port enable. The outputs are driven from 5V 'HC CMOS logic. Pin 3 is defined as Output A, while pin 4 is Output B. The two available inputs are at pins 8 (Input A) and 9 (CAS detect input). The input voltages should be limited to ground and +5V in order to prevent damage to the internal 'HC CMOS buffers. Both Input A and Input B have 10 kohm resistors to ground in order to prevent floating inputs. The pin assignment for the DB9 connector is as follows:

- Pin 1: +5V (can draw up to 0.25A from this pin) (internally fused)
- Pin 2: Reserved Output (do not use)
- Pin 3: External Output A ('HC CMOS 5V output)
- Pin 4: External Output B ('HC CMOS 5V output)
- Pin 5: Ground
- Pin 6: Reserved Output (do not use)
- Pin 7: Digital Output Enabled (connect to ground to enable outputs)
- Pin 8: External Input A ('HC CMOS 5V input)
- Pin 9: CAS Detect Input ('HC CMOS 5V input)

## ■ Section 4 How to Start, Stop, and Reset a Test

---

The key to controlling a test is the timer. The timer, which is displayed in the upper right corner of the main window, controls both the CAS Tone Generator and the Data Logger in order to maintain proper synchronization for the test.

Before starting the timer and a test, all of the test parameters must be setup. Depending on the type of test, this can involve modifying the Equalizer settings, the CAS Tone Generator Settings, the Data Logger settings, and changing the signal flow. For example, when running a Signal Recognition test or a Talkdown test, it is important to program the CAS generator to produce the desired number of CAS bursts at the prescribed rate. The Data Logger should also be set to analyze the data based on a Signal Recognition/Talkdown test. For a Talkoff test, there is no need for the CAS generator. As such it should be set to a continuous mode of operation where it can be left turned off, or just don't route the signal to the telephone interface or the BNC output connector. The Data Logger should also be set for a Talkoff Only test, to insure proper analysis of the pulse data collected.



Once all the proper settings have been made for a test, the timer can be used to control its progress. Before starting, if the time value shown on the timer is not set to zero, press the reset button or select [TIMER] [RESET TIMER] from the menu. This will zero the timer and clear out all of the data stored in the Data Logger. Pressing the start button, F5, or its equivalent menu command will start the timer, Data Logger, and CAS generator (if set in burst timing mode). As the timer runs, it will continually update the current test time. Any pulses detected by the Data Logger, while the timer runs, will be analyzed and stored. The timer will continue to run until one of three events occur. These are, pressing the stop button, pressing the reset button, or until all of the CAS pulses have been sent (if the auto-stop feature is enabled).

Pressing the stop button, F6, or its equivalent menu command will stop the timer and Data Logger, and freeze the CAS generator. This means that the time display will stop incrementing, the Data Logger will ignore any further CAS pulses, and the CAS generator will be frozen in its current state. If it had been generating a tone before pressing stop, it will continue to do so indefinitely. The stop command is normally used in two situations. The first is when the test is complete. Here the analysis windows can be viewed to look at the data, or saved to disk. The second situation is where a pause is required to change the speech signals injected into the system. If tapes are used as the speech source, once a tape is complete, the stop button is pressed, the tape can be changed or rewound, then pressing the start button will resume the test.

Pressing the reset button, F7, or its equivalent menu command, will stop the timer, the Data Logger, and the CAS generator. All of the collected data will be cleared and the time display set to zero. Pressing the stop button while the timer

is reset has no effect, while pressing the start button will start a test from the beginning.

The third event that will cause the timer to stop is if the auto-stop feature is enabled in the CAS Tone Generator setup window. This feature will stop the timer once all of the CAS bursts have been sent. When the timer is stopped in this manner, it can not be started again by pressing the start button. The timer must be first reset. If not enabled, the timer will continue to run, and the Data Logger continues to collect the data even after the CAS generator has sent all of its bursts.

---

Note: While a test is running, that uses the CAS generator, it is important not to change the settings of the CAS generator, or even display the settings window. This is because, when the CAS Tone Generator settings window is closed, the number of bursts to send parameter is reset to the programmed value. This will overwrite the current CAS burst counter and more bursts will be sent than initially desired.

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## ■ Section 5

## Analyzing Test Results

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The CAS2200 program has three main analysis tools to help determine the results of various tests performed. The first two use the data gathered by the Data Logger, and process the resulting information in either a numeric or graphical format. The CAS Pulse Analysis window shows the numeric results of the test performed, while the CAS Pulse Waveform window allows the user to view the actual data recorded by the Data Logger. The third analysis tool is the CAS Performance Calculator. Using the data gathered from the Talkdown and Talkoff tests, the calculator computes the Talkdown Miss Matrix and the Talkoff Hit Matrix. These tables are then used to calculate the three criteria for qualifying the CAS detector performance as outlined in Bellcore SR-TSV-002476.

Topics covered in the following sections:

- 1) The CAS Pulse Analysis Window
- 2) The CAS Pulse Waveform Window
- 3) The CAS Performance Calculator



## ■ Section 5-1

## CAS Pulse Analysis

The CAS Pulse Analysis window displays the results of the data captured by the Data Logger. This window is displayed by selecting [VIEW] [CAS PULSE ANALYSIS] or by pressing the F3 short cut key. If the timer is currently running, bringing up the analysis window will show the results up to the point in time the window was opened. As such the results can be viewed while the test is still in progress. Pressing the Update button, will force a recalculation of the results up to the current timer value. So that as a test is running, the intermediate results can be viewed.

The window is broken into five sections, as indicated by the horizontal lines. The top section contains the update and close buttons, and shows the test type setting of the Data Logger. This can be either Talkdown and Talkoff, or Talkoff Only. This setting is important as it will effect the other results displayed.

The second section simply shows the total number of pulses detected. If the polarity setting in the Data Logger is set to active high, a pulse is defined as a rising edge followed by a falling edge. In the case that, the polarity is set to active low, a pulse is defined as a falling edge followed by a rising edge. Each pulse will have a start time, and a duration associated with it.

**CAS Pulse Analysis**

Update Close Measurement Type: Talkdown and Talkoff

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Total number of pulses received: 257

---

The number of pulses that are considered valid CAS pulses by the CPE: 248

Duration: Mean: 79.8 Std: 0.5 Shortest: 78 Longest: 81 msec

Of Those valid CAS pulses:

|     |   |
|-----|---|
| 248 | Are considered as Talkdown pulses           |
| 0   | Are considered as Talkoff pulses            |
| 0   | Are considered as suppressed Talkoff pulses |
| 0   | Are considered as rejected pulses           |

---

Talkdown test results:

Number of CAS tones sent: 250 giving a miss rate of: 0.400% (derated)

Of the Talkdown pulses, the delay between the start of CAS tone and the start of the pulse is:

Delay: Mean: 5.0 Std: 0.2 Shortest: 4 Longest: 6 msec

---

Talkoff test results:

Total test time of: 000:04:10 with a derated Talkoff test time of: 000:03:00

giving a false detect rate of: 0.000 (per hour) per hour.

The third section deals with the pulses detected that have been classified as valid CPE pulses. This is a pulse that the CPE would accept as a valid CAS

pulse. This distinction is made since the CPE's microcontroller may further qualify the pulses received from the CAS decoder. Valid pulses are defined by having a duration between a minimum and maximum value, and not having drop-outs exceeding a certain time interval. These definitions are set in the Data Logger settings window.

The total number of pulses that have been deemed valid CPE pulses are shown, along with the statistics of their duration. Further to this, each valid CPE pulse is classified into one of four possible groupings. The groupings are talkdown, talkoff, suppressed talkoff, and rejected. This distinction is based only upon the start time for the pulses. If a pulse's start time falls within the specified window surrounding the CAS generated bursts, it is considered as a talkdown pulse. If the pulse occurs in the window between CAS generated bursts, it is considered as a talkoff pulse. Pulses that fall in-between the talkdown and talkoff window are deemed rejected. For the "Talkoff Only" tests, a pulse suppression window can be defined following any talkoff pulses. If any other pulses occur in this window, they are classified as suppressed and not used in the talkoff calculations. Both the rejected pulses and the suppressed pulses are not used in any further analysis.

The fourth section deals with the Talkdown or Signal Recognition test only. If the Talkoff Only test is selected, this section has no meaning. By taking the number of CAS bursts that were programmed to be sent and the number of talkdown pulses received, the de-rated miss rate is calculated. Since the talkdown pulses must fall within a time window after the CAS burst, the statistics on the delay between the start of the CAS burst and the CAS pulse is also given.

Finally, for the talkoff tests, the fifth section calculates the number of false detects per hour. The total test time is shown here along with the de-rated talkoff time. The de-rated talkoff time is the reduced total test time, because talkoff pulses are only accepted in a time window between CAS generator bursts. This effectively reduces the talkoff test time, and must be taken into account. If the measurement type is set to "Talkoff Only", then it is assumed that no CAS bursts are sent. In this case, there is no de-rating of the talkoff time.

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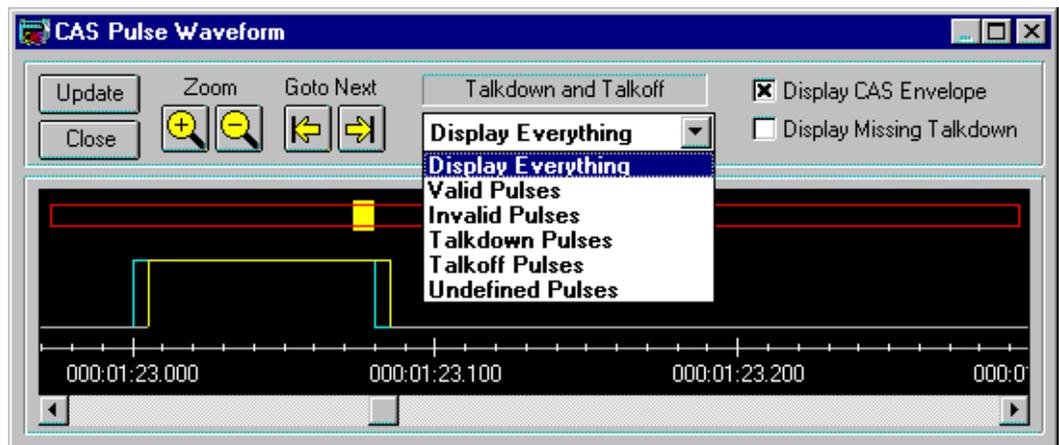
Note: The results in this window can be re-calculated by pressing the update button. Thus after a test is completed, it is possible to change the settings of the Data Logger, and then re-calculate the test results. For example, the definition of what constitutes a valid CPE pulse can be changed, and then the results re-calculated. This allows for "what if" scenarios, where various parameters can be adjusted after the data has been collected by the Data Logger.

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## ■ Section 5-2

## CAS Pulse Waveform

The CAS Pulse Waveform window provides a means of examining the collected data as a graphical waveform. This can be useful in determining why certain pulses have been classified by the analysis window as one type or another. It is also useful in viewing the characteristics of the pulses generated by the CAS detector.

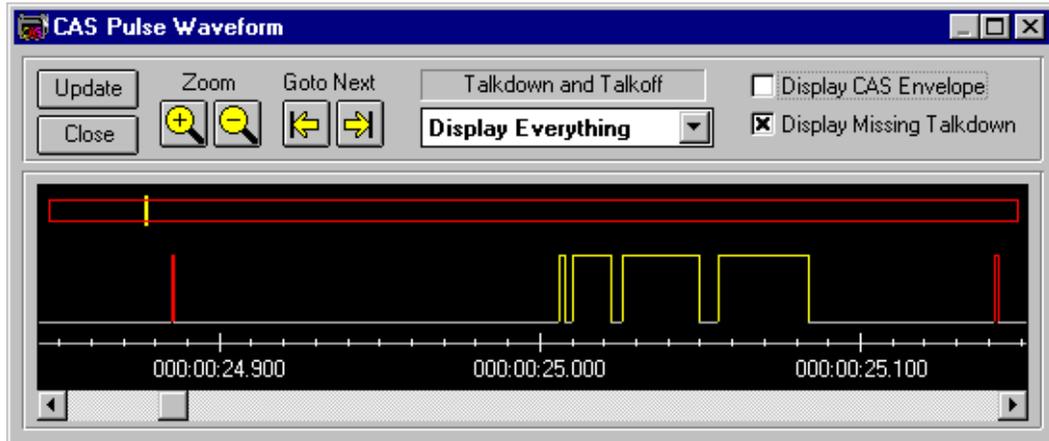


The window is opened by selecting the [VIEW] [CAS PULSE WAVEFORM] menu item or by pressing the F4 key. When the window is opened, the data displayed will be from the start of the test to the timer value when the window was opened. Like the CAS Pulse Analysis window, this window may be viewed while the test is running. Pressing the Update button will display any new data collected between the time when the window was opened and the current reading of the timer.

The window will indicate the test type setting as either "Talkdown and Talkoff" or "Talkoff Only" as this has an effect on how the data is displayed. The drop-down list allows for various combinations of pulse classifications to be displayed. This helps in isolating only the pulses that are of interest to the user.

The graph portion of the window, can be zoomed in or out and panned left or right. The two zoom buttons are used to zoom in and out respectively, while the scroll bar allows for panning the display left or right. The "Goto Next" left and right buttons will center the screen on the next pulse displayed that is either to the left or right of the current position. This is a fast way of moving between pulses that are separated by a large amount of time.

One option exists to display the CAS generator envelope. If enabled, the envelope of the CAS generator will be displayed in a deep blue. This helps in understanding the timing relationship between the CAS generator and the detected pulses from the CAS detector. The previous figure shows an isolated talkdown pulse in relationship to the CAS generator envelope. As shown, the pulse is simply a delayed version of the CAS tone. The next figure shows a possible CAS detector output under noisy or interference conditions.



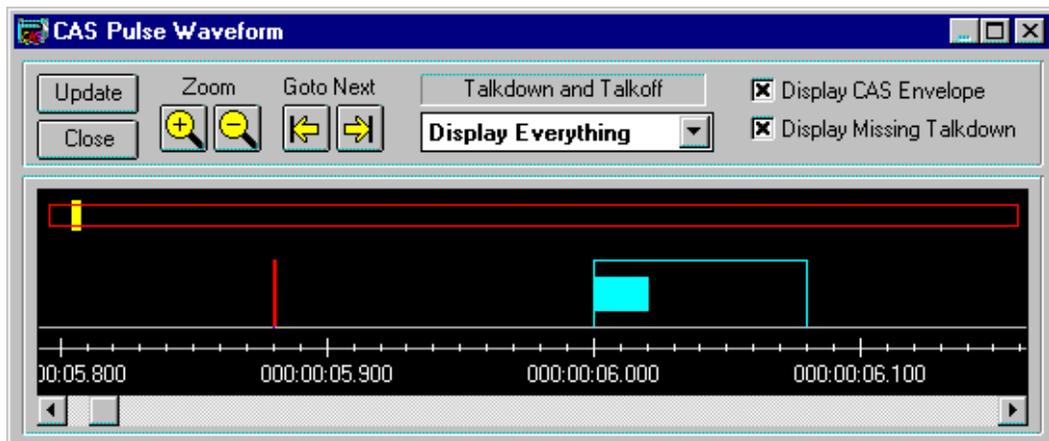
As the previous figure, a single talkdown pulse is shown. However, the pulse contains various signal drop-outs and some very short pulses that precede and follow the CAS burst. The graph is color coded to represent the various pulses detected. The talkdown pulse is shown in yellow, while the short invalid pulses are shown in red. The talkdown pulse is still valid with the drop-outs, since the setting in the Data Logger specified a maximum drop-out time of 10 msec, which is greater than the drop-outs recorded.

The color code for the display is as follows:

|             |   |
|-------------|---|
| Red:        | Invalid CPE pulses                                |
| Yellow:     | Talkdown pulses                                   |
| Green:      | Talkoff pulses                                    |
| Light Blue: | Rejected pulses for the "Talkoff & Talkdown" test |
| Light Blue: | Suppressed pulses for the "Talkoff Only" test     |
| Dark Blue:  | CAS generator envelope                            |

#### **Missing Talkdowns:**

For talkdown testing, it can very convenient to know when a pulse was not detected, since this is generally a more unique event. This is possible by enabling the check box labeled "Display Missing Talkdown" as in the following figure.

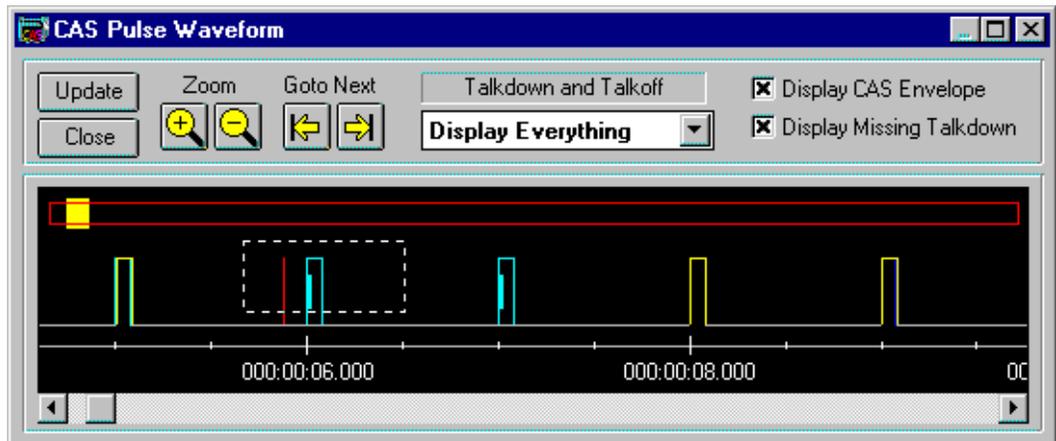


In this case, the CAS tone envelope shows that a CAS tone was generated at 6.000 seconds, and lasting for 80 msec. However, the CAS detector produced no output from this tone. As a result of enabling the “Missing Talkdown” option, a light blue band is displayed that marks the missing pulse. The blue band is drawn over a time span that matches the settings in the data logger for when a valid “talkdown” pulse should have been detected. In this case, the data logger was expecting that pulses starting 10 msec +/- 10 msec after the CAS tone started would be classified as a talkdown pulse. As such, the blue band is drawn from 0 msec to 20 msec after the CAS tone had started.

Enabling the option to display the missing talkdown pulses is a quick way to isolate the lack of any pulses detected; however, it should be noted that enabling this option will slow down the drawing rate when dealing with large amounts of test data.

#### ***Zooming with the Mouse:***

The mouse can be used to quickly zoom into particular event by “drawing” a zoom box on the displayed waveform. This is done by pressing and holding the left mouse button and then dragging the mouse. This draws a dashed box on the graphing waveform as shown below. Releasing the mouse button will zoom into the graph with the dashed box representing the starting and ending time of the waveform displayed. The figure below shows a dashed box being drawn around a single missing talkdown pulse. Once the mouse button is release, the waveform will be re-drawn, but zoomed into the time span of the dashed box.



The mouse can also be used to quickly zoom out to full span. This is done by simply pressing the right mouse button.

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**Note:** The Data Logger samples the CAS pulse input at a rate of once every millisecond. As a result, the start time and duration of any pulses are always in terms of milliseconds. However, this also means that pulses shorter than a millisecond may not be captured by the Data Logger.

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## ■ Section 5-3 CAS Performance Calculator

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The CAS Performance Calculator is used to compute the final talkdown and talkoff results in accordance with the Bellcore SR-TSV-002476 test plan. The various miss rates from the talkdown test and the hit rates from the talkoff test are entered into the calculator. From this information, the talkdown miss matrix and talkoff hit matrix are derived. Finally the three talkdown conditions and the three talkoff conditions can be calculated. These six values are the final result of the process and can be used to compare the performance of the CAS detector to the desired performance level stated in the SR-TSV-002476 test plan.

Selecting the menu command [VIEW] [CAS PERFORMANCE CALCULATOR] will bring up the following window. The calculator consists mainly of six different grids, which can be viewed by pressing the corresponding button at the top of the window. The first two grids, "Talkdown Results" and "Talkoff Results" are used to enter the test data gathered from the various tests outlined in the test plan. These are the only two grids where data can be entered. The following two grids labeled "Talkdown Miss Rate" and "Talkoff Hit Rate" display the miss matrix and hit matrix along with the three talkdown and talkoff conditions. Note that if no data has been entered into the first two grids, or if the data is incorrectly entered, you will not be able to view the talkdown miss matrix or talkoff hit matrix. In this case, a message will be generated, describing the reason the matrix could not be calculated.

The final two grids show the "Talkdown Test Matrix" and "Talkoff Test Matrix" respectively. These two matrices show the various joint probabilities used in calculating the miss matrix and hit matrix. These values match the values given in SR-TSV-002476, and are shown for reference purposes only.

### ***Talkdown Data Analysis***

The following image shows the "Talkdown Results" grid. This grid is used to enter the data needed for the calculation. Of the six columns contained in the grid, only two of them are required for the miss rate matrix calculation. These are the "Signal to Speech Ratio" and the "De-rated Miss Rate".

**CAS Performance Calculator**

View:

| Row | Signal Level (dBm/Tone) | Speech Level (dBm) | Signal to Speech Ratio (dB) | Number of CAS Pulses Received | Number of CAS Pulses Sent | Derated Miss Rate (%) |
|-----|-------------------------|--------------------|-----------------------------|-------------------------------|---------------------------|-----------------------|
| 1   | -26.0                   | -7.0               | -19.0                       | 17285                         | 40000                     | 28.3938               |
| 2   | -28.0                   | -13.0              | -15.0                       | 23101                         | 40000                     | 21.1238               |
| 3   | -22.0                   | -10.0              | -12.0                       | 27937                         | 40000                     | 15.0788               |
| 4   | -26.0                   | -16.0              | -10.0                       | 31426                         | 40000                     | 10.7175               |
| 5   | -28.0                   | -22.0              | -6.0                        | 35893                         | 40000                     | 5.1338                |
| 6   | -22.0                   | -19.0              | -3.0                        | 38692                         | 40000                     | 1.6350                |
| 7   | -28.0                   | -28.0              | 0.0                         | 39776                         | 40000                     | 0.2800                |
| 8   |                         |                    |                             |                               |                           |                       |
| 9   |                         |                    |                             |                               |                           |                       |
| 10  |                         |                    |                             |                               |                           |                       |
| 11  |                         |                    |                             |                               |                           |                       |
| 12  |                         |                    |                             |                               |                           |                       |

Enter the results of the Talkdown tests:  
 Only the data for the Signal to Speech Level and Derated Miss Rate is required for the calculations. If you enter the Signal Level and Speech Level, the Signal to Speech level will be calculated.

The other four columns are provided for completeness sake. However, if only the Signal Level and Speech Level columns are filled with data, the program will automatically calculate and enter the Signal to Speech Ratio. The same applies to the CAS Pulses Received and CAS Pulses Sent columns. If data is entered into these two columns the program will compute and enter the miss rate automatically.

For the purposes of the calculation, the program requires that the column of Signal to Speech Ratio values be in ascending order. Also wherever an entry exists for the Signal to Speech Ratio, a corresponding entry must also exist for the De-rated Miss Rate, and vice versa. However, not all the rows need to be entered with data. The program will ignore blank rows. This way the Talkdown test can be performed at the extremes of the signal levels first. The data is then entered in two rows, but leaving blank rows in between the extreme level values. Thus only after two data points, a rough estimate of the CAS detector performance can be calculated. More data points can then be taken, and filled into the blank rows, gaining better confidence of the results with each additional data point.

Once the data is entered, pressing the "Talkdown Miss Rate" button will force a calculation of the data. If no data entry errors are detected, the grid will display the miss rate matrix. An example is shown below.

| CAS Performance Calculator |                  |                 |                    |                  |                      |                     |           |          |
|----------------------------|------------------|-----------------|--------------------|------------------|----------------------|---------------------|-----------|----------|
| View:                      | Talkdown Results | Talkoff Results | Talkdown Miss Rate | Talkoff Hit Rate | Talkdown Test Matrix | Talkoff Test Matrix |           |          |
|                            | -30 dBm          | -28 dBm         | -26 dBm            | -24 dBm          | -22 dBm              | -20 dBm             | -18 dBm   | -16 dBm  |
| -7 dBm                     | 35.6638 ^        | 32.0288 ^       | 28.3938            | 24.7588 ~        | 21.1238              | 17.0938 ~           | 12.8981 ~ | 9.3216 ~ |
| -10 dBm                    | 30.2113 ^        | 26.5763 ~       | 22.9413 ~          | 19.1088 ~        | 15.0788              | 10.7175             | 7.9256 ~  | 5.1338   |
| -13 dBm                    | 24.7588 ~        | 21.1238         | 17.0938 ~          | 12.8981 ~        | 9.3216 ~             | 6.5297 ~            | 3.9675 ~  | 1.6350   |
| -16 dBm                    | 19.1088 ~        | 15.0788         | 10.7175            | 7.9256 ~         | 5.1338               | 2.8013 ~            | 1.1833 ~  | 0.2800   |
| -19 dBm                    | 12.8981 ~        | 9.3216 ~        | 6.5297 ~           | 3.9675 ~         | 1.6350               | 0.7317 ~            | 0.0000 *  | 0.0000 * |
| -22 dBm                    | 7.9256 ~         | 5.1338          | 2.8013 ~           | 1.1833 ~         | 0.2800               | 0.0000 *            | 0.0000 *  | 0.0000 * |
| -25 dBm                    | 3.9675 ~         | 1.6350          | 0.7317 ~           | 0.0000 *         | 0.0000 *             | 0.0000 *            | 0.0000 *  | 0.0000 * |
| -28 dBm                    | 1.1833 ~         | 0.2800          | 0.0000 *           | 0.0000 *         | 0.0000 *             | 0.0000 *            | 0.0000 *  | 0.0000 * |
| -31 dBm                    | 0.0000 *         | 0.0000 *        | 0.0000 *           | 0.0000 *         | 0.0000 *             | 0.0000 *            | 0.0000 *  | 0.0000 * |

Condition 1 (nominal) : 98.365 % (requirement >= 99.5 %)

Condition 2 (worst 1%) : 75.911 % (requirement >= 93.0 %)

Condition 3 (global) : 96.657 % (requirement >= 99.5 %)

~interpolated ^extrapolated \*clamped to min/max

The signal level in dBm per tone represents the column headings, and the speech level in dBm represents the row headings. At the intersection of the columns and rows the estimated miss rate for the given signal level and speech level is displayed. Three different symbols may be appended to the miss rate value under certain circumstances. These are ~, ^, or \*. The ~ symbol means that the value shown was interpolated between two entered data points. The ^ symbol is used to indicate that the computed miss rate was an extrapolation of the data points entered. Finally, the \* symbol indicates that the displayed value is clamped to its maximum or minimum possible value. The maximum possible de-rated miss rate is 50%, while the minimum is 0%.

At the bottom of the window, the three Talkdown conditions are calculated and displayed. Condition #1 is simply the success rate, 100 percent minus the miss rate, for the nominal signal to speech ratio. This occurs at a signal level of -22 dBm per tone and a near end speech level of -19 dBm. Condition #2 is a worst case CAS success rate, taken by calculating the average success rate within the worst 1% of the Talkdown Test Matrix signal to speech ratios. Finally, Condition #3 is the average CAS success rate taken over the entire matrix of varying signal to speech ratios.

## Talkoff Data Analysis

The following image shows the "Talkoff Results" grid. This grid is used to enter the data required for the calculation. The talkoff test results in the presence of near end speech is entered into the first three columns, while the results taken with far end speech is entered into the last three columns. For each near end and far end data point, the speech level in dBm, number of CAS pulses detected, and length of test in hours must be entered. As with the following example, both near end and far end data are not required for every row. Provided that any row, that contains near end data, must have all three near end columns filled. Likewise with the far end data.

**CAS Performance Calculator**

View:

| Row | Near End Speech Level (dBm) | Number of Hits for Near End Speech | Length of Test (hours) | Far End Speech Level (dBm) | Number of Hits for Far End Speech | Length of Test (hours) |
|-----|-----------------------------|------------------------------------|------------------------|----------------------------|-----------------------------------|------------------------|
| 1   | -7.0                        | 15                                 | 96.0                   |                            |                                   |                        |
| 2   | -10.0                       | 13                                 | 96.0                   |                            |                                   |                        |
| 3   | -13.0                       | 13                                 | 96.0                   | -13.0                      | 12                                | 96.0                   |
| 4   | -16.0                       | 11                                 | 96.0                   | -16.0                      | 12                                | 96.0                   |
| 5   | -19.0                       | 9                                  | 96.0                   | -19.0                      | 7                                 | 96.0                   |
| 6   | -22.0                       | 8                                  | 96.0                   | -22.0                      | 5                                 | 96.0                   |
| 7   | -25.0                       | 7                                  | 96.0                   | -25.0                      | 2                                 | 96.0                   |
| 8   | -28.0                       | 4                                  | 96.0                   | -28.0                      | 0                                 | 96.0                   |
| 9   | -31.0                       | 0                                  | 96.0                   | -31.0                      | 0                                 | 96.0                   |
| 10  |                             |                                    |                        |                            |                                   |                        |
| 11  |                             |                                    |                        |                            |                                   |                        |
| 12  |                             |                                    |                        |                            |                                   |                        |
| 13  |                             |                                    |                        |                            |                                   |                        |

Enter the results of the Talkoff tests:

The program requires that the near end speech level be entered in descending order. This is also true for the far end speech level. However, the speech levels entered on any given row do not have to be the same for the near and far end. The example does keep the near and far end speech levels the same on matching rows, however, this is not required.

Once the data is entered, pressing the "Talkoff Hit Rate" button will force a calculation of the data. If no data entry errors are detected, the grid will display the hit rate matrix. An example is shown below.

| CAS Performance Calculator |                  |                 |                    |                  |                      |                     |         |
|----------------------------|------------------|-----------------|--------------------|------------------|----------------------|---------------------|---------|
| View:                      | Talkdown Results | Talkoff Results | Talkdown Miss Rate | Talkoff Hit Rate | Talkdown Test Matrix | Talkoff Test Matrix |         |
|                            | -13 dBm          | -16 dBm         | -19 dBm            | -22 dBm          | -25 dBm              | -28 dBm             | -31 dBm |
| -7 dBm                     | 0.1406           | 0.1406          | 0.1146             | 0.1042           | 0.0885               | 0.0781              | 0.0781  |
| -10 dBm                    | 0.1302           | 0.1302          | 0.1042             | 0.0938           | 0.0781               | 0.0677              | 0.0677  |
| -13 dBm                    | 0.1302           | 0.1302          | 0.1042             | 0.0938           | 0.0781               | 0.0677              | 0.0677  |
| -16 dBm                    | 0.1198           | 0.1198          | 0.0938             | 0.0833           | 0.0677               | 0.0573              | 0.0573  |
| -19 dBm                    | 0.1094           | 0.1094          | 0.0833             | 0.0729           | 0.0573               | 0.0469              | 0.0469  |
| -22 dBm                    | 0.1042           | 0.1042          | 0.0781             | 0.0677           | 0.0521               | 0.0417              | 0.0417  |
| -25 dBm                    | 0.0990           | 0.0990          | 0.0729             | 0.0625           | 0.0469               | 0.0365              | 0.0365  |
| -28 dBm                    | 0.0833           | 0.0833          | 0.0573             | 0.0469           | 0.0313               | 0.0208              | 0.0208  |
| -31 dBm                    | 0.0625           | 0.0625          | 0.0365             | 0.0260           | 0.0104               | 0.0000              | 0.0000  |

Condition 1 (nominal) : 1 hit in 21.3 hours (requirement  $\geq$  45.0 hours)  
 Condition 2 (worst 1%) : 1 hit in 9.0 hours (requirement  $\geq$  10.0 hours)  
 Condition 3 (global) : 1 hit in 17.3 hours (requirement  $\geq$  35.0 hours)  
 ~interpolated ^extrapolated \*clamped to minimum

Close

The far end speech level in dBm represents the column headings, and the near end speech level in dBm represents the row headings. At the intersection of the columns and rows the hit rate for the given near and far end speech level is displayed. Three different symbols may be appended to the hit rate value under some circumstances. These are ~, ^, or \*. The ~ symbol means that the value shown was interpolated between two entered data points. The ^ symbol is used to indicate that the computed hit rate was an extrapolation of the data points entered. Finally, the \* symbol indicates that the displayed value is clamped to its minimum possible value. The minimum possible de-rated hit rate is 0 hits per hour.

At the bottom of the window, the three Talkoff conditions are calculated and displayed. Condition #1 is simply the number of hours for 1 hit to occur, for the nominal near and far end speech levels. This occurs at a far end speech level of -28 dBm and a near end speech level of -19 dBm. Condition #2 is a worst case hit rate, taken by calculating the average hours per hit within the worst 1% of the Talkoff Test Matrix. The worst case occurring with the highest combinations of near and far end speech levels. Finally, Condition #3 is the average hours per hit taken over the entire matrix of varying near and far end speech levels.

## ***Test Matrices***

The Talkdown and Talkoff test matrices are used in the computation of the talkdown/talkoff miss/hit results. The table entry values are taken from the Bellcore SR-TSV-002476 document. However, if a need arises it is possible to modify these test matrices to suit unusual circumstances. The talkdown and talkoff test matrix values are stored in the files: bc\_tdtm.csv and bc\_totm.csv respectively. These files can be read by most spreadsheets as a text format. In this manner, these values can be modified using any common spreadsheet program. Even a basic text editor program can also be used to modify the contents of the files. Care should be taken not to corrupt the file as unpredictable results may occur.

For the calculations of Condition 1 and Condition 2, special symbols are used within the test matrix. The single entry that is used in the Condition 1 calculation has a # symbol appended to it. For the Condition 2 calculation, those entries with a \* symbol appended will be used in the calculation. In this manner it is possible to change which entries are associated with the Condition 1 and Condition 2 calculations.

## ■ Section 6

## Scripting Language

---

The scripting language capability gives the user a method in which to automate complex or lengthy test procedures. A script program is composed from a series of commands that can modify, change, and control various aspects of how the CAS detector is tested. Since these tests are generally very long in length and quite repetitive, they lend themselves to automation via a scripting language.

Script programs can be composed with the built in editor or any other ASCII text editor and loaded into the built in script editor for execution. Once a script program has been created or loaded from a file off the disk, selecting the [SCRIPTING] [RUN SCRIPT PROGRAM] menu command will start the execution of the script program.

***The contents of this section:***

- 1) The Basics of Script Program Syntax
- 2) How the Script Program Editor Works
- 3) Script Messages and the Log Window
- 4) Script Command Reference
- 5) Running a Script Program

## The Basics of Script Program Syntax

The following example program is used to explain some of the basics in writing a script program.

### Example Program:

```

1:          *****
2:          *   CAS Test #5:
3:          *   Testing for sensitivity to CAS Freq. variations
4:          *   Freq A is 1% high, Freq B is 1% low
5:          *****
6:
7:          Parameter  Reset                ;set params to known defaults
8:
9:          Parameter  CAS_FREQA  *= 1.01   ;increase Freq A by 1%
10:         Parameter  CAS_FREQB  *= 0.99   ;decrease Freq B by 1%
11:         Parameter  CAS_BURSTS  = 1000   ;send 1000 bursts
12:
13:         PrintScreen "Running Test #5"
14:         Start                ;start sending the CAS bursts
15:         SaveFile  Config  "tst_5.cfg"   ;save results for future
           analysis
16:
17:         End

```

### Comment Fields:

If the first non-space character on any line starts with the "\*" or ";" character, the entire line will be interpreted as a comment line and ignored during program execution. In the example, the first five lines will be treated as comment fields since they start with the "\*" character. If within a command line, a ";" character is encountered, the rest of that line will be treated as a comment field, and ignored during program execution. Program lines 7, 9-11, 14, and 15 are examples of this form of commenting the script commands. Blank lines, or lines with only spaces are also ignored.

### Program Commands:

Any line that does not start with "\*" or ";" will be treated as what should be a valid command. The commands or data that follow are not case sensitive. So it does not matter if the program is written in upper case, lower case, or a combination of the two. It is important to use spaces (1 or more) between the command words and any data fields in a program line. Spaces are used by the script file interpreter to separate the command and data fields from each other. The only exception is any text that is placed within quotation marks "".

### What the Example Program Does:

The example program would execute as follows. The first 6 lines would be ignored since the first 5 start with the "\*" character, and the 6th is a blank line.

The first command encountered is the PARAMETER command. This is one of the most used commands as it allows for changing almost any of the various program settings. However, in the example here, the keyword RESET is used,

which causes all the program settings to return to their default value. It is a very good practice to use this command at the beginning of any script program in order to return all the program settings to a known default state. The next group of command lines (9 to 11) also use the parameter command in its more common form. Here the parameter command is used to change the setting of a specific parameter. Line 9 sets the frequency of one of the CAS tones to a value that is 1.01 times higher than its current value. This effectively increases the frequency by 1%. Likewise line 10 decreases the other CAS tone frequency by 1%. Line 11 then sets the number of CAS tone bursts to send at 1000.

The PRINTSCREEN command in line 13 allows the script program to display messages to user on the screen. This is useful in indicating to the user any actions the script program may be performing. Immediately following the message being displayed on the screen, the START command begins a single test. The START command performs the same functionality as pressing the START button on the timer control panel. Any execution of further script commands is halted until the started test has run to its completion. At that time the script interpreter will continue to execute the remaining commands.

The SAVEFILE command at line 15 is used to save all the data collected during the test to the specified configuration file. Once the program configuration is saved, the user can load this file at a later time and examine the state of all the program settings and the data collected. Finally, the END command at line 17 stops the script interpreter from executing any further commands. The END command is not explicitly needed, since the program would automatically end at the last line.

---

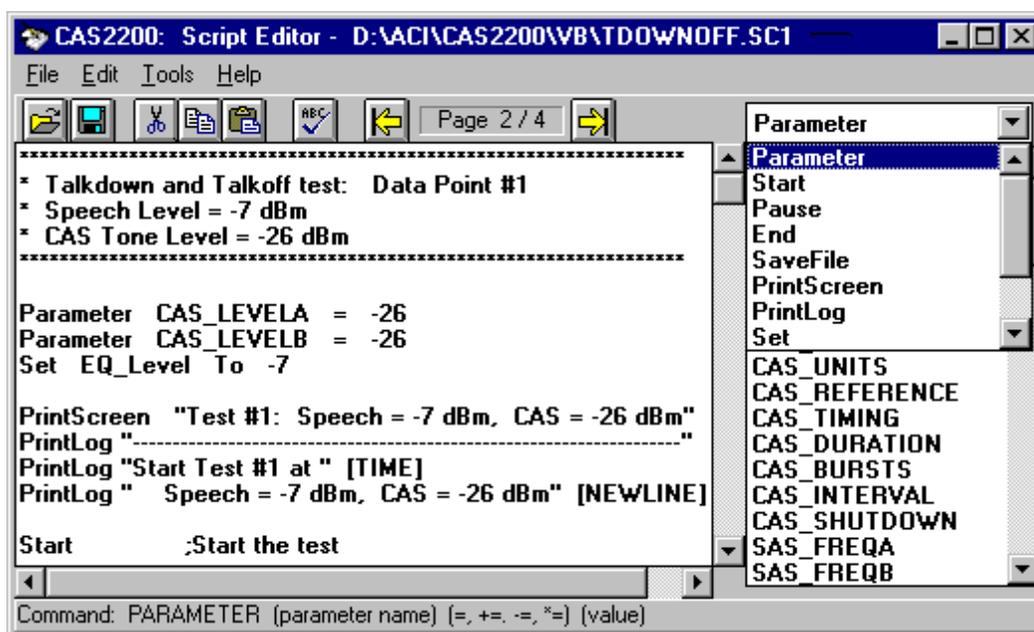
Note: It is important to understand that any changes made to the parameters will be in effect after the program finishes. In the case above, the CAS tone frequencies will be set 1% higher and lower than their default values when the program finishes. They will not be returned to their value prior to running the script program. This is why it is important to always reset the program state to its default settings at the beginning of a script program.

---

## How the Script Program Editor Works

The built in script editor provided contains some features to simplify the composing of script programs. This includes a script command builder, which minimizes the requirements of remembering the syntax of the scripting commands. Also, the script editor includes a syntax checker that can be used to verify that the syntax is what the script interpreter expects to see. This is very useful, since it can be quite troublesome to have the script interpreter flag a syntax error in the middle of an extremely long test.

The following figure shows an example of the script editor. To display the editor from the main program window, select the [VIEW] [SCRIPT LANGUAGE EDITOR] option from the menu, or just simply press the F2 key. The editor contains a small set of menu commands, toolbar of commonly used functions, text area for composing the script program, command builder controls at the right of the window, and a hint line at the bottom.



The menu commands and the toolbar allow for loading and saving the files to and from disk storage along with common editing features to cut, copy, and paste sections of text. Under the TOOLS menu, a syntax check of the current program can be performed along with enabling or disabling the command builder. Finally the Help menu can be used to access the on-line scripting help file.

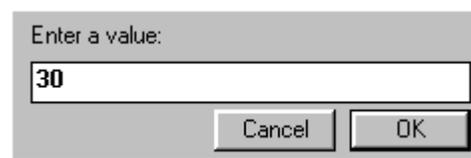
The script editor can work with up to four "pages". Each page can contain up to 32 kbytes of characters. This allows for very long and complex script programs. The left and right arrow buttons on the toolbar are used to change the current page being displayed.

## Command Builder

The command builder provides a very simple way to compose script programs without the complexity of remembering the syntax of each command. All of the available commands are contained in the drop-down list displayed in the toolbar. By selecting a command from the list, a simple description of it appears in the hint line. Also, if the command requires further operands or key words, they appear directly below the command in the list box. Double clicking the mouse will cause the selected command and operand to be transferred to the script program area at the current cursor position.

For example, a common operation is to change the value of a program setting. If we wished to enter a command that changes the telephone interface line voltage to 30 Volts, the steps would be as follows:

- 1) Select the PARAMETER command from the command list. This causes the operand list box below to fill up with all the possible parameter names. Clicking the mouse on any of the parameter names will display its full name on the hint line.
- 2) Since we want to select the LINE\_VOLTAGE parameter, double click the mouse on LINE\_VOLTAGE. This transfers the command and parameter name to the text area.
- 3) Since the script command is not complete, more options are displayed in the list box. For the parameter command, the operators are displayed. In this case, double click the mouse on “=”.
- 4) The equal character is now transferred to the text area. The list box now displays “(value)”, which indicates that a numeric value is needed to complete the command. Double clicking the mouse on the “(value)” item displays a small pop-up window where the user can enter a value.



The image shows a small, rectangular dialog box with a light gray background. At the top left, it says "Enter a value:". Below this is a white text input field containing the number "30". At the bottom right of the dialog box, there are two buttons: "Cancel" and "OK".

Type the number 30 and press the ENTER key or click the OK button with the mouse.

- 5) This again transfers the value 30 to the text area, and since the command is now complete, a carriage return and line feed are also entered automatically.

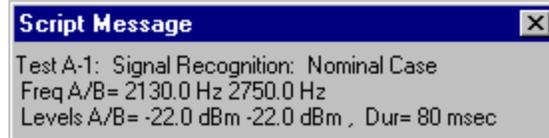
Most of the commands work in a similar fashion. The basic method in using the command builder is to select the root command from the drop-down list, then by using the mouse, double click on the desired operands or key words from the list box until the command is complete.

Some commands, such as START, PAUSE, and END, are single word commands. In this case, no further key words are needed to specify the command. As such, the list box below the command is empty. To transfer these commands to the text area, just click the right mouse button anywhere over the empty list box. Clicking the right mouse button over the list box at any time will cause the current command and a carriage return and line feed to be inserted in the text area.

Some commands like PRINTSCREEN and PRINTLOG have variable lengths since the number of operands displayed can vary over a range. In this case, clicking the right mouse button is an easy way to terminate the command by inserting a carriage return and line feed to the text area.

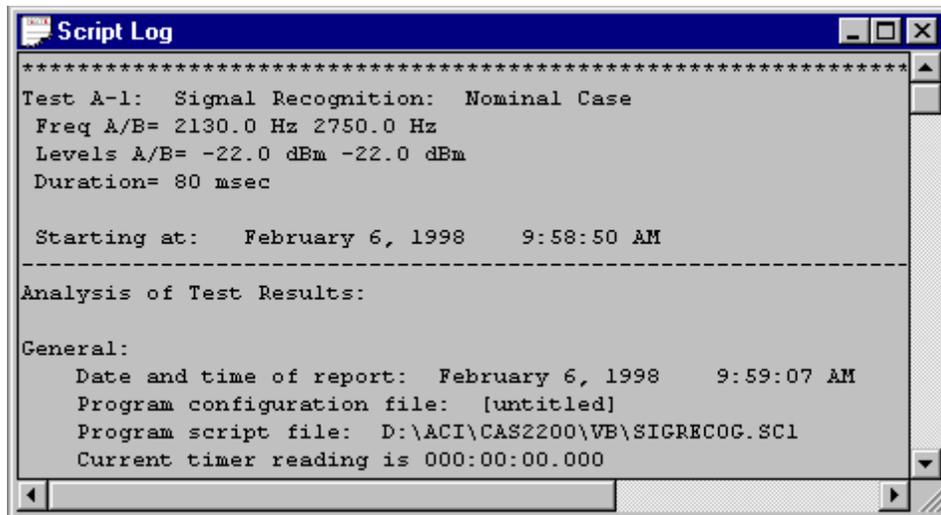
### ***Script Messages and the Log Window***

The script program has the capability to display various messages to the user operating the program. This is useful for explaining what function the script program is performing along with various results of the tests. The messages are generated by the PRINTSCREEN command and produce a window displayed in the center of the screen with the desired message. In the following example, at the beginning of each sub-test, the PRINTSCREEN command is used to display what sub-test is being executed and the parameter settings of the CAS tone.



The script messages can be cleared from the screen with the CLEAR command, and automatically disappear when the script program ends.

For recording the analysis and conditions of various tests, the script log is more powerful than the message window. The script log is a text buffer which is limited in size only by the amount of free hard drive space. As the script program executes the results and status of the various tests can be sent to the log window by using the PRINTLOG command.



```
Script Log
*****
Test A-1: Signal Recognition: Nominal Case
Freq A/B= 2130.0 Hz 2750.0 Hz
Levels A/B= -22.0 dBm -22.0 dBm
Duration= 80 msec

Starting at: February 6, 1998 9:58:50 AM
-----
Analysis of Test Results:

General:
Date and time of report: February 6, 1998 9:59:07 AM
Program configuration file: [untitled]
Program script file: D:\ACI\CAS2200\VB\SIGRECOG.SC1
Current timer reading is 000:00:00.000
```

The PRINTLOG command has the same format and capabilities as the PRINTSCREEN command, with the only difference that the output is sent to the log file. At the end of all the tests, the SAVEFILE command can be used to save the contents of the script log to a file.

Selecting the [VIEW] [SCRIPT PROGRAM LOG] from the menu displays the log file. However, if the size of the script log exceeds 32 kbytes, only the last 32 kbytes is displayed. This does not affect the SAVEFILE command, which saves the log file in its entirety. The CLEAR command should be used to clear the script log at the beginning of the script program; otherwise, the log file can progressively grow to an extremely large size as successive script programs are executed. The script log can be manually cleared by selecting the [SCRIPTING] [CLEAR SCRIPT LOG] menu command.

## ***Script Command Reference***

The script command reference describes the function of the script command words. All of the command words currently supported are listed below.

### ***Command Word List:***

|                    |   |
|--------------------|---|
| <b>START</b>       | Starts timer in order to perform a single test          |
| <b>PAUSE</b>       | Suspends operation of the script program                |
| <b>END</b>         | Ends operation of the script program                    |
| <b>PARAMETER</b>   | Changes any of the program settings                     |
| <b>SAVEFILE</b>    | Saves either the program configuration or script log    |
| <b>PRINTSCREEN</b> | Displays a text string on the screen for user prompting |
| <b>PRINTLOG</b>    | Writes a text string to the log file                    |
| <b>WAIT</b>        | Suspends the script program for a specified time        |
| <b>SET</b>         | Used to set relative equalizer levels                   |
| <b>CLEAR</b>       | Used to clear various program objects                   |
| <b>RECORD</b>      | Used to record various test results                     |
| <b>CAV2</b>        | Controls a CD player via Sony's CAV-2 interface         |

## Script Command: START

### **Description:**

The START command is used to begin a single test. The command is equivalent to pressing the timer RESET button followed by the timer START button on the upper right hand corner of the main window. By resetting the timer before actually starting it, the script command insures that all the data collected from the previous test has been cleared.

Once the START command has been processed, the script program execution is suspended until the test has completed itself. The time required for this is entirely dependent on the CAS tone parameter settings. The number of CAS tones to send and the interval between the tone starts define the length of the test. Once the test has completed, then any following script commands will be executed.

### **Syntax:**

START

### **Example:**

The example program simply sets the CAS tone generator to produce 1000 tone bursts separated with an interval of 4 seconds, and then runs a single test with those settings.

```

1:      Parameter  Reset                ;set params to known defaults
2:
3:      Parameter  CAS_INTERVAL = 4000 ;time between tones in msec
4:      Parameter  CAS_BURSTS  = 1000  ;send 1000 bursts
5:
6:      PrintScreen "Starting a test"
7:      Start                                ;start a single test and
      wait
8:      PrintScreen "The test is over"
9
10:     End

```

## Script Command: PAUSE

### **Description:**

The PAUSE command suspends any further execution of the script program. Once the script program is put into its paused mode, it can be restarted by pressing the start script button, pressing the F8 key, or by selecting the [SCRIPTING] [RUN SCRIPT PROGRAM] menu command. If restarted, the script program will continue execution starting from the first line following the pause command. The script program can also be stopped while in the pause mode, by either pressing the stop script button, pressing the F12 key, or by selecting the [SCRIPTING] [STOP AND RESET SCRIPT PROGRAM] menu option.

The PAUSE command finds use when coupled with the PRINTSCREEN command. This allows the script program to display messages to the user requesting some action to be taken and then placing the program in the pause mode. The user can then restart the script program by pressing the start script button.

**Syntax:**  
PAUSE

**Example:**

The example program simply displays a message to the user with the PrintScreen command in line 1. Once the message is displayed, the script program executes line 2 which puts the program in pause. Pressing the Start Script button will restart the script program which then executes the remainder of the program starting at line 4..

```

1:      PrintScreen "Ready to start, make sure the CPE is off-hook."
2:      Pause
3:
4:      Start
5:
6:      End

```

## Script Command: END

**Description:**

The END command stops execution of the script program. Once stopped, the script program is reset and can only be started from the beginning. The END command is optional in that the script program execution will automatically be stopped at the last line of the script program. END can be used in the middle of a script program to stop execution of the remaining program.

**Syntax:**  
END

**Example:**

The example program runs a single test due to the START command in line 2, then stops at the END command in line 3. The second START command in line 6 will not be executed.

```

1:      Start                               ;start test
2:
3:      End                                 ;end script program
4:
5:      * The following commands will not be executed
6:      Start                               ;start test

```

## Script Command: PARAMETER

### **Description:**

The PARAMETER command is used to change almost any one of the programs various settings. Changes to the CAS tone generator, SAS tone generator, equalizer, telephone interface, speech level meter, data logger, and signal routing controls can be made with the PARAMETER command.

Two different types of parameters are used throughout the program. The first type are numeric in nature. This means that the parameter value can take on any numeric value in a specified range. The second type is a multiple choice parameter. These parameters can only take on any one of a limited number of choices. An example of this is the LINE\_POLARITY parameter, which can only be set to "normal" or "reversed" as opposed to a range of numeric values. For numeric parameters, four different operators can be used. These are "=", "+=", "-=", and "\*=". The "=" assigns the following value to the parameter, while the other operators can add to, subtract by, and multiply by the current parameter value with the specified value. In the case of multiple choice parameters, only the "=" operator is allowed.

If a numeric parameter is assigned a value that is outside its valid range, then its value will be clamped to the upper or lower limit respectively. A warning message will be sent to the script log file to inform the user that an attempt was made to set the parameter value outside its valid range.

A special case of the parameter command resets all of the parameter values to their default values. This can be useful at the beginning of a complex script program, since it sets all the parameter values back to their default value. The syntax to reset the parameters is simply following the parameter command word with "reset".

### **Syntax:**

```
PARAMETER (numeric parameter name) ( = , += , -= , *= ) (value)
PARAMETER (multiple choice parameter name) = (value)
PARAMETER RESET
```

### **Example:**

The following example program uses the parameter command to adjust the levels and frequencies of the CAS tone. The first use of the parameter command in line 3 is used to reset all the parameter values back to their default state. This is important so that the script program begins execution from a known state. Two tests are run with the CAS tone levels at a twist level of + 6 dB and -6 dB. The third test returns the CAS twist to 0 dB, and changes the tone frequencies by +1% and -1%.

```

1:      *   Run multiple tests at different CAS tone levels and frequencies
2:
3:      Parameter  Reset
4:
5:      Parameter  CAS_LEVEL_A  -= 6      ;reduce CAS A tone level by 6
           dB
6:      Start                                           ;run the test
7:
8:      Parameter  CAS_LEVEL_A  += 6      ;return CAS A tone level to
           normal
9:      Parameter  CAS_LEVEL_B  -= 6      ;reduce CAS B tone level by 6 dB
10:     Start                                           ;run the test
11:
12:     Parameter  CAS_LEVEL_B  += 6      ;return CAS B tone level to
           normal
13:     Parameter  CAS_FREQ_A    *= 1.01   ;increase CAS A freq. by 1%
14:     Parameter  CAS_FREQ_B    *= 0.99   ;decrease CAS B freq. by 1%
15:     Start                                           ;run the test

```

## Script Command: SAVEFILE

### **Description:**

The SAVEFILE command can be used to save the current program configuration to a file, or save the current contents of the script log to a file. After executing a test with the script program, or a series of tests, it is beneficial to save the program configuration after each test has been completed. The configuration file saves all of the settings and data collected during the test. This allows users to perform a more detailed analysis on the results of a test after it was made. A good use for the script log file is to serve as summary of results after a series of tests have been completed. In order to make sure that the summary is not lost once the tests have been completed, the SAVEFILE command can be used to save the log file. If the file name is specified without a drive letter, e.g. "C:\", then the filename specified is stored in the same directory as the program.

### **Syntax:**

```

SAVEFILE Config "file name"
SAVEFILE Log    "file name"

```

**Example:**

The following example program conducts three different tests at three different equalizer gain settings. After each test the program configuration is saved with the SAVEFILE command. Once the three tests have been completed the final SAVEFILE command in line 18 saves the script log file to the "testdone.cfg" file name.

```

1:          * Run a bunch of tests and save the results of each one
2:
3:          Parameter EQ_GAIN_1K -= 3      ;reduce equalizer gain by 3 dB
4:          Start
5:          PrintLog "Test over at:" [TIME] [NEWLINE] [RESULTS]
6:          SaveFile Config "test1.cfg"
7:
8:          Parameter EQ_GAIN_1K -= 3      ;reduce equalizer gain by 3 dB
9:          Start
10:         PrintLog "Test over at:" [TIME] [NEWLINE] [RESULTS]
11:         SaveFile Config "test2.cfg"
12:
13:         Parameter EQ_GAIN_1K -= 3      ;reduce equalizer gain by 3 dB
14:         Start
15:         PrintLog "Test over at:" [TIME] [NEWLINE] [RESULTS]
16:         SaveFile Config "test3.cfg"
17:
18:         SaveFile Log "testdone.log"
19:         End

```

**Script Command: PRINTSCREEN/PRINTLOG****Description:**

The PRINTSCREEN and PRINTLOG commands are very similar in that they generate text that is either sent to a window on the screen or to the script log file. The syntax and keywords for both commands are the same. The PRINTSCREEN and PRINTLOG commands can display either arbitrary text strings enclosed in quotation marks or special variables used in the scripting language. Up to 9 text or script variable items can be specified with one command. The script variables that can be displayed include the following:

- a) Parameter names: If a parameter name enclosed in [ ] brackets is specified, the PrintScreen or PrintLog commands will display the current value of the parameter. For example the following command displays the specified text string along with the value contained in the SAS\_LEVEL parameter.

```
PRINTSCREEN "The SAS level is: " [SAS_LEVEL]
```

Would display the following:

```
The SAS level is: -20 dBm
```

- b) Test results: Specifying the keyword "[RESULTS]" will display the test results of the current data stored in memory. This display contains the same basic data as shown in the CAS Pulse Analysis window.

- c) Signal recognition results: A special script log named “[SIGNALREC]” is used to store the results of CAS signal recognition tests. The data stored in this log is controlled with the RECORD command. Using the [SIGNALREC] keyword with the PRINTSCREEN or PRINTLOG command will cause the results of the signal recognition tests to be displayed.
- d) Time variable: Specifying the keyword “[TIME]” will display the current date and time.
- e) New line variable: The keyword “[NEWLINE]” can be used to insert a carriage return and line feed between other items on the command line. For example, modifying the example above by inserting the [NEWLINE] keyword would display the following:

```
PRINTSCREEN "The SAS level is: " [NEWLINE] [SAS_LEVEL]
```

Output to screen or log file:

```
The SAS level is:
-20 dBm
```

**Syntax:**

```
PRINTSCREEN "text message enclosed in quotation marks" ...
PRINTSCREEN [parameter name] ...
PRINTSCREEN [RESULTS] ...
PRINTSCREEN [SIGNALREC] ...
PRINTSCREEN [TIME] ...
PRINTSCREEN [NEWLINE] ...
```

**Example:**

The example program starts by displaying a message to the user that the test will begin when the Start Script button is pressed. Following this, line 4 will show the number of CAS tone bursts that will be generated during the test and line 5 will send to the script log the starting time of the test. Once the test has been completed, line 9 sends the script log the finishing time of the test, along with the test results.

```
1:      PrintScreen "About to begin test. Press Start"
2:      Pause
3:
4:      PrintScreen "Sending" [CAS_BURSTS] " CAS tone bursts."
5:      PrintLog "Starting test at:" [TIME]
6:
7:      Start
8:
9:      PrintLog "Test ending at:" [TIME] [NEWLINE] [RESULTS]
```

A possible example of what the script log file would appear like after running this script program is as follows:

```
Starting test at: February 12, 1998  1:31:19 PM
Test ending at: February 12, 1998  2:06:49 PM
-----
Analysis of Test Results:

General:
Date and time of report: February 12, 1998  2:06:49 PM
```

Program configuration file: D:\ACI\CAS2200\VB\SAMPLE.CFG  
 Program script file: [untitled]  
 Current timer reading is 000:35:30.000

The CAS Tone Generator was set to send 250 bursts with a duration of 80, at a rate of 1 every 8000 msec.

The Time remaining until all of the CAS bursts have been sent is 000:00:00.  
 The Data Logger has been setup for: Talkdown and Talkoff test.

**CAS Pulses:**

The total number of pulses received is 238.  
 The number of pulses that are considered valid CAS pulses by the CPE are 232.  
 With a mean duration of 23.1 msec, and a standard deviation of 0.5 msec.  
 The shortest valid pulse was 22.0 msec, while the longest was 24.0 msec.  
 Of those valid CAS pulses,  
     232 Are considered as Talkdown pulses.  
     0 Are considered as Talkoff pulses.  
     0 Are considered as Suppressed Talkoff pulses.  
     0 Are considered as Rejected pulses.

**Talkdown Results:**

With the CAS Tone Generator sending 250 bursts,  
 the talkdown rate is: 3.600% (derated).

Of the Talkdown pulses, the mean delay between the start of the CAS tone and the start of the pulse is 59.8 msec, with a standard deviation of 0.4 msec.  
 The shortest delay was 59 msec, while the longest was 60 msec.

**Talkoff Results:**

The Talkoff test time is 000:03:00  
 This time is adjusted for the reject windows surrounding the CAS bursts.  
 Thus giving a Talkoff rate of 0.000 (derated) per hour.

## Script Command: WAIT

**Description:**

The WAIT command can be used to insert a programmed delay into the script program. The time delay can range from 0 to 30,000 seconds, with a resolution of 1 second. The syntax for this command is.

**Syntax:**

WAIT (time delay in seconds)

**Example:**

The example program uses the WAIT command as a method of displaying messages with the PRINTSCREEN command for a specified amount of time.

```

1:      PrintScreen "Starting a series of talkdown/talkoff tests"
2:      Wait 2
3:      PrintScreen "***** MAKE SURE SPEECH SOURCE IS ON *****"
4:      Wait 5
5:
6:      PrintScreen "Test #1: Equalizer level is " [EQ_GAIN_1K]
7:      Start
  
```

## Script Command: SET

### **Description:**

The SET command is used to specify relative gain levels for the equalizer. The ability to work with relative levels for the equalizer gain is very useful in developing script programs that must vary the speech level passed through the equalizer. The equalizer gain reference level is set by the EQ\_REFERENCE keyword. Once the reference level has been set, then by using the EQ\_LEVEL keyword, absolute speech levels can be specified. This is because the actual equalizer gain will be the difference between the EQ\_LEVEL and EQ\_REFERENCE.

### **Syntax:**

```
SET EQ_REFERENCE To (value)
SET EQ_LEVEL To (value)
```

### **Example:**

The following example uses the SET command to be able to specify speech levels in absolute terms. In this example, it was measured that with an equalizer gain of 0 dB, the ASL at the CPE was -8.3 dBm. This value is set as the reference point to the equalizer in line 1. With the reference level set, the remainder of the script program can set the equalizer level to the desired speech level directly. This is done in line 11 of the sample script program. The Set EQ\_LEVEL command will set the equalizer gain to -13 dBm - (-8.3 dBm) or -4.7 dB. The advantage of using the SET command is that the script program can specify all speech levels in absolute terms. If for some reason the testing environment changes in the future and the speech level must be re-measured, only the first line of the script program must be changed.

```

1:          Set EQ_REFERENCE To -8.3
2:
3:          *****
4:          * Talkdown & Talkoff test
5:          * Speech Level = -13 dBm
6:          * CAS Tone Level = -26 dBm
7:          *****
8:
9:          Parameter CAS_LEVELA = -26
10:         Parameter CAS_LEVELB = -26
11:         Set EQ_LEVEL To -13
12:         Start
13:
14:         * Continue with further tests at different Speech and CAS levels...
```

## Script Command: CLEAR

### **Description:**

The CLEAR command can be used to erase the contents of various script program objects. The syntax for the variations of this command are as follows:

### **Syntax:**

a) Clear the script log file:

The script log file contains all of the text generated by the PRINTLOG command. The clear log command erases its contents and is good practice to begin each script program by deleting the current contents of the log file.

CLEAR LOG

- b) Clear the display message:  
The clear command can also be used to clear any message windows being displayed by the PRINTSCREEN command.

CLEAR MESSAGE

- c) Clear the CAS Performance Calculator  
This script command will clear the contents of the CAS Performance Calculator. If the script program uses the RECORD command to input data into the calculator, then it should always begin the script program by erasing its contents to ensure the script program starts from a known state.

CLEAR CALCULATOR

- d) Clear the signal recognition results log  
This script command will clear the contents of the signal recognition log. If the script program uses the RECORD command to input data into this data log, then it should always begin the script program by erasing its contents to ensure the script program starts from a known state.

CLEAR SIGNALREC

**Example:**

The following program resets all of the program settings back to their default value and is a good way to start any script program. The CLEAR commands in lines 6 to 8 clear the script log file, CAS Performance Calculator, and signal recognition data log. If the RECORD command is not used, then it is not necessary to clear the CAS Performance Calculator or the signal recognition data log.

```

1:      *****
2:      * Initialization sequence for script programs
3:      *****
4:
5:      Parameter Reset
6:      Clear Log
7:      Clear Calculator
8:      Clear SignalRec

```

## Script Command: RECORD

**Description:**

The RECORD command is used to help in automating the processing of the data collected after each test. In conducting talkdown or talkoff tests, the

RECORD command can be used to automatically enter data into the CAS Performance Calculator. While for signal recognition tests, the RECORD command stores the results in the signal recognition data log.

**Syntax:**

- a) For talkdown tests:

The RECORD command can be used to enter the talkdown results from a test into the CAS Performance Calculator. The following syntax shows how the command line is constructed. After the TalkDown keyword, two values must be specified. These are the talkdown line number to enter the data into and the speech level at which the test was conducted. The CAS tone level, number of CAS tones sent, and the number of talkdown pulses received will be automatically entered by the command. The line number must be in the range of 1 to 63, corresponding to the row number in the CAS Performance Calculator's talkdown grid. It is important to note that the Signal-to-Speech ratios must be entered into the calculator in ascending order.

```
RECORD TalkDown (line #) (speech level)
```

- b) For talkoff tests:

Like for the talkdown results, the RECORD command can be used to enter the talkoff results into the talkoff grid of the CAS Performance Calculator. The following syntax shows how the command line is constructed. Either the near end or far end talkdown results can be specified. Like the talkdown case, the command line must specify the row number in the calculator's grid and the speech level. The RECORD command will automatically enter the number of talkoffs received and the length of the test. It is important to note that the speech levels must be entered in descending order for the talkoff results.

```
RECORD TalkOff_Near (line #) (speech level)
```

```
RECORD TalkOff_Far (line #) (speech level)
```

- c) Signal Recognition tests:

When performing CAS signal recognition tests, the RECORD command can be used to store the results in the signal recognition log. The signal recognition log is a table of results of all the signal recognition tests. The table stores the CAS tone parameters in terms of frequency, level, and duration, along with the number of CAS bursts sent and the number correctly received. Each time the RECORD command is used, another line is added to the table. Once all of the tests have been completed, the PRINTLOG [SignalRec] command can be used to send the contents of the signal recognition log to the script log for viewing or saving to disk.

```
RECORD SignalRec
```

An example of the signal recognition log after running 13 tests with different CAS parameters is as follows:

| Signal Recognition Test Results Log |             |             |               |               |               |        |        |
|-------------------------------------|-------------|-------------|---------------|---------------|---------------|--------|--------|
| Test #                              | Freq A (Hz) | Freq B (Hz) | Level A (dBm) | Level B (dBm) | Duration (ms) | # Sent | # Rcv. |
| 1                                   | 2130.0      | 2750.0      | -22.0         | -22.0         | 80            | 1000   | 1000   |

|    |        |        |       |       |    |      |      |
|----|--------|--------|-------|-------|----|------|------|
| 2  | 2119.0 | 2750.0 | -22.0 | -22.0 | 80 | 1000 | 1000 |
| 3  | 2141.0 | 2750.0 | -22.0 | -22.0 | 80 | 1000 | 1000 |
| 4  | 2130.0 | 2736.0 | -22.0 | -22.0 | 80 | 1000 | 1000 |
| 5  | 2130.0 | 2764.0 | -22.0 | -22.0 | 80 | 1000 | 1000 |
| 6  | 2130.0 | 2750.0 | -14.0 | -14.0 | 80 | 1000 | 1000 |
| 7  | 2130.0 | 2750.0 | -32.0 | -32.0 | 80 | 1000 | 1000 |
| 8  | 2130.0 | 2750.0 | -14.0 | -20.0 | 80 | 1000 | 1000 |
| 9  | 2130.0 | 2750.0 | -32.0 | -26.0 | 80 | 1000 | 1000 |
| 10 | 2130.0 | 2750.0 | -20.0 | -14.0 | 80 | 1000 | 1000 |
| 11 | 2130.0 | 2750.0 | -26.0 | -32.0 | 80 | 1000 | 1000 |
| 12 | 2130.0 | 2750.0 | -22.0 | -22.0 | 75 | 1000 | 1000 |
| 13 | 2130.0 | 2750.0 | -22.0 | -22.0 | 85 | 1000 | 1000 |

The CLEAR SignalRec command deletes all the table entries and should be done before starting a script program that uses the RECORD SIGNALREC command.

**Example:**

The example program uses the RECORD command to transfer the talkdown and talkoff results of the test to the CAS Performance Calculator. Line 13 records the talkdown test data into row 5 of the calculator with a speech level of -13 dBm. Lines 14 and 15 record the talkoff test data into row 8 of the calculator with the same speech level of -13 dBm.

```

1:          Set EQ_REFERENCE To -8.3
2:
3:          *****
4:          * Talkdown & Talkoff test
5:          * Speech Level = -13 dBm
6:          * CAS Tone Level = -26 dBm
7:          *****
8:
9:          Parameter CAS_LEVELA = -26
10:         Parameter CAS_LEVELB = -26
11:         Set EQ_LEVEL To -13
12:         Start
13:         Record Talkdown 5 -13
14:         Record Talkoff_Near 8 -13
15:         Record Talkoff_Far 8 -13
16:
17:         * Continue with further tests at different Speech and CAS levels...

```

**Script Command: CAV2****Description:**

The CAV-2 is a product from Sony that allows a PC to control the operation of CD players and other consumer audio/video products. By using the CAV2 script command, the script program can control the operation of Sony CD changers via the CAV-2. This helps to automate talkoff and talkdown testing when using the Bellcore speech material CD's in conjunction with a Sony CD changer such as the CDP-CX255.

**Syntax:**

- a) Assign a serial port for the CAV-2:  
The CAV-2 connects to the PC via a serial port. The PORT keyword is used to specify which communications port is connected to the CAV-2.

The port number can range from 1 to 4. This command must be executed before any other commands dealing with the CAV-2.

CAV2 PORT (com port #)

- b) Initialize the CAV-2:  
The INIT keyword will send a series of initialization data to the CAV-2. If the CAV-2 is not connected, or the communications port is not defined, a warning message will be generated and the script program will be paused. This command should follow the use of the CAV2 PORT command and come before any other commands.

CAV2 INIT

- c) Define the Communications Format:  
The CAV-2 can communicate to the CD player in one of two methods. The first is via its built in IR emitter. In this mode, the CAV-2 emulates the IR remote control for the CD player. The second method is via a hardwire link known as Control A1. In this case the CAV-2 is directly connected to the CD player, which eliminates any potential IR interference issues. In conjunction with the two communication methods, two different command sets can be used. These are termed CD1 and CD2. Some products will operate with a fixed command set, while others will have a control allowing the user to select between CD1 and CD2. The FORMAT keyword is used to define the communications method and command set.

CAV2 FORMAT (IR/ControlA1) (CD1/CD2)

Note that the Sony Control A1 link is not the same as the Sony Control A link.

- d) CD changer control functions:  
The following keywords are used to play, pause, or stop a CD, in addition to advancing the track and returning to the previous track. For the CD players that support multiple CD's, the play command can be followed by an option number from 1 to 200 that represents the CD to play.

CAV2 PLAY (optional CD number)

CAV2 PAUSE

CAV2 STOP

CAV2 TRK+

CAV2 TRK-

- e) User defined CAV-2 command codes:  
The SEND keyword can be used to send an arbitrary command sequence to the CAV-2. Up to 18 bytes can be transmitted to the CAV-2 by following the SEND keyword with byte values.

CAV2 SEND (byte1 byte2 byte3 ... byte n)

**Example:**

The example program will play a CD for 5 minutes then stop it. The first three lines are used to assign the com port used with the CAV-2, initialize the CAV-2,

and set the communications format between the CAV-2 and the CD player. In this case, serial port #2 connects the PC to the CAV-2, and the Control A1 link connects the CAV-2 to the CD player. The CD2 command is used for communicating with the CD player. Line 5 will cause the CD player to play disk number 24. Following a time interval of 300 seconds (5 minutes), the command in line 7 stops the CD player.

```
1:          CAV2 Port 2                ;use COM Port #2
2:          CAV2 Init                  ;init the CAV-2
3:          CAV2 Format ControlA1 CD2  ;set the communications
          format
4:
5:          CAV2 Play 24                ;play CD number 24
6:          Wait 300                   ;wait 5 minutes
7:          CAV2 Stop                   ;stop the CD player
```

## Running a Script Program

Once a script program has been written using the built in editor or loaded from disk, it can be executed by selecting [SCRIPTING] [START SCRIPT PROGRAM] from the menu, or by pressing the F8 key. Also, once a script program has been loaded into memory, a small script program control panel will become visible just underneath the timer display.



The panel indicates the current status of the script program, along with three buttons that can be used to start, pause, or stop the script program execution.

While executing the script program, if the language interpreter encounters any errors it will stop the script program and display an error message concerning the offending line. Also, the script editor will highlight the line that caused the error. Since some script programs run a large number of tests that take a long time to run, it is good practice to use the syntax checking feature of the script editor before starting the script program. The syntax check will quickly spot any possible scripting errors and alert the user with an error message. A list of all the script error messages is contained in Appendix C.

During the execution of a script program, the user is not prevented from overriding the script program settings. This can be quite useful in some circumstances to change a setting during the course of a script program test. However, caution must be exercised as changing key settings will dramatically effect the operation of the current test in progress.

If the script program attempts to change a program setting, via the PARAMETER command, to a value outside its minimum or maximum value, the value will be clamped to either the minimum or maximum value. A warning note will be sent to the script log that the parameter value has been clamped, but the script program will not stop on this warning.

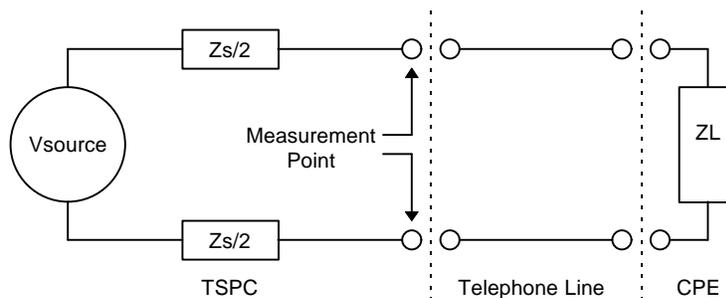
## ■ Section 7

## Signal Levels

### *Telephone Interface*

Signal levels are a common source of confusion with most signal generation equipment. This section aims to explain how the telephone interface signal levels are calculated within the program.

It is important to understand how the Telephone Signal Processing Card (TSPC) delivers its AC signals to the CPE under test. The figure below shows a simplified version of the AC signal path from the TSPC to the CPE. The TSPC consists of basically a programmable AC voltage source followed by two impedance's. The two impedance's combined represent the total source impedance ( $Z_s$ ) of the TSPC which can be set to 600 ohms, 900 ohms, or a complex impedance in the Telephone Interface settings window. The CPE under test is represented by the impedance  $Z_L$ .



The Active Speech Level meter can use either the telephone interface or the equalizer output as its signal source. When set to receive signals from the telephone interface, the meter measures the level present across the tip and ring leads. As such, the meter will measure both the signals generated by the TSPC and the signals generated by the CPE. The same applies to the true RMS meter present in the status bar, as it receives its signal from the same source as the Active Speech Level meter.

### **The CAS Tone Generator Levels**

For the CAS tone generator, its level can be specified to refer to the telephone interface or the BNC outputs. Depending on which setting has been selected, the program calculates the signal output levels in different manners. In both cases the levels can be specified either in units of dBm or dBV. If the levels have been referred to the telephone interface, the calculations for the signal levels are as follows:

***Levels referred to the Telephone Interface:***

For CAS level units of **dBm**, signal levels are specified in "dBm (600 ohms)", meaning the signal power relative to a milliwatt into a 600 ohm load. As such, if the tone generator is programmed for an output level of 0 dBm, the TSPC will deliver 1 milliwatt of signal power to the CPE provided its impedance (ZL) is 600 ohms. This is independent of whether the TSPC's source impedance has been set to 600 ohms or 900 ohms, as the program will compensate for the difference in source impedance.

If the CPE's impedance (ZL) is not 600 ohms, the power level delivered to the CPE will be different from what is specified. The voltage level can be calculated in any case from the following formula:

$$V_{cpe} = V_{specified} * \frac{Z_s + 600}{600} * \frac{Z_L}{Z_s + Z_L}$$

where:  $V_{cpe}$  is the voltage level at the CPE in Vrms  
 $V_{specified}$  is given in Vrms  
 ZL is the load impedance of the CPE  
 Zs is the source impedance of the TSPC

$V_{specified}$  can be determined from the dBm value by using the relationship of 0.7746 Vrms being equal to 0 dBm (into 600 ohms).

As can be seen from the previous formula, if the telephone line is unterminated, then the voltage levels will be 6 dB (2 times) higher than specified if the source impedance is set to 600 ohms, and 7.96 dB (2.5 times) higher if the source impedance is set to 900 ohms.

In the case that the TSPC's source impedance is set to the complex setting, the program can not compensate for the source impedance since its magnitude and phase response varies with frequency. When using the complex impedance, the signal levels will always be calculated assuming an **unterminated** telephone line. The above formula can still be used by substituting a value of zero for Zs and infinity for ZL.

For CAS level units of **dBV**, the signal levels are much simpler to deal with. All signal levels are specified in dBV with an open circuit impedance for the CPE. As such the voltage source of the TSPC will be set to the level specified by the program in dBV regardless of the TSPC's source impedance, or the load impedance of the CPE.

The voltage at the CPE can then be calculated simply as:

$$V_{cpe} = V_{specified} * \frac{Z_L}{Z_s + Z_L}$$

where:  $V_{cpe}$  is the voltage level at the CPE in Vrms  
 $V_{specified}$  is given in Vrms  
 ZL is the load impedance of the CPE  
 Zs is the source impedance of the TSPC

**Levels referred to the BNC Output:**

If the tone generator's output levels are referred to the BNC output and the signals are also routed to the telephone interface, the AC voltage source of the

telephone interface will produce a voltage level that is 12 dB (4 times) higher than what is at the BNC output connector. The actual voltage at the tip and ring leads of the telephone interface will then depend on the TSPC's source impedance and the load impedance of the CPE.

---

Note: The SAS tone generator behaves in the same manner as the CAS tone generator with respect to the signal levels.

---

### The Equalizer Output Level

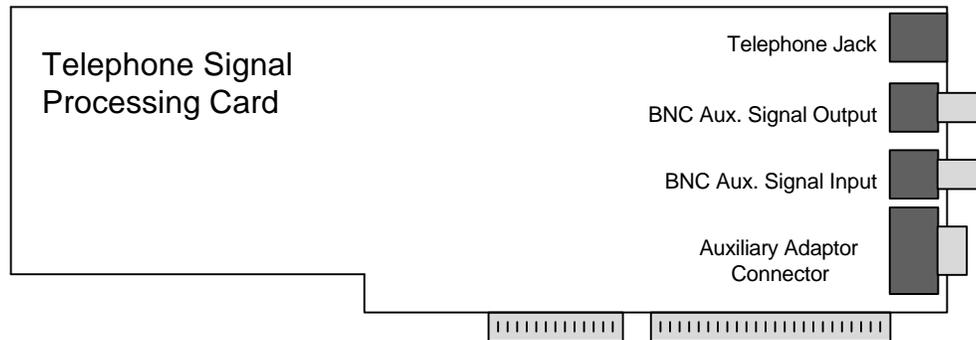
It is possible to route the equalizer output to the telephone interface. In this case, the level present at the tip and ring leads will depend on the telephone interface's source impedance and the impedance of the CPE. The gain of the equalizer is defined as the ratio between the signal levels at the BNC output connector and the BNC input connector, and not the telephone interface. There is a fixed gain relationship between the telephone interface levels and the BNC output levels, which allows the calculation of the output level. This relationship is that the voltage generated by the AC source in the telephone interface is 4 times (12 dB) higher than the voltage present at the BNC output (into a high impedance load). As such, if the equalizer gain is set to 0 dB, and 0 dBV is applied to the BNC input, the AC voltage source of the telephone interface would be generating +12 dBV. Depending on the telephone interface's source impedance and the CPE's load impedance, the level at the tip and ring leads would be given by the following formula.

$$V_{tr} = V_{in} * EQ_{gain} * 4 * \frac{Z_L}{Z_s + Z_L}$$

Where:  $V_{tr}$  is the voltage level at the tip and ring leads  
 $V_{in}$  is the voltage level at the BNC input connector  
 EQgain is the gain of the equalizer  
 $Z_s$  is the source impedance of the telephone interface  
 $Z_L$  is the load impedance of the CPE

## BNC Input & Output

The two BNC connectors on the rear of the Telephone Signal Processing Card (TSPC) can be used to monitor various signals to and from the CPE, and to inject signals into the programmable equalizer. The figure below shows the BNC signal output connector being located below the telephone jack, and just above the BNC signal input connector.



### BNC Input Connector

The auxiliary signal input has an input impedance of approximately 100 kohms. Signals injected in this input are routed to the equalizer. The equalizer can apply a gain of up to 20 dB or a loss of up to 60 dB. Along with the programmable gain or loss, the equalizer can apply controlled spectral shaping before sending the signals to either the BNC output, telephone interface, or both.

### BNC Output Connector

The signal at the BNC output connector can come from three different sources. These are the equalizer output, the CAS tone generator, and from the telephone interface. The BNC output's source impedance is fixed to 600 ohm. For the purposes of defining the signal levels, it is assumed that measurements of the BNC output level are made with a high impedance meter. If loaded by a 600 ohm impedance, all the gains and levels will of course be reduced by 6 dB.

The gain of the equalizer **always** refers to the difference in signal level between the BNC output connector and the BNC input connector. Thus a 6 dB gain in the equalizer means that the level at the BNC output is twice that of the voltage at the BNC input connector. This assumes that the BNC output drives a high impedance load. Even in the case where the equalizer signal is not routed to the BNC output, the definition of the equalizer gain remains the same.

For the CAS tone generator, its signal level parameters can be referred to either the telephone interface or the BNC Output. If the CAS tone generator's levels are referred to the telephone interface (default setting), then the voltage level at the BNC output connector will always be always 12 dB less than the AC voltage source driving the telephone interface. It's important to remember that the level

measurements occur at the tip and ring leads, and not at the AC voltage source. The difference between these two points depends on the selected source impedance and the CPE's load impedance.

In the second case that the CAS tone generator's levels are referred to the BNC output, then the level specified will exactly match the signal level at the BNC output with a high impedance load. For example, setting a level of 0 dBV will cause an output level of 1 Vrms at the BNC output. Likewise a level of 0 dBm will correspond to an output level of 0.7746 Vrms (0 dBm = -2.22 dBV).

The BNC output can also be programmed to monitor the signals from the telephone interface. In this case, the output signal of the BNC connector will be 6 dB less than the signal level present at the tip and ring leads. So if a level of 0 dBm is present at the CPE terminals and the CPE represents a 600 ohm load the voltage level will be -2.22 dBV. Routing this signal to the BNC output connector will give it a level of -2.22 dBV - 6 dB = -8.22 dBV.

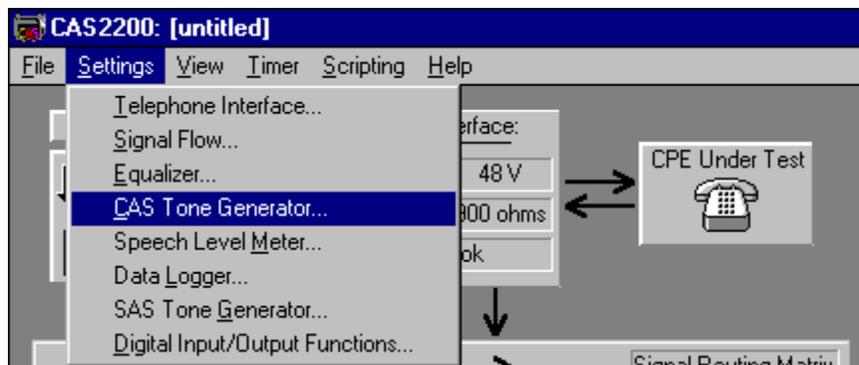


## ■ Section 8

## Program Reference

### *Menu Options*

This section lists each command available at the program's command line, along with its function.



The program menu bar contains the following headings.

- 1) FILE menu heading
- 2) SETTINGS menu heading
- 3) VIEW menu heading
- 4) TIMER menu heading
- 5) SCRIPTING menu heading
- 6) HELP menu heading

### **FILE Menu Heading**

**[LOAD CONFIGURATION]** This option will display a dialog window where the user can select a configuration file to be loaded into the program. The configuration files contain an exact snap shot of all of the settings and data stored in the program at the time the configuration file is saved.

**[SAVE AS CONFIGURATION]** This option will display a dialog window where the user can select a file name for saving the program's configuration. The resulting configuration file will contain a snap shot of all settings and data stored in the program. This configuration file can then be loaded into the program at any time to quickly return to the same state as when it was saved.

**[LOAD SCRIPT PROGRAM]** Selecting this option will display a dialog window where the user can select a script program file to load. Once a script program has been loaded, it can be edited by the script editor, or executed by pressing the start script button.

**[SAVE SCRIPT LOG]** The log file, that a script program generates, can be saved to a file on disk by selecting this menu option. A dialog window will be shown where the file name and its path can be specified. The script log file is saved in an ASCII format and can be read by virtually any other text editor.

**[PRINT CONFIGURATION]** Selecting this option sends a snapshot of all the program settings to the currently selected printer. The settings are defined as any parameter that can be accessed and changed under the SETTINGS menu item.

**[PRINT CAS PULSE ANALYSIS]** This option prints a report consisting of an analysis of the CAS pulse data that is currently stored in the program. The output is similar in form to the results presented by the CAS Pulse Analysis window, under the VIEW menu item.

**[PRINT CAS WAVEFORM]** This option outputs to the printer a snap-shot of the CAS Pulse Waveform window at its current position, zoom level, and display options.

**[PRINT CAS PERFORMANCE RESULTS]** This option sends, to the printer, a report containing all the information entered and calculated by the CAS Performance Calculator. The CAS Performance Calculator is displayed by selecting it from the VIEW menu item. The printed report contains both the Talkdown and Talkoff data entered, and miss rate/hit rate matrices respectively.

**[PRINTER SETUP]** If various printing devices are connected to the current system, this option allows the user to select the preferred printer, along with various printing options.

**[RESTORE DEFAULT SETTINGS]** This option resets the current program settings to their default value. Any data collected by the Data Logger is lost, along with any entries in the CAS Performance Calculator. Effectively, this command results in the same actions as quitting and restarting the program.

**[EXPORT PULSE DATA]** The current data collected by the Data Logger can be saved into a file compatible with most spreadsheet programs. The format is usually termed "text & commas" in which the entries in a row are separated by commas, and a carriage return marks the end of a row. The data saved consists of all the pulses received by the data logger. This includes a time stamp of its start time, duration of the pulse, and the type of pulse. The pulse types can be classified as:

- i) Talkdown: Where the pulse matches the criteria as defined in the Data Logger settings window, by occurring within the specified time window linked to the CAS tone generator.
- ii) Talkoff: Where the pulse matches the criteria as defined in the Data Logger settings window.

- iii) Rejected: Where the pulse did not occur in the Talkdown or Talkoff time windows, and thus was rejected by the analysis.
- iv) Suppressed: Where in the case of a Talkoff test being performed, the pulse started too closely to the previous pulse, and has been suppressed for the purposes of the Talkoff analysis.
- v) Rejected: Where the pulse did not meet the definition of a valid CPE CAS pulse, as defined in the Data Logger settings window.
- vi) Joined: Where the pulse is joined with the previous pulse to form what is classified as a valid CPE CAS pulse.

**[EXIT]** This option will shut down the telephone signal processing card, and end the program's operation. All data that has not been save at this time will be lost.

## SETTINGS Menu Heading

**[TELEPHONE INTERFACE]** This menu item will display the Telephone Interface settings window, where changes to the current setup of the telephone interface can be made. Any changes made are acted on when closing the window. Double clicking the mouse on the telephone interface panel on the main window has the same effect as selecting this menu item.

**[SIGNAL FLOW]** This menu item will display the Signal Flow settings window, where changes to the current setup of the signal routing matrix can be made. Any changes made are acted on when closing the window. Changes to the signal flow can also be initiated by clicking on the down arrow buttons contained within the signal routing matrix displayed on the main window.

**[EQUALIZER]** This menu item will display the Equalizer settings window, where changes to the current setup of the equalizer can be made. Any changes made are acted on when closing the window. Double clicking the mouse on the equalizer panel on the main window has the same effect as selecting this menu item.

**[CAS TONE GENERATOR]** This menu item will display the CAS Tone Generator settings window, where changes to the current setup of the tone generator can be made. Any changes made are acted on when closing the window. Double clicking the mouse on the tone generator panel on the main window has the same effect as selecting this menu item.

**[SPEECH LEVEL METER]** This menu item will display the Active Speech Level Meter settings window, where changes to the current setup of the meter can be made. Any changes made are acted on when closing the window. Double clicking the mouse on the speech meter panel on the main window has the same effect as selecting this menu item.

**[DATA LOGGER]** This menu item will display the CAS Pulse Data Logger settings window, where changes to the current setup of the data logger

can be made. Any changes made are acted on when closing the window. Double clicking the mouse on the data logger panel on the main window has the same effect as selecting this menu item.

**[SAS TONE GENERATOR]** This menu item will display the SAS Tone Generator settings window. Changes to any of the SAS tone parameters can be made, which are acted on when closing the window. This window can also be displayed by clicking on the "Change SAS Settings..." button on the CAS Tone Generator window.

**[DIGITAL INPUT/OUTPUT FUNCTIONS]** This menu item will display the Digital I/O Functions window. Any changes made are acted on when closing the window. Double clicking the mouse on the DB9 pin connector icon on the main window has the same effect as selecting this menu item.

## VIEW Menu Heading

**[CAS PULSE ANALYSIS]** This option displays the CAS Pulse Analysis window. The window displays the analysis results of the data captured by the Data Logger. A printed report similar to the information displayed in this window is generated by selecting the [PRINT CAS PULSE ANALYSIS] item from the [FILE] menu.

The short cut key for this command is: **F3**

**[CAS PULSE WAVEFORM]** This option displays the CAS Pulse Waveform window. The window displays in a graphical form the data collected by the Data Logger. The various pulses can be displayed according to their classification and examined for their waveshape and timing information.

The short cut key for this command is: **F4**

**[CAS PERFORMANCE CALCULATOR]** This option displays the CAS Performance Calculator window. This window can be used to enter the results of the Talkdown and Talkoff tests, and then calculate the miss and rate matrixes respectively. Also calculated are the three performance conditions, as specified by Bellcore, for both the Talkdown and Talkoff tests.

**[SCRIPT PROGRAM EDITOR]** This menu option will display the script program editor. If a script program has already been loaded, it will be displayed in the editor. Script programs can also be loaded or saved from within the editor window.

**[SCRIPT PROGRAM LOG]** If not already visible, this menu option will show the script program log file. The script program log is a window where the script program can direct output messages for the user to view and/or save to a file on disk.

## TIMER Menu Heading

**[START TIMER]** This option starts the timer displayed in the upper right corner of the main window. The timer is synchronized to the CAS tone generator and the Data Logger in order to generate the CAS tones and record the pulses returned by the CPE. This menu command performs the same function as clicking the START button located on the timer display. Note, that if the timer has been stopped automatically when all the CAS bursts have been sent, and the auto-stop feature has been enabled in the CAS Tone Generator settings window, then the START button will have no effect, until the timer has been reset.

The short cut key for this command is: **F5**

**[STOP TIMER]** This option stops the timer displayed in the upper right corner of the main window. The timer is synchronized to the CAS tone generator and the Data Logger, and as such, also freezes them. Selecting **[START TIMER]** will re-start the timer from the stopped state, along with the CAS tone generator and the Data Logger. This menu command performs the same function as clicking the STOP button located on the timer display.

The short cut key for this command is: **F6**

**[RESET TIMER]** This option resets the timer back to zero, as displayed in the upper right corner of the main window. Since the timer is closely coupled to the CAS tone generator and the Data Logger, they will also be reset. For the Data Logger, this means that all of the collected data will be lost. This command should be used after a test has been completed and the data analyzed, saved, or printed. After the timer is reset, the system is ready to start another test. This menu command performs the same function as clicking the RESET button located on the timer display.

The short cut key for this command is: **F7**

## SCRIPTING Menu Heading

The scripting menu is enabled only if a script program has been loaded or the script editor has been invoked. Otherwise, these menu commands will be disabled. A script program can be loaded by selecting the **[FILE] [LOAD SCRIPT PROGRAM]** menu command. To invoke the script editor select the **[VIEW] [SCRIPT PROGRAM EDITOR]** menu command, or press F2.

**[RUN SCRIPT PROGRAM]** This menu option will start execution of the currently loaded script program. Selecting this command has the same effect as clicking the mouse on the start script button. Once a program is running, it can be put into a pause mode or stopped altogether by selecting one of following two menu commands.

The shortcut key for this command is: **F8**

**[PAUSE SCRIPT PROGRAM]** This menu option will pause execution of any script program running. Selecting this command has the same effect as clicking the mouse on the pause script button. Once in the pause mode, pressing the start button will restart the script program. If the script program is paused during a START or WAIT command and then the start script button pressed, the script program will not wait until the previous START or WAIT command has completed. Rather it will immediately execute the next command in the script program.

The shortcut key for this command is: **F11**

**[STOP & RESET SCRIPT PROGRAM]** This menu option will stop and reset any script programs that are running or paused. This command has the same effect as clicking the mouse on the stop script button.

The shortcut key for this command is: **F12**

**[CLEAR SCRIPT LOG]** Selecting this menu option will erase the contents of the script log file.

## HELP Menu Heading

**[CONTENTS]** This menu option displays the help window table of contents. From the table of contents, specific areas of program help can be reached by clicking on the underlined topic heading.

The shortcut key for this command is: **F1**

**[SEARCH FOR HELP ON]** This menu option displays the Windows Help Search dialog box. By typing key words, the help program will display help topics that relate to the key word entered.

**[TECHNICAL SUPPORT]** This menu option shows how you can contact us for questions concerning this product.

**[ABOUT CAS2200]** This menu option displays the program version code, along with the revision and product codes for the telephone signal processing card. The base I/O address used to communicate with the telephone signal processing card is also displayed.

## Shortcut Keys

Pressing the shortcut keys are equivalent to selecting its associated menu option.

|                              |            |  |
|------------------------------|------------|--|
| View - CAS Pulse Analysis    | <b>F3</b>  | See also: <a href="#">Menu Options</a>   |
| View - CAS Pulse Waveform    | <b>F4</b>  | "  |
| View - Script Program Editor | <b>F2</b>  | "  |
| Help                         | <b>F1</b>  | "  |
| Start Timer                  | <b>F5</b>  | "  |
| Stop Timer                   | <b>F6</b>  | "  |
| Reset Timer                  | <b>F7</b>  | "  |
| Run Script Program           | <b>F8</b>  | "  |
| Pause Script Program         | <b>F11</b> | "  |
| Stop & Reset Script Program  | <b>F12</b> | "  |
| Set dBr Value                | <b>F9</b>  | This key, when pressed, sets the dBr reference value to the current reading of the RMS meter in the status bar. Note that there is no menu equivalent for this function. |

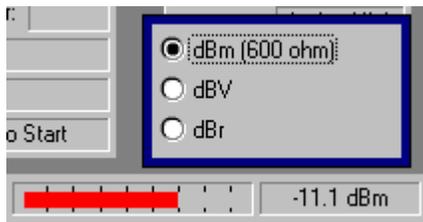
## The Status Bar

The status bar at the bottom of the main window has two main components to it. They are a general hint line, and a true RMS signal level meter. A sample display of the status bar is shown below.



The hint line will display various messages about the features and controls within the program. What is displayed on the hint line depends on the mouse position. Placing the mouse over certain panels, buttons, or text fields will display various messages on the hint line. When setting the many parameter values located in the settings windows, the hint line will indicate the allowable minimum and maximum value for any parameter the mouse is placed over.

The signal level meter, included as part of the status bar, continuously updates itself during the operation of the program. This meter measures the true RMS level of the signal present at the same measuring point as the Active Speech Level Meter. This can be changed between the signal on the Tip and Ring leads of the telephone interface, and the output of the programmable equalizer. To change this setting, select the [SETTINGS] [SIGNAL FLOW] command from the menu, or click the mouse on the down arrow button beside the Speech Meter panel. The voice band filter that can be enabled for the active speech level measurements, will also effect the RMS meter on the status bar. This filter will start to attenuate signals below 200 Hz and above 5.5 kHz, if enabled. The filter can be turned on or off in the Active Speech Level Meter settings window.



The graphical scale of the meter is fixed to represent dBm's with 10 dB steps, while the numeric readout can have different units displayed. To change the units of the numeric display, double click the mouse on the numeric display. This will cause a small pop-up window to appear, where new units can be selected. The units can be one of either, dBm measured into 600 ohms, dBV, or dBr. The reference value for the dBr is the same as for the Active Speech Level meter dBr units, and is set in the settings window for the Active Speech Level Meter.

The use of the dBr units can be very useful when setting up the relative levels for the Talkdown test. This would be accomplished by first setting the desired CAS tone level and measuring that level with the RMS meter. Once set, press F9, which takes the current RMS meter reading and uses that value as the dBr reference quantity. Now speech levels can be measured relative to the CAS tone level for the Talkdown tests. It is important to note, that the Talkdown test specifies the signal aspect of the "signal to speech ratio" as the power per tone. Since the RMS meter measures the level of the combined tones, which is 3 dB

higher (assuming uncorrelated CAS tones), a 3 dB correction must be applied to the reading when setting up the signal to speech ratio.



## ■ Appendix A

## Glossary of Terms

---

|                 |  |
|-----------------|--|
| <b>ACK Tone</b> | Acknowledge Tone - The term given to the signal generated by the CPE after it has detected a CAS tone. The Acknowledge tone is equivalent to the DTMF 'D' tone (low group frequency of 941 Hz and high group tone of 1633 Hz) for Type II CPE's, or DTMF 'A' tone (697 Hz & 1633 Hz) for Type III CPE's. |
| <b>AF</b>       | Activity Factor - A percentage quantity representing the relative time the measured signal exceeds the threshold margin as per Method B of Recommendation P.56 "Objective Measurement of Active Speech Level".   |
| <b>ASL</b>      | Active Speech Level - For the purposes of this program, ASL refers to the measurement of speech level according to Method B of Recommendation P.56 "Objective Measurement of Active Speech Level". This document is published in the CCITT Blue Book, Volume V Telephone Transmission Quality, 1989.     |
| <b>CAS Tone</b> | CPE Alerting Signal - A signal consisting of two tones that are sent to the CPE to alert it of an off-hook Caller ID message. The frequency of each tone is specified as 2130 Hz and 2750 Hz.  |
| <b>CID</b>      | Caller ID - Usually refers to a Type I Caller ID transmission, where the data is sent with the CPE being in the on-hook state.   |
| <b>CIDCW</b>    | Caller ID with Call Waiting - Generally refers to a Type II Caller ID transmission, where the data is sent with the CPE being in the off-hook state.   |
| <b>CPE</b>      | Customer Premises Equipment - A device connected to the telephone network that resides at the customers location.  |
| <b>SAS Tone</b> | Subscriber Alerting Signal - A tone sent to the CPE in the off-hook state to alert the user that another caller is trying to call the user. This tone precedes the CAS tone in a Type II Caller ID transmission.   |
| <b>SNR</b>      | Signal-to-Noise Ratio - A numerical value that represents the ratio of the power of a specific signal, and the power of the noise present at the measuring point. Usually specified in logarithmic values (dB).  |

|                      |  |
|----------------------|--|
| <b>SPCS</b>          | Stored Program Control System - Generally referred to a telephone switch used in a central office which links the CPE to the telephone network.                            |
| <b>Talkdown Test</b> | For the purposes of this program, a test that attempts to quantify the number of times a CAS tone will be missed by a Type II CPE, when in the presence of speech signals. |
| <b>Talkoff Test</b>  | For the purposes of this program, a test that attempts to quantify the number of times a CPE's CAS tone detector will incorrectly interpret speech signals as a CAS tone.  |
| <b>Type I</b>        | Caller ID transmission occurring while the CPE is in the on-hook state.  |
| <b>Type II</b>       | Caller ID transmission occurring while the CPE is in the off-hook state. Also referred to CIDCW.   |

## ■ Appendix B Script Command Summary

---

### Commands

|             |  |
|-------------|--|
| START       |  |
| PAUSE       |  |
| END         |  |
| PARAMETER   | (parameter name) (operator) (value)  |
| SAVEFILE    | LOG (file name)  |
| SAVEFILE    | CONFIG (file name)   |
| PRINTSCREEN | "text string" [(parameter name)] [TIME] [NEWLINE]<br>[RESULTS] [SIGNALREC] |
| PRINTLOG    | "text string" [(parameter name)] [TIME] [NEWLINE]<br>[RESULTS] [SIGNALREC] |
| WAIT        | (time delay in seconds)  |
| SET         | EQ_REFERENCE (level)   |
| SET         | EQ_LEVEL (level)   |
| CLEAR       | LOG  |
| CLEAR       | MESSAGE  |
| CLEAR       | CALCULATOR   |
| CLEAR       | SIGNALREC  |
| RECORD      | TALKDOWN (line number) (speech level)                                      |
| RECORD      | TALKOFF_NEAR (line number) (speech level)                                  |
| RECORD      | TALKOFF_FAR (line number) (speech level)                                   |
| RECORD      | SIGNALREC  |
| CAV2        | PORT (com port # 1 to 4)   |
| CAV2        | (INIT/PAUSE/STOP/TRK+/TRK-)  |
| CAV2        | FORMAT (IR/ControlA1) (CD1/CD2)  |
| CAV2        | PLAY (optional CD #)   |

### Parameters

| <i>Script Name</i> | <i>Range of Values</i>      |
|--------------------|-----------------------------|
| LINE_VOLTAGE       | 20 to 52 Volts              |
| LINE_CURRENT       | 20 to 40 mA                 |
| LINE_POLARITY      | Normal, Reversed            |
| LINE_IMPEDANCE     | 600_ohms, 900_ohms, Complex |
| CAS_FREQA          | 50 to 10000 Hz              |
| CAS_FREQB          | 50 to 10000 Hz              |
| CAS_LEVELA         | -70 to 0 dBm                |
| CAS_LEVELB         | -70 to 0 dBm                |
| CAS_UNITS          | dBm, dBV                    |
| CAS_TIMING         | Burst, Continuous           |
| CAS_DURATION       | 1 to 1,000,000 msec         |
| CAS_BURSTS         | 1 to 100,000                |
| CAS_INTERVAL       | 1 to 1,000,000 msec         |
| CAS_SHUTDOWN       | Enabled, Disabled           |
| SAS_FREQA          | 50 to 10000 Hz              |
| SAS_FREQB          | 50 to 10000 Hz              |
| SAS_LEVELA         | -70 to 0 dBm                |
| SAS_LEVELB         | -70 to 0 dBm                |
| SAS_UNITS          | dBm, dBV                    |

|                  |   |
|------------------|---|
| SAS_ENABLE_A     | Yes, No                                 |
| SAS_ENABLE_B     | Yes, No                                 |
| SAS_BURSTS       | 0 to 4                                  |
| SAS_DURATION_1   | 0 to 1000 msec                          |
| SAS_DURATION_2   | 0 to 1000 msec                          |
| SAS_DURATION_3   | 0 to 1000 msec                          |
| SAS_DURATION_4   | 0 to 1000 msec                          |
| SAS_INTERVAL_1   | 0 to 1000 msec                          |
| SAS_INTERVAL_2   | 0 to 1000 msec                          |
| SAS_INTERVAL_3   | 0 to 1000 msec                          |
| SAS_INTERVAL_4   | 0 to 1000 msec                          |
| EQ_FLAT          | Yes, No                                 |
| EQ_GAIN_1K       | -60 to 20 dB                            |
| EQ_S1_FREQ       | 50 to 10000 Hz                          |
| EQ_S2_FREQ       | 50 to 10000 Hz                          |
| EQ_S1_GAIN       | -12 to 12 dB                            |
| EQ_S2_GAIN       | -12 to 12 dB                            |
| EQ_S1_Q          | 0.1 to 5.0                              |
| EQ_S2_Q          | 0.1 to 5.0                              |
| ASL_UNITS        | dBm, dBV, dBr, Vrms                     |
| ASL_DBR          | 0 to 10 Vrms                            |
| ASL_MEASTIME     | 1 to 1,000,000 seconds                  |
| ASL_MODE         | Continuous, SingleShot, Manual          |
| ASL_SAMPLERATE   | 200 to 2000 samples per second          |
| ASL_SMOOTHING    | 0.001 to 1.0 seconds                    |
| ASL_HANGOVER     | 0.001 to 1.0 seconds                    |
| ASL_MARGIN       | 0 to 40 dB                              |
| ASL_FILTER       | Enabled, Disabled                       |
| CP_POLARITY      | Active_High, Active_Low                 |
| CP_VALID_MIN     | 1 to 20,000 msec                        |
| CP_VALID_MAX     | 1 to 20,000 msec                        |
| CP_VALID_DROP    | 0 to 20,000 msec                        |
| CP_TD_DELAY      | 0 to 20,000 msec                        |
| CP_TD_DELAY_TOL  | 0 to 20,000 msec                        |
| CP_TO_RJT_AFTER  | 0 to 20,000 msec                        |
| CP_TO_RJT_BEFORE | 0 to 20,000 msec                        |
| CP_TO_SUPPRESS   | 0 to 20,000 msec                        |
| CP_DEG_ACTIVE    | Yes, No                                 |
| CP_DEG_TIME      | 0 to 100 msec                           |
| CP_MEAS_TYPE     | TD/TO, TO                               |
| STM_UNITS        | dBm, dBV, dBr                           |
| ROUT_BNC_OUT     | Tip/Ring, Equalizer, CAS, Equalizer&CAS |
| ROUT_TEL_OUT     | Equalizer, CAS, Equalizer&CAS           |
| ROUT_AS_LIN      | Tip/Ring, Equalize                      |
| DIO_OUTA_POL     | High, Low                               |
| DIO_OUTA_SAS     | Yes, No                                 |
| DIO_OUTA_CAS     | Yes, No                                 |
| DIO_OUTB_POL     | High, Low                               |
| DIO_OUTB_SAS     | Yes, No                                 |
| DIO_OUTB_CAS     | Yes, No                                 |
| DIO_INA_HALT     | Yes, No                                 |
| DIO_INA_POL      | High, Low                               |

## ■ Appendix C Script Language Errors

---

The following is a list of script program errors:

**Program Line contains unmatched quotation marks.**

Quotation marks are used to delimit text strings used with various commands. As such quotation marks must always appear in sets of two.

**Program Line contains a command name that is unknown.**

The first word of a non-comment line (does not start with \* or ;) is the command word. This error indicates that the script interpreter does not recognize the first word as a command word. See appendix B for a summary of the script command words. The script interpreter is insensitive whether the commands are in upper or lower case.

**Program line syntax is incorrect for the specified command.**

The command has been recognized, but the line's syntax is incorrect. This is usually due to too many or too few operands on the program line. Remember that spaces are required between operands and that anything following a ";" character is treated as a comment.

**The specified parameter name is unknown. Please check its spelling.**

The parameter name, which is specified after the PARAMETER command is unknown to the script interpreter. Possible causes include incorrect spelling or the lack of spaces between the parameter name and the following operator.

**The specified operator is unknown.**

For the commands that require an operator, this error occurs if the specified operator is either incorrectly spelt, or not valid for the specific command.

**The value specified in the command is not a numeric quantity.**

Various commands require numeric values as part of the command line. If the value given is not numeric, then this error occurs. This error usually occurs if the value given has a non-numeric character in it.

**The value specified in the command is not recognized and is invalid.**

This error can occur if the value specified is outside its permissible range or if specifying a non-numeric parameter value that does not match any of the possible values.

**The file type specified is unknown to this command.**

This error occurs if the file type specified with the SAVEFILE command is not either a configuration or script log file.

**The type of data to record to the CAS Performance Calculator is unknown.**

When using the RECORD command, the type of data to record must be given as either Talkdown, Talkoff\_Near, Talkoff\_Far, or SignalRec.

**The keyword used with the command is unknown.**

Various commands use a single or string of keywords following the command word. This error will occur if any of the keywords are unrecognized to the script interpreter.

**The value specified is outside its valid range.**

If a numeric value specified is outside its valid range, this error will be displayed. The value given must either be increased in value or decreased in value depending on what limit it exceeded.

**The SET EQ\_LEVEL command can not be used before the equalizer reference level is set.**

This error will occur if the SET EQ\_LEVEL command is used to change the value of the equalizer gain before a reference level has been set with the SET EQ\_REFERENCE command.

## ■ Appendix D Modifying the Complex Impedance

The telephone line impedance that is presented to the CPE can be set to ,under program control, to one of three possible values. These are:

- i) 600 ohms (real)
- ii) 900 ohms (real)
- iii) Complex impedance ZR

Where the complex impedance ZR is modeled by the following schematic diagram:

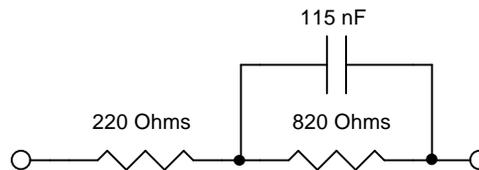


Figure 2. ZR Impedance

However, it is possible to change various components on the TSPC in order to present other custom or user defined impedance's. Figure 3 represents a network of components present on the TSPC that determine the value of the complex line impedance. The line impedance presented to the CPE will be 0.1 times the impedance of the network shown in figure 3. As such, the default complex impedance of ZR can be changed to other values simply by changing values of components R1, R2, C1, C2, and C3.

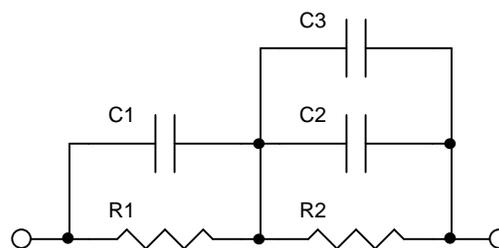


Figure 3. Complex Impedance Network

The default values for the components, in order to present a ZR impedance, are:

- R1 = 2200 ohms
- R2 = 8200 ohms
- C1 = open (not used)
- C2 = 10.0 nF
- C3 = 1.50 nF

The position of these components on the TSPC is shown in figure 4.

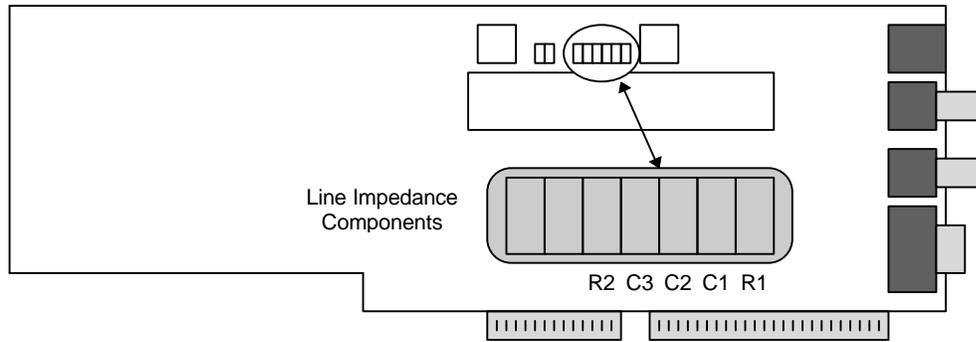


Figure 4. Complex Line Impedance Components

If the component values are to be changed, make sure that standard ESD precautions are taken during the removal of the existing components and soldering of the new components. Of course, the PC should be turned off and the TSPC removed from the PC before any changes are made.

## ■ Appendix E

## General Specifications

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### TSPC

#### CAS Tone Generator

|                     |                              |
|---------------------|------------------------------|
| Output Level        | -70 dBm to +6 dBm +/- 0.3 dB |
| Frequency Range     | 50 Hz to 10 kHz              |
| Flatness            | +/- 0.3 dB                   |
| THD+N               | 0.09% C-message              |
| Harmonic Distortion | > 65 dBc                     |
| Frequency Accuracy  | 0.015%                       |

#### Level Meter

|                 |                            |
|-----------------|----------------------------|
| Level Accuracy  | +/- 0.2 dB                 |
| Frequency Range | 10 Hz to 10 kHz            |
| Flatness        | 100 Hz to 5 kHz +/- 0.2 dB |
| Maximum Input   | +14 dBm                    |
| Residual Noise  | <-70 dBmC                  |

#### Telephone Line

|                  |                        |
|------------------|------------------------|
| Output Impedance | 600 or 900 ohms +/- 2% |
| Output Impedance | complex ZR +/- 3%      |
| Loop Voltage     | 20 - 52 Volts +/- 1V   |
| Loop Current     | 20 - 40 mA +/- 10%     |

#### CAS Pulse Data Logger Input (pin 9 DB9)

|                             |                    |
|-----------------------------|--------------------|
| Max Valid Logic Low Input   | 1.35 V             |
| Min Valid Logic High Input  | 3.15 V             |
| Max Allowable Voltage Range | -1.5 V to 6.5 V    |
| Input Impedance             | 10 kohms to ground |

### CAS2200

#### CAS Pulse Data Logger

|                          |                          |
|--------------------------|--------------------------|
| Maximum Number Of Pulses | 100,000 (200,000 edges)  |
| Maximum Test Length      | 298.26 hours (12.4 days) |
| Time Stamp Accuracy      | +/- 1 msec               |



## ■ Appendix F

## Technical Support

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If you encounter problems while using the CAS2200 program, please contact us so that we can provide assistance. You may reach us in any one of the following manners:

Email: techsupport@adventinst.com

In North America:

Tel: (604) 944-4298

Fax: (604) 944-7488

Mail: Advent Instruments Inc.  
111 - 1515 Broadway Street  
Port Coquitlam, BC, V3C 6M2  
Canada

In Asia:

Tel: (852) 8108-1338

Fax: (852) 2900-9338

Mail: Advent Instruments (Asia) Limited  
Room 3E04, HKPC Building,  
78 Tat Chee Avenue,  
Kowloon, Hong Kong

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Note: Please include the program version, TSPC product code, revision code, option code, and TSPC base I/O address as given in the [HELP] [ABOUT CAS2200] window in your correspondence.

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