User Manual

Models 2571/2572

250 MS/s Single / Dual
Arbitrary Waveform Generators

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Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuits points.

Before operation this instrument:

1. Ensure the instrument is configured to operate on the voltage at the power source. See Installation Section.

2. Ensure the proper fuse is in place for the power source to operate.

3. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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Getting Started

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What's in This Chapter

This chapter contains a general description of the Model 2572 Waveform Generator and an overall functional description of the instrument. It also describes the front and rear panel connectors and indicators.

Introduction

Model 2572 is a dual-channel, Universal Waveform Generator. It is a high performance waveform generator that combines two separate and powerful channels in one small package. Supplied free with the instrument is ArbConnection software utility, which is used for controlling the 2572 and for generating, editing and downloading waveforms from a remote computer. The following highlights the 2572 and ArbConnection features.

2572 Feature Highlights

- Dual output configuration with Independent waveform control
- Tight phase offset control between channels (1 point resolution)
- 16-bit vertical resolution
- 16-bit LVDS level digital pattern output
- 2M memory depth for each channel
- 250MS/s sample clock frequency
- 100MHz output bandwidth
- 1ppm clock stability
- Extremely low phase noise carrier
- FM, AM, FSK, PSK Frequency hops and more
- Built-in standard waveforms
- Separate sequence generators for each channel
- Multiple instrument synchronization with tight phase control
- Remote calibration without removing case covers
- GPIB, USB and Ethernet interfaces

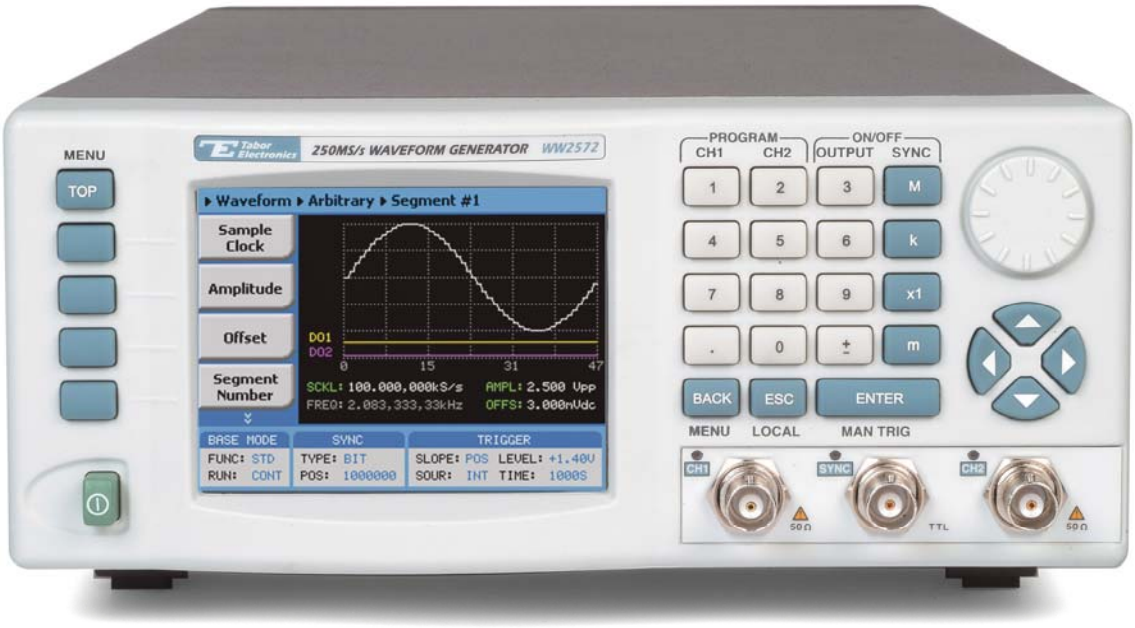

Figure 1-1, Model 2572

ArbConnection Feature Highlights

- Four powerful tools in one software package: Complete instrument control, Waveform, pulse and FM composers
- Detailed virtual front panels control all 2572 functions and modes
- Wave composer generates, edits and downloads complex waveforms
- FM wave composer generates and downloads complex modulating signals
- Easy, on-screen generation of complex pulses using the pulse composer
- Equation editor generates waveforms from equations
- SCPI command and response editor simulates ATE operation
- Translates waveform coordinates from ASCII and other formats
- Simplifies generation of complex sequences

Various screens of the ArbConnection program are shown in Figures 1-2 through 1-5.

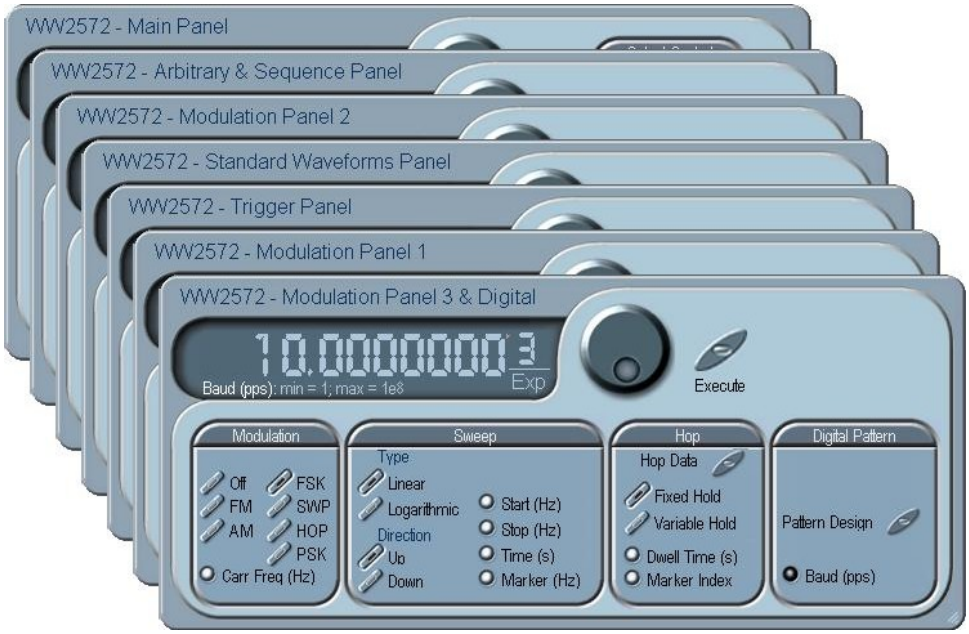

Figure 1-2, ArbConnection – The Control Panels

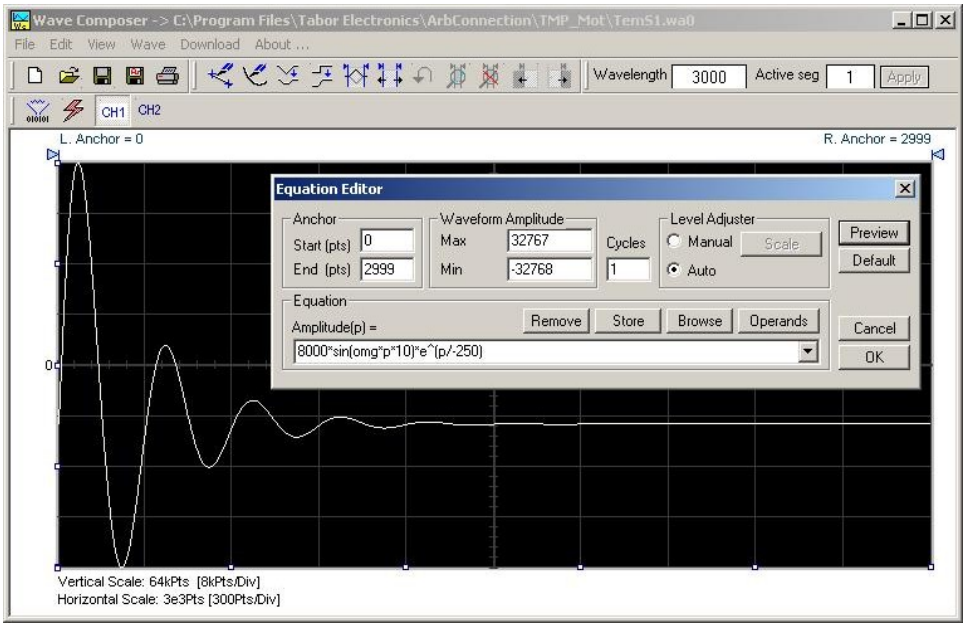

Figure 1-3, ArbConnection – The Wave Composer

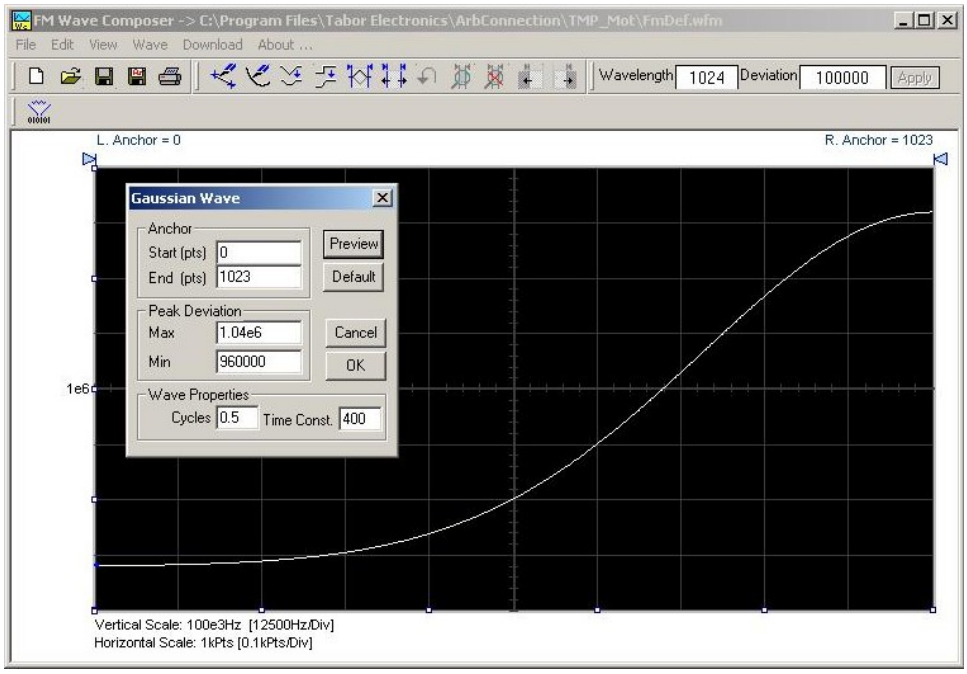

Figure 1-4, ArbConnection – The FM Wave Composer

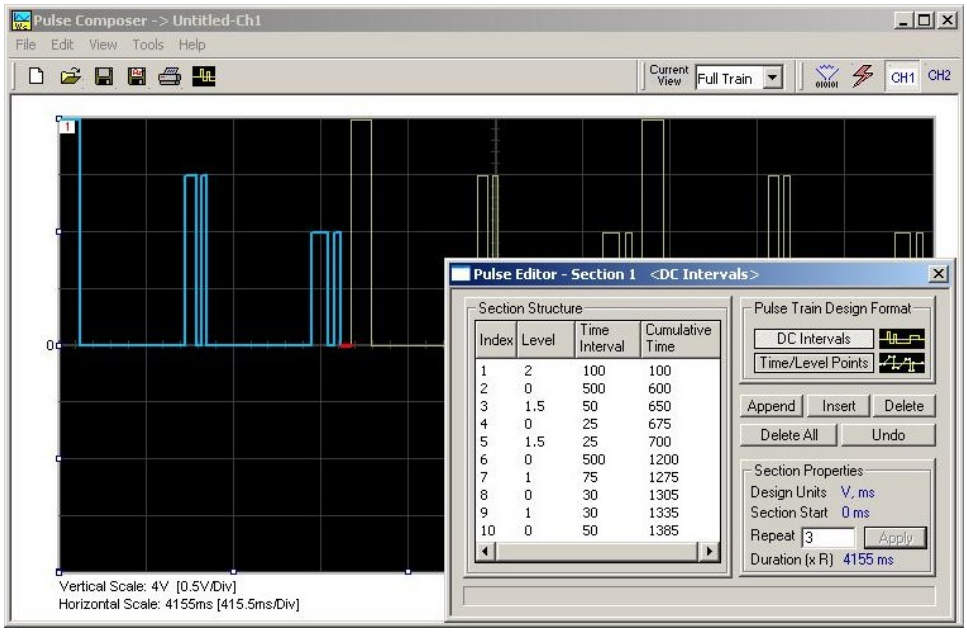

Figure 1-5, ArbConnection – The Pulse Composer

Introduction

A detailed functional description is given following the general description of the features, functions, and options available with the Model 2572.

The Model 2572 is a bench-top, 2U high, half rack wide, dual-channel synthesized Waveform Generator, a high performance instrument that provides multiple and powerful functions in one small package. The 2572 generates an array of standard waveforms from a built-in waveform library as well as arbitrary, sequenced and modulated waveforms. It can also generate 16-bit digital patterns in parallel to its channel 1 output. The generator outputs 16-bit waveforms from two channels at up to 250MS/s with different waveform properties. The unique design provides increased dynamic range and lower “noise floor” making it ideal for the generation of multi-tone signals and I&Q modulation.

Direct Digital Synthesis (DDS) technology, utilized in the design of the 2572, allows flexibility in usage of features like FM, FSK, PSK, sweep and frequency hopping. For example, the FM feature can be stimulated by an internal source, or arbitrary FM waveform allowing the production of customized chirp signals. The included ArbConnection software can be used to breadboard custom frequency modulation profiles graphically.

Sample rates up to 250MS/s are available with memory size up to 2Meg. Channels 1 and 2 are both synchronized to the same sampling clock however, each channel can output a different waveform shape and length.

Based entirely on digital design, the 2572 has no analog functions resident in its hardware circuits and therefore, data has to be downloaded to the instrument for it to start generating waveforms. The instrument can compute and generate a number of standard functions such as sine, square, triangle and others however, complex waveforms must be converted to an appropriate format and downloaded to the 2572 as waveform coordinates. Dedicated waveform memory stores waveforms in memory segments and allows playback of a selected waveform, when required. The waveforms are backed up by batteries or can be stored in a flash memory for use at a later time.

Frequency accuracy of the output waveform is determined by the clock reference. Using the internal TCXO the reference oscillator provides 1ppm accuracy and stability over time and temperature. If higher accuracy and/or stability are required, one may connect an external reference oscillator to the rear panel input and use this input as the reference for the 2572. Frequency may be is programmed with up to 14 digits, so using an external reference is recommended, if you intend to utilize the full resolution provided by the instrument.

Output amplitude for each of the channels may be programmed separately from 32mV to 32V peak-to-peak into an open circuit, and 16mV to 32V into 50Ω. Amplitude and offsets are programmed independently with 4 digits of resolution as long as the +8V and the -8V rail limitations (double into open circuit) are not exceeded.

Besides its normal continuous mode, the Model 2572 responds to a variety of trigger sources. The output waveform may be gated, triggered, or may generate a counted burst of waveforms. A built-in re-trigger generator with a programmable period can be used as a replacement of an external trigger source. Triggers can be delayed to a specific interval by a built-in trigger delay generator that has a range of 200ns to over 20 seconds.

The arbitrary waveform memory is comprised of a bank of 16-bit words. Each word represents a point on the horizontal waveform scale. Each word has a horizontal address that can range from 0 to 2Meg and a vertical address that can range from -32767 to +32768 (16 bits). Using a high speed clocking circuit, the digital contents of the arbitrary waveform memory is extracted and routed to the Digital to Analog Converter (DAC). The DAC converts the digital data to an analog signal, and the output amplifier completes the task by amplifying or attenuating the signal at the output connector.

There is no need to use the complete memory bank every time an arbitrary waveform is generated. Waveform memory can be divided into up to many smaller segments and different waveforms can be loaded into each segment. The various segments may then be loaded into a sequence table to generate long and complex waveforms. The sequence table can link and loop up to multiple segments in user defined order. Each channel has its own sequence generator.

The Tabor Model 2572 can be operated from either GPIB, USB, or LAN interfaces. The product is supplied with IVI.COM driver and ArbConnection software. ArbConnection simulates an array of mechanical front panels with the necessary push buttons, displays and dials to operate the Model 2572 from a remote interface as if it is a bench-top instrument. ArbConnection also allows on-screen creation and editing of complex waveforms and patterns to drive the 2572 various outputs.

It is highly recommended that the user become familiar with the 2572 front panel, its basic features, functions and programming concepts as described in this and the following chapters.

Options

Several options are available for the 2572. These are listed below:

1. Multi-instrument synchronization. This option provides synchronization capability between two or more instruments. The Multi-instrument synchronization option is not field installable and therefore, it must be ordered with the product. Compare the option number below with the number printed on your instrument to check if the multi-instrument synchronization option is installed in your equipment.
2. 2 Meg Waveform Memory. This option increases the memory capacity from 1 Meg to 2 Meg. The 2 Meg waveform memory

option is not field installable and therefore, it must be ordered with the product. Compare the option number below with the number printed on your instrument to check if the 2 Meg waveform memory option is installed in your equipment.

Manual Changes

Technical corrections to this manual (if any) are listed in the back of this manual on an enclosed MANUAL CHANGES sheet.

Safety Considerations

The Model 2572 has been manufactured according to international safety standards. The instrument meets EN61010-1 and UL1244 standards for safety of commercial electronic measuring and test equipment for instruments with an exposed metal chassis that is directly connected to earth via the chassis power supply cable.

WARNING

Do not remove instrument covers when operating the instrument or when the power cord is connected to the mains.

Any adjustment, maintenance and repair of an opened, powered-on instrument should be avoided as much as possible, but when necessary, should be carried out only by a skilled person who is aware of the hazard involved.

Supplied Accessories

The instrument is supplied with a CD that includes the User Manual, ArbConnection and IVI engine and driver.

The instrument is supplied with a power cord and a CD which contains ArbConnection, manual, IVI driver and supporting files. USB, LAN and synchronization cables and a service manual are available upon request.

Specifications

Instrument specifications are listed in Appendix A. These specifications are the performance standards or limits against which the instrument is tested. Specifications apply under the following conditions: output terminated into 50Ω after 30 minutes of warm up time, and within a temperature range of 20°C to 30°C. Specifications outside this range are degraded by 0.1% per ^{o}C.

Functional Description

A detailed functional description is given in the following paragraphs. The description is divided into logical groups: Front panel input and output connectors, rear panel input and output connectors, operating modes, output type, output state, synchronization, and front panel indicators.

Front Panel Connectors and Indicators

The Model 2572 has 3 BNC connectors on its front panel: two main outputs and one SYNC output. Each connector on the front panel has an LED associated with it, indicating when the output is active (LED on), or when inactive (LED off). The function of each of the front panel connectors is described in the following paragraphs.

Main Output - Channels 1 and 2

The main output connectors generate fixed (standard) waveforms to 100MHz, user (arbitrary), sequenced and modulated waveforms. The arbitrary and sequenced waveforms are sampled with sampling clock rate to 250MS/s. CW from the modulated function is programmable to 100NHz. Output source impedance is 50Ω, hence the cable connected to this output should be terminated with 50Ω load resistance. If the output is connected to a different load resistance, determine the actual amplitude from the following equation:

$$V_{out} = 2V_{prog}\left(\frac{50\Omega}{50\Omega + R_L}\right)$$

The output amplitude is doubled when the output impedance is above roughly 10kΩ.

SYNC Output

The SYNC output generates a single or multiple TTL pulses for synchronizing other instruments (i.e., an oscilloscope) to the output waveform. The SYNC signal always appears at a fixed point relative to the waveform. The location of the pulse sync along the waveform is programmable. The SYNC output is used as marker output when the 2572 is programmed to one of the modulation functions. The source of the sync can be programmed to source from channel 1 or channel 2.

Front Panel Controls

Front panel controls and keys are grouped in logical order to provide efficient and quick access to instrument functions and parameters. Refer to Figure 1-6 throughout the following description to learn the purpose and effect of each front panel control.

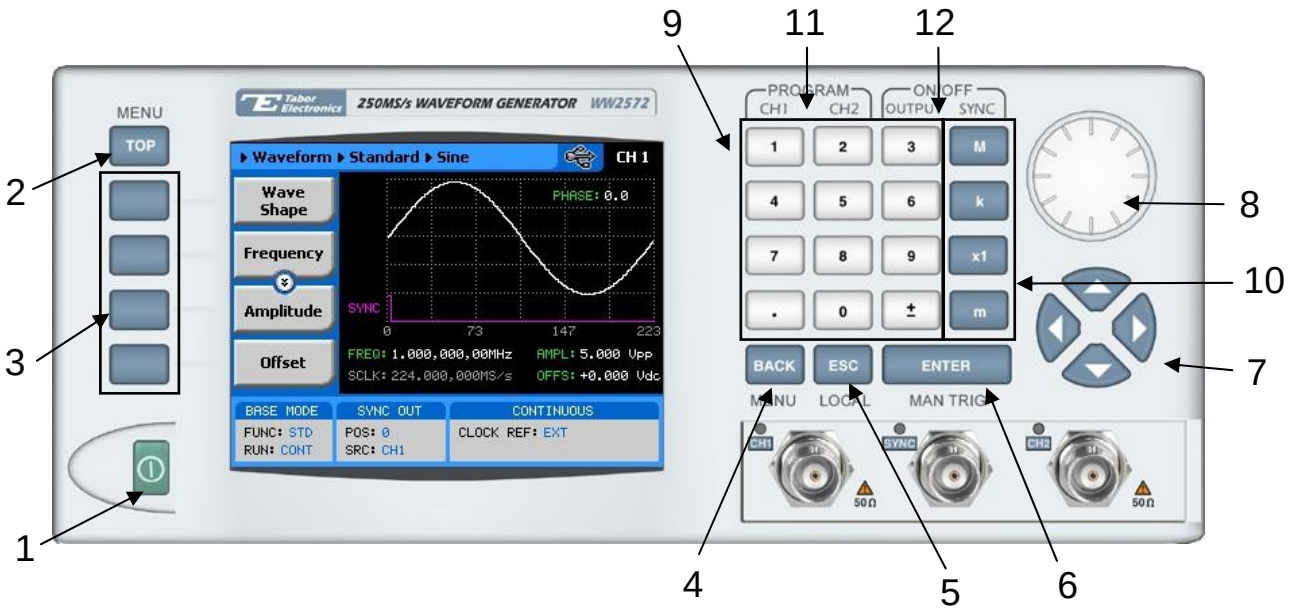

Figure 1-6, 2572 Front Panel Controls

Note

The index in the following paragraphs point to the numbered arrows in Figure 1-6.

1. *Power Switch* – Toggles 2572 power ON and OFF
2. *Menu Top* – Selects the root menu. This button is disabled during parameter editing
3. *Menu Soft Keys* – Soft keys have two functions:
   1) Selects output function shape or operating mode,
   2) Selects parameter to be audited

   These buttons are disabled during parameter editing
4. *Menu Back* – Backs up one menu position. This button is disabled during parameter editing
5. *Cancel (Local)* – Has two functions:
   1) When in edit mode, cancels edit operation and restore last value
   2) When operating the 2572 from a remote interface, none of the front panel buttons are active. The Local button moves control back from remote to front panel buttons
6. *Enter (Man Trig)* – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the

parameters. Pressing Enter selects the parameter for edit. After the parameter has been modified, the Enter button locks in the new variable and releases the buttons for other operations

2) When the 2572 is placed in “Triggered” run mode, the Man Trig button can be used to manually trigger the 2572

7. Cursor *UP, Down, Left and Right* – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters
   2) When parameter is selected for editing, cursor buttons right or left move the cursor accordingly. Cursor buttons up or down modify parameter value accordingly
8. *Dial* – Has similar functionality as the cursor UP and Down keys
9. Numeral *keypad* – These keys are used for modifying an edited parameter value
10. *Parameter Suffixes (M, k, x1 and m)* – These keys are used to place suffix at the end of the parameter. They are also used for terminating an edit operation
11. Program CH1, CH2 – Use Program CH1 to modify the screen to display channel 1 parameters. Use Program CH2 to modify the screen to display channel 2 parameters. These keys can be used only when the 2572 is not in edit mode
12. *ON/OFF Output, Sync* – These keys can be used only when the 2572 is not in edit mode. The Output ON/OFF toggles output waveform, at the output connector, ON and OFF. The Sync ON/OFF toggles the sync waveform, at the SYNC output connector, ON and OFF

Rear Panel Input & Output Connectors

The 2572 has a number of connectors on its rear panel. These connectors are described below. Figure 1-7 shows rear panel plugs, indicators, connectors and other parts.

TRIG IN

In general, the trigger input is used for stimulating output waveforms at the main output connector(s). The trigger input is inactive when the generator is in continuous operating mode. When placed in trigger, gated or burst mode, the trigger input is made active and waits for the right condition to trigger the instrument. The trigger input is edge sensitive, i.e., it senses transitions from high to low or from low to high.

Trigger level and edge sensitivity are programmable for the trigger input. For example, if your trigger signal rides on a dc level, you can offset the trigger level to the same level as your trigger signal, thus assuring correct threshold for the trigger signal. The trigger level is adjustable from -5V to +5V.

The trigger input is common to both channels. Therefore, if the 2572 is placed in trigger mode, both channels share the same mode and the trigger input causes both channels to start generating waveforms at the same time. Phase relationship between channels is tightly controlled in trigger mode and therefore, you should expect both channels to start generating waves with exactly the same start phase. Further control of leading edge offset between channels is also provided.

The same input is also used in FSK mode, where the output shifts between two frequencies – carrier and shifted frequencies. The output generates carrier frequency when the input signal is false (below trigger level) and shifted frequency when the input is true (above trigger level).

Figure 1-7, 2572 Rear Panel

REF IN

This SMB connector accepts 10MHz, TTL level reference signal. The external reference input is available for those applications requiring better accuracy and stability than what is provided by the 2572. The reference input is active only after selecting the external reference source mode.

16-bit Digital Out

This 68 pin, high density SCSI-2 connector outputs 16 bits, LVDS (Low Voltage Differential Signal) logic level. The output to this connector is routed from channel 1 only and can be turned on and off from the front panel and from an interface bus. The digital

patterns are derived from lines that are connected to the DAC and therefore, when the digital pattern output is enabled, the 16 bits that drive the DAC are routed to this connector in parallel. The digital patterns can be designed in two ways: 1) Downloaded to the 2572 from an external utility as an arbitrary waveform and 2) ArbConnection lets you write the patterns to a simple table (hex words) and then this table can be loaded to the instrument through a remote interface. An example how to create digital patterns from ArbConnection is shown in Figure 1-8.

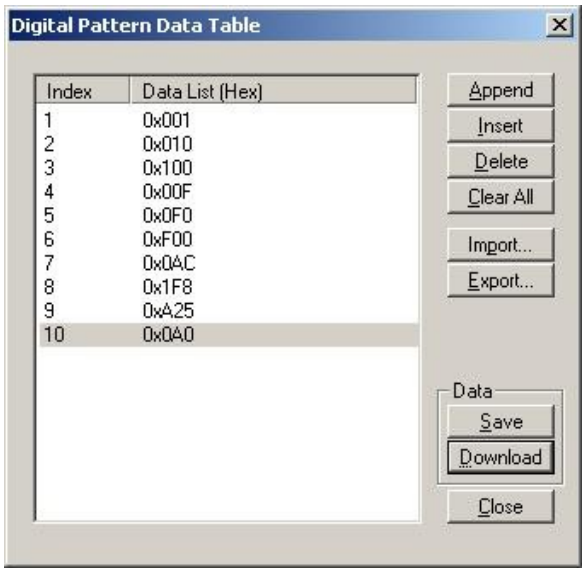

Figure 1-8, Digital Pattern Data Table Example

LAN

This RG45 connector accepts standard Ethernet cable. Correct setting of the IP address is required to avoid conflicts with other instruments or equipment on the network. Information how to change IP address and load instrument drivers to the computer is provided in the Installation chapter of this manual.

USB

This connector accepts standard USB-1 cable. The connection to the host computer is automatic and does not require any address setting from within the 2572. The first time the 2572 is connected to the computer, it will request the driver file. This file is located on the CD which is supplied with the instrument. Information how to install the driver is provided in the Installation chapter of this manual.

GPIB

This 24-pin connector accepts standard GPIB cable. The GPIB address is configured using the front panel utility menu. The 2572 conforms to the IEEE-488.2 standard. Programming protocol is SCPI version 1993.0. GPIB cables are available separately from your Tabor dealer.

AC LINE

This 3-prong AC LINE connector accepts ac line voltage. The 2572 senses the line voltage and sets the appropriate range automatically. Therefore, the traditional line voltage selector is not available on the rear panel. To avoid potentially hazardous situations, always connect the center pin to mains ground using the line cord that is supplied with the instrument.

AC FUSE

The AC fuse protects the 2572 from excessive current. Always replace the fuse with the exact type and rating as printed on the rear panel. If the fuse blows again after replacement, we recommend that you refer your instrument immediately to the nearest Tabor service center.

X-INST SYNC

The X_INST SYNC (Multi-Instrument Synchronization) group of is comprised of four SMB connectors, designated as SCLK OUT/IN, and COUPLE OUT/IN. Theses connectors are installed in your instrument only if you ordered the multi-instrument synchronization option. Besides the rear panel connectors, you should receive a few other cables. Information how to connect and synchronize between two or more instrument is given later in this manual.

SCLK OUT

This SMB connector outputs the programmed sample clock frequency. Output level is 400mVp-p, terminated into 50Ω. Note that correct termination is necessary for this output otherwise you will not see this signal at all. This output generates sample clock waveforms continuously, regardless if the 2572 is operating in continuous, trigger, or gated modes.

The sample clock output is used for multiple-instruments synchronization. In master mode, connect this output with an SMB to SMB cable to the SCLK IN on the adjacent slave instrument. You may also use this output to synchronize other components in your system to one master clock.

SCLK IN

This SMB connector accepts 300mVp-p to 1Vp-p into 50Ω level signal. Normally, this input is disabled. When enabled, the clock at this input replaces the internal clock generator and the 2572 generates waveforms having the external sample clock rate.

When synchronizing you 2572 as a slave unit, an SMB to SMB cable is connected from the Master SCLK OUT connector to this SCLK IN connector.

COUPLE OUT

This SMB connector outputs the coupling signals to the slave unit. Output level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this output to the COUPLE IN connector on the slave unit.

COUPLE IN

This SMB connector accepts coupling signals from the master unit. Input level is LVPECL, terminated into 50Ω to 1.3V. For multi-instrument synchronization, connect this input to the COUPLE OUT connector on the master unit.

Run Modes

The 2572 can be programmed to operate in one of four run modes: Continuous, Triggered, Gated and counted burst. There are two other modes that can operate in conjunction with the basic four run modes, these are: Delayed Trigger and Re-Trigger, The various run mode options are described below. Summary of run modes and optional trigger sources are listed in Table 1-1, identifying legal run modes and listing possible setting conflicts.

Continuous

In normal continuous mode, the selected waveform is generated continuously at the selected frequency, amplitude and offset. Only when operated from a remote interface, the output can be toggled on and off using a trigger command.

Triggered

In triggered mode, the Model 2572 circuits are armed to generate one output waveform. The trigger circuit is sensitive to transitions at the trigger input. Select between positive or negative transitions to trigger the instrument. You may also program the trigger level to the desired threshold level. When triggered, the generator outputs one waveform cycle and remains idle at the last point of the waveform. The Model 2572 can be triggered from a number of sources: 1) Rear panel connector, designated as TRIG IN, 2) Front panel button marked as MAN TRIG (second function to the Enter button) and 3) bus commands that are applied to the instrument from any interface, LAN, USB or GPIB. Description of the various trigger source options is given in the following paragraphs.

The trigger signal, whether it comes from an external source or from an interface command, is routed through some electrical circuits. These circuits cause some small delay known as system delay. System delay cannot be eliminated completely. The system delay is a factor that must be considered when applying a trigger signal. It defines the time that will lapse from a valid trigger edge or software command to the instant that the output reacts.

Burst

The burst mode is an extension of the triggered mode where the Model 2572 can be programmed to output a pre-determined number of waveforms. Note that the burst run mode cannot be applied to sequenced waveform because the two functions share the same circuit and therefore, whenever counted burst is selected for sequenced waveforms, the generator will issue a setting conflict error.

Gated

In gated mode, the 2572 generates output waveforms between two gating signal. Only hardware triggers can be used to open and close the gate. The gate opens on the first trigger transition and closes on the second transition. Trigger level and trigger slope are programmable. Trigger delay and re-trigger do not apply to the gated run mode.

Delayed Trigger

The delayed trigger function is exactly the same as the trigger mode except a programmable delay inhibits signal output for a pre-determined period after a valid trigger. The delay time defines the time that will lapse from a valid trigger (hardware or software) to output. The delay is programmable in steps of 20ns from 200ns to 21 seconds. The trigger delay can be applied to all run modes: continuous, trigger and burst.

Re-Trigger

The Re-trigger run mode requires only one trigger command to start a sequence of triggered or counted burst of signals. The re-trigger delay defines the time that will lapse from the end of a signal to the start of the next signal. Re-trigger delay is programmable in steps of 20ns from 200ns to 21 seconds.

Table 1-1, Run Modes and Trigger Source Options Summary

Run Mode	***Trigger Option***	***Status***
Continuous	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger* (*) Output signal is toggled on and off using interface triggers	*Disabled* *Active*(*) *Disabled* *Active* *Disabled*
Triggered	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Active* *Active* *Active*
Counted Burst	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger* (*) Not in conjunction with Re-Trigger (**) Not in conjunction with Mixed	*Active* *Active* *Active(*)* *Active* *Active(**)*
Gated	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*

Trigger Source

The Model 2572 can be triggered from a number of sources: 1) Rear panel connector, designated as TRIG IN; 2) Front panel button marked as MAN TRIG (second function to the Enter button); and 3) bus commands that are applied to the instrument from any interface, LAN, USB or GPIB. Description of the various trigger source options is given in the following paragraphs. Summary of trigger options and optional trigger sources are listed in Table 1-2, identifying legal operating modes and listing possible setting conflicts.

External

When selecting the External trigger source, the rear panel TRIG IN connector becomes active and every legal signal that is applied to this input is causing the 2572 to trigger. Alternately, if an external signal is not available, the front panel MAN TRIG button may also be used to trigger the instrument. When EXT is selected, triggers commands from a remote interface are ignored. EXT is the default trigger source.

Bus

When selecting the Bus as a trigger source, the rear panel TRIG IN connector and the front panel MAN TRIG button are disabled and only trigger commands from a remote interface are accepted by the instrument. Make sure that the appropriate trigger source is selected if you mix remote and local operation.

Mixed

Mixed trigger advance source defines special trigger behavior where the 2572 expects to first receive remote bus trigger and only then accept hardware triggers. The first time that the 2572 is placed in this mode, all EXT (rear and front panel hardware) triggers are ignored until a remote *TRG is issued. Following the first software trigger, subsequent triggers from the remote interface (software) are ignored and only rear and front panel triggers are accepted by the instrument.

Table 1-2, Trigger Source Options Summary

Trigger Option	***Source/ Description***	***Status***
External	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button*	*Disabled* *Active* *Active*
Bus	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button*	*Active* *Disabled* *Disabled*
Mixed	*Interface trigger commands* *Rear panel TRIG IN connector* *Front panel MAN TRIG button* (*) First trigger from BUS only, subsequent triggers from EXT only	*Active*(*) *Active*(*) *Active*(*)

Output Type

The Model 2572 can output five types of waveforms: Standard, Arbitrary, Sequenced and Modulated waveforms. The instrument can also generate Digital Patterns with or without any of the basic output types. The various output types are described in the following paragraphs.

Standard Waveforms

The 2572 can generate an array of standard waveforms. The waveforms are generated mathematically from standard equations and converted to waveform coordinates that are downloaded to the working memory. Unlike analog function generators that use

electrical circuits to produce the wave shapes, the 2572 must compute the waveform coordinates every time a new function is selected or every time the parameters of the function change.

The 2572 can produce 11 standard waveforms: sine, triangle, square, ramp and pulse, sinc, gaussian and exponential pulses, dc and Pseudo-random noise. Some of the waveforms parameters can be modified such as start phase for sine and triangle, duty cycle for square, rise and fall times for pulses etc. The standard waveforms are the most commonly used wave shapes and therefore were collected to a library of standard waveforms that can be used without the need to compute and download waveform coordinates.

The repetition rate of the standard waveforms is given in units of Hz. Both channels share the same clock source and therefore, when a standard function shape is selected for re-play, the frequency of the waveforms is the same at the output connectors of both channels. Also, when standard waveforms are used, both channels share the same run mode, as well as delayed trigger and re-trigger settings. On the other hand, each channel can have a unique set of waveform, amplitude, offset and waveform parameters without interference between the channels.

When both channels are programmed for standard waveforms, the skew between the channels is minimal. Refer to Appendix A for the skew between channels specification.

Figure 1-9 shows typical front panel for the standard waveform display and Figure 1-10 shows typical standard waveform panel as displayed when ArbConnection is used for remote programming.

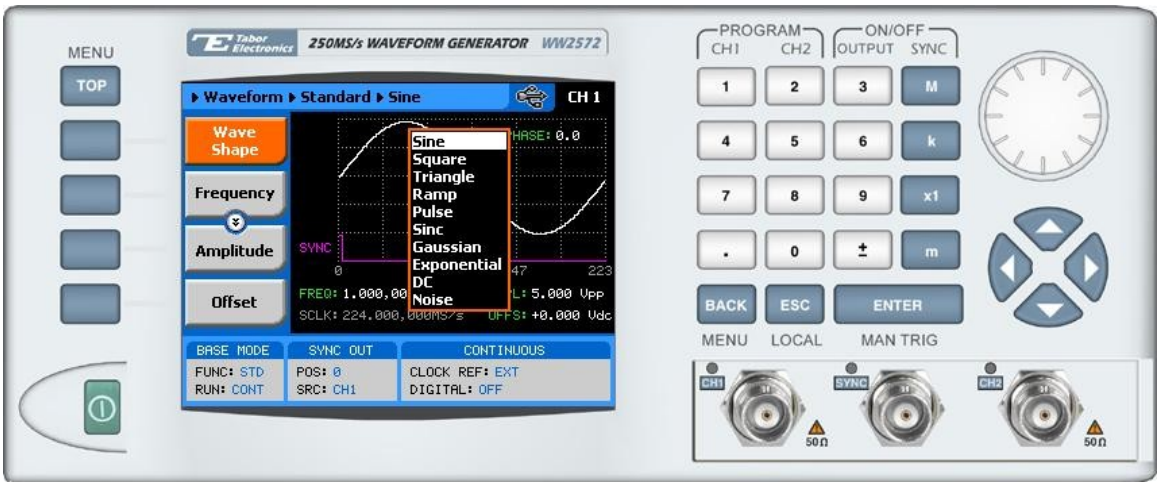

Figure 1-9, Typical 2572 Standard Waveforms Display

Figure 1-10, ArbConnection Example - Typical Standard Waveforms Panel

Arbitrary Waveforms

One of the main functions of the Racal model 2572 is generating real-life waveforms. These are normally not sinewaves and squares but user specific waveforms. Generating such waveforms require external utilities such as MatLAB or even spreadsheets but having the program alone is not enough for the 2572; Once the waveform is computed and defined, it must be converted to a format which the instrument can accept and coordinates downloaded to the generator memory for re-play.

Arbitrary waveforms are stored as digital XY coordinates in a special memory, normally referred to as working memory. Each coordinate is referred to as waveform point, or waveform sample. The waveform is better defined if it has many waveform points. For example, with only 8 point, sine waveform will hardly resemble the shape of a sinewave and will look more like an up-down staircase, but with 100 points, the same sine waveform will look almost perfect.

The final shape of the waveform is produced by a DAC (Digital to Analog Converter) The waveform samples are clocked to the DAC at a rate defined by the sample clock frequency. The output of the DAC converts the digital data to analog levels and passes on the signal to the output amplifier. The shape of the function is more or less the same as it comes out of the DAC except it could be amplified or attenuated, depending on the require amplitude level.

The size of the working memory is limited to the way the hardware was designed. The 2572 has 1Meg points available as standard (2 Meg point optional) to build one or more waveforms. There is no need to use the entire memory for only one waveform; The memory can be divided into smaller segments loaded with different waveforms while the instrument can be programmed to output one segment at a time.

The Model 2572 has separate arbitrary waveform memories for each channel and each channel can be loaded with different waveforms. Channels are not limited by the number of segments and by the shape of the waveforms.

Figure 1-11 shows typical front panel for the arbitrary waveform display and Figure 1-12 shows typical ArbConnection panel as displayed when ArbConnection is used for remote programming.

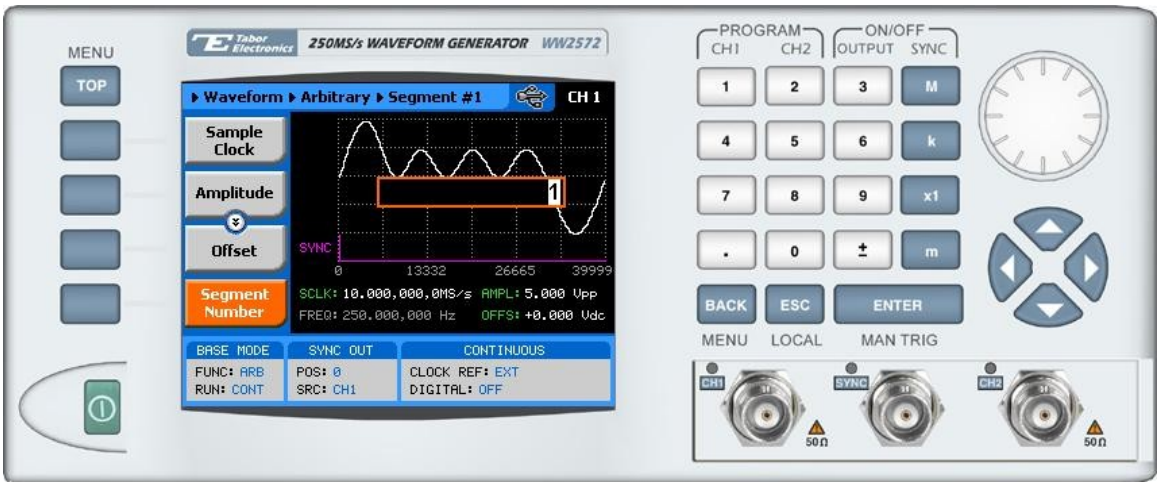

Figure 1-11, Typical 2572 Arbitrary Waveforms Display

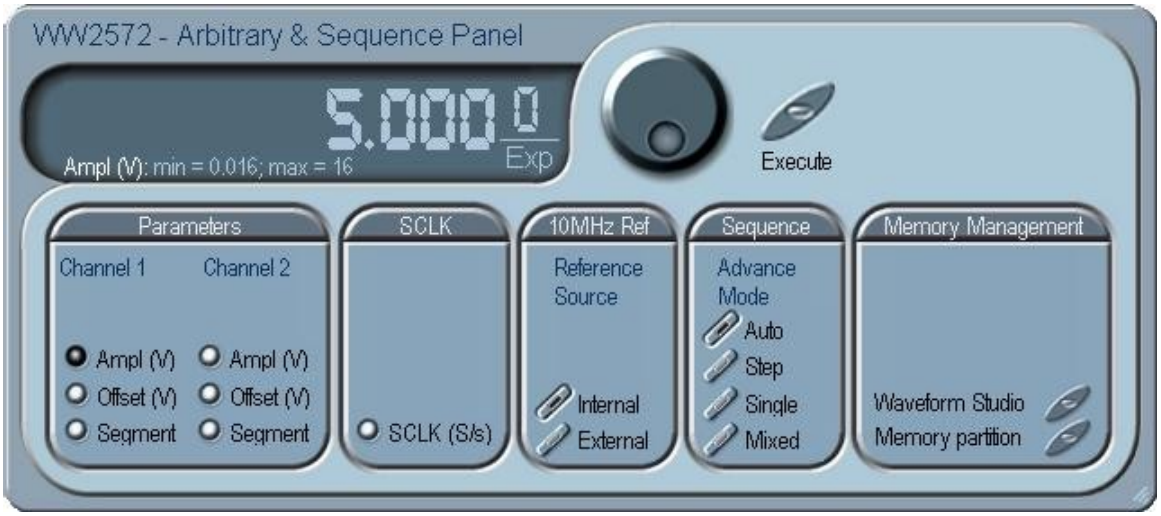

Figure 1-12, ArbConnection Example – Typical Arbitrary & Sequenced Waveforms Panel

Sequenced Waveforms

The sequence generator is a very powerful tool that lets you link and loop segments in any way you desire. The Model 2572 has two separate sequence generators – one for each channel. Each sequence generator is dedicated to its own channel.

The sequence circuit is useful for generating long waveforms with repeated sections. The repeated waveform has to be programmed once and the repeater will loop on this segment as many times as selected. When in sequenced mode, there is no time gap between linked or looped segments. Sequence tables must be loaded to the generator before sequenced waveforms can be generated. The data for the sequence table is first prepared on an external platform, then downloaded to the generator.

As a simple example of a sequenced waveform, look at Figures 1-13 through 1-15. The waveforms shown in these figures were placed in memory segments 1, 2 and 3, respectively. The sequence generator takes these three waveforms links and loops them in a predefined order to generate the waveform shown in Figure 1-16.

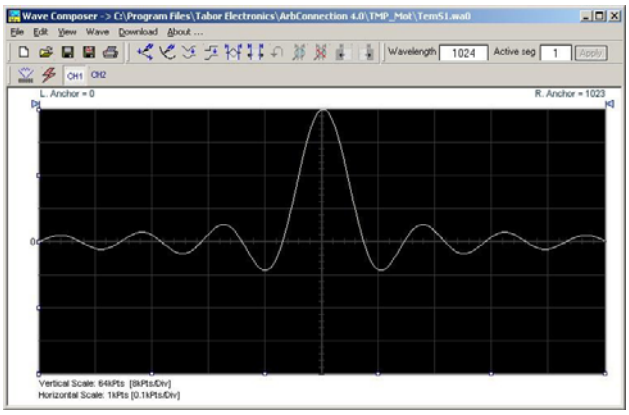

Figure 1-13, Segment 1 Waveform – Sinc

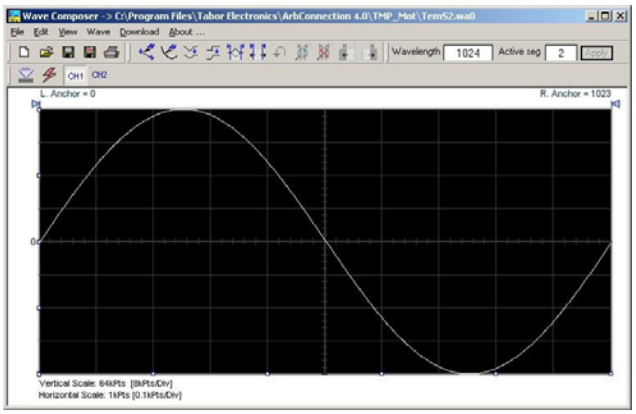

Figure 1-14, Segment 2 Waveform - Sine

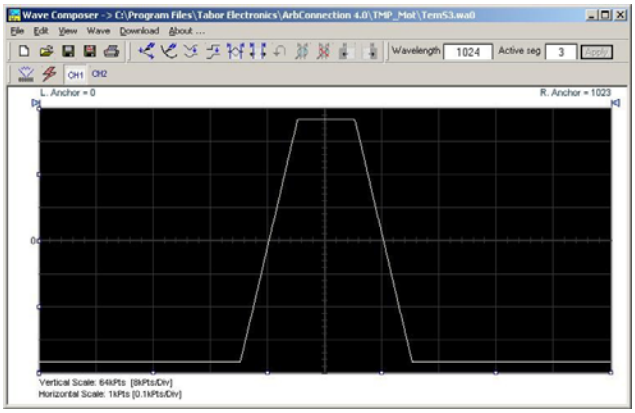

Figure 1-15, Segment 3 Waveform - Pulse

The following sequence was made of segment 2 repeated twice, segment 1 repeated four times, and segment 3 repeated two times.

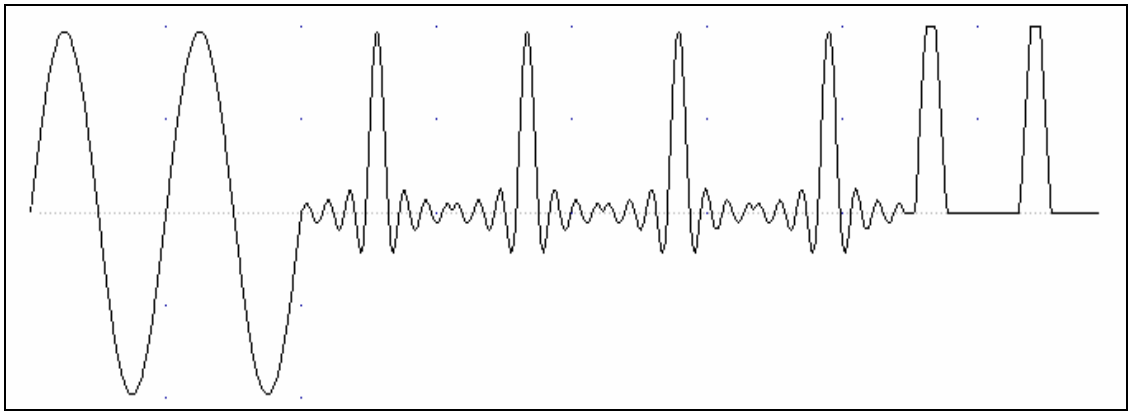

Figure 1-16, Sequenced Waveform

Figure 1-17 shows typical front panel entry for the above sequence and Figure 1-18 shows the waveform studio as is typically being used for building and generating the sequence table from remote.

Figure 1-17, Typical Front Panel Programming of a Sequence Table

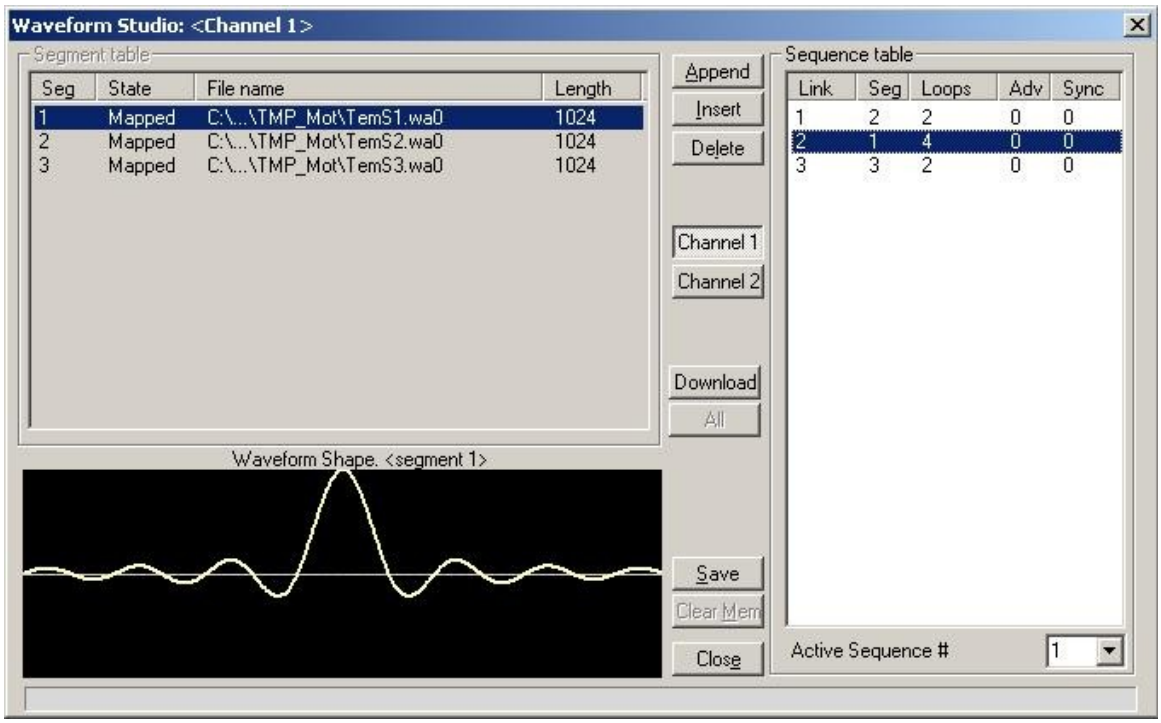
Waveform Studio: <Channel 1>
Segment table
Seg State File name Length
1 Mapped C:\...\TMP_Mot\TemS1.wa0 1024
2 Mapped C:\...\TMP_Mot\TemS2.wa0 1024
3 Mapped C:\...\TMP_Mot\TemS3.wa0 1024
Waveform Shape. <segment 1>
Append
Insert
Delete
Channel 1
Channel 2
Download
All
Save
Clear Mem
Close
Sequence table
Link Seg Loops Adv Sync
1 2 2 0 0
2 1 4 0 0
3 3 2 0 0
Active Sequence # 1

Figure 1-18, ArbConnection Sequence Table Studio

Sequence Advance Modes

As shown above, sequences are built as simple table of which define link, segment, loops and advance bits. When placed in sequenced mode, the output is changing from link to link in an ascending order. The term Sequence Advance Modes defines what is causing the instrument to step from link to link. There are four basic advance modes that can be selected for the sequence mode: Auto, Stepped, ingle and Mixed. These modes are explained in the following paragraphs. Also note that there are some limitations that

should be observed while using the various sequenced advance modes. These limitations are summarized in Table 1-3.

Auto Auto advance sequence is the mode that you want to use when the sequence is expected to run continuously from the first step in the table to the last, and then resume from the first step. There are no interrupts between steps and between the last and the first step of the sequence. When auto mode is selected, the 2572 can also be placed in triggered and gated run modes. The various run mode options that are available for the auto advance mode are summarized in Table 1-3.

Stepped Stepped advance sequence is the mode that you want to use when the sequence is expected to advance on triggers only. The trigger source is selectable from either external or bus commands. The step will run continuously until a trigger advances the sequence to the next step. When the last step is reached, the next trigger will advance to the first step in the sequence and this sequence will repeat itself as long as triggers are applied to the generator. Note that the generator operates in continuous run mode; Trying to place it in trigger or gated run mode will issue a settings conflict error message. The various run mode options that are available for the step advance mode are summarized in Table 1-3.

Single Single sequence advance is the mode that you want to use when the sequence is expected to advance on triggers only. The trigger source is selectable from either external or bus commands. The step will run once until a trigger advances the sequence to the next step. When the last step is reached, the next trigger will advance to the first step in the sequence and this sequence will repeat itself as long as triggers are applied to the generator. Note that the generator operates in triggered run mode; Trying to place it in continuous or gated run mode will issue a settings conflict error message. The various run mode options that are available for the single advance mode are summarized in Table 1-3.

Mixed Mixed advance sequence is the mode that you want to use when some steps of the sequence are expected to run as if in Auto advance mode while some steps that are flagged should wait and operate as if in Stepped sequence mode. The base run mode of the instrument is continuous. The sequence will step through segments of the table that are marked as continuous and will stop and wait for a trigger on sequence steps that are marked with a special flag. Note that the generator operates in continuous run mode; Trying to place it in trigger or gated run mode will issue a settings conflict error message. The various run mode options that are available for the step advance mode are summarized in Table 1-3.

Table 1-3, Sequence Advance and Trigger Options Summary

Run Mode	**Run Mode**	**Status**	**Trigger Option**	**Status**
Auto	*Continuous* *Triggered* *Gated* *Burst*	*Active* *Active* *Active* *Disabled*	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*
Step	*Continuous* *Triggered* *Gated* *Burst*	*Active* *Disabled* *Disabled* *Disabled*	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*
Single	*Continuous* *Triggered* *Gated* *Burst*	*Disabled* *Active* *Disabled* *Disabled*	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*
Mixed	*Continuous* *Triggered* *Gated* *Burst*	*Active* *Disabled* *Disabled* *Disabled*	*External* *Bus* *Mixed* *Delayed Trigger* *Re-Trigger*	*Active* *Active* *Disabled* *Active* *Disabled*

Modulated Waveforms

Using the latest DDS technology, the 2572 is capable of producing an array of modulation which places this generator in-line with stand-alone, high performance modulation generators. The 2572 can produce: Sweep, FSK, Frequency Hops, AM, FM and the most advanced modulation function - Arbitrary FM. It can also generate 3D modulation where amplitude, frequency and phase are swept as a function of time. When modulation is used from one channel, the other channel is 90° phase shifted, specifically convenient for applications such as I & Q modulation. Description of the various modulation functions is given below.

Figure 1-19 shows typical front panel entry for modulated waveform and Figure 1-20 shows an ArbConnection example of a modulation panel.

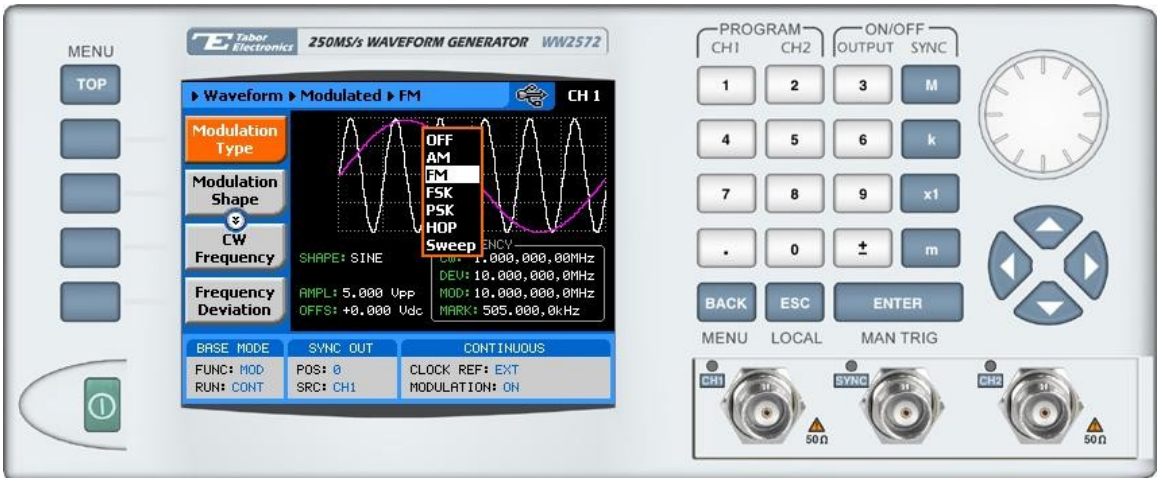

Figure 1-19, Typical Modulated waveform Display

Figure 1-20, ArbConnection Example - Modulation panel 1

Modulation Off

The Modulation Off is a special case of the modulation function where the output is not modulated but generates carrier waveform (CW) frequency only. CW is the sine waveform that is being modulated. When placed in Modulation Off, the sine waveform is generated from the main outputs continuously. The advantage of this mode is that sine waveforms can be generated from a few 100µHz to 100MHz. The disadvantage of this mode is that the modulation off operates in continuous mode only. The CW parameter does not change when you switch from one modulation function to another.

AM

The AM function enables amplitude modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as envelop waveform. The envelop waveform can be selected from sine, triangle square or ramp shapes. There are other parameters that control how the CW is amplitude modulated, these are:

Envelop Frequency – defines the frequency of the modulating waveform. The modulating waveform is programmed from 10mHz to 100kHz.

Modulation depth – programmed in units of % and defines the depth of the modulating envelop. Modulation depth is programmed from 0% to 100%.

FM

The FM function allows frequency modulation of a carrier waveform (CW). The carrier waveform is sinewave and it is being modulated by an internal waveform, normally referred to as modulating waveform. The modulating waveform can be selected from sine, triangle or square waveforms. Carrier waveforms are programmed with 10 digits resolution from 10mHz to 100MHz. There are other parameters that control how the frequencies are hoped, these are:

Modulation Frequency – defines the frequency of the modulating waveform. The modulating waveform is programmed from 10mHz to 100kHz.

Peak Deviation – defines the range of frequencies of which the modulation will go through. The peak value is symmetrical around the value of the carrier waveform frequency.

Marker Position – programs a unique frequency where the SYNC output generates a pulse to mark this frequency.

Arbitrary FM

The Arbitrary FM function is very similar to the standard FM function except the modulating waveform is user programmable. The arbitrary waveform to modulate the carrier is generated using the FM composer panel from ArbConnection. It also can be generated by the user using other utilities. The arbitrary FM waveform has an array size of 20000 frequency points. If you look at the following FM composer example, you'll see that the vertical scale is made of frequency points, The change in frequency will follow the curve shown in the FM composer panel.

The frequency of the arbitrary FM wave is computed in the same way as a standard arbitrary waveform.

Frequency = Sample Clock / Number of waveform points

In the example shown in Figure 21 below, the frequency of the waveform will change from 960kHz to 1.04MHz. The sample clock for the modulating waveform can be programmed from 1S/s to

2.5MS/s while the carrier waveform frequency can be selected from 10mHz to 100MHz. Note that the CW wave is always sine waveform however, the modulating waveform can take any shape defined by the FM composer panel.

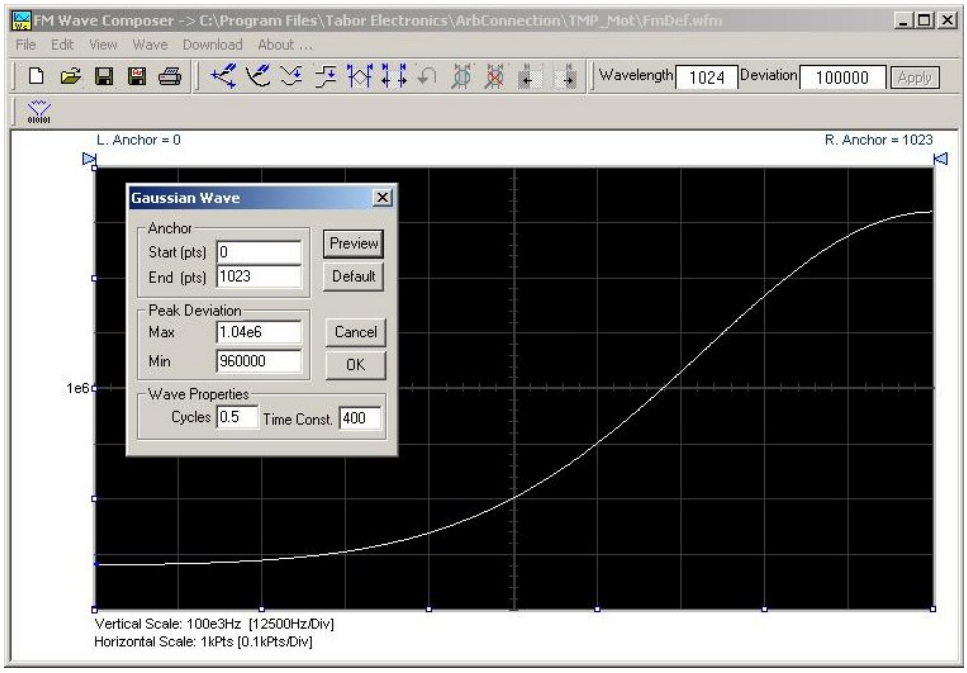

Figure 1-21, ArbConnection Example - Arbitrary FM Composer Panel

FSK

FSK (Frequency Shift keying) modulation allows frequency hops between two pre-programmed frequencies: Carrier Waveform Frequency and Shifted Frequency. Note that CW is sinewave only. The CW and shifted frequencies can be programmed with 10 digits throughout the entire frequency range of the instrument, from 100μHz to 100MHz. There are other parameters that control how the frequencies are shifted, these are:

Baud – defines the rate of which the frequencies are toggled. The rate can be programmed within the range of 1bits/s to 10Mbits/s.

FSK Data – defines the sequence of which the frequencies will toggle. FSK data is stored in an external table. The length of the table is limited from 1 to 4096 toggle sequences.

PSK

PSK (Phase Shift keying) modulation allows phase hops between two pre-programmed phases: The initial phase can be programmed from 0 to 360°, the shifted phase can also be programmed through the same range. There are other parameters that control how the frequencies are shifted, these are:

Baud – defines the rate of which the frequencies are toggled. The rate can be programmed within the range of 1bits/s to 10Mbits/s.

PSK Data – defines the sequence of which the phase will toggle.PSK data is stored in an external table. The length of the table is limited from 1 to 4096 toggle sequences.

Frequency Hop

Frequency hop modulation allows frequency hops throughout the entire range of the instrument. The base frequency is always CW (sine waveform). Frequencies are programmed with 9 digits resolution from 100μHz to 100MHz. There are other parameters that control how the frequencies are hoped, these are:

Hop Sequence – defined using a hop table. The hop table is a list of “0”s and “1”s which determine the sequence. “0” defines CW and “1” defines shifted frequency. The hop table is limited to 4096 frequency hops.

Dwell Time – defines the lapse of time for a hop step. There are two options: fixed or variable. Using the variable time option, each step can be programmed to have a unique dwell time value. Dwell time is programmable in steps of 20ns from 200ns to 21 seconds.

Sweep

Sweep modulation allows carrier waveform (CW) to sweep from one frequency, defined by the sweep start parameter to another frequency, defined by the sweep stop parameter. Note that CW is sinewave only. The start and stop frequencies can be programmed with 10 digits throughout the entire frequency range of the instrument, from 10mHz to 100MHz. There are other parameters that control how the waveforms are swept, these are:

Sweep Time – defines the time that will lapse from sweep start to sweep stop frequencies. Sweep time is programmable from 1.4μs to 40s.

Sweep Step – selects between linear or logarithmic steps.

Sweep Direction – defines if the carrier will sweep from start to stop or from stop to start frequencies.

Marker Position – programs a unique frequency where the SYNC output generates a pulse to mark this frequency.

Modulation Run Modes

Run modes are shared by all waveforms that are generated by the 2572, including modulation. However, when in modulation function, where run mode options take different meaning. When in triggered, burst or gated run modes, the 2572 outputs sine carrier waveform (CW) until a valid trigger is received and then reacts to the trigger. If triggers cease to stimulate the input, the output resumes generating CW frequency only. Carrier frequency is common to all modulation functions and can be programmed from the modulation menus.

Digital Patterns

Digital patterns are generated through a special rear-panel connector. The output is generated from channel 1 only. Patterns are user programmable using 16-bit hex words and are stored in pattern tables, as shown in figure 1-8. The digital pattern output is activated from the front panel, or using remote programming commands.

Output State

The main outputs can be turned on or off. The internal circuit is disconnected from the output connector by a mechanical switch (relay). This feature is useful for connecting the main outputs to an analog bus. For safety reasons, when power is first applied to the chassis, the main output is always off.

Programming the Model 2572

The Model 2572 has no controls on its front panel. Instrument functions, parameters, and modes can only be accessed through VXIbus commands. There are a number of ways to “talk” to the instrument. They all require that an appropriate software driver be installed in the Resource Manager (slot 0). The rest is a matter of practice and knowledge of the language in use. There are other system considerations like address selection that have to be settled before programming the instrument. These topics are discussed in later chapters.

Low level programming of the Model 2572 is done using SCPI commands. Programming aspects are covered in Chapters 4.

High level drivers like IVI drivers are beyond the scope of this manual. Contact your Tabor representative for more information about high level drivers for the Model 2572.

Chapter 2
Configuring the Instrument

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Installation Overview

This chapter contains information and instructions necessary to prepare the Model 2572 for operation. Details are provided for initial inspection, grounding safety requirements, repackaging instructions for storage or shipment, installation information and Ethernet address configuration.

Unpacking and Initial Inspection

Unpacking and handling of the generator requires normal precautions and procedures applicable to handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to determine that the shipment is complete.

Safety Precautions

The following safety precautions should be observed before using this product. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

CAUTION

This product is intended for use by qualified persons who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on power cables, connector jacks, or test fixtures. The American National Standard Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak or 60 VDC are present.

WARNING

For maximum safety, do not touch the product, test cables, or any other instrument parts while power is applied to the circuit under test. ALWAYS remove power from the entire test system before connecting cables or jumpers, installing or removing cards from the computer, or making internal changes such as changing the module address.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always keep your hands dry while handling the instrument.

When using test fixtures, keep the lid closed while power is applied to the device under test. Carefully read the Safety Precautions instructions that are supplied with your test fixtures.

Before performing any maintenance, disconnect the line cord and all test cables. Only qualified service personnel should perform maintenance.

Performance Checks

The instrument has been inspected for mechanical and electrical performance before shipment from the factory. It is free of physical defects and in perfect electrical order. Check the instrument for damage in transit and perform the electrical procedures outlined in the section entitled **Unpacking and Initial Inspection.**

Power Requirements

The function generator may be operated from a wide range of mains voltage 85 to 265 Vac. Voltage selection is automatic and does not require switch setting. The instrument operates over the power mains frequency range of 48 to 63Hz. Always verify that the operating power mains voltage is the same as that specified on the rear panel.

The 2572 should be operated from a power source with its neutral at or near ground (earth potential). The instrument is not intended for operation from two phases of a multi-phase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms.) should be typically within the range of 1.3 to 1.6 at 10% of the nominal rms. mains voltage.

Grounding Requirements

To ensure the safety of operating personnel, the U.S. O.S.H.A. (Occupational Safety and Health) requirement and good engineering practice mandate that the instrument panel and enclosure be “earth” grounded. Although BNC housings are isolated from the front panel, the metal part is connected to earth ground.

WARNING

Do not attempt to float the output from ground as it may damage the Model 2572 and your equipment.

Long Term Storage or Repackaging for Shipment

If the instrument is to be stored for a long period of time or shipped to a service center, proceed as directed below. If repacking procedures are not clear to you or, if you have questions, contact your nearest Tabor Electronics Representative, or the Tabor Electronics Customer Service Department.

1. Repack the instrument using the wrappings, packing material and accessories originally shipped with the unit. If the original container is not available, purchase replacement materials.
2. Be sure the carton is well sealed with strong tape or metal straps.
3. Mark the carton with the model and serial number. If it is to be shipped, show sending and return address on two sides of the box.

NOTE

If the instrument is to be shipped to Tabor Electronics for calibration or repair, attach a tag to the instrument identifying the owner. Note the problem, symptoms, and service or repair desired. Record the model and serial number of the instrument. Show the RMA (Returned Materials Authorization) order as well as the date and method of shipment. ALWAYS OBTAIN AN RMA NUMBER FROM THE FACTORY BEFORE SHIPPING THE 2572 TO TABOR ELECTRONICS.

Preparation for Use

Preparation for use includes removing the instrument from the container box, installing the software and connecting the cables to its input and output connectors.

Installation

If this instrument is intended to be installed in a rack, it must be installed in a way that clears air passage to its cooling fans. For inspection and normal bench operation, place the instrument on the bench in such a way that will clear any obstructions to its rear fan to ensure proper airflow.

CAUTION

Using the 2572 without proper airflow will result in damage to the instrument.

Installing Software Utilities

The 2572 is supplied with a CD that contains the following programs: IVI Driver, ArbConnection, USB driver and some other utilities to aid you with the operation of the instrument. For bench operation, all that you need from the CD is this manual however, it is recommended that you stow away the CD in a safe place in case you'll want to use the 2572 from a host computer or in a system.

The *IVI driver* is a useful utility that provides standard communication and commands structure to control the 2572 from remote. Programming examples are also available to expedite your software development. The IVI driver comes free with the 2572 however, you'll need the IVI engine and visa32.dll run time utilities to be able to use the IVI driver. The additional utilities can be downloaded for free from NI's (National instrument) web site – www.ni.com.

ArbConnection is a user friendly program that lets you control instruments functions and features from a remote computer. It also lets you generate and edit arbitrary waveforms on the screen, build sequence tables, modulating signals and much more and then download the signals to your 2572 without the hustle of writing complex programs and utilities. This is also a great tool for you to experiment simple, or complex command string to gain experience before you write your own code. ArbConnection has a command editor feature that allows direct low-level programming of the 2572 using SCPI commands, just as you will be using them in your program. Installation of ArbConnection is simple and intuitive and only requires that visa32.dll runtime file be added to your Windows system folder. Download the file from NI's (National instrument) web site – www.ni.com. Installation and operating instruction for ArbConnection are given in Chapter 4.

The *USB* driver is required if you intend to connect the 2572 to a host computer on a USB bus. Information how to connect the USB cable and how to load the software is given in this chapter.

Controlling the Instrument from Remote

In general, the 2572 can be controlled from remote using one of the following interfaces: USB, Ethernet and GPIB. Remote interface cables are not supplied with the instrument so if you plan on using one of the remote programming option, make sure you have a suitable cable to connect to your host computer. The following paragraphs describe how to connect and configure the 2572 to operate from remote. The description is given for computers fitted with Windows XP but little changes will show while installing software on different Windows versions.

Connecting to a Remote interface

You can connect your Tabor 2572 to GPIB, USB, or LAN adapters, depending on your application and requirements from your system. Installing interface adapters in your computer will not be described in this manual since the installation procedures for these adapters change frequently. You must follow the instructions supplied with your particular adapter. Before proceed with the remote interface installation, install an adapter card and follow the instructions in the following paragraphs.

GPIB Connection
Direct connection between a host computer and a single device with GPIB is not recommended since GPIB adapter is usually expensive and is not really required for direct connection. Use GPIB connection in cases where download speed is critical to the system or when you already have GPIB system in place and you are adding the 2572 as a GPIB device. The GPIB port is connected with a special 24-wire cable. Refer interconnection issues to your GPIB supplier. After you connect the 2572 to the GPIB port, proceed to the GPIB Configuration section in this chapter for instructions how to select a GPIB address.

USB Connection
Direct connection between a single host computer and a single device with USB is most recommended as this does not require any specific considerations and device configuration. Just connect your Tabor 2572 to your PC using a standard USB cable and the interface will self configure. After you connect the 2572 to the USB port, proceed to the USB Configuration section in this chapter for instructions how to install the USB driver.

LAN Connection
Direct connection between a single host computer and a single device with 10/100 BaseT is possible, but you must use a special cable that has its transmit and receive lines crossed. If your site is already wired connect the 2572 via twisted pair Ethernet cable. Take care that you use twisted pair wires designed for 10/100 BaseT network use (phone cables will not work). Refer interconnection issues to your network administrator. After you connect the 2572 to the LAN port, proceed to the LAN Configuration section in this chapter for instructions how to set up LAN parameters.

Selecting a Remote interface

The 2572 is supplied by the factory with the active remote interface set to USB. If you intend to use USB connection, then all you need to do is connect your USB cable and proceed with the USB Configuration instructions as given in this chapter to install the USB driver and to configure the USB port (first connection only). If you already used your instrument in various platforms and want to re-select your interface

To select an active Interface, you need to access the Select

Interface screen as shown in Figure 2-1. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup option and press the Enter key. The Select Interface soft key will update the display with the interface parameters.

Use the curser keys left and right to point to the required interface option then press Enter. The new interface will Initialize and the icon at the top will be updated and will flag the active interface option.

The interface icon is always displayed at the top of the screen so if you are not sure which of the interfaces is selected, compare the following icons to what you have on the screen:

Designates GPIB interface is selected and active. GPIB configuration is required to communicate with your PC.

Designates USB interface is selected and active. First connection requires USB configuration and software driver installation to communicate with your PC.

Designates LAN interface is selected and active. LAN configuration is required to communicate with your PC.

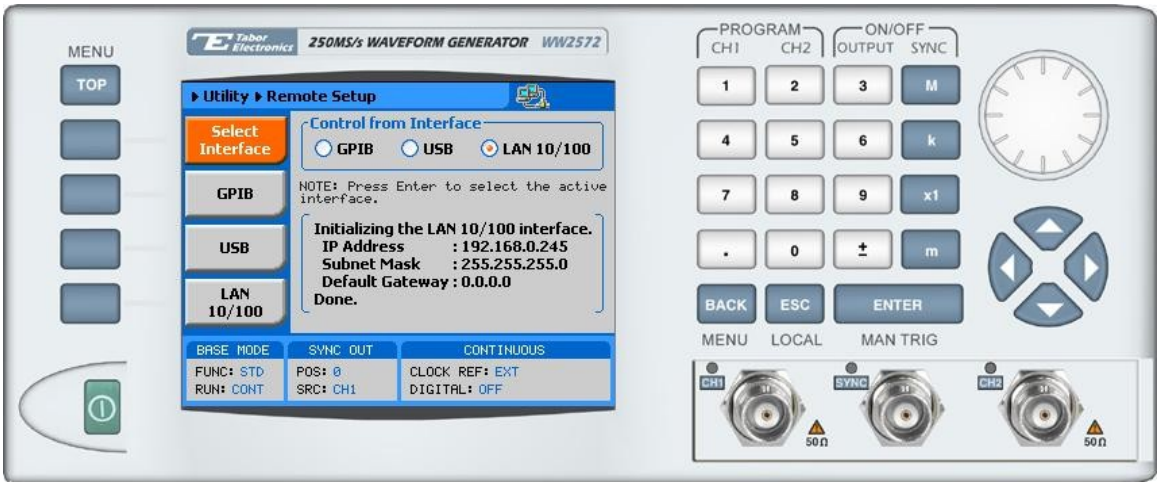

Figure 2-1, Selecting a Remote interface

GPIB Configuration

GPIB configuration requires an address setting only. If you intend to use more than one instrument on the bus, you have to make sure each device has a unique address setting. GPIB address is programmed from the front panel Utility menu as shown in Figure 2-2. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup

option and press the Enter key. The GPIB soft key will update the display with the GPIB address parameter. The default address is 4. To modify the address, press the Enter key and use the dial or keypad to select the new address. Press Enter for the 2572 to accept the new address setting.

Note

Configuring your GPIB address setting does not automatically select the GPIB as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given hereinbefore.

Figure 2-2, GPIB Configuration Screen

USB Configuration

The USB requires no front panel configuration parameters. Following simple installation steps as shown later, just connect your Tabor 2572 to your PC using a standard USB cable and the interface will self configure. The first time you connect the generator to your PC, the new hardware will be detected and the message as shown in Figure 2-3 will appear:

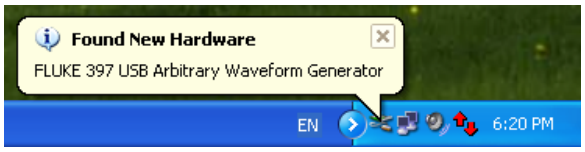

Figure 2-3, USB Device Detected

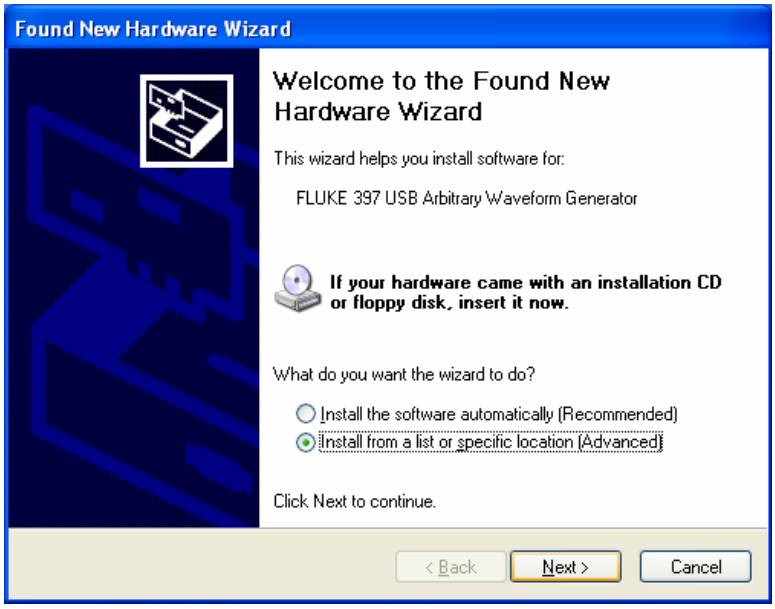

Figure 2-4, Found New Hardware Wizard

Immediately thereafter, the Found New Hardware Wizard will open, as shown in Figure 2-4. Select the Install from a list or specific Location option and click on next. At this time insert the installation CD into your CD driver. If you know the logical letter for your CD drive, type in the information in the path field. If you are not sure where this driver is, click on the Browse button and look for the path. Check the appropriate controls as shown in Figure 2-5 and then click on Next. To complete the process press on Finish, as shown in Figure 2-6.

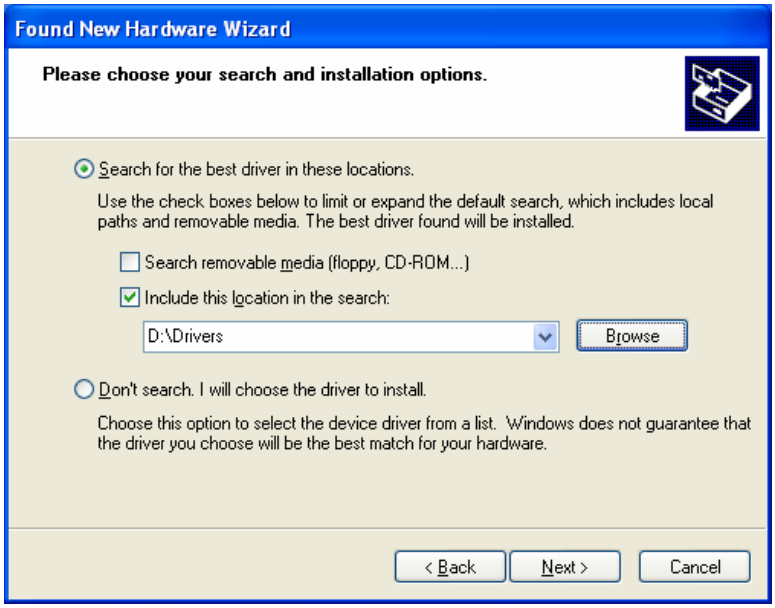

Figure 2-5, Choose Your Search and installation Options

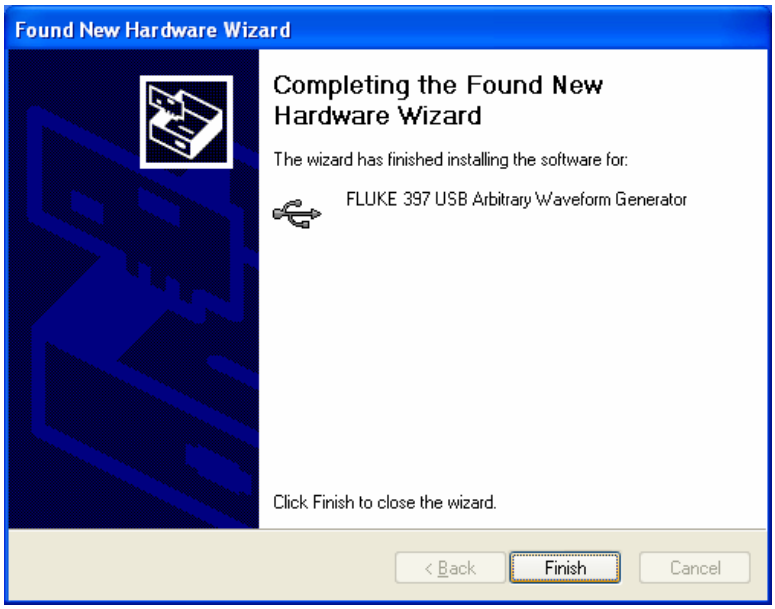

Figure 2-6, New Hardware Found and Software installed

Figure 2-6 shows that the Tabor 2572 USB Waveform Generator has been found and software driver installed. However, the process does not end at this point but continues to assign a logical port address to the USB driver. After you click on Finish, the Found New Hardware message appears however, this time it has found a USB serial port, as shown in Figure 2-7.

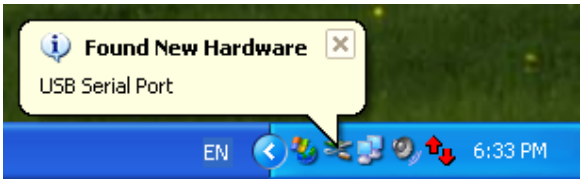

Figure 2-7, Found New Hardware - USB Serial Port

Proceed with the installation till a logical drive is assigned to the USB port. The process is very similar to what you have done before, just select the path and options in the next dialog box and click on Next as shown in Figure 2-8. To complete the process click on Finish.

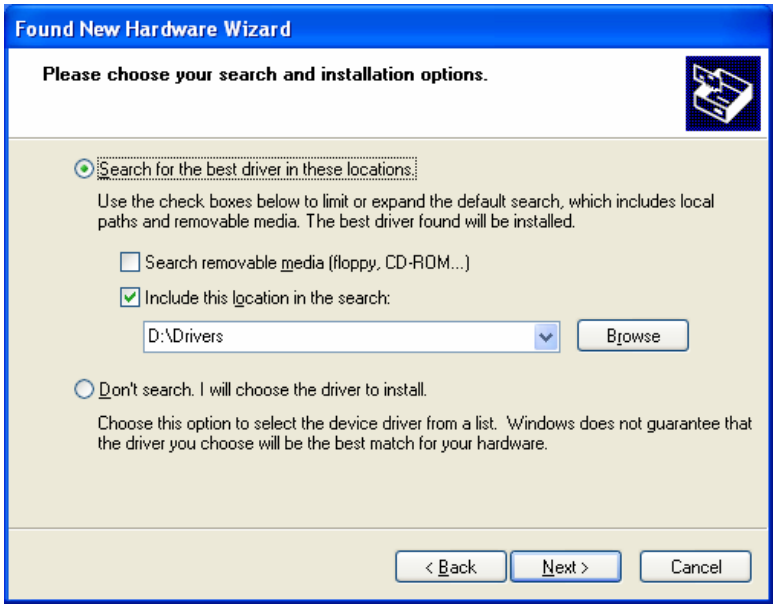

Figure 2-8, Choose Your Search and installation Options

Figure 2-9, New Hardware Found and Software installed

The process above detected a USB device and installed the software for it, then it has assigned a Serial Port address to the USB post. In fact, this ends the process unless you want to verify that the drivers and the port are correctly assigned on your PC.

To make sure your USB port and the Tabor 2572 configured correctly, compare your Device Manager to the example in Figure 2-10.

Note

Configuring your USB setting does not automatically select the USB as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given hereinbefore.

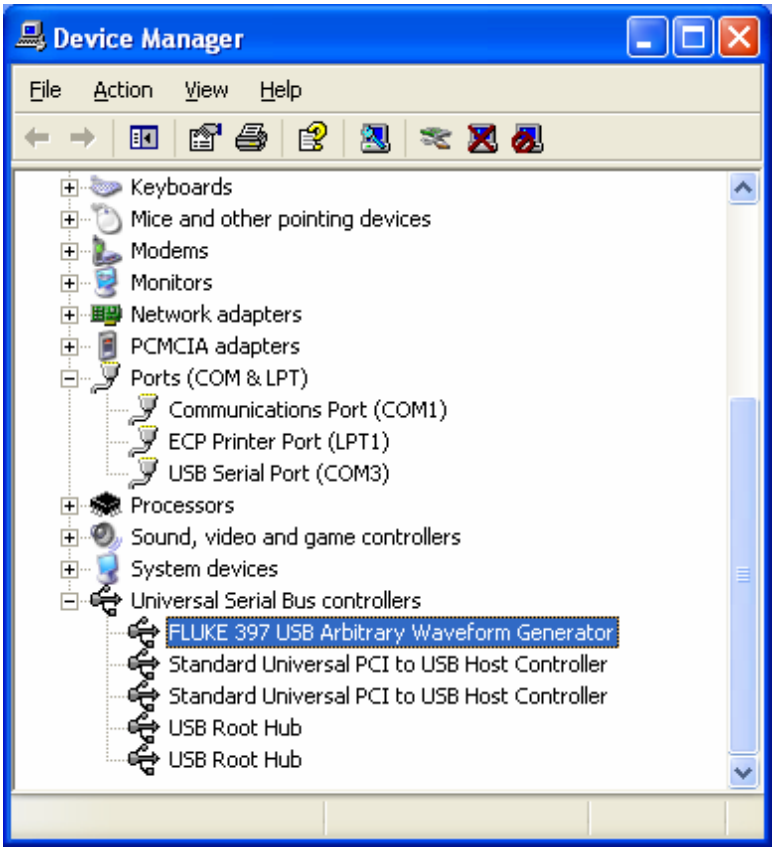

Figure 2-10, Model 2572 Configured for USB Operation

LAN Configuration

There are several parameters that you may have to set to establish network communications using the LAN interface. Primarily you'll need to establish an IP address. You may need to contact your network administrator for help in establishing communications with the LAN interface. To change LAN configuration, you need to access the LAN 10/100 screen as shown in Figure 2-11. To access this screen press the TOP menu button, then select the Utility soft key and scroll down with the dial to the Remote Setup option and press the Enter key. The LAN 10/100 soft key will update the display with the LAN parameters.

Note there are some parameters that are shown on the display that cannot be accessed or modified; These are: Physical Address and Host Name. These parameters are set in the factory and are unique for product. The only parameters that can be modified are the IP Address, the Subnet mask and the Default gateway. Correct setting of these parameters is essential for correct interfacing with the LAN network. Description of the LAN settings and information how to change them is given in the following.

Note

Configuring your LAN setting does not automatically select the LAN as your active remote interface. Setting a remote interface is done from the Select interface menu. Information how to select and Interface is given herinbefore.

Figure 2-11, LAN Configuration Screen

There are three LAN parameters in this screen that can be modified and adjusted specifically to match your network setting; These are described below. Consult your network administrator for the setting that will best suit your application.

- **IP address** - The unique, computer-readable address of a device on your network. An IP address typically is represented as four decimal numbers separated by periods (for example, 192.160.0.233). Refer to the next section - Choosing a Static IP Address.
- **Subnet mask** - A code that helps the network device determine whether another device is on the same network or a different network.
- **Gateway IP** - The IP address of a device that acts as a gateway, which is a connection between two networks. If your network does not have a gateway, set this parameter to 0.0.0.0.

Choosing a Static IP Address

For a Network Administered by a Network Administrator

If you are adding the Ethernet device to an existing Ethernet network, you must choose IP addresses carefully. Contact your network administrator to obtain an appropriate static IP address for your Ethernet device. Also have the network administrator assign the proper subnet mask and gateway IP.

For a Network without a Network Administrator

If you are assembling your own small Ethernet network, you can choose your own IP addresses. The format of the IP addresses is determined by the subnet mask. You should use the same subnet mask as the computer you are using with your Ethernet device. If your subnet mask is 255.255.255.0, the first three numbers in every IP address on the network must be the same. If your subnet mask is 255.255.0.0, only the first two numbers in the IP addresses on the network must match.

For either subnet mask, numbers between 1 and 254 are valid choices for the last number of the IP address. Numbers between 0 and 255 are valid for the third number of the IP address, but this number must be the same as other devices on your network if your subnet mask is 255.255.255.0.

Table 2-1 shows examples of valid and invalid IP addresses for a network using subnet mask 255.255.255.0. All valid IP addresses contain the same first three numbers. The IP addresses in this table are for example purposes only. If you are setting up your own network, you probably do not have a gateway, so you should set these values to 0.0.0.0.

Table 2-1, Valid and Invalid IP Addresses for Subnet Mask 255.255.255.0

IP Address	Comment
123.234.45.211	Valid.
123.234.45.213	Valid. The first three numbers match the previous IP address. The fourth number must be a unique number in the range of 1 to 254.
123.202.45.214	Invalid. Second number does not match the previous IP addresses. The first three numbers must match on all IP addresses with subnet mask 255.255.255.0.
123.234.45.0	Invalid. The first three numbers are valid but the fourth number cannot be 0.
123.234.45.255	Invalid. The first three numbers are valid but the fourth number cannot be 255.

TIP

To find out the network settings for your computer, perform the following steps:

- **For Windows 98/Me/2000/XP**

  1. **Open a DOS prompt.**
  2. **Type IPCONFIG.**
  3. **Press <Enter>.**

If you need more information, you can run ipconfig with the /all option by typing IPCONFIG /all at the DOS prompt. This shows you all of the settings for the computer. Make sure you use the settings for the LAN adapter you are using to communicate with the LAN device.

- **For Windows 95**

  1. **Open a DOS prompt.**
  2. **Type WINIPCFG.**
  3. **Press <Enter>.**

Select the Ethernet adapters you are using to communicate with the *Ethernet device* from the drop-down list.

Chapter 3
Using the Instrument

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Overview

This chapter contains information about how to operate the Tabor 2572. Operation is divided into two general categories: basic bench operation, and remote operation (GPIB, USB and ENET). Basic bench operation, which is covered in this section, describes how to use the arbitrary waveform generator using front panel sequences. The 2572 is supplied with ArbConnection, a PC based software package with a graphical user interface to allow users to program all of the functions directly. LabView drivers and a set of SCPI commands are available for more experienced programmers.

The following paragraphs describe the various modes of operation and give examples of how to program the Model 2572. The manual is organized by instrument function and instructions are given in each paragraph on how to use the function from both the front panel and ArbConnection.

Inter-Channel Dependency

The 2572 has two output channels. Although this is a two-channel instrument, many of the commands that set parameters and functions are common for both channels. For example, sample clock and run modes can not be set separately for each channel. On the other hand, you may program each channel to have different function shape, amplitude and offset. Table 3-1 lists the function and parameters and their related Inter-channel dependency.

Output Termination

During use, output connectors must be properly terminated to minimize signal reflection or power loss due to impedance mismatch. Proper termination is also required for accurate amplitude levels at the output connectors. Use 50Ω cables and terminate the main and SYNC cables with terminating resistors. Always place the 50Ω termination at the far end of the cables.

Input / Output Protection

The Model 2572 provides protection for internal circuitry connected to input and output connectors. Refer to the specifications in Appendix A to determine the level of protection associated with each input or output connector.

Power On/Reset Defaults

The 2572 utilizes non-volatile memory backup that automatically stores the last setup before the generator has been turned off. Every time you turn on the instrument, the non-volatile memory updates the front panel setting with modes, parameters and waveforms from its last setting with only one exception, for safety reasons, the outputs remain off even if they were turned on before powering down the 2572.

After power on, the instrument displays information messages and updates the display with the last setup information. The 2572 can always be reset to its default values; Information on how to restore default parameters is given below.

If you are not yet fully familiar with front panel operation of the 2572, you may find yourself locked into a "dead-end" situation where nothing operates the way it should. The fastest way to restore the generator to a known state is by resetting the instrument to factory defaults.

Observe Figure 3-1 and reset parameters to factory defaults as follows:

1. Press the Utilities soft key
2. Scroll down to the, or
3. Press button 3 to restore factory defaults

Table 3-1 summarizes factory defaults for the most common parameters. A complete list of all parameters, their defaults, as well as their maximum and minimum values is given in Chapter 4.

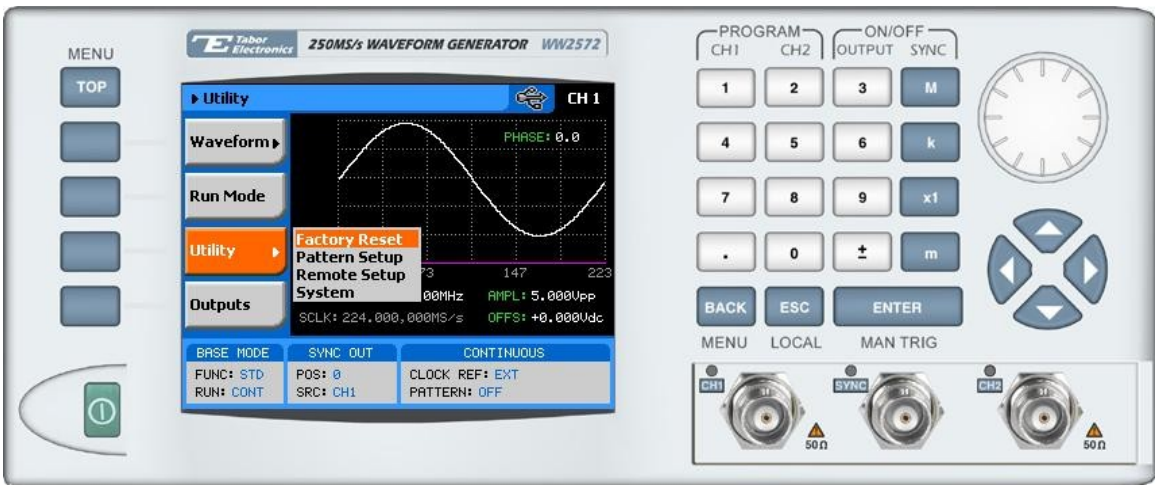

Figure 03-1, Reset 2572 to Factory Defaults

Table 03-1, Default Conditions After Reset

Function / Parameter	Default	Inter-Channel Dependency
Outputs State:	Off	Separate
SYNC State:	Off	Common
Operating Mode:	Continuous	Common
Active Channel:	1	Separate
Digital Pattern State:	Off	Separate
Output Function:	Standard	Separate
Output Function Shape:	Sine	Separate
Standard Wave Frequency:	1MHz	Common
User Wave Sample Clock:	10MS/s	Common
Sample Clock Source & Reference:	Internal	Common
Amplitude:	5V	Separate
Offset:	0V	Separate
Filter State:	Off	Separate
Filter Type:	Auto	Separate
Trigger Slope:	Positive	Common
Trigger Level:	1.6V	Common
Trigger Source:	External	Common
Trigger Delay:	Off	Common
Re-Trigger:	Off	Common
Modulation State:	Off	Common

Controlling the 2572

Controlling 2572 function, modes and parameters is simply a matter of pressing once or twice the appropriate button as described in the following paragraphs. Refer to Figure 3-2 throughout this description.

1. ***Power Switch*** – Toggles 2572 power ON and OFF
2. ***Menu Top*** – Selects the root menu. This button is disabled during parameter editing
3. ***Menu Soft Keys*** – Soft keys have two functions:
   1) Selects output function shape or operating mode,
   2) Selects parameter to be audited

   These buttons are disabled during parameter editing
4. ***Menu Back*** – Backs up one menu position. This button is disabled during parameter editing

5. ***Cancel (Local)*** – Has two functions:
   1) When in edit mode, cancels edit operation and restore last value
   2) When operating the 2572 from a remote interface, none of the front panel buttons are active. The Local button moves control back from remote to front panel buttons

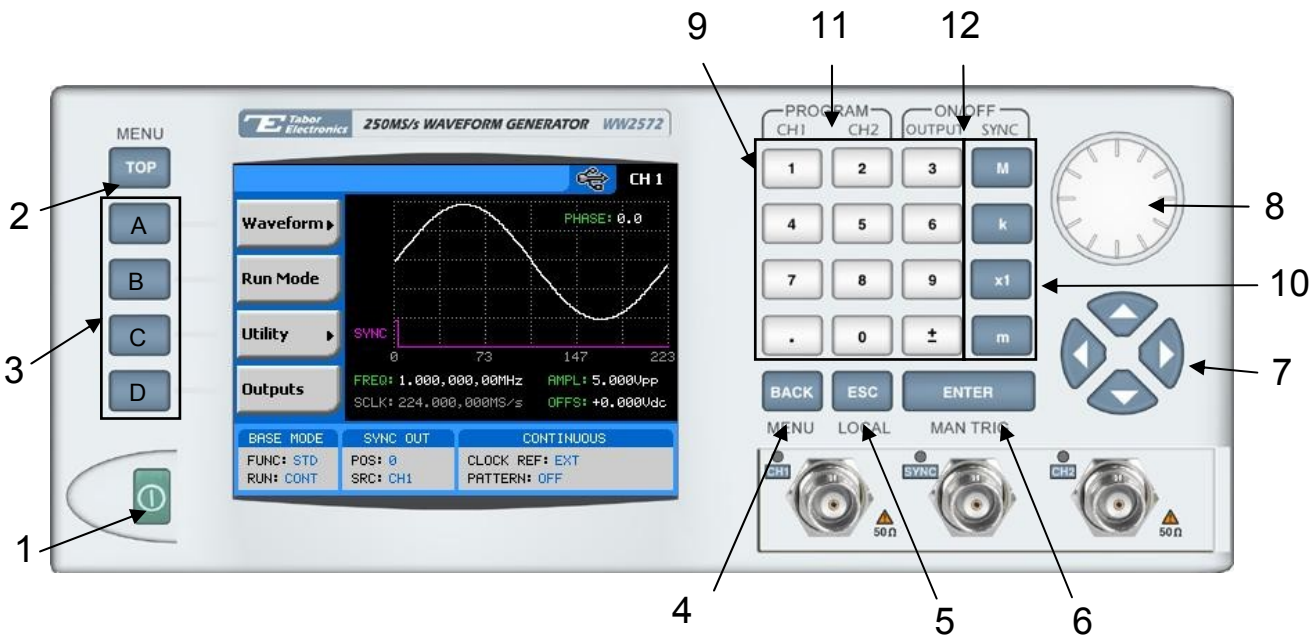

Figure 03-2, 2572 Front Panel Operation

6. ***Enter (MAN TRIG)*** – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters. Pressing Enter selects the parameter for edit. After the parameter has been modified, the Enter button locks in the new variable and releases the buttons for other operations
   2) When the 2572 is placed in “Triggered” run mode, the Man Trig button can be used to manually trigger the 2572
7. **Cursor *UP, Down, Left and Right*** – Has two functions:
   1) When multiple parameters are displayed on the screen, the cursor and the dial scroll through the parameters
   2) When parameter is selected for editing, cursor buttons right or left move the cursor accordingly. Cursor buttons up or down modify parameter value accordingly
8. ***Dial*** – Has similar functionality as the cursor UP and Down keys
9. **Numeral *keypad*** – These keys are used for modifying an edited parameter value

10. ***Parameter Suffixes (M, k, x1 and m)*** – These keys are used to place suffix at the end of the parameter. They are also used for terminating an edit operation
11. ***Program CH1, CH2*** – Use Program CH1 to modify the screen to display channel 1 parameters. Use Program CH2 to modify the screen to display channel 2 parameters. These keys can be used only when the 2572 is not in edit mode
12. ***ON/OFF Output, Sync*** – These keys can be used only when the 2572 is not in edit mode. The Output ON/OFF toggles output waveform, at the output connector, ON and OFF. The Sync ON/OFF toggles the sync waveform, at the SYNC output connector, ON and OFF

Table 0-2, Front Panel Menus

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Notes
A	Waveform			
A		Standard		
A			Waveshape	Select from a wave shapes list
B			Frequency	Programs standard waveform frequency
C			Amplitude	Programs output amplitude
D			Offset	Programs output offset
↓D (*)			Phase	Parameters depend on selected shape
↓D			Reset Parameters	Resets parameters for this waveform only
B		Arbitrary		
A			Sample Clock	Programs sample clock frequency
B			Amplitude	Programs output amplitude
C			Offset	Programs output offset
D			Segment Number	
↓D			Delete Segments	
C		Sequenced		
A			View Table	
B			Advance Mode	
C			Advance Source	
D			Sample Clock	
↓D			Amplitude	
↓D			Offset	
↓D			Active Segment	

Table 0-2, Front Panel Menus (continued)

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Mod. Opt.	Notes
D		Modulated			
A			Modulation Type		Selects from Off, AM, FM, FSK, PSK, Hop and Sweep
B			CW Frequency	Off	Programs the carrier waveform frequency
C			Amplitude	Off	Programs the CW Amplitude
D			Offset	Off	Programs the CW Offset
B			Modulation Shape	AM	Programs the modulating waveform shape
C			Modulation Depth	AM	Parameter modulation depth
D			Modulation Freq	AM	Parameter envelop frequency
↓D			CW Frequency	AM	Programs the carrier waveform frequency
↓D			Amplitude	AM	Programs the CW Amplitude
↓D			Offset	AM	Programs the CW Offset
B			Modulation Shape	FM	Programs the modulating waveform shape
C			CW Frequency	FM	Programs the carrier waveform frequency
D			Frequency Deviation	FM	Programs FM deviation frequency
↓D			Modulation Freq	FM	Parameter modulation frequency
↓D			Marker	FM	Programs the marker frequency
↓D			Amplitude	FM	Programs the CW Amplitude
↓D			Offset	FM	Programs the CW Offset
B			FSK Data	FSK	Displays and edits FSK data table
C			CW Frequency	FSK	Programs the carrier waveform frequency
D			Shifted Frequency	FSK	Programs the shifted frequency
↓D			Baud	FSK	Programs the baud frequency
↓D			Marker	FSK	Programs the marker position
↓D			Amplitude	FSK	Programs the CW Amplitude
↓D			Offset	FSK	Programs the CW Offset
B			PSK Data	PSK	Displays and edits PSK data table
C			CW Frequency	FSK	Programs the carrier waveform frequency
D			Start Phase	PSK	Programs the start phase
↓D			Shifted Phase	PSK	Programs the shifted phase
↓D			Baud	PSK	Programs the baud frequency
↓D			Marker	PSK	Programs the marker position
↓D			Amplitude	PSK	Programs the CW Amplitude
↓D			Offset	PSK	Programs the CW Offset
B			Hop Data	HOP	Programs the frequency hops table
C			Dwell Type	HOP	Selects between fixed and variable
D			Dwell Time	HOP	Programs hop dwell time (fixed mode)
↓D			Marker	HOP	Programs the marker position
↓D			Amplitude	HOP	Programs the CW Amplitude
↓D			Offset	HOP	Programs the CW Offset

Table 3-2, Front Panel Menus (continued)

Soft Key	TOP Menu	2nd Level Menu	3rd Level Menu	Mod. Opt.	Notes
B			Sweep Type	Sweep	Selects from linear or logarithmic
C			Direction	Sweep	Selects from up or down
D			Start Frequency	Sweep	Programs the start frequency
↓D			Stop Frequency	Sweep	Programs the stop frequency
↓D			Sweep Time	Sweep	Programs the sweep time
↓D			Marker	Sweep	Programs the marker frequency
↓D			Amplitude	Sweep	Programs the CW Amplitude
↓D			Offset	Sweep	Programs the CW Offset
C	Utility				Provides access to 2572 Factory Reset, Pattern Setup, Remote Setup and System parameters
D	Outputs				Provides access to output parameters, sync properties and start phase offset between channels.

(*) ↓D denotes you have to scroll down to access the menu. Scroll using the arrows up or down or the dial.

Enabling the Outputs

For safety reasons, main outputs default setting is OFF. The outputs can be turned on and off using either the hot keys, or the Output Menu. Observe Figure 3-3 and disable or enable the main outputs using the procedure below. The same procedure can be used for enabling and disabling the SYNC output. The numbers on Figure 3-3 correspond to the procedure steps in the following description.

1. While not editing any parameter, select the channel you want to turn on using the PROGRAM CH1 or CH2 keys
2. Press ON/OFF OUTPUT or SYNC to toggle main and sync output on and off

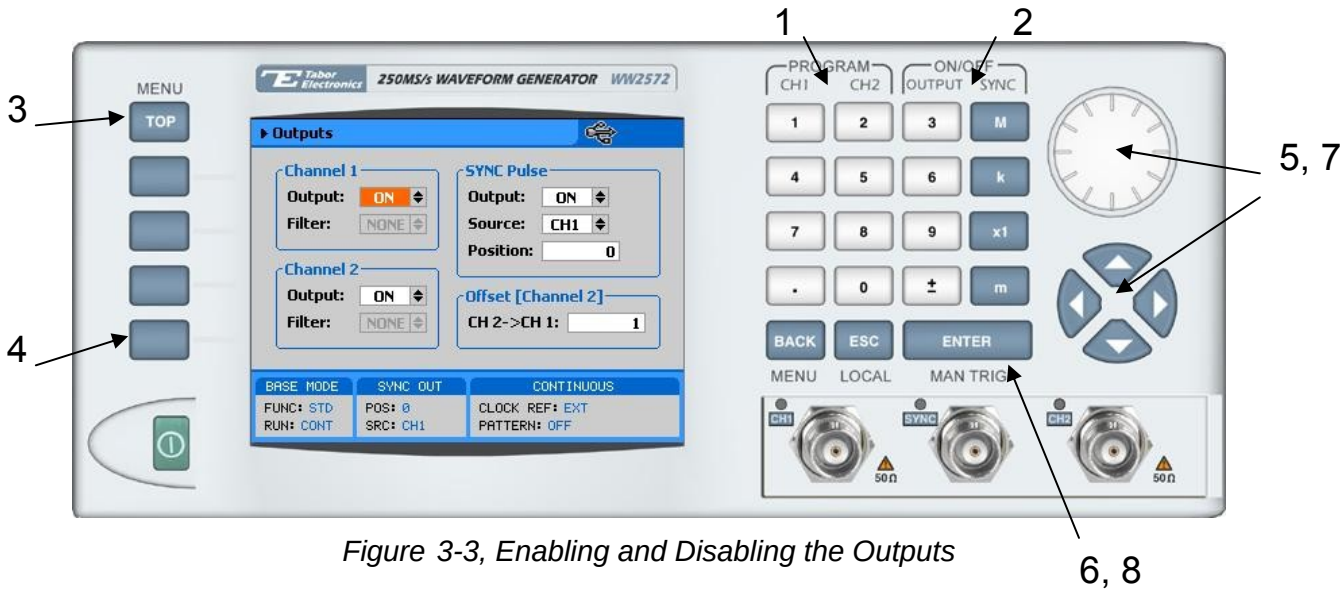

Figure 3-3, Enabling and Disabling the Outputs

Alternately, the outputs can be turned on and off from the Outputs sub menu. Use the following procedure to open the Outputs dialog box press to toggle output state:

3. Press TOP to display the root menu
4. Press Outputs to open the Outputs dialog box as shown in Figure 3-3
5. Use the dial or arrow keys to access the required field. Focus is on a filed that is painted orange.
6. To edit the field press Enter. The edited field will turn white with orange borders
7. Use the dial or arrow keys to change the field
8. Press Enter again to lock in the setting

Selecting a Waveform Type

There are four main types of waveforms that the 2572 can produce: Standard, Arbitrary, Sequenced and Modulated waveforms. Standard and modulated waveforms are computed from equations and tables that are built into the program. The instrument can output arbitrary and sequenced waveforms however, only after waveform data has been downloaded into its memory.

Digital patterns can also be generated from a rear-panel connector in conjunction with the arbitrary waveform output. The digital patterns, however, will be described and discussed separately in this chapter.

Refer to Figure 3-4 and use the following procedure to select an output type.

Note that there are sub-menus associated with each output type menu. Accessing and using these sub-menus is described later in this chapter. The numbers on Figure 3-4 correspond to the procedure steps in the following description.

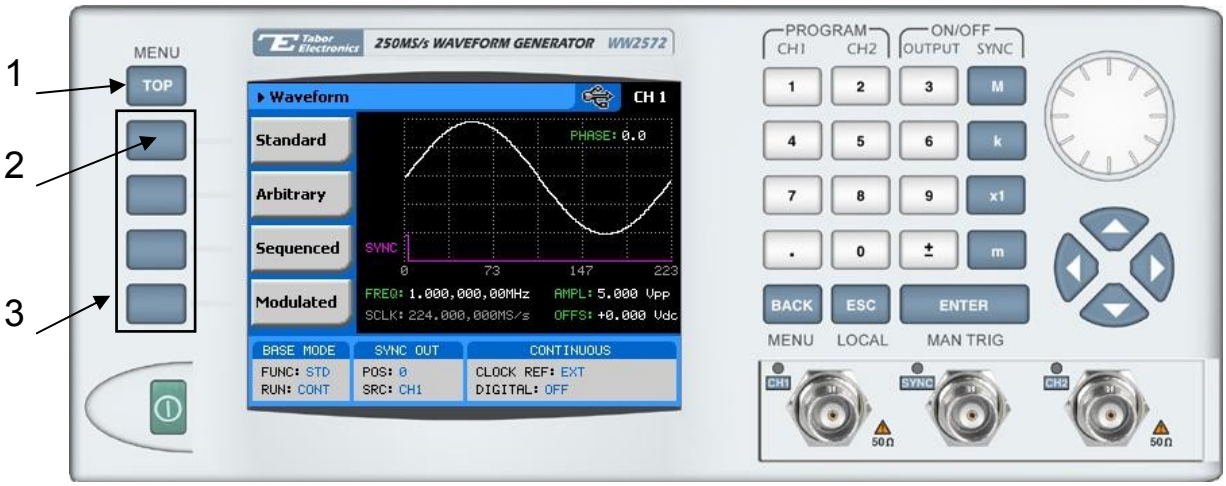

Figure 3-4, Selecting an Output Waveform Type

Alternately, the outputs can be turned on and off from the Outputs sub menu. Use the following procedure to open the Outputs dialog box press to toggle output state:

1. Press TOP to display the root menu
2. Press Waveforms, the display as shown in Figure 3-4 will open.
3. Press one of the soft keys to select the required waveform.

Note the waveform screen shows a sine waveform. The sine is the default waveform. After you select a different waveform type, the screen will be updated with a new symbol, which is associated with the new type.

Note

The picture in the 2572 LCD display is an icon only. The actual output waveform may look entirely different.

Changing the Output Frequency

You should be careful not to confuse waveform frequency with sample clock frequency. The waveform frequency parameter is valid for standard waveforms only and controls waveform frequency at the output connector; The sample clock frequency parameter is valid for arbitrary and sequenced waveforms only and defines the frequency of which the generator clocks data points.

Standard waveform frequency is measured in units of Hz. Arbitrary waveform sample clock frequency is measured in units of S/s (samples per second). The frequency of a given arbitrary waveform at the output connector is dependant on sample clock frequency, the number of data points, and other specific waveform definitions.

The frequency of the output waveform will change only if a standard waveform is generated. First select a standard waveform as described earlier and then proceed with frequency modification.

Observe Figure 3-5 and modify frequency using the following procedure. The index numbers in Figure 3-5 correspond to the procedure steps in the following description.

1. Press the Frequency soft key to select the frequency parameter
2. Use the numeric keypad to program the new frequency value
3. Press M, k, x1 or m to terminate the modification process

Alternately, you can modify the frequency value with the dial and arrow keys but then the termination of the process is by pressing Enter only.

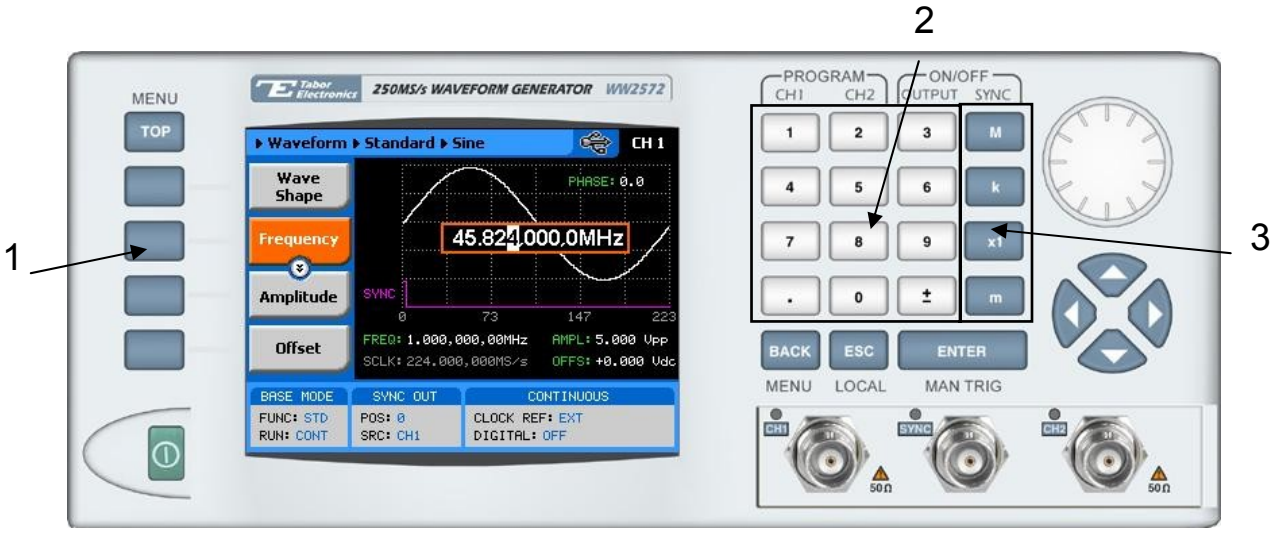

Figure 3-5, Modifying Output Frequency

Note

If you use the dial or arrow keys to modify the frequency parameter, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

Changing the Sample Clock Frequency

The frequency of the sample clock will affect the output waveform only if arbitrary or sequenced waveforms are generated. First select an arbitrary waveform as described earlier and then proceed with sample clock frequency modification.

Observe Figure 3-6 and modify the sample clock using the following procedure. The index numbers in Figure 3-6 correspond to the procedure steps in the following description.

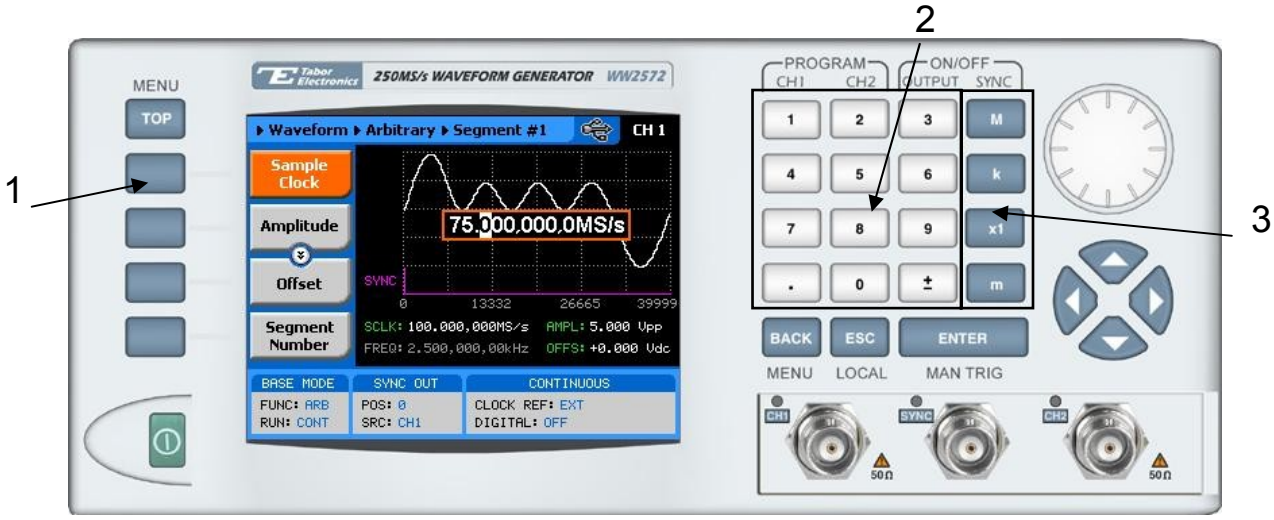

Figure 03-6, Modifying Sample Clock Frequency

1. Press the Frequency soft key to select the Sample Clock parameter
2. Use the numeric keypad to dial the new sample clock frequency value
3. Press “M” for MHz, “k” for kHz, “x1” for Hz, or “m” for mHz to terminate the modification process

Alternately, you can modify the sample clock frequency value with the dial and arrow keys but then the termination of the process is by pressing Enter only.

Note

If you use the dial or arrow keys to modify the sample clock frequency parameter, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

Programming the Amplitude and Offset

Output amplitude and offset can be programmed independently and separately for each channel. Amplitude and offset are set within windows, so before you select values for these parameters, make sure you do not exceed the limits.

Amplitude and offset can be programmed independently as long as the following relationship between the two values is not exceeded:

$$Window \geq \frac{Amplitude}{2} + |Offset|$$

The first thing you do before you program amplitude and offset setting is define which of the channels is being programmed. The active channel is displayed at the upper right corner of the LCD display.

When the display shows CH 1 at the upper right corner, you are currently programming channel 1 parameters. Keypads “1” and “2” are used as hot keys for channel selection. While not editing any parameter, press key “2” to program channel 2 parameters.

When the display shows CH 2 at the upper right corner, you can proceed with channel 2 programming.

The amplitude and offset parameters are duplicated in multiple screens however, when changed for a specific function shape, the new value is updated on all screens for all other function shapes. Refer to Figure 3-7 and modify amplitude and offset using the procedure as described below. The index numbers in Figure 3-7 correspond to the procedure steps in the following description.

1. Press the Amplitude soft key button
2. Press Enter to edit the Amplitude value
3. Use the numeric keypad to program the new value
4. Press “m” for mV, or “x1” for volts to select the suffix letter.
5. Press Enter to lock in the value

Alternately, you can modify the amplitude value with the dial and arrow keys but then the termination of the process is by pressing Enter.

Offset is programmed the same way as amplitude except select Offset from the soft key menus to access the offset parameter.

Note

If you use the dial or arrow keys to modify the amplitude or offset parameters, the output is updated immediately as soon as you modify the parameter. The final value will be locked in as soon as you press Enter. If you choose to leave the old value, press Cancel to terminate the process and to discard of any change made to this parameter

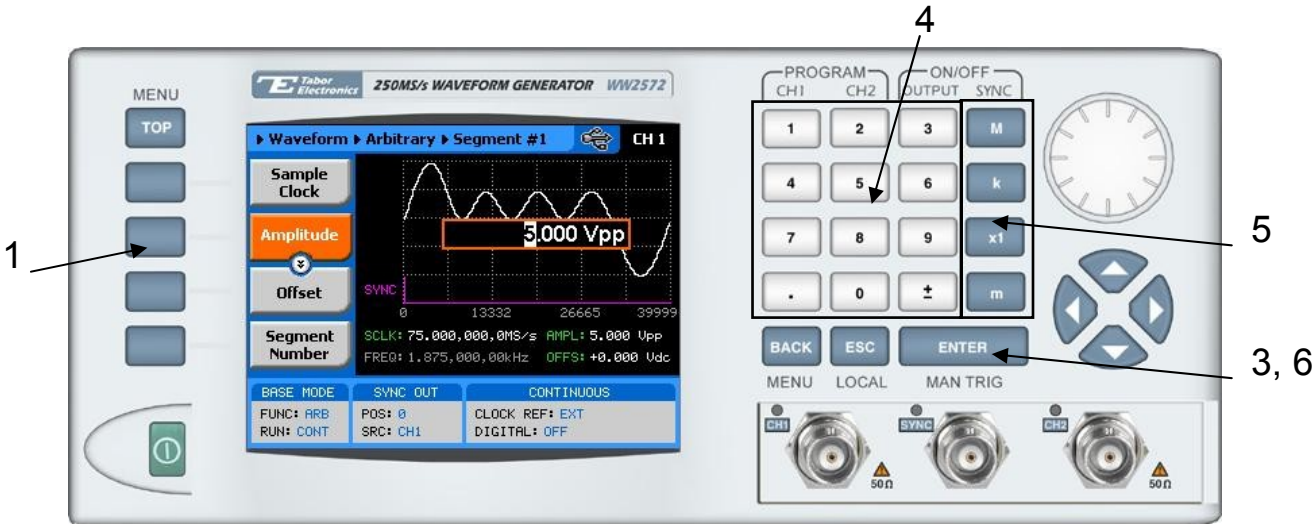

Figure 3-7, Programming Amplitude and Offset

Selecting a Run Mode

The Model 2572 offers four run modes: Continuous, Triggered, Gated and Burst.

The selected waveform is repeated continuously when the instrument is set to operate in Continuous mode. The continuous output can be turned on and off from a remote interface, and thus controlling the start and stop of the waveform from an external source. The operating mode defaults to continuous after reset.

Triggered, Gated, and Burst modes require an external signal to initiate output cycles. In some case, an internal trigger generator is available to generate the required trigger stimuli without the need to connect to external devices. Figure 3-8 show the run mode options. Press one of the soft keys in the left to select the required run mode.

Description of the various run modes and the parameters that are associated with each run mode is given in the following paragraphs.

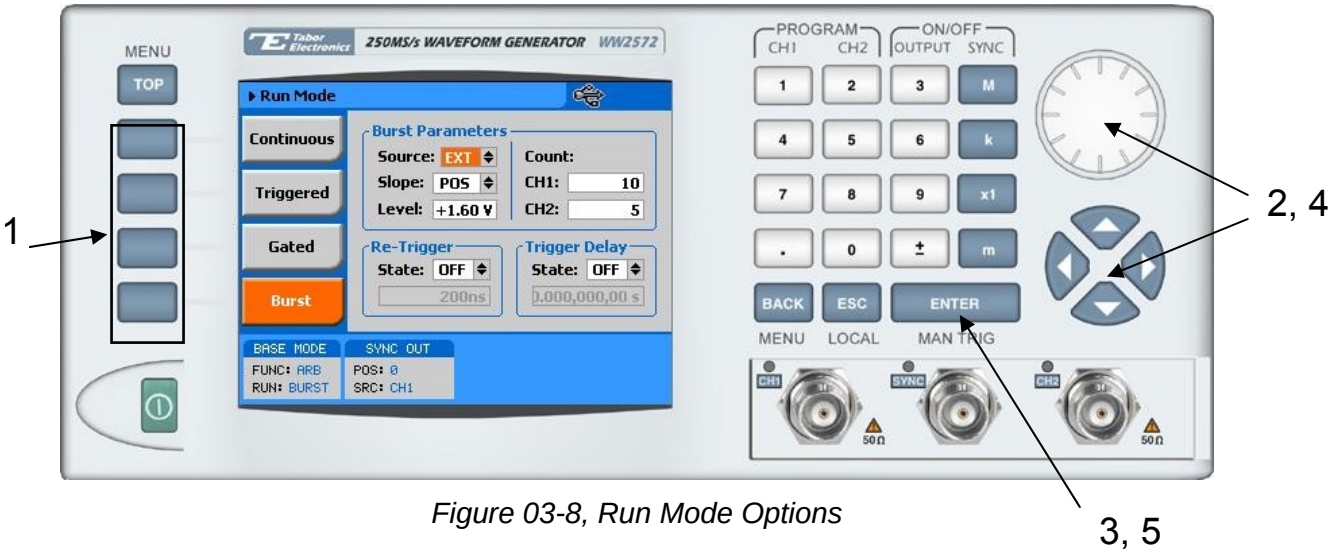

Figure 03-8, Run Mode Options

Note

Burst run mode is shown in Figure 3-8 as an example however, the following description applies to all Run Mode menus.

In general, a specific run mode is selected from the Run Mode soft key menu. The screen as shown in Figure 3-8 is displayed. Proceed to select the run mode and to program parameters as follows:

1. Press one of the soft keys to select from: Continuous, Triggered, Gated or burst. The output will immediately be updated with the selected run mode

2. Use the arrow keys or the dial to scroll down to the parameter field you want to modify
3. Press Enter to edit the Divider value
4. Use the arrow keys or the dial to modify the edited parameter
5. Press Enter to lock in the value

Triggered Mode

In Triggered mode, the output remains at a DC level as long as a valid trigger signal has not occurred. Each time a trigger occurs, the 2572 generates one complete output waveform. At the end of the output cycle, the output resumes position at a DC level that is equal to the amplitude of the last point of the waveform.

The instrument may be triggered from one of the following sources: A rear panel input, designated as TRIG IN, front panel button, marked MAN TRIG and a remote command such as *TRG. When placed in EXT (external) trigger source, remote commands are ignored and the instrument monitors the TRIG IN connector or the MAN TRIG control. When in BUS, the hardware inputs are ignored and only remote commands can trigger the instrument. The MIX is a special trigger advance mode that senses the first remote trigger and only then enables the hardware sources.

There are four parameters you can adjust for this mode:

Source – defines the trigger source. EXT enables the rear panel trigger input, BUS enables remote commands and MIX enables remote command and after the first trigger enables the EXT source.

Slope – defines edge sensitivity for the trigger input

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will trigger the instrument. When the slope is set to negative, transitions to below the trigger level will trigger the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

Trigger Delay – defines the state of the delayed trigger function.

Re-Trigger – defines the state of the re-trigger function

You may use the triggered mode to trigger standard, arbitrary sequenced and modulated waveforms. However, note that in modulation mode, the output generate CW frequency before and after the trigger event. The Trigger run mode parameters are shown in Figure 3-9.

Figure 03-9, Trigger Run Mode Parameters

Delayed Trigger

The delayed trigger function operates in conjunction with the triggered and counted burst modes. When enabled, it inhibits the output signal for a pre-determined period after a valid trigger. The delay time defines the time that will lapse from a valid trigger (hardware or software) to output. To enable the delayed trigger feature, scroll down to the Trigger Delay State field and press Enter. Use the down key to change the sate to ON and press enter again to lock in the state position. The delay field then becomes active. Scroll down to the delay field and press enter. Modify the delay to match your delay requirement and press Enter again.

Note that the minimum delay is 200ns and can be increased to over 20 seconds with 20ns resolution.

Re-Trigger

The re-trigger function operates in conjunction with the triggered and counted burst modes. When enabled, it does not modify the output except when a valid trigger is received. It then starts an automatic sequence of internal triggers that generate repeated output cycles or bursts. The time in the re-trigger group defines the time that will lapse from the end of the signal to the start of the next signal.

To enable the re-trigger feature, scroll down to the Re-Trigger State field and press Enter. Use the down key to change the sate to ON and press enter again to lock in the state position. The re-trigger time field then becomes active. Scroll down to the re-trigger time field and press enter. Modify the time to match your requirement and press Enter again.

Note that the minimum re-trigger interval is 200ns and can be increased to over 20 seconds with 20ns resolution.

Gated Mode

When set to gated mode, the 2572 output remains at a DC level as long as the rear-panel TRIG IN signal remains inactive. The output gates on and off between two transitions, either positive or negative, depending on the slope setting. Only the rear panel TRIG IN connector can be used for operating the gated mode.

When placed in gated mode, the generator idles on a DC level until the first gate on transition. The signal will complete after the gate off transition and the generator will once again resume DC level equal to the last point of the waveform.

There are two parameters you can adjust for the gated mode:

Source – defines the gating signal source. Since the gated run mode relies on hardware transitions, only EXT is a valid source for the gated mode.

Slope – defines if the generator is gating on and off on positive or negative transitions.

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will gate the instrument. When the slope is set to negative, transitions to below the trigger level will gate the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

You may use the gated mode to gate standard, arbitrary, sequenced and modulated waveforms. The gated run mode parameters are shown in Figure 3-10.

Figure 03-10, Gated Mode Parameters

Burst Mode

Burst mode is similar to Triggered mode with the exception that only one trigger signal is needed to generate a counted number of output waveforms. In Burst mode, the output remains at a DC level as long as a valid trigger signal has not occurred. Each time a trigger occurs, the 2572 generates a counted number of burst of waveforms. At the end of the output burst, the output resumes position at a DC level that is equal to the amplitude of the last point of the waveform.

The instrument may be triggered from one of the following sources: A rear panel input, designated as TRIG IN, front panel button, marked MAN TRIG and a remote command such as *TRG. When placed in EXT (external) trigger source, remote commands are ignored and the instrument monitors the TRIG IN connector or the MAN TRIG control. When in BUS, the hardware inputs are ignored and only remote commands can trigger the instrument. The MIX is a special trigger advance mode that senses the first remote trigger and only then enables the hardware sources.

There are four parameters you can adjust for this mode:

Source – defines the trigger source. EXT enables the rear panel trigger input, BUS enables remote commands and MIX enables remote command and after the first trigger enables the EXT source.

Slope – defines edge sensitivity for the trigger input

Level – sets the trigger level crossing point for the rear panel TRIG IN connector. Signal transition to above the trigger level will trigger the instrument. When the slope is set to negative, transitions to below the trigger level will trigger the instrument. Trigger level sensitivity and maximum level should be observed to avoid damaging the input

Burst – Defines the number of cycles the generator will output after a trigger signal. Each channel can be programmed to have a unique burst counter.

Trigger Delay – defines the state of the delayed trigger function.

Re-Trigger – defines the state of the re-trigger function

You may use the counted burst mode in conjunction with standard, arbitrary and modulated waveforms only. Sequenced waveforms can not be used in burst mode. The Burst run mode parameters are shown in Figure 3-11.

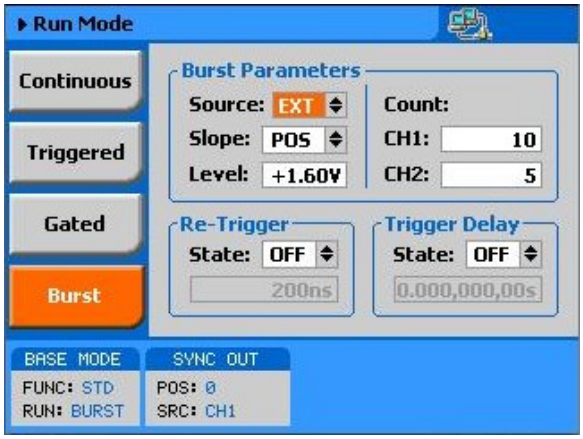

Figure 3-11, Burst Run Mode Parameters

Using the Manual Trigger

The manual trigger allows you to trigger or gate the 2572 directly from the front panel. This button is active only when the generator is placed in external trigger only. The MAN TRIG button is a second function to the Enter button and can be used only when the display is not in editing mode.

Using the SYNC Output

For safety reasons, every time you turn the 2572 OFF and ON, the SYNC output defaults to OFF. If you want to use the SYNC output you must turn it on immediately after you power up the generator. You can turn the SYNC on using the ON/OFF SYNC hot key as was explained earlier in this chapter or you can do it from the Outputs menus shown in Figure 3-12.

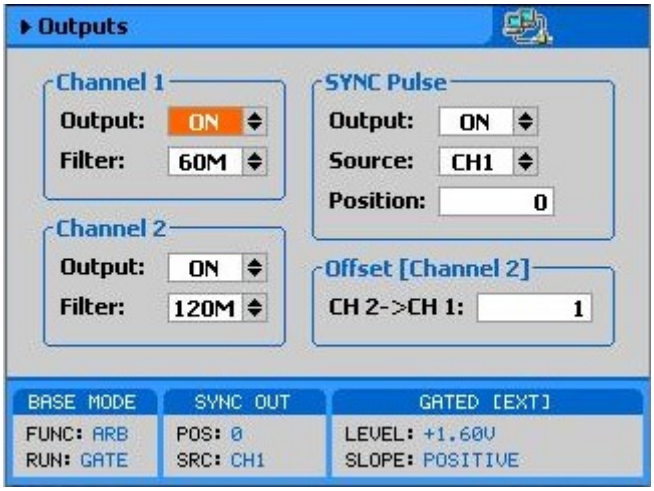

Figure 03-12, SYNC and Filter Parameters

There are four parameters you can adjust for the SYNC output:

Output – Turns the SYNC output on and off. Note that the termination of the output state shifts the dc level to 0V but leaves a low impedance path to the connector and therefore, if your UUT (unit under test) is sensitive to level transitions, make sure you remove the cable from this connector before turning the output state off.

Source – Selects if the output is synchronized to channel 1 or 2. In fact, the two channels are always synchronized between themselves however, one may select either channel because the waveforms may be different for each channel and thus the selection options.

Position – Lets you place the sync start at any point along the length of the waveform. Placement resolution is 4 points. As default, the sync signal is positioned at the beginning of the waveform.

The SYNC parameters are shown in Figure 3-12. The Menu is accessible by selecting the Outputs soft key as shown in Figure 3-3.

Applying Filters

Two filters are available for each channel. These filters have fixed cutoff frequencies of which their properties are specified in Appendix A. The built-in filters are switched in after the DAC circuit and are used for reducing the noise, harmonics and spurious signals above the cutoff frequency.

The built-in filters are available for the user in standard, arbitrary, sequenced and modulated modes. The only function where the Model 2572 does not allow external control is when standard sinusoidal waveform is selected.

Note

The default output function of the generator is the sine waveform. The instrument is using filters to reconstruct this waveform and therefore, the state of the filters can not be changed until another output function is selected. A setting conflict error will occur if one attempts to change the filter state before changing to another output function.

If you do not plan on using the filters, make sure that you leave the selection OFF. This will eliminate confusing setting conflicts.

Modification of the filter state and range is done from the Outputs menu. To access this menu select the Outputs screen as shown in Figure 3-3 and modify the parameters as shown in Figure 3-12.

Selecting the SCLK Source and Reference

In cases where synchronization to other instruments in a system is needed, you have two options: Use an external clock source for the 10MHz reference clock or replace the internal sample clock generator entirely with an external clock source. Either way, this is a major twist in the 2572 basic operation because if, for any reason, you leave one or both source options on external and do not apply the necessary signal to the input, the operation of the generator will be impeded without visual references that something is wrong.

The SCLK and the 10MHz reference source menu were placed in the System menu, as shown in Figure 3-13. Change these settings only if you are absolutely sure that another reference source is available at the appropriate inputs.

The SCLK input is located on the rear panel. Use this input to replace the internal sample clock generator. The external sample clock input accepts ECL level signals, terminated to –2V into 50Ω.

The 10MHz reference input is also located on the rear panel. It accepts TTL level signals only. Note that the 2572 internal reference is accurate to 1ppm.

The display and modify the SCLK or the 10MHz clock source, press TOP, then Utility and scroll down to the System option.

Figure 3-13, Modifying the SCLK and 10MHz Clock Source

Generating Standard Waveforms

The majority of applications require the use of common waveforms such as sinusoidal, triangular and square. In fact, these are the only waveforms that function generators can produce and therefore, one should expect that these waveforms be available even in a complex generator such as this. The 2572, being a completely digital instrument, has a library of built-in waveforms that allow generation of these basic waveforms plus many more.

By default, the 2572 is programmed to generate one of the common waveforms in the market – sine waveform. Figure 3-14 shows a list of all other waveforms that the instrument can generate however, one must not forget that the waveforms are generated digitally from either lookup tables or formulated from standard equations and therefore, each time a new waveform is selected, one should expect to have a slight delay between the time the waveform was selected to when it is being generated at the output connector.

The waveforms that reside in the built- in library are referred to as Standard Waveforms. The meaning of this term is that these waveforms have standard characteristics that is commonly known and or associated with these waveforms. For example, sine waveform has known spectral and power distribution that could be compared to published mathematical equations. The quality of the generator determines how closeness of the waveform generation to its pure mathematical properties.

The 2572 has a library of 9 standard waveforms: Sine, Triangle, Square, Ramp, pulse, sinc, Gaussian, Exponential, DC and Noise. Some of the parameters for these waveforms can be modified to fine tune the waveforms for specific applications. For example, changing the sine start phase of the 2nd channel can create a 2-phase sine system. The standard waveforms and their parameters that can be modified are summarized in the following paragraphs.

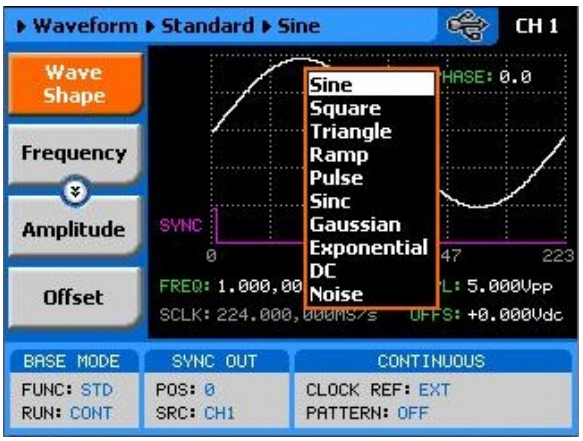

Figure 03-14, Built-in Standard Waveforms Menu

Sine Wave

The sine waveform is the most commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the sine waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically up to a point where filters are being switched in to

reconstruct the waveform. The technique of generating sine waves above certain frequency is not within the scope of this manual however, one should remember that above certain frequency the waveform is loosing purity and quality because the number of points that are available to construct the waveform are inversely proportional to the output frequency. This statement is true for all standard waveforms and this is the reason for limiting the upper frequency of certain waveforms.

There are certain menus that provide access to sine waveform parameters; These are:

Frequency – programs the frequency of the sine waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Phase – sets the start phase of the output waveform. You will not be able to see any change in the waveform if you generate a continuous sine waveform however, if you place the generator in triggered run mode, the output will start the sine wave generation from a point defined by the Phase parameter. The start phase is programmed in units of degree.

Reset Parameters – Resets the sine wave parameters to their original factory defaults.

Square Wave

The square waveform is a commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the square waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically.

There are certain menus that provide access to square waveform parameters; These are:

Frequency – programs the frequency of the square waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Duty Cycle – programs the square wave duty cycle (pulse width to period ratio). The duty cycle is programmed as percent of the period. The default value is 50%.

Reset Parameters – Resets the square wave parameters to their original factory defaults.

Triangle Wave

The triangle waveform is a commonly used waveform. The waveform is generated from a lookup table that has 1000 points and therefore, the triangle waveform is generated with 1000-points accuracy up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The triangular waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape becomes distorted to a point where it is not usable anymore.

There are certain menus that provide access to triangle waveform parameters; These are:

Frequency – programs the frequency of the triangle waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-

computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Phase – sets the start phase of the output waveform. You will not be able to see any change in the waveform if you generate a continuous triangular waveform however, if you place the generator in triggered run mode, the output will start the triangle wave generation from a point defined by the Phase parameter. The start phase is programmed in units of degree.

Reset Parameters – Resets the triangular wave parameters to their original factory defaults.

Ramp Wave

The ramp waveform is a special case of the triangular waveform with a slight difference, the ramp can be adjusted for its rise and fall times. The ramp waveform is a very common waveform and is required for numerous applications however, not being a true ramp generator, the ramp parameters are computed and programmed as percent of the ramp period. The waveform is computed every time a parameter is modified. 1000 points are allocated for the ramp shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The ramp waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the resolution of the parameters is lost to a point where it is not usable anymore.

There are certain menus that provide access to ramp waveform parameters; These are:

Frequency – programs the frequency of the ramp waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Delay – sets the delay time for the ramp start. The delay is programmed as percent of the ramp period.

Rise – programs the ramp rise time. The rise time is programmed as percent of the ramp period.

Fall – programs the ramp fall time. The fall time is programmed as percent of the ramp period.

Note that the sum of the delay, rise and fall times cannot exceed 100%. If the sum is less than 100%, the end of the ramp will remain at a dc level to the completion of the period.

Reset Parameters – Resets the ramp wave parameters to their original factory defaults.

Pulse Wave

The pulse waveform is a very common waveform and is need for the majority of the applications however, not being a true pulse generator, the pulse parameters are computed and programmed as percent of the pulse period. The waveform is computed every time a parameter is modified. 1000 points are allocated for the pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the resolution of the parameters is lost to a point where it is not usable anymore.

There are certain menus that provide access to pulse waveform parameters; These are:

Frequency – programs the frequency of the pulse waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Delay – sets the delay time for the ramp start. The delay is programmed as percent of the ramp period.

Rise – programs the ramp rise time. The rise time is programmed as percent of the ramp period.

Fall – programs the ramp fall time. The fall time is programmed as percent of the ramp period.

Note that the sum of the delay, rise, high and fall times cannot exceed 100%. If the sum is less than 100%, the end of the pulse will remain at a dc level to the completion of the period.

Reset Parameters – Resets the pulse wave parameters to their original factory defaults.

Sinc Wave

The sinc pulse (sine x/x) waveform is a very common waveform and is required in many applications however, not being a true pulse generator, the sinc pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the sinc pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The sinc pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to sinc pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

#Cycles – sets the number of "0" crossing cycles for the sinc function. Note that the default value is 4. Changing the value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the sinc pulse wave parameters to their original factory defaults.

Gaussian Wave

The gaussian pulse waveform is useful in many applications. The gaussian pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the gaussian pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The gaussian pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to gaussian pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Exponent – sets the exponent factor for the gaussian function. Changing the default exponent value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the gaussian pulse wave parameters to their original factory defaults.

Exponential Wave

The exponential pulse waveform is useful in applications simulating capacitor charge or discharge. Not being a true pulse generator, the exponential pulse parameters are re-computed every time a parameter is changed. 1000 points are allocated for the exponential pulse shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The exponential pulse waveform is reasonable up to about 25MHz where 10 points are available to generate its shape. As the number of points decrease further, the shape of the pulse is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to sinc pulse waveform parameters; These are:

Frequency – programs the frequency of the sinc waveform. Note that at low frequencies (up to about 250kHz), when you modify the frequency parameter, the output responds with coherent change however, at higher frequencies, the waveform has to be re-computed every time and therefore, when you modify the frequency, the output wanders until the waveform is being re-computed and then restored to full accuracy.

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Exponent – sets the exponent factor for the exponential function. Setting the exponent to a negative value inverts the exponential function. Changing the default exponent value to a different number requires re-calculation of the waveform and may take a few seconds until the waveform is computed and generated at the output connector.

Reset Parameters – Resets the exponential pulse wave parameters to their original factory defaults.

DC Wave

The DC waveform is useful applications requiring simply an accurate DC level.

There are certain menus that provide access to the DC waveform parameters; These are:

DC Level – programs the level of the DC output function. The amplitude is programmed in units of volts and generated continuously at the output connector in a similar way as a power supply generates its output. Note however, that the amplitude is calibrated when the output is terminated into 50Ω load impedance.

Reset Parameters – Resets the DC amplitude parameter to its original factory default.

Noise Wave

The noise waveform is useful in applications requiring generation of simple noise. The spectral spread of the noise is pseudo-random and is limited in its bandwidth by the bandwidth parameter. The noise parameters are re-computed every time a parameter is changed. 1000 points are allocated for the noise shape up to about frequency setting of 250kHz (output frequency = sample clock frequency / number of points). As frequency is increased above 250kHz the number of points is being reduced automatically. The noise waveform is reasonable up to about 2.5MHz where 100 points are available to generate its shape. As the number of points decrease further, the shape of the noise is deteriorated to a point where it is not usable anymore.

There are certain menus that provide access to noise waveform parameters; These are:

Amplitude – programs the amplitude of the output waveform. Note that amplitude and offsets can be programmed freely within the specified amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the amplitude parameter in this menu overrides amplitude setting in all other menus.

Offset – programs the offset of the output waveform. Note that offset and amplitude can be programmed freely within the specified

amplitude window, as explained in the Programming Amplitude and Offset section in this chapter. Note that setting the offset parameter in this menu overrides offset setting in all other menus.

Bandwidth – sets the sample clock rate which generates the noise. It also serves as a simple tool to limit the bandwidth of the noise to a know value.

Note that while generating noise, bear in mind that the noise is generated in a certain memory size and it is being repeated over and over until the function is disabled. Therefore, the noise is not really random as is the pure translation of the word.

Reset Parameters – Resets the gaussian pulse wave parameters to their original factory defaults.

Generating Arbitrary Waveforms

In general, the Model 2572 cannot by itself create arbitrary waveforms. If you want to use arbitrary waveforms, you must first load them into the instrument. The 2572 is supplied with waveform creation and editing, called – ArbConnection. Besides waveform generation, ArbConnection has instrument control features, sequence table generator, FM and pulse composers and many other features that will be described separately. Figure 3-15 shows an example of a waveform that was created with the ArbConnection. Once the waveform is created on the screen, downloading it to the 2572 is just a click of a mouse away.

Detailed information on the structure of the arbitrary waveform and the commands that are needed to download arbitrary waveforms to the 2572 is given in Chapter 5. Information in this Chapter will give you some general idea what arbitrary waveforms are all about.

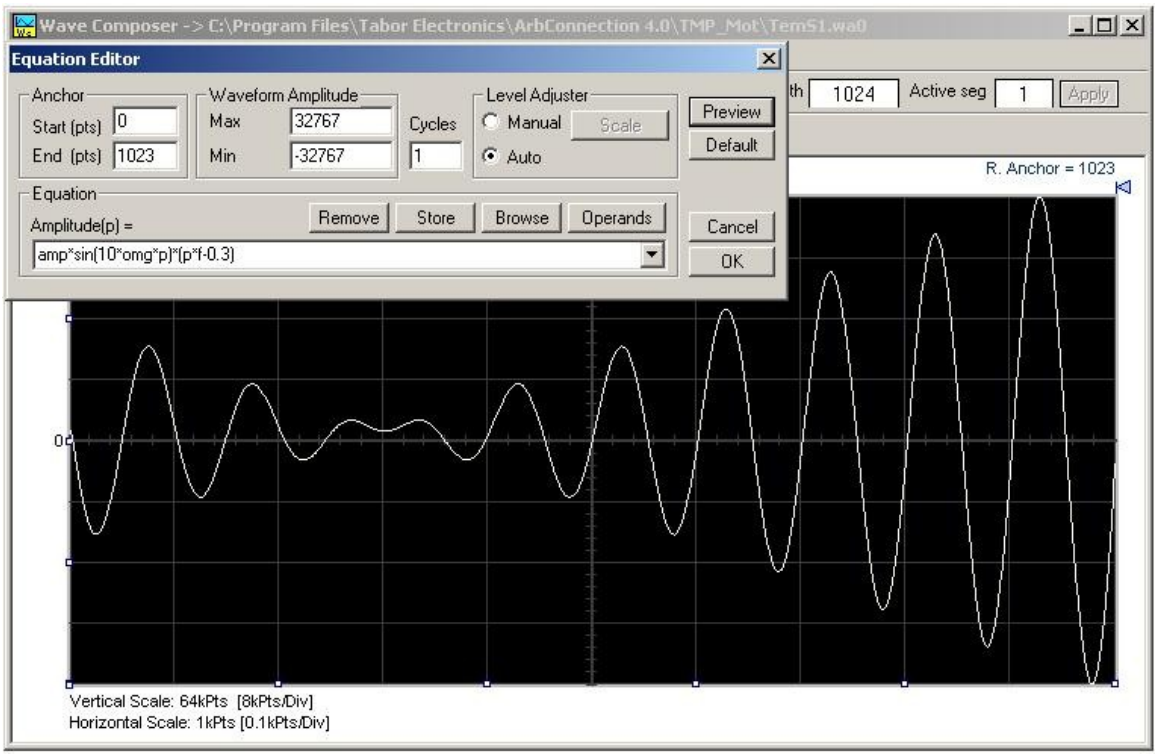

Figure 3-15, The Wave Composer Tool for Generating Arbitrary Waveforms

What Are Arbitrary Waveforms?

Arbitrary waveforms are generated from digital data points, which are stored in a working memory. The working memory is connected to a digital to analog converter (DAC) and a sample clock generator is clocking the data points, one at a time, to the output circuit. In slow motion, the output generates a waveform that resembles the look of a staircase. In reality, the DAC is generating amplitude hops that depend on bit arrangement and sample clock speed.

The working memory has two major properties: vertical resolution and memory depth.

Vertical Resolution – This term defines the precision along the vertical axis of which data points can be placed and generated by the DAC. The 2572 is using 16-bit DAC's to generate arbitrary waveforms. Converting 16 bits to precision shows that each data point can be placed along the vertical axis with a precision of 1/65,536.

Memory Depth – Defines how many data points can be stored for a single waveform cycle. The 2572 has 1M waveform memory capacity and 2M waveform memory as an option.

Having such large memory capacity is an advantage. Modern applications in the telecommunications industry require simulation of long waveforms without repeatable segments. The only way to create such waveforms is having sufficient memory depth. On the

other hand, if you do not need to use very long waveforms but must have many other waveforms stored in your working memory, the 2572 lets you divide the memory bank to smaller segments and load different waveforms into each segment.

Generating Arbitrary Waveforms

Downloading waveforms to the 2572 and managing arbitrary memory are explained in the programming section of this manual. This section assumes that you have already downloaded waveforms and want the instrument to output these waveforms.

Refer to Figure 3-16 and use the following description to learn how to output arbitrary waveforms and how to program arbitrary waveform parameters. To select Arbitrary waveforms as the output waveform type press Waveforms, then Arbitrary. The screen as shown in Figure 3-16 will display and the output will already generate arbitrary waveforms. Note the channel you are currently program and make sure the icon at the upper right corner agrees with your required programming sequence. Use the following procedure to modify the parameters that are associated with the arbitrary waveform function:

1. Press the soft key next to the required parameter to display the edit field
2. Punch in the value using the numeric keypad. Be careful not to exceed parameter limits while you key the numbers
3. Select and press a suffix
4. Press Enter to lock in the new value

Alternately, after you display the edit field, you may use the dial and/or the arrow keys to modify the field then, press Enter to lock in the new value. If you did not make programming errors and did not make any mistake while downloading your waveform segment(s), then the output should generate your desired waveform.

There are four parameters that are available for programming in this window:

Sample Clock – Defines the sample clock frequency for the arbitrary waveform. Information how to modify the sample clock is given in this chapter.

Amplitude – Defines the amplitude of the arbitrary waveform. Note that regardless of the amplitude setting, the vertical resolution of which the waveform is generated is always 14 bits.

Offset – Defines the offset value of the arbitrary waveform. The offset and the amplitude can be freely programmed within a 10V window (+5V to -5V rails).

Segment Number – Defines which of the segments in the working memory is currently active at the output connector. As was discussed earlier, the working memory can be divided to 2k

segments and different waveforms loaded in each segment. Any segment is available at the output connector only if it has been selected to be the active segment. The segment selection field lets you select any segment from 1 to n regardless if it contains waveform data or not so be careful when you select a segment number as it may be empty and no output will be generated.

Delete Segments – Allows distractive removal of all segments from the memory. In fact, this command does not erase the memory but only removes the table that defines start and stop for each segment location. If you have recorded your segment sizes you can always re-define the segment table, which will restore the original waveforms in each segment. There is however, no way back if you perform a download action after you delete the segment table.

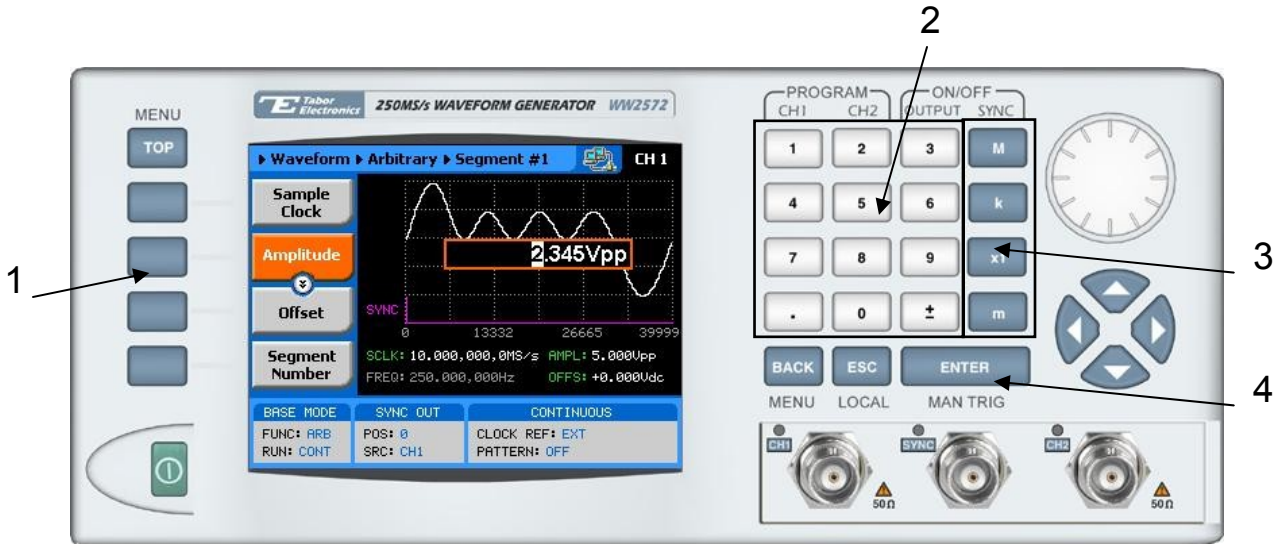

Figure 3-16, Programming Arbitrary Waveform Parameters

Generating Sequenced Waveforms

In general, the Model 2572 cannot by itself create sequenced waveforms. If you want to use sequenced waveforms, you must first load them into the instrument. The 2572 is supplied with waveform creation and editing, called – ArbConnection. Besides waveform creation, ArbConnection has instrument control features, sequence table generator, FM composer and many other features that will be described separately. To generate a sequence you must first download waveforms to the instrument, generate a sequence table and download the sequence table to the instrument. Sequences are generated easily using the waveform Studio as demonstrated in Figure 3-17. Note that different sequences can be generated for each channel.

Detailed information on the structure of the arbitrary waveform and the commands that are needed to download arbitrary waveforms to

the 2572 is given in Chapter 5. There, you can also find information how to create and download sequence tables using SCPI programming commands. Information in this chapter will give you some general idea what sequenced waveforms are all about.

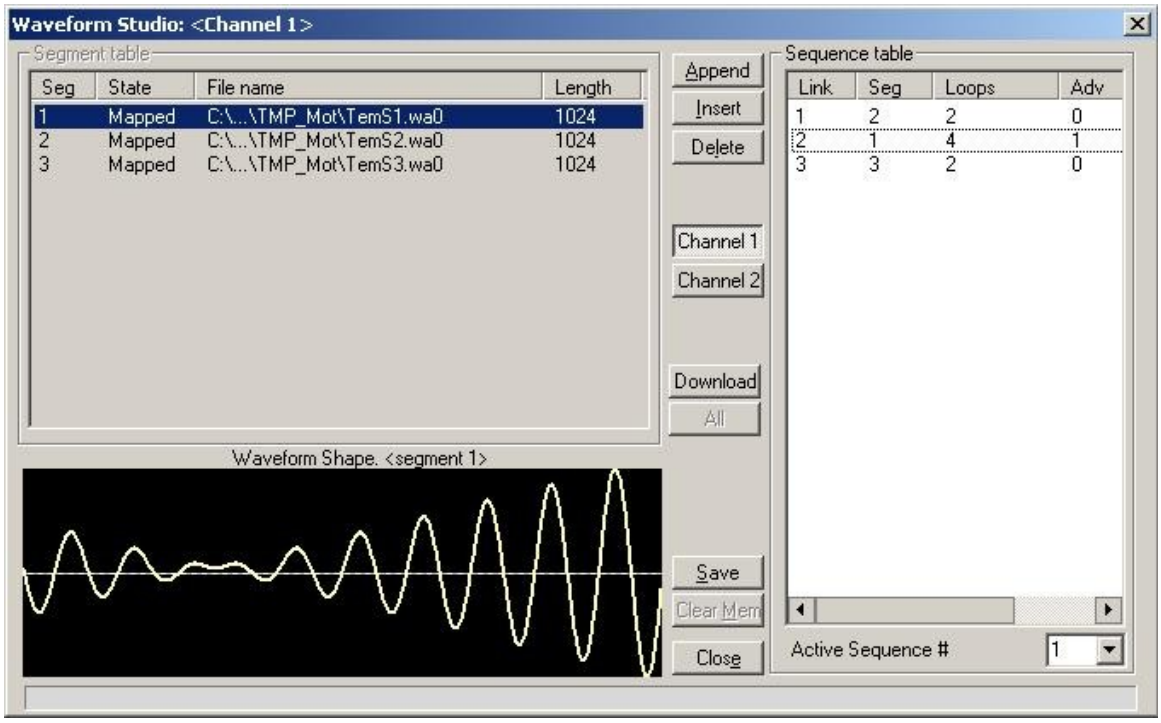
Waveform Studio: <Channel 1>
Segment table
Seg State File name Length
1 Mapped C:\...\TMP_Mot\TemS1.wa0 1024
2 Mapped C:\...\TMP_Mot\TemS2.wa0 1024
3 Mapped C:\...\TMP_Mot\TemS3.wa0 1024
Waveform Shape. <segment 1>
Append
Insert
Delete
Channel 1
Channel 2
Download
All
Save
Clear Mem
Close
Sequence table
Link Seg Loops Adv
1 2 2 0
2 1 4 1
3 3 2 0
Active Sequence # 1

Figure 3-17, Using ArbConnection to Generate Sequences

What Are Sequenced Waveforms?

Sequenced waveforms are constructed from two or more arbitrary waveforms, which are linked and looped in any way you can imagine, as long as you observe the limitations set forth in the specification section of this manual.

The first thing to do before you can generate sequenced waveforms is download waveforms to the 2572. You may use ArbConnection or any other application to create waveform segments. Then, you can build your sequence table. An example of how sequenced waveforms work with three different waveforms is demonstrated in Chapter 1, Figures 1-8 through 1-11.

The sequence table, as shown in Figure 3-17, specifies: Link, Seg, Loops and Adv. Description of the various elements within the sequence table is given below.

Link - This parameter defines an index array for the sequence generator. When generating sequences, the instrument steps though the link # in descending order therefore, make sure that you enter your waveform segments in exactly the order you would like

them at the output.

Seg - This parameter associates waveform segments with links. You can use different segments for different links or you can use the same segment for a number of links. There are no limitations how you associate links to segments, except you can not program in the sequence table segments that were not defined earlier.

Loops – This parameter define how many times the segment will loop for the selected link. For example, if you program 2, the waveform will cycle twice through the same segment before transitioning to the next link.

Adv – This field is a special code that is used in conjunction with the mixed advance mode. This bit flags the 2572 if the selected link is continuous or stepped. Information on the Mixed sequence advance mode is given later. “0” flags continuous, “1” flags stepped.

Assuming that you already downloaded waveforms, created and downloaded sequence table, you can proceed now with the following description how to set the 2572 to output sequenced waveforms.

Refer to Figure 3-18 and use the following description to learn how to output sequenced waveforms and how to program sequence parameters. To select Sequenced waveforms as the output waveform type press Waveforms, then Sequenced. The screen as shown in Figure 3-18 will display and the output will already generate arbitrary waveforms. Note the channel you are currently program and make sure the icon at the upper right corner agrees with your required programming sequence.

Use the following procedure to modify the parameters that are associated with the Sequenced waveforms function:

1. Press the soft key next to the required parameter to display the edit field
2. Punch in the value using the numeric keypad. Be careful not to exceed parameter limits while you key the numbers
3. Select and press a suffix
4. Press Enter to lock in the new value

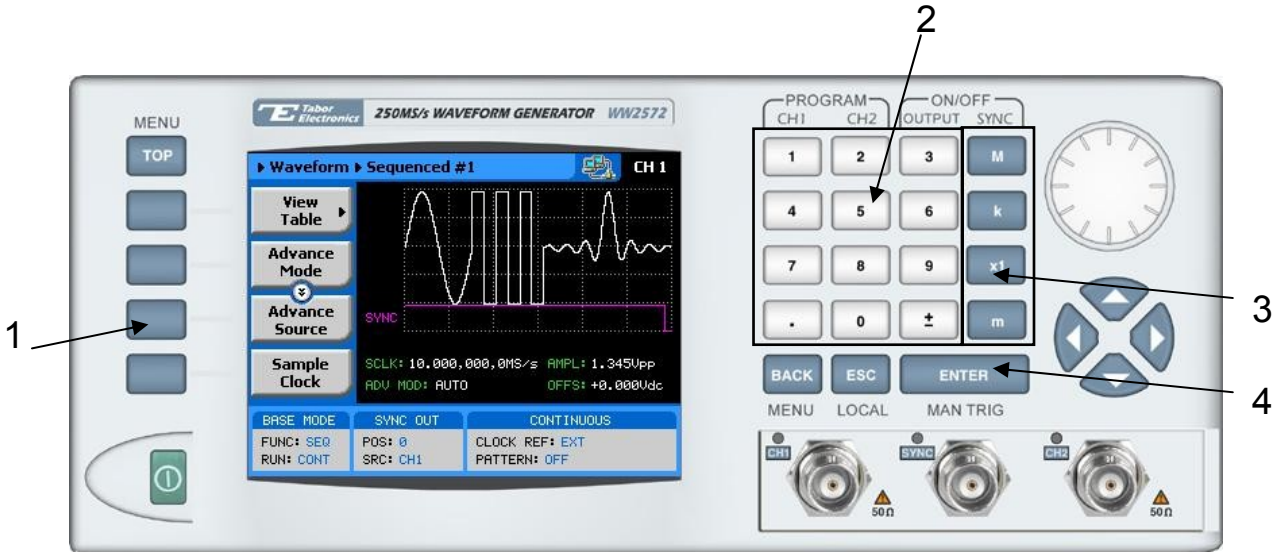

Figure 3-18, Sequence Parameters

Alternately, after you display the edit field, you may use the dial and/or the arrow keys to modify the field then, press Enter to lock in the new value. If you did not make programming errors and did not make any mistake while downloading your waveform segment(s), then the output should generate your desired waveform.

There are seven parameters that are available for programming in this window:

View Table – Provides access to a sequence table. If no table was yet defined, you can define the sequence table from this menu. You can also edit an existing sequence table from this command. Information on editing the sequence table is given later.

Advance Mode – Defines the advance mode for the sequence. There are four advance mode options you can select from: Automatic, Stepped, Single and Mixed. A description of the various advance modes is given later. Note that advance mode depends on run mode and therefore, if you selected continuous run mode for the 2572, you will not see the Single advance mode in the advance mode options list. Similarly, if you selected triggered run mode, Stepped and Mixed will be omitted from the list.

Advance Source – Defines which of the triggers inputs will advance the sequence. The advance source has no effect on Automatic advance source.

Sample Clock – Programs the sample clock frequency for the sequenced waveform. The final period of the complete sequence can be extracted from the following relationship:

$$\text{Sequence Duration} = 1 / (\text{SCLK} / n)$$

n = the number of waveform points in the sequence, including looped waveforms.

Amplitude – Defines the amplitude of the sequenced waveform.

Offset – Defines the offset of the sequenced waveform.

Active segment – Programs the active segment in a sequence. The SYNC will start at the active segment. There is no other purpose for this parameter in the sequence.

Tip

Use the arrow keys or the dial to scroll through the sequence parameters. The View Table will remain at the top while the others may be accessed selectively.

Editing the Sequence Table

If you select the View option as was described above, the sequence table will display as shown in Figure 3-19. If you already have a sequence table in place, you can edit the steps and modify the table per your new requirements. If you do not have a sequence table, you can construct the table from this screen however, you must make sure first that the segments you intend to use are loaded with waveforms.

Observe Figure 3-19 and note the commands that are available for editing and creating a sequence table.

Apply Changes – After you make modifications to the sequence table, you must use this command to update the internal registers with the new table settings and output updated immediately with the new settings. Changes, if made, in the table will be updated automatically when you exit the Edit Table screen however, the output will change to the new settings only after you re-enter the sequence function.

Edit Step – Provides entry point to the table. You may scroll between the fields using the arrow keys. If you want to edit a specific step, place the cursor on the step and press Enter. Edit the field as required and press Enter again to lock in the new value.

Insert Step – Allows adding another step to the sequence table. You have a choice of adding the step above or below the cursor line or at the end of the sequence table.

Go to Step – Provides entry point to the sequence table at a specific step number. Continue editing the step as described above.

Delete Step – Use this command to delete a specific step from the sequence. You'll be asked to confirm if you really want to delete the step before the final execution.

Delete Table – Use this command to delete the entire sequence table. You'll be asked to confirm if you really want to delete the step before the final execution.

Tip

Use the arrow keys or the dial to scroll through the edit parameters. The Apply Changes will remain at the top while the others may be accessed selectively.

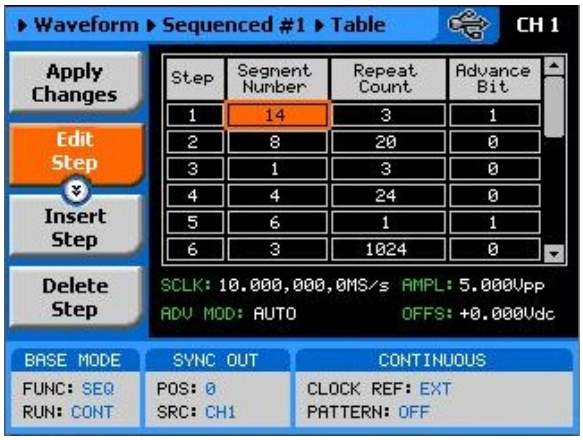

Figure 3-19, Editing the Sequence Table

Selecting Sequence Advance Modes

As was explained above, the 2572 steps through an index of links; It may loop a few times on a designated link and eventually, after the last link, the process repeats itself. Stepping from link to link through the sequence table is done automatically by the instrument. However, there are applications requiring control when and how the link is stepped. The 2572 has a number of sequence advance options: Auto, Stepped, Single and Mixed. These advance modes are described in the following.

Automatic – specifies continuous advance where the generator steps continuously and automatically through the links to the end of the sequence table and then repeats the sequence from the start. For example, if a sequence is made of three segments – 1, 2, and 3, and AUTO mode is used, the sequence will generate an infinite number of 1, 2, 3, 1, 2, 3, 1, 2, 3…waveforms. Of course, each link (segment) can be programmed with its associated loop (repeat) number. AUTO is the default sequence advance mode. Note, to use this mode, the 2572 must be in *continuous* operating mode.

Stepped – Using this advance mode, the sequence is advanced to the next link only when a valid trigger is received. The output of the 2572 generates the first segment continuously until a trigger signal advances the sequence to the next link. If repeats were selected for a segment, the loop counter is executed automatically. Note, although the trigger input controls advanced steps, to use this mode, the 2572 must be in *continuous* operating mode.

Single – Using this advance mode, the 2572 idles between steps until a valid trigger signal is sensed. The single advance mode requires that the 2572 be in trigger operating mode only. An attempt to select the Single advance mode when the instrument is in continuous operating mode can not be done. When triggered, the generator outputs one waveform cycle. Then, the output level idles at a DC level equal to the last point of the last generated waveform. If loops were programmed, the output will repeat this segment for n times automatically. Only after executing all of the programmed loops will the sequence step to the next assigned link.

Note

To use the single advance mode, the 2572 must be in programmed first to *triggered* run mode.

Mixed – This sequence advance mode allows combination of automatic and stepped links in one sequence table. To use this mode, in the sequence table, mark the Adv field "1" to flag stepped link or "0" for continuous link. Then, download the sequence table to the 2572. Note, to use this mode, the 2572 must be in *continuous* operating mode. Step with a "0" bit assigned to a step it will advance automatically to the next step. If "1" is assigned to a step, the instrument will generate this step and its associated number of repeats then, will wait for the next trigger to advance to the next step.

1. Refer to Figure 3-20 and select the Advance Mode with the appropriate soft key. The advance mode options, as shown in Figure 3-20 will display. Use the dial or arrow keys to scroll down to the required mode and press Enter to lock in the selected mode.

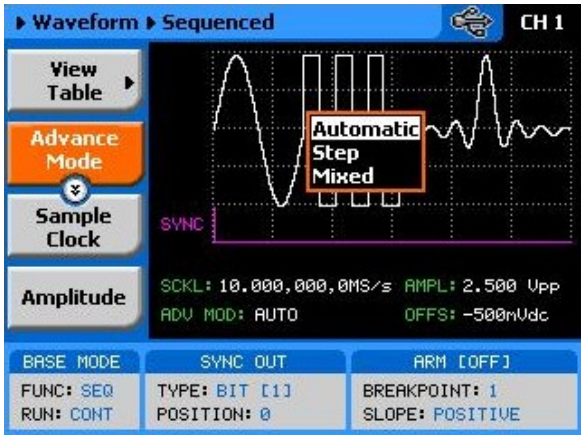

Figure 3-20, Sequence Advance Options

Note

The operating mode of the instrument, as selected from the Run Modes menu, affects the way that the 2572 lets you access the sequence advance mode parameter. If you are in continuous mode, as shown in Figure 3-20, you can select one of: AUTO, STEP, or MIXED. If you already selected the triggered run mode, you'll be able to select from AUTO, or SINGLE only as advance modes.

Generating Modulated Waveforms

Utilizing DDS (direct digital synthesis) technology, the Model 2572 is extremely frequency-agile. Changing the sample clock frequency is as easy as changing bits at the DDS control. The DDS has an extremely wide dynamic range with excellent linearity throughout the complete range. The properties of the DDS are passed on directly to the output therefore, the frequency is modulated within an extremely wide band, without loosing linearity. For example, the 2572 can sweep linearly from minimum to its maximum frequency whereas similar instruments that use the standard VCO design can sweep through 3 decades only.

The 2572 has the following modulation options: OFF, AM, FM, FSK, PSK, Hop and Sweep. These functions are described below.

Modulated waveforms are selected from the waveforms menu. Figure 3-21 shows how to select the FM. To access this menu, press TOP, then waveforms and select the Modulated waveforms option.

Modulation type is selected from the Modulation Type menu. Refer to Figure 3-21 and use the following procedure to select the modulation type.

1. Press on the Modulation Type soft key. The following options will display: Off, AM, FM, FSK, PSK, Hop and Sweep
2. Using the dial or the up and down arrow keypad, scroll down to the desired option
3. Press Enter to lock in the selected modulation type. The output will be updated immediately after you press the Enter button.

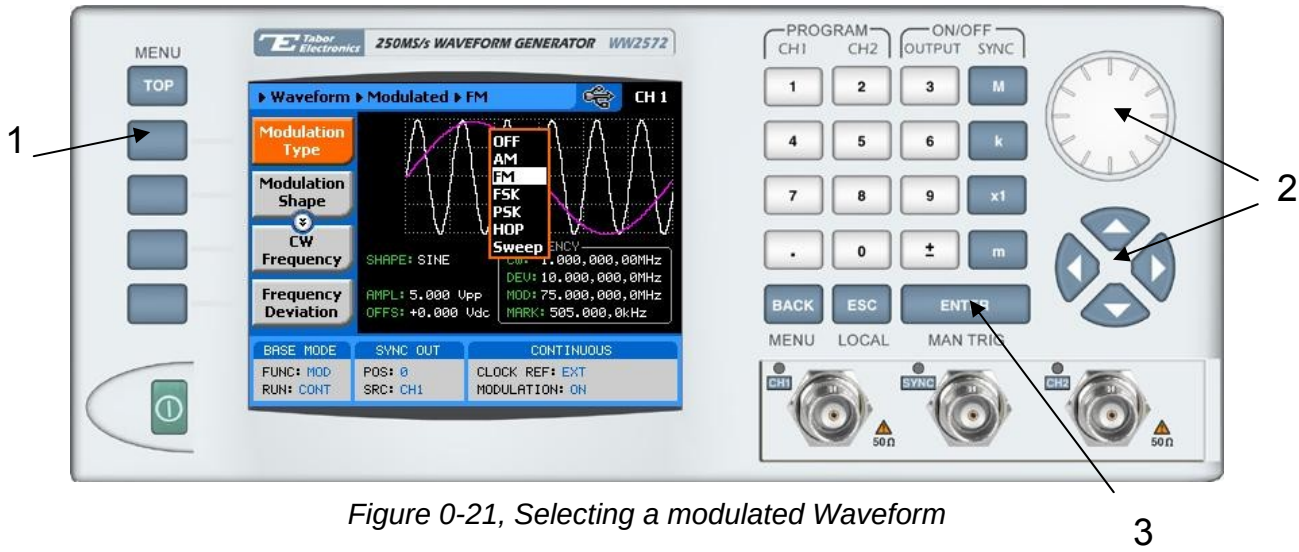

Figure 0-21, Selecting a modulated Waveform

Off

In modulation OFF, the output generates continuous Carrier Waveform frequency. The carrier waveform is sinewave and its frequency can be programmed using the CW Frequency menu. The value programmed for the CW Frequency parameter, is used for all other modulation functions.

Amplitude and offset can also be programmed from the modulation off menus, as shown in Figure 3-22.

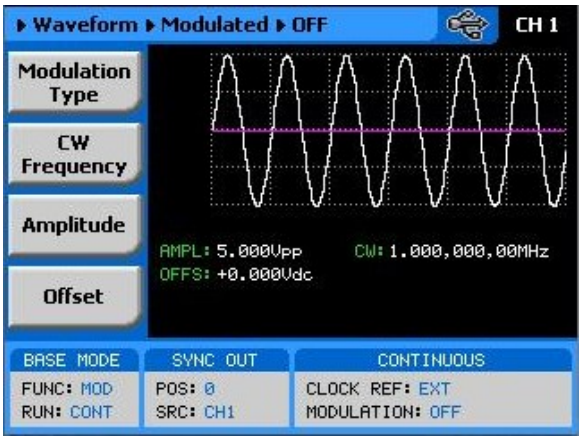

Figure 03-22, Modulation OFF Parameters

AM

When AM is selected, the menus that are associated with AM will be accessible. The AM function has a number of menus that control the modulation parameters. These are shown in Figure 3-23 and described in the following paragraphs:

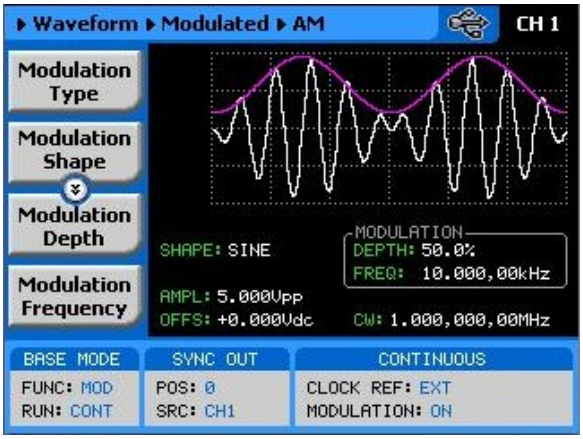

Figure 03-23, AM Menus

Modulation Shape – selects between the following shapes: sine, triangle, square or ramp waveforms.

The carrier waveform (CW) is always sine wave and the waveform that modulates the CW, normally referred to as envelop waveform, can be selected from the following waveform shapes: sine, triangle, square or ramp waveforms. The Modulation Shape menu that provides access to the selection of the envelop waveform is shown in Figure 3-24.

Modulation Depth – programs the modulation depth. The depth is programmed in units of percent.

Modulation Frequency – defines the frequency of the modulating waveform.

CW Frequency – programs the carrier waveform frequency. The shape of the carrier waveform is always sine wave.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

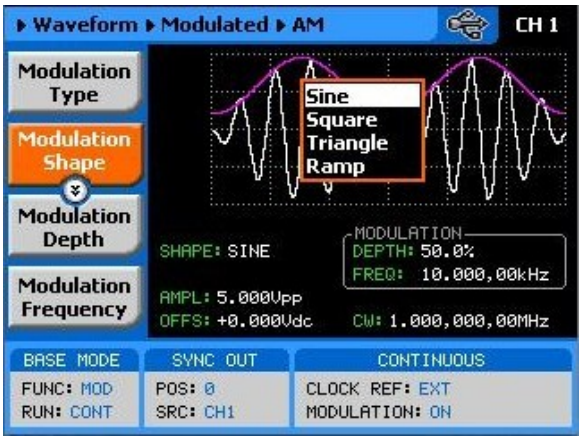

Figure 03-24, Modulating Waveform Shapes

FM – Standard Waveforms

Frequency modulation is the most common modulation scheme used in telecommunications. In this mode, the carrier waveform (CW) is modulated by an internal modulating waveform. The FM function has a number of menus that control the modulation parameters. These are shown in Figure 3-25 and described in the following paragraphs:

Modulation Shape – Defines the shape and type of the modulating waveform. Although there are 5 options shown in the menu, there is a significant difference between the first four: Sine Triangle, Square and Ramp, and the last option – Arbitrary. The two types are described below. The Modulation Shape menu that provides access to the selection of the envelop waveform is shown in Figure 3-26.

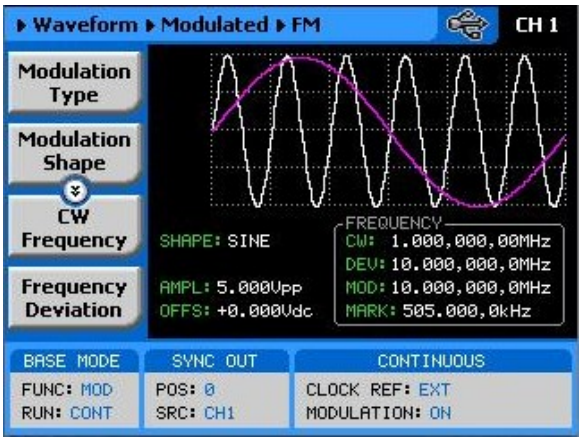

Figure 0-25, FM Modulation Parameters

CW Frequency – programs the carrier waveform frequency. The shape of the carrier waveform is always sine wave.

Frequency Deviation – programs the frequency deviation of the modulating waveform. The deviation is normally programmed as peak to peak deviation from the center (CW) frequency.

Modulation Frequency – programs the frequency of the modulating waveform.

Marker – programs the frequency position of the marker. The marker is output through the front panel SYNC OUT connector as a single pulse when the CW frequency is equal to the marker frequency setting.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

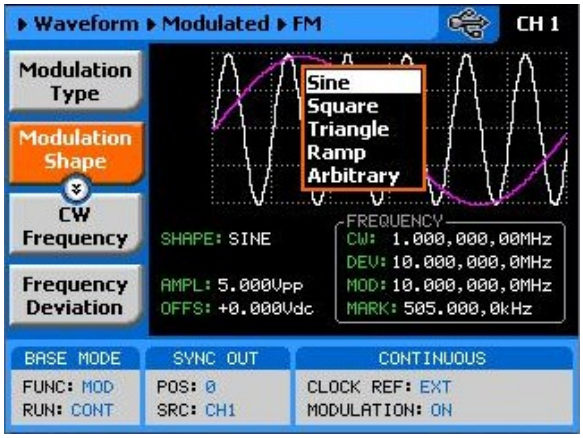

Figure 0-26, Modulation Waveform Shapes

FM – Arbitrary Waveforms

There are two separate FM functions within the 2572 of which differ in the way that the carrier is being modulated. Looking at Figure 3-26, the first four modulating waveforms are created internally by the instrument and their parameters can be characterized by the user wither from the front panel or from a remote interface. The arbitrary modulating waveform option opens an avenue for the user to create proprietary and application specific waveforms that will be used for modulating the carrier waveform. The arbitrary modulating waveform must be created and downloaded to the instrument; It is being downloaded to a special memory, separate to the main arbitrary working memory and thus, one can create arbitrary waveforms and modulate them with an arbitrary modulating waveform where the only limitations are memory size and creativity. The 2572 is supplied with an FM composer that lets you create, edit, store and download arbitrary modulating waveforms.

The arbitrary modulating waveform you will create and download to the 2572 resides in a separate and dedicated memory; It can be programmed to have variable length (4 to 20000 points) and has a separate and independent sample clock control (9 digits, 1S/s to 2.5MS/s). The equivalent minimum and maximum modulating frequencies you can generate with the arbitrary FM are 50µHz to 1.6MHz. While the low frequency is very useful in applications like wander and slow drifting oscillators, the higher frequencies are as much needed for testing fast modems, PLL circuits and for wide-band digital modulation technology.

The arbitrary FM function has a number of menus that control the modulation parameters. These are shown in Figure 3-27 and described in the following paragraphs:

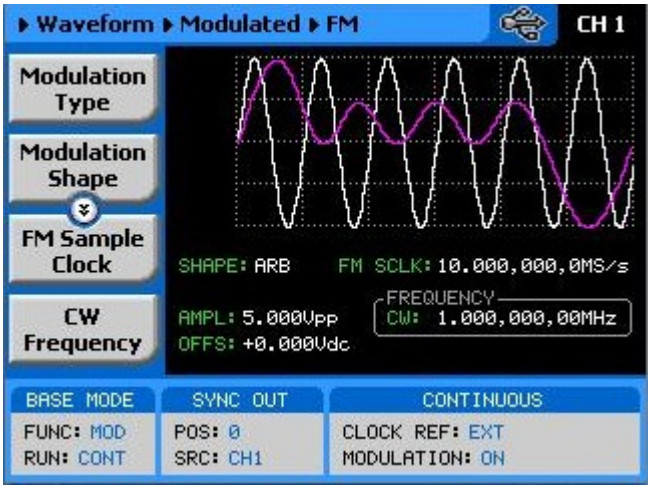

Figure 03-27, Arbitrary Frequency Modulation menus

FM Sample Clock – programs the sample clock for the arbitrary modulating waveform. Do not confuse sample clock setting with the FM sample clock setting as these are two parameters that derive from two independent generators. This is extremely convenient in cases where you want to modulate an arbitrary waveform with an arbitrary modulating waveform. An FM composer example of an arbitrary modulating waveform is shown in Figure 3-28.

CW Frequency – programs the carrier waveform frequency. The shape of the carrier waveform is always sine wave.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

Tip

Use the arrow keys or the dial to scroll through the FM parameters. The Modulation Type option will remain at the top while the others may be accessed selectively.

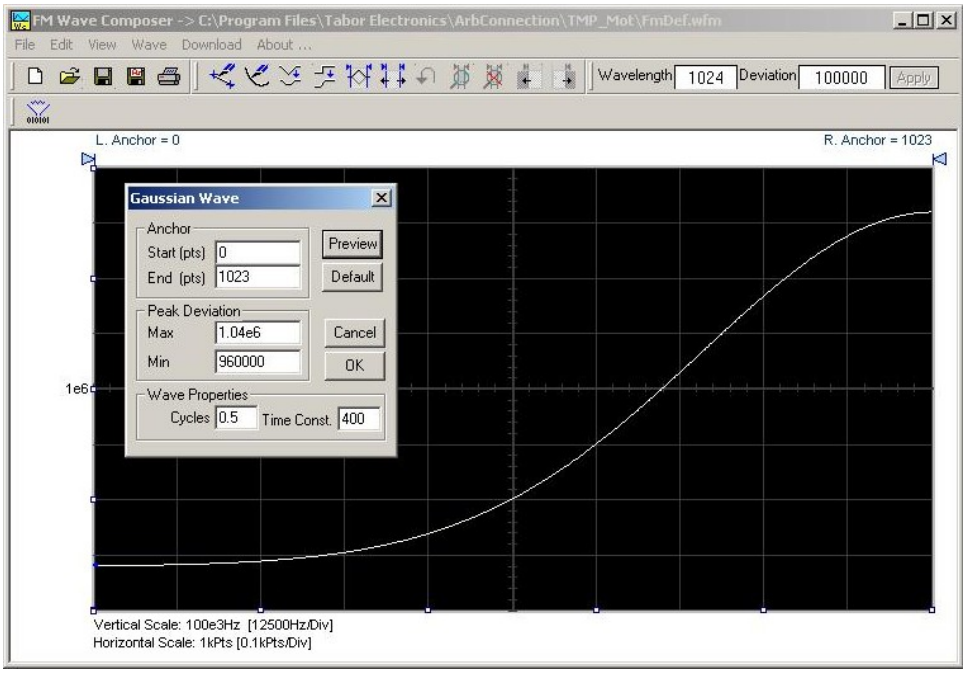

Figure 0-28, Using ArbConnection to Generate Arbitrary Modulating Waveforms

FSK

In Frequency Shift Keying (FSK), the output of the 2572 hops between two frequency settings: carrier and shifted frequency. The FSK sequence is designed in an FSK table that can either be loaded from the front panel or downloaded from a remote interface from a utility such as ArbConnection. An example of the FSK table, as created in ArbConnection, is shown in Figure 3-29.

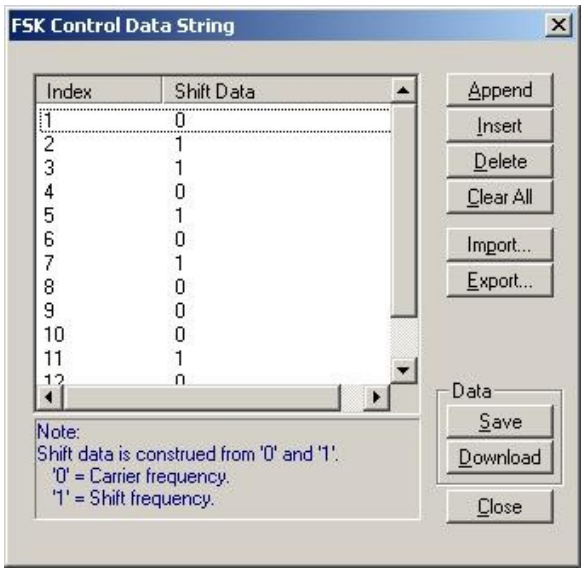

Figure 3-29, FSK Control Data String Example

When you select FSK modulation, the parameters, as shown in Figure 3-30 and described in the following paragraphs, will be available for modification:

CW Frequency – programs the carrier waveform frequency. The shape of the carrier waveform is always sine wave.

Shifted Frequency – programs the shifted frequency parameter.

Baud – programs the rate of which the frequency shifts between frequencies. Baud is programmed in units of Hz.

Marker – programs the location of the marker pulse along the shift sequence. The marker pulse is output from the SYNC output connector.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

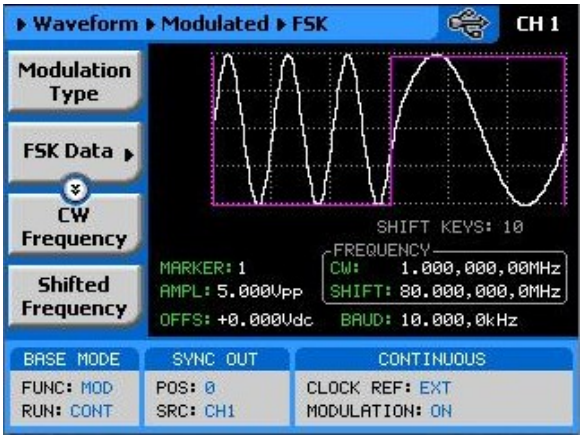

Figure 0-30, FSK Menus

PSK

In Phase Shift Keying (FSK), the output of the 2572 hops between two phase settings: start and shifted phase while the frequency of the carrier waveform remain the same. The PSK sequence is designed in a PSK table that can either be loaded from the front panel or downloaded from a remote interface from a utility such as ArbConnection. An example of the PSK table, as created in ArbConnection, is shown in Figure 3-31.

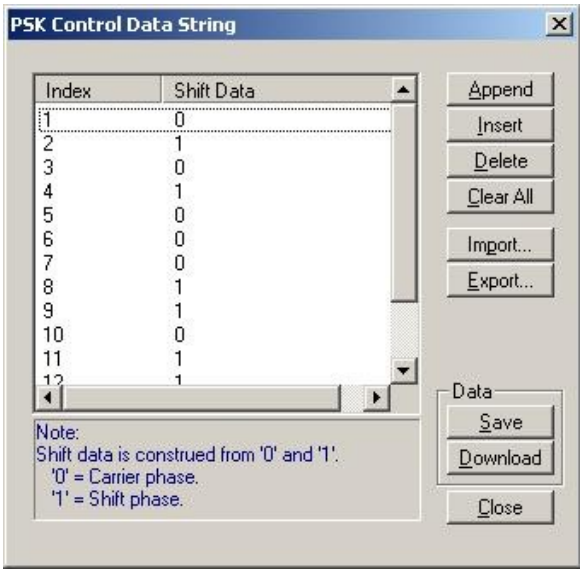

Figure 3-31, PSK Control Data String Example

When you select PSK modulation, the parameters, as shown in Figure 3-32 and described in the following paragraphs, will be available for modification:

CW Frequency – programs the carrier waveform frequency. The

shape of the carrier waveform is always sine wave.

Start Phase – programs the start phase of the PSK sequence.

Shifted Phase – programs the shifted phase parameter.

Baud – programs the rate of which the phase shifts the two settings. Baud is programmed in units of Hz.

Marker – programs the location of the marker pulse along the shift sequence. The marker pulse is output from the SYNC output connector.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

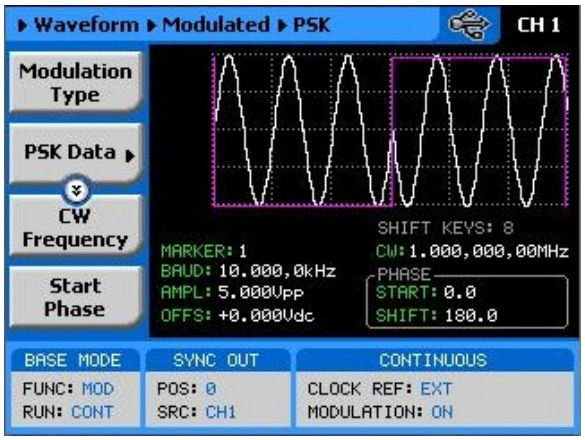

Figure 03-32, PSK Menus

Hop

In frequency hop mode, the output waveform (sinewave) hops from frequency to frequency in a sequence defined by the hop table. There are two hop types:

1. Frequency hops with fixed dwell time and
2. Frequency hops with variable dwell time

Dwell time defines the time that the frequency will remain stable and of which the frequency will change at the end of this interval. With the fixed dwell time, the waveform hops from frequency to frequency at constant intervals, defined by the fixed dwell time parameter. When the variable dwell time is selected, each hop can be programmed to have a unique dwell interval.

When you select hop modulation, the menus, as shown in Figure 3-33 and described in the following paragraphs, will be available for modification:

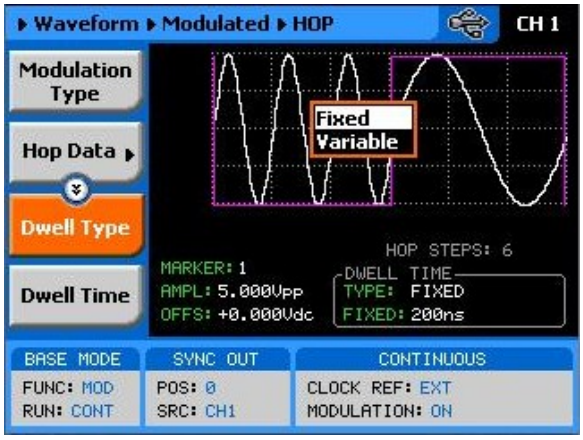

Figure 03-33, Frequency Hop Menus

Hop Data – allows programming and editing of the hop table. The hop table depends on the Dwell Type selection and will display the dwell time parameter only if the variable dwell time option has been selected. The hop table as shown in Figure 3-34 is an example how such table are programmed from ArbConnection.

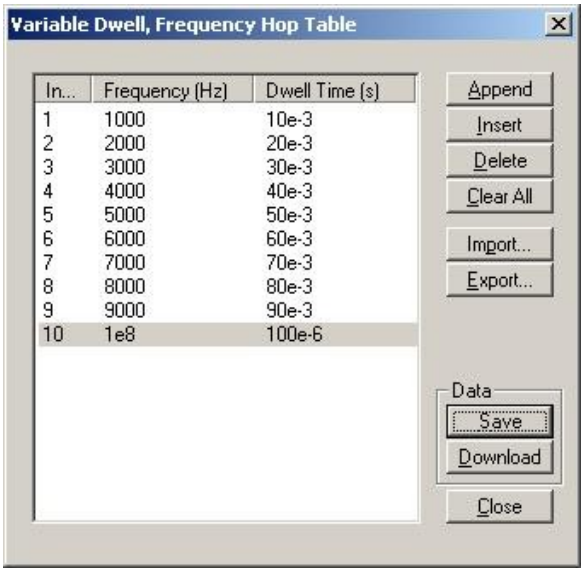

Figure 03-34, Variable Dwell Time Hop Table Example

Dwell Type – selects between Fixed – constant dwell time for each hop, or Variable – programmable dwell time for each hop.

Dwell Time – programs the dwell time for the fixed dwell time.

Marker – programs the location of the marker pulse along the hop sequence. The marker pulse is output from the SYNC output connector.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

Sweep

In sweep modulation, the 2572 sweeps from start to stop frequencies at a rate set by the sweep time.

When you select sweep modulation, the menus, as shown in Figure 3-35 and described in the following paragraphs, will be available for modification:

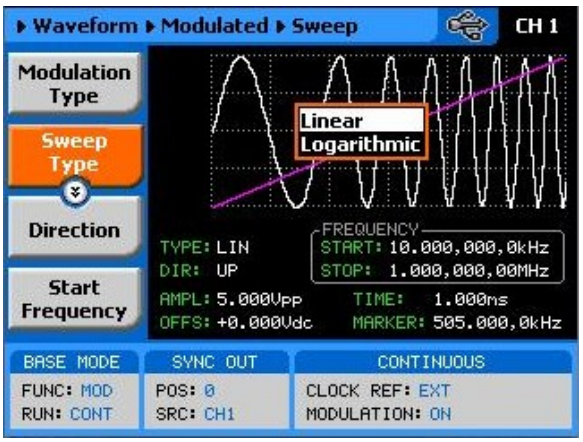

Figure 03-35, Sweep Menus

Sweep Type – defines the steps of which the frequency increments or decrements from start to stop frequencies. A choice is provided between linear and logarithmic steps. If you select linear sweep the carrier waveform frequency steps through the frequencies within a time interval which is set by the sweep time parameter. Likewise, using the logarithmic sweep type, the frequency span between the start and stop frequencies is stepped through using logarithmic steps.

Direction – defines the sweep direction. UP sets sweep direction from start frequency to stop frequency; DOWN reverses the sweep direction so the output sweeps from stop frequency to start frequency.

Start Frequency – programs the start frequency value for the carrier waveform.

Stop Frequency – programs the stop frequency value for the carrier waveform.

Sample Clk – This parameter specifies where the sweep will stop.

Note that sweep stop does not necessarily have to have lower value than the sweep stop frequency. If you define sweep stop frequency higher than the sweep start frequency, then the generator will sweep up. You can also reverse the direction of the sweep by using the sweep direction parameter.

Sweep Time – sets the time that will lapse for the 2572 output to execute one complete sweep cycle.

Marker – defines a frequency of which, when transitioned through, will output a marker pulse at the SYNC output connector. The default position of the marker is the sweep start frequency.

Amplitude – programs the amplitude of the carrier waveform.

Offset – programs the offset of the carrier waveform.

Adjusting Phase Offset between Channels

The 2572 has two output channels that can generate various and numerous waveforms. Although the control over waveform parameters is separate for each channel, the sample clock is derived from a single source. Having a single source for both channels is of great advantage because of two main reasons: 1) There is no jitter between the two channels and 2) If we ignore the initial skew, both waveforms start at exactly the same phase.

Understanding the initial skew term is very important. If you set both channels to output square waveforms and then connect these signals to an oscilloscope; If you then set the oscilloscope to its fastest time base setting, you'll see the two rising edges of the 2572 signals. They do not overlap exactly because the instrument has a skew spec of ±2 ns.

Skew is caused as a result of many factors. Although the two channels were designed exactly the same, small variations in printed circuit board layout or component values are enough to cause skew. These factors were known during the design phase and were minimized as practical. On the other hand, skew can also be generated from external factors that are controlled by the user alone. Examples for these factors are variation in cable length and quality, as well as, non-symmetrical end termination. Therefore, if you want to eliminate skew between channels, you have to use exactly the same cable type, the same cable length and the same termination on both channels.

There are times, however, that you do need to offset phase between channels. In that case, the 2572 lets you adjust phase-offset variations with resolution of one point. When you do, just keep in mind that the initial skew will escort your programmed phase offset throughout the entire phase offset range.

Notice that phase offset resolution is given in points, not degrees.

This is because the 2572 can generate arbitrary waveforms that you download from an external application. After you download waveforms, there is no way for the instrument to determine phase because all it has is just number of points and no further knowledge of the shape of your waveform. If you insist, you can convert points to degrees on your waveform from the following equation:

Phase (in °) = Phase point x 360 / number of waveform points

If you are using standard waveforms, you can determine the number of points that the 2572 is using from the standard waveform. Note the Freq and the SCLK values. The number of points is derived from the following relationship:

Number of Waveform Points = SCLK / Freq

Knowing the number of points, you can easily calculate the phase point from the above equation.

When you modify the phase offset parameter, you are offsetting the phase of channel 2 in reference to edge of channel 1. For example, if you program phase offset of 100 points and check the results on an oscilloscope, what you should expect to see is channel 1 start phase lagging channel 2 by 100 points.

Phase offset between channels is programmed in the Outputs menu, as shown in Figure 3-36. Place the cursor on the CH2->CH1 field and press Enter. Modify the value using the numeric keypad or the dial and then press Enter to lock in the new value.

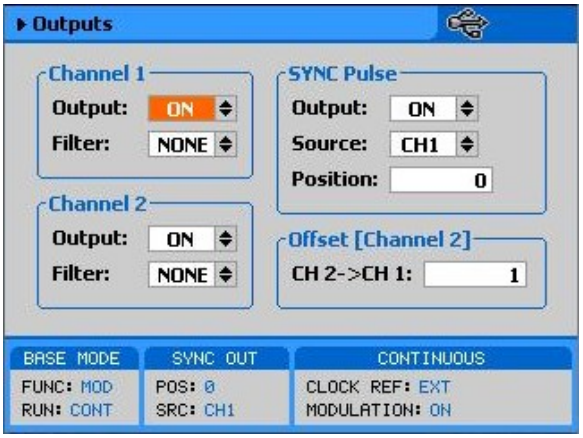

Figure 03-36, Adjusting Phase Offset between Channels

Generating Digital

Channel 1 can be programmed to output digital patterns through a 68 pin high density, SCSI-2 connector that is located on the rear

Patterns

panel. The output level is LVDS (Low Voltage Differential Signal) logic level. The digital patterns are derived from lines that are connected to the DAC and therefore, when the digital pattern output is enabled, the 16 bits that drive the DAC are routed to this connector. The digital patterns are designed in an external software utility such as ArbConnection and then downloaded to the instrument using a remote interface. The patterns are written in a simple table (hex words) as shown in Figure 3-37.

Patterns can be used with or without the main output turned on. He recommended way to use the patterns is of course generating arbitrary waveforms from channel 2 and patterns from channel 1 however, one can use the channel 1 output and in parallel generate the digital patterns from the rear panel to synchronize to other devices.

Patterns are turned on from the Utility menu, as shown in figure 3-38. Invoke the Utility menu and scroll down to the Remote Setup option, then press Enter. The dialog box as shown in Figure 3-39 will provide access to the digital pattern menus. The parameters are discussed in the following paragraphs.

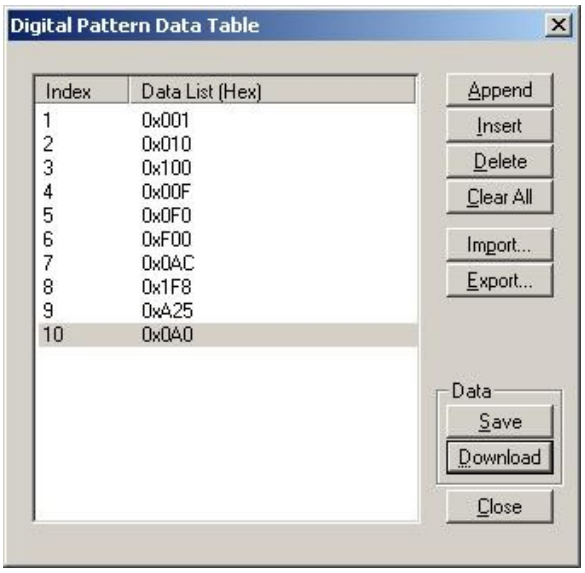

Figure 03-37, Digital Pattern Data Table Example

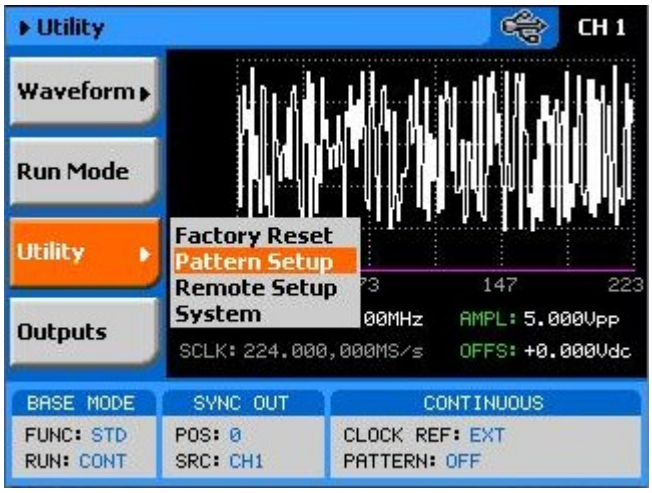

Figure 0-38, Selecting the Digital Patterns Setup Menus

State On/Off – turned the digital pattern output on and off. This switch affects the rear panel connector only. In the On state, the digital pattern outputs are active and generate parallel LVDS data into a terminated load source. The channel 1 front panel output can be turned off if signal is not required through this connector. In the Off state, the rear panel connector is inactive.

Sample Clock – defines the sample clock rate for the digital output. Note that the same parameter is used for the arbitrary and sequenced waveforms and therefore, it can be accessed from other menus as well.

Go to Line – provides access to a specific line in the pattern sequence. Line cannot be added from the front panel as patterns can be downloaded from a remote controller only however, when a line is accessed from the front panel, it can be modified using the field modification procedure as described in many instances in this chapter.

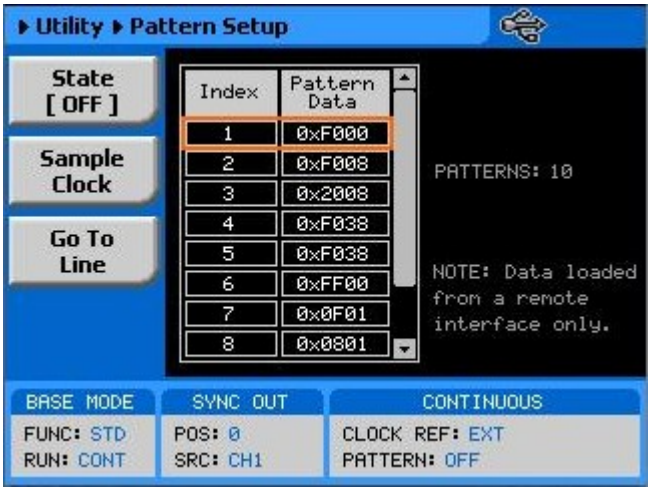

Figure 03-39, Digital Pattern Menus

Chapter 4
ArbConnection

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What's in This Chapter?

This Chapter contains information how to install, invoke and use ArbConnection. Introduction to ArbConnection and examples how to program instrument controls and parameters and how to generate waveforms and download them to the 2572 are also given in the following sections.

Introduction to ArbConnection

In general, ArbConnection is a utility program that serves as an aid for programming the Model 2572. ArbConnection has many functions and features of which all of them share a common purpose – controlling 2572 functions from remote. As minimum, to use ArbConnection, you'll need the following tools:

1. Computer, Pentium III or better
2. Windows 2000/XP, or higher
3. High resolution screen, at least, 1024 x 768 pixels
4. Pointing device, mouse or ball
5. Visa 2.6, or higher installation
6. Last, but not least, some basic knowledge how to operate computers and Windows-based programs.

ArbConnection operation is divided into three main functions: 1) Front panel control, 2) Waveform generation and editing and 3) FM waveform generation and editing. These operating options are described in this chapter however, you must install ArbConnection before you can use it. The next paragraphs describe installation and first steps before going into in-depth operation.

Installing ArbConnection

The installation program installs ArbConnection on a logical drive of your choice. The default is drive C. It automatically creates a new directory and copies the files that are required to run the program. Before you install ArbConnection, make sure that there is at least 10 megabytes of available memory on your hard disk drive.

To install ArbConnection, insert the distribution disk in the A: drive.

Invoke Run and type:

```
A:\Setup
```

The install program does the complete job far you and creates a workgroup and icons to start ArbConnection.

Quitting ArbConnection

Before you start roaming through menus and editing commands, we strongly recommend that you make yourself familiar with ArbConnection basics and concept. For now quit the program and spend some more time with this section of the manual. Point the mouse cursor to the File menu and press the left mouse button. Move the mouse cursor to the Exit command and press the left mouse button.

For the New and Advanced Users

For the New User
Learning to use ArbConnection is easy, intuitive and quick, even if you have never used such programs before. After you have installed ArbConnection on your computer read the following paragraphs to learn how to find your way around ArbConnection's menus.

Once you are familiar with the basics, you'll continue to learn about features, programming, and editing commands. If you can't find the answer to a question in this guide, call your distributor or the LeCroy customer support service near you and we'll gladly assist you with your problems.

For the Advanced User
If you are already familiar with computer conventions and have basic knowledge of Windows programming, you may want to skip some of the following paragraphs.

Conventions Used in This Manual

This manual uses certain typographical conventions to make it easier for you to follow instructions. These conventions are described in the following:

[Enter, or ↵] Press the Enter or Return key.

[Esc] Press the Escape key.

[Alt-F] Press the Alt key and the key that follows, simultaneously. In this example the key that follows is F.

[Ctrl-S] Press the Control key and the letter that follows, simultaneously. In this example, the letter is S. The control key also appears in the menus as a target sign.

[↑] [↓] [→] [←] Press the Arrow key with the symbol pointing in the direction specified (i.e., up, down, left, or right).

<+> Press the key for the character or word enclosed in angle brackets. In this case, the Plus sign key.

The Opening Screen

Invoke ArbConnection by double clicking on the icon. If you cannot find the icon on your desktop, click on Start, Programs and ArbConnection. The opening screen will show. If you installed the program correctly, your screen should look as shown in Figure 4-1.

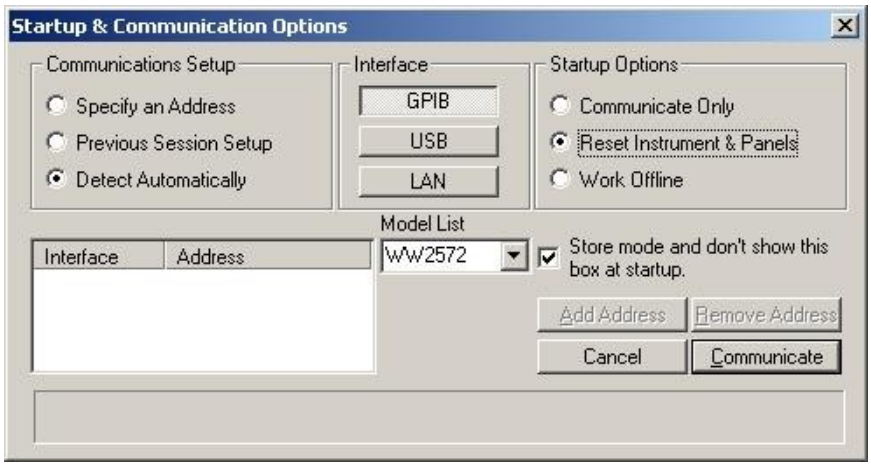

Figure 4-1, Startup & Communication Options

The Startup & Communication Options dialog box is displayed. You can check the “Store and don’t show…” so next time you invoke ArbConnection, this dialog box will not be displayed. The purpose of this dialog box is to update the program in the way you intend to use it. For example, if you are using a GPIB device that has address 4, you can click on the Specify an Address option and type in the required address so the next time you use ArbConnection, the program will automatically resume communication with the same address as was originally detected.

If you chose to hide this dialog box, you can still access and change the options from the System command, at the top of the screen.

Make your selection and click OK. The Startup & Communication Updater dialog box will be removed from the screen. And the Main panel will now be accessible. But before we go into panel operation, let’s look at the toolbars at the left top of the screen as shown in Figure 4-2.

Figure 4-2, ArbConnection's Toolbars

The standard Windows **Menu Bar** is the top bar. It provides access to main system controls like saving files, and viewing or removal of screen images.

The second bar is called **Link** bar. It provides direct access to different instruments that are active on the active interface bus. ArbConnection can control a number of 2572 units simultaneously. If the instruments were connected to the interface while invoking ArbConnection, they will automatically be detected by the program and will be placed in the Link pull-down window. The active instrument is displayed with its associated address. If you run ArbConnection in offline mode, the Link bar will show 2572, Offline.

The **Panels** bar provides direct access to instrument control panels. The individual control panels are explained later in this chapter. The MAIN, STD, ARB, TRIG, MOD1 and the other buttons will bring up to the screen panels that are associated with these names. The WAVE and FM buttons will open the waveform and FM waveform composers. The first time you launch ArbConnection, the opening screen will have the Main panel open. Click on other buttons and interactively get the feel how ArbConnection opens and closes control panels.

ArbConnection Features

ArbConnection's main purpose is controlling 2572 functions and parameters. The 2572 can generate standard waveforms from a built-in library, arbitrary waveforms from user-downloaded coordinates, modulated waveforms, digital patterns and much more. The only way to access all of these features is through software utilities such as Plug & Play drivers, and soft front panels. ArbConnection is built to provide complete control over the 2572.

ArbConnection has four main screens: 1) Control panels, 2) Waveform composer 3) FM composer and 4) Pulse Composer. The various screen images along with instructions how to access and use them are described below in detail.

The Control Panels

The control panels look and feel just as if you would operate an instrument from its front panel. They even look like instrument front panels, so operating function and changing parameters is easy and intuitive. Let's look at the first panel that shows at the opening screen. This panel, as shown in Figure 4-3, is called the Main Panel.

To begin with, let's explore the panel controls to see how they feel, react and what they do. All other panels share almost the same feel, so the description of how to operate the Main Panel can serve as general guide for controlling the rest of the panels.

Looking at the panel you can identify the following controls: Push buttons, LED's, radio buttons, Dial and Digital display. The function of each control is described below.

Push Buttons – These are used for toggling a function on and off. For example, the Output Enable button in the Output group toggles the output on and off. The first mouse click will push the button inwards and will turn on a red bar at the center of the button, indicating that the function is on. The second mouse click will turn the function off.

Radio Buttons – Are used for changing operating modes, or selecting between mode options. One of the radio buttons is always on with a red dot in its center, indicating its state condition.

LED's – The LED's indicate which of the parameters are displayed on the Digital Display. Red LED indicates that the parameter name next to this LED is selected. Only one LED can be ON at a time.

HINT

LED's are turned on by clicking on the LED or the text next to it. The selected parameter is flagged by a darker LED shade.

Dial – Use the dial to modify displayed reading. To use the dial, press and hold the mouse cursor on the dial and move the mouse in a clockwise circle to increase the number, or counterclockwise circle to decrease the displayed number. The dial modifies digits at the cursor position and will allow modification within the legal range of the displayed parameter. If you reach the end of the range, the dial will have no further effect on the display. If you do not want to use the dial, you can still change the display reading by using the [↑], or [↓] keys, or simply type the required number using the standard keyboard features.

NOTE

After you change the displayed readout, the 2572 will be updated with the new parameter only after you press the Execute button.

Digital Display – The display is used for displaying and reading various 2572 parameters, just as you would use it on your instrument.

The Main Panel

The Main Panel, as shown in Figure 4-3, is the first panel you see after invoking ArbConnection. Notice how buttons and LED's are grouped; this is done specifically so that common parameters are placed in functional groups. The Main Panel groups allow (from left to right) adjustment of amplitude and offset, selection of waveform mode, selection of run mode and control over SYNC and Main output parameters. Controls, where applicable, are provided for each channel separately.

Figure 4-3, the Main Panel

If you are connected properly to a PC and ArbConnection has detected your instrument, then every time you press a button, you are getting an immediate action on the 2572. It is different if you are changing parameters on the display; Doing this, you'll have to press the Execute button for the command to update the instrument. The functional groups in the Main Panel are explained below.

CH1 and CH2 Parameters

The Parameters group has two parameters for each channel: Amplitude and Offset and a phase offset parameter that defines the phase shift of CH2 in respect to CH1. To access the required parameter, click on the LED or the text next to it to display the required parameter. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

Function

The Function group is used for selecting between function types. The 2572 provides four types of waveforms: Standard, Arbitrary, Sequenced and Modulated. By pressing one of these buttons output waveform will change to the selected option. The default function type is Standard. If you want to change standard waveform parameters, you can select this STD panel from the Panels bar.

Run Mode

The Run Mode group is used for selecting the active run mode for the instrument. You can select between continuous, triggered, gated and burst modes. There is no additional panel associated with the continuous mode, but if you press one of the other run mode options, you'll be able to adjust the trigger parameters from the Trigger Panel.

Output Control

The output control group controls the state of the main outputs and the sate of the SYNC output. Click on the State buttons to toggle the outputs on and off.

From this group you also control the position of the SYNC pulse and the source of the sync. If you select the SYNC source to come from channel 1, the waveform that is generated at the CH1 output connector will be synchronized with the rising edge of the SYNC output pulse. Selecting the SYNC source as CH2, transfers the synchronization to the second channel. Note that you'll notice a difference only if you have different waveforms and waveform length in channels 1 and 2.

The Standard Waveforms Panel

The Standard Waveforms panel, as shown in Figure 4-4, is accessible after you click on the STD button in the Panels bar. The functional groups in the Standard Waveforms Panel are described below.

CH 1 and CH 2 Waveforms

The Waveforms group provides access to a library of built-in standard waveforms. The library includes: Sine, Triangle, Square, Pulse Ramp, Sinc, Exponential, Gaussian and DC waveforms. Each waveform has one or more parameters that can be adjusted for the required characteristics of the output. For example, phase start can be adjusted for the sine and triangle waveforms and duty-cycle can be adjusted for the square waveform. The pulse waveform can be adjusted for rise and fall time as well as width and delay. Parameters that are associated with each waveform are automatically displayed when the waveform is selected.

Note that by clicking a button in this group, you are immediately updating the 2572 output with this waveform shape.

Figure 4-4, the Standard Waveforms Panel

Parameters

The parameters group contains buttons that control the source of the 10MHz reference and the setting of the output frequency for the standard waveforms function.

The 10MHz Ref controls toggle between an internal and external references. The default setting is internal, which provides frequency accuracy of 1ppm. If such accuracy is not sufficient for your application, click on the external option but make sure that a reference source is applied to the rear panel connector; otherwise, the accuracy of the output will deteriorate completely.

The Frequency control lets you program the output frequency of the selected waveform shape. The frequency parameter may be modified when the LED illuminates. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

The Arbitrary & Sequence Panel

The Arbitrary & Sequence panel, as shown in Figure 4-5, is invoked by pressing the ARB button on the Panels bar. Note that if you invoke the Arbitrary & Sequence Panel from the Panels menu, the 2572 will not change its output type. On the other hand, if you select the arbitrary, or the sequenced options from the Main Panel, the 2572 will immediately change its output to the selected waveform type. The functional groups in the Arbitrary Waveforms Panel are described below.

Parameters

The Parameters group contains three parameters for each channel: Amplitude and Offset. Actually, the values exhibited in this group are exactly the same as in the Main Panel, so every time you change amplitude and offset in the Parameters group, the other panels are updated automatically. The segment parameter provides access to the active segment for each channel.

To access the required parameter, click on the parameter name. The LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

Figure 4-5, the Arbitrary & Sequence Panel

SCLK

The SCLK (Sample Clock) group is comprised of parameters that control the sample clock frequency. The sample clock setting affects the 2572 in arbitrary mode only.

The sample clock rate is programmed in units of S/s (samples per second) and will affect the instrument only when it is programmed to output arbitrary or sequenced waveforms. The SCLK parameter has no effect on the frequency of the standard waveforms.

The two switches in the SCLK group select between internal and external sample clock inputs. The internal is the default setting. When you select the external sample clock option, make sure an appropriate signal is connected to the external sample clock

connector on the rear panel.

To access the required parameter, click on the button until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

***10MHz* Ref**
The 10MHz Ref controls toggle between an internal and external references. The default setting is internal, which provides frequency accuracy of 1ppm. If such accuracy is not sufficient for your application, click on the external option but make sure that a reference source is applied to the rear panel connector; otherwise, the accuracy of the output will deteriorate completely.

Sequence
The Sequence Advance Mode group provides control over advance modes for the sequence generator. Advance options are: Auto, Stepped, Single and Mixed. Refer to the 2572 manual to find out more when and how to use these advance modes. You should be careful while selecting modes because it is possible to cause settings conflict, for example, if you select the Single option before you modified the run mode to Triggered.

Memory Management
The memory management group provides access to the memory partition and waveform studio screens. The Waveform Partition button opens a screen as shown in Figure 4-6 and the Waveform Studio button opens a screen as shown in Figure 4-7. Information how to use these screens is given in the following paragraphs.

Using the Memory Partition Table

If you want to learn more about waveform memory and segment control, you should refer to section 3 of this manual. In general, the 2572 can generate arbitrary waveforms but, before it can generate waveforms, they must be downloaded to the instrument from a host computer. Waveforms are downloaded to the instrument as coordinates and are stored in the 2572 in a place designated as “waveform memory”. The waveform memory has a finite size of 2M.

Having such long memory does not necessarily mean that you have to use the entire memory every time you download a waveform. On the contrary, the 2572 allows segmentation of the memory so that up to 4096 smaller waveforms could be stored in this memory. There are two ways to divide the waveform memory to segments: 1) Define a segment and load it with waveform data, define the next and load with data, then the third etc. or 2) Use what ArbConnection has to offer and that is to make up one long waveform that contains many smaller segments, download it to the instrument in one shot

and then download a memory partition table that splits the entire waveform memory into the required segment sizes. Want to use it? Here is how it is done. Point and click on the Memory Partition. A dialog box as shown in Figure 4-6 will pop up.

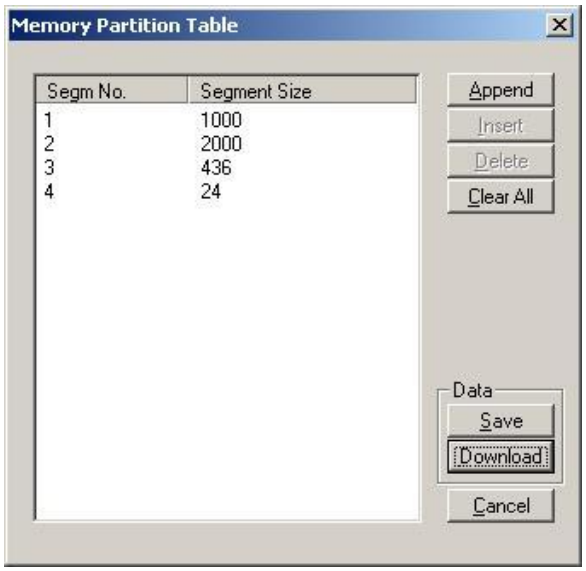

Figure 4-6, the Memory Partition Table

The two main fields in the segment table are Segment number and segment size. The **Seg No** (segment number) is an index field that can has values only, from 1 to 2048. The **Segment Size** is always associated with the segment number. You can program any segment size from 16 to 2M.

Use the **Append** key to add a segment at the end of the segment list. If you highlighted a segment, the Append key turns automatically to insert Use the **Insert** key to insert a segment at the cursor location. The **Delete** key is used for deleting a segment at the cursor position.

The **Clear All** key will remove all segments from the table and will let you start designing your segment table from fresh.

Click on the **Close** to discard of the contents of the dialog box without saving your last actions and to remove the Segment Table from the screen.

The **Save** key saves the current session so you can start the Memory Partition table from the same point after you close this session. The **Download** key updates the 2572 with the present segment table settings.

TIP

The Memory Partition table does not download waveforms. Use the memory partition table only if you merged a few waveforms to one. The partition table then divides the memory to the individual and original size of each waveform. If you download waveforms using the waveform studio, they already contain segment size and there is no need for further use of the memory partition table.

Using the Waveform Studio

The Waveform Studio, as shown in Figure 4-7 has two parts: 1) Segment Table and 2) Sequence Table. The purpose of the waveform studio is to provide access to waveform files that are already resident in the system. These files can be delegated to various segments and later be used as individual waveforms or combined into complex sequences.

The Segment Table

Using the Segment Table you may list and download waveform files that were previously stored on the computer. The table shows the segment number and its associated file name, length and its download status. There are other means to download waveforms to memory segments such as the Wave Composer and individual function calls; The waveform studio makes it easier by combining multiple and complex commands into one simple dialog box.

To access the Segment table, click anywhere on the Segment Table area. If it was not yet, it will turn white as opposed to the Sequence Table area that turns gray. The Segment Table area is divided into three parts: the table area, the waveform shape area and control buttons. When you point and click on one of the waveforms, its shape is shown in the Waveform Shape window.

The Segment Table has four fields:

The **Seg** field contains numbers from 1 through 2048, designating the programmed memory segment. Note that memory segments are numbered from 1 to 2048.

The **State** field shows the current status of the memory segment. It can be *Free*, if no file has yet been assigned to this segment number, or *Mapped*, if file name has been assigned to the segment but the Download button has not been used yet to move the file to the 2572 memory, or *Loaded*, if the process has been completed by pressing either the Download button or the All (download all) button.

The **File** field is an edit field that lets you browse and select file names to be applied to a specific memory segment. To change or

add file name, point and click on the File name field and either type your path or browse to the file location and let Windows find the right path.

The **Length** field displays the length of the selected memory segment. Memory segments size may be programmed from 16 to 2M. Note that the length field is not accessible and shown for reference purpose only.

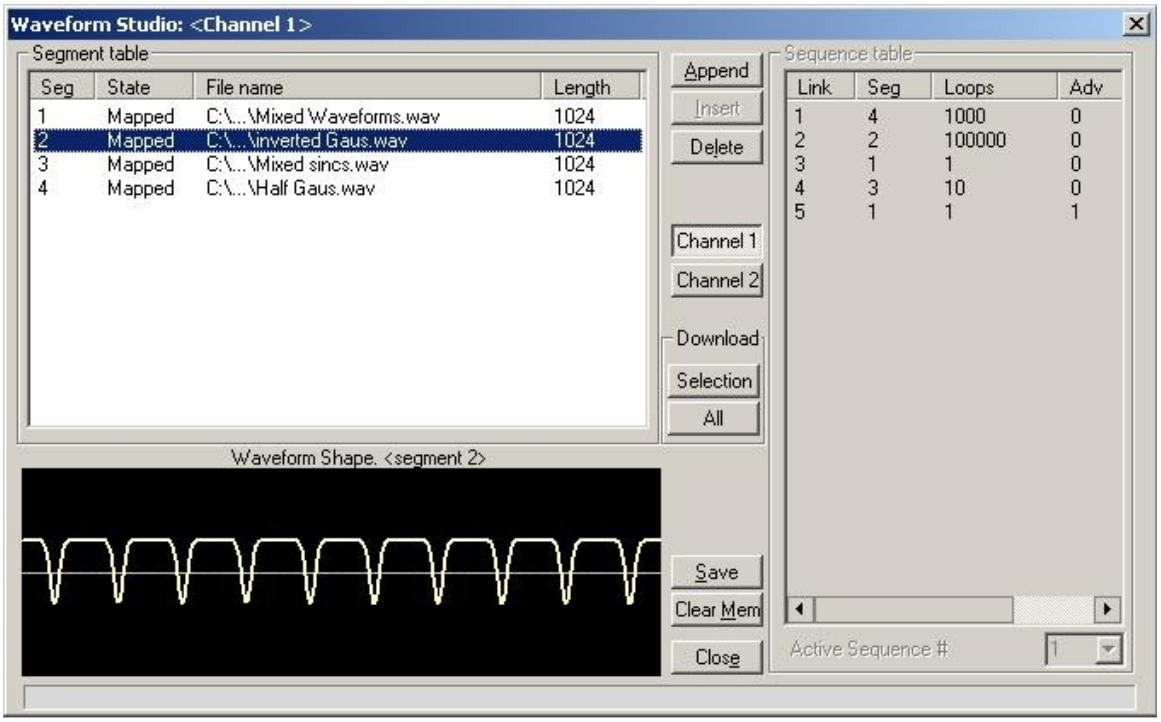
Waveform Studio: <Channel 1>
Segment table
Seg State File name Length
1 Mapped C:\...\Mixed Waveforms.wav 1024
2 Mapped C:\...\inverted Gaus.wav 1024
3 Mapped C:\...\Mixed sincs.wav 1024
4 Mapped C:\...\Half Gaus.wav 1024
Append
Insert
Delete
Channel 1
Channel 2
Download
Selection
All
Sequence table
Link Seg Loops Adv
1 4 1000 0
2 2 100000 0
3 1 1 0
4 3 10 0
5 1 1 1
Waveform Shape. <segment 2>
Save
Clear Mem
Close
Active Sequence #
1

Figure 4-7, the Waveform Studio

TIP

Point and click on one of the segments to show its shape in the Waveform Shape window.

Description of the various buttons in the Segment Table is given below.

Append – adds segment number at the end of the table

Insert – adds a segment above a highlighted segment line

Delete – removes a highlighted segment

Channel 1 – shows segment table for channel 1 only

Channel 2 – shows segment table for channel 2 only

Save – saves current table settings

(Download) Selection – downloads a highlighted segment only to the 2572 memory

(Download) All – downloads the complete table to the 2572 memory

Clear Mem – wipes out the entire memory and clears the table for fresh settings

Close – removes the Waveform Studio from the screen. If you have not saved your work, the table setting will be lost.

The Sequence Table

As was explained in the above, the waveform memory can be divided into smaller segments and up to 2048 segments can be defined and used as individual arbitrary waveforms. Having a limited size of waveform memory can, for some applications, pose a limitation however, if sections of the waveform are repetitive, one may use the sequence generator to take these segments and replay them as part of the complete waveform without loosing valuable memory space and without scarifying waveform coherences, or integrity. The tool for using repetitive and multiple segments in one long waveform is called Sequence Generator. The 2572 has two separate sequence generators, one for each channel and ArbConnection has a special dialog box where sequences are designed. This tool is called – Sequence Table.

Using the Sequence table you can use waveforms that you already downloaded to the 2572 from the Segment table, link and loop in random order to create one long and complex waveform that combines the individual memory segments.

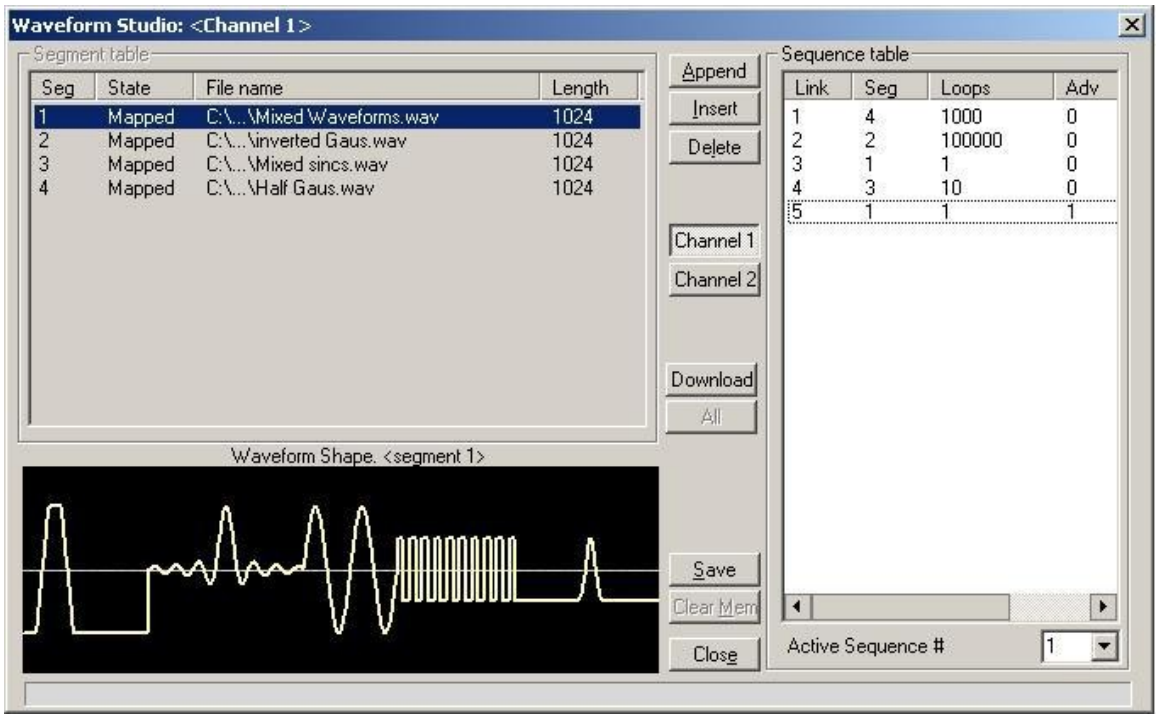
Waveform Studio: <Channel 1>
Segment table
Seg State File name Length
1 Mapped C:\...\Mixed Waveforms.wav 1024
2 Mapped C:\...\inverted Gaus.wav 1024
3 Mapped C:\...\Mixed sincs.wav 1024
4 Mapped C:\...\Half Gaus.wav 1024
Waveform Shape. <segment 1>
Append
Insert
Delete
Channel 1
Channel 2
Download
All
Save
Clear Mem
Close
Sequence table
Link Seg Loops Adv
1 4 1000 0
2 2 100000 0
3 1 1 0
4 3 10 0
5 1 1 1
Active Sequence #
1

Figure 4-8, the Sequence Table

The Sequence Table is demonstrated in Figure 4-8. To access the Sequence table, click anywhere on the Sequence Table area. If it was not yet, it will turn white as opposed to the Segment Table area that turns gray.

There are four major elements that you should consider while programming a sequence table. They are: Link, Seg, Loops and Adv. These terms are explained below.

Link - This parameter defines an index array for the sequence generator. When generating sequences, the instrument steps though the links in descending order therefore, make sure that you enter your waveform segments in exactly the order you would like them at the output.

Seg - This parameter associates waveform segments with links. You can use different segments for different links or you can use the same segment for a number of links. There are no limitations how you associate links to segments, except you cannot program in the sequence table segments that were not defined earlier.

Loops – This parameter define how many times the segment will loop for the selected link. For example, if you program 2, the waveform will cycle twice through the same segment before transitioning to the next link.

Adv – This parameter flags the advance mode for the specific segment. This flag is active when the advance mode is Stepped.

When set to 0, the sequence will advance through the list automatically until a segment that is flagged 1 is encountered. When 1 is encountered, the generator will idle on this segment until an external trigger is applied. Learn more about the sequence advance modes in Chapter 3.

Figure 4-8 shows an example of a 5-step sequence of which the first waveform is made of segment 2, which will loop 15 times; segment 4, looping 2 times; segment 1, looping 7 times; segment 2, once and segment 3, looping 4 times. The Adv bits on links 2 and 5 are set to 1 and therefore, external triggers are required for the sequencer to step through these links.

HINT

The 2572 has two separate sequence generators, one for each channel. If the 2572 is programmed to continuous run mode, make sure both channels have the same sequence length for inter-channel synchronization. For triggered run mode, each channel can be programmed for a unique sequence length.

The control buttons on the left of the Sequence Table have the same functionality as for the Segment Table.

Use the **Append** key to add a step at the end of the sequence list. Use the **Insert** key to insert a step at the cursor location. The **Delete** key is used for deleting a step at the cursor position.

Click on the **Close** to discard of the contents of the dialog box without saving your last actions and to remove the sequence Table from the screen but click on the **Save** key if you want just to save your work before you close the dialog box.

The **Download** key has double action, it will download the sequence table to the instrument and will save the contents of your table so the next time you open this table, it will have the same contents as you saved in your previous session.

Active Sequence

The active sequence field let you select between 10 different sequence settings. You may program each sequence separately and replay them individually as required. The output is updated with the selected sequence number as soon as the active sequence is selected.

The Trigger Panel

The Trigger panel, as shown in Figure 4-9, is invoked by pressing the TRIG button on the Panels bar. Note that if you invoke the Trigger Panel from the Panels menu, the 2572 will not change its trigger mode. To modify the instrument run mode, use the Main Panel. The trigger parameters and setting in the Trigger Panel will have an effect on the 2572 only if an appropriate run mode setting has been selected. The functional groups in the Trigger Panel are described below.

Figure 4-9, the Trigger Panel

Trigger Modifier

The Trigger modifier group provides access to delayed trigger state and its delay parameter, to the Re-trigger state and its parameter and to the burst count for channel 1 and channel 2.

To change trigger burst count for channels 1 or 2, point and click on one of these parameters. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed

value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

Trigger Parameters

Slope - The Slope group lets you select edge sensitivity for the trigger input of the 2572. If you click on Pos, the instrument will trigger on the rising edge of the trigger signal. Likewise, if you click on Neg, the instrument will trigger on the falling edge of the trigger signal.

Source - The 2572 can accept triggers from a number of sources: BUS, External or Mixed. When the BUS option is selected, only bus commands triggers the instrument. The EXT position is the default trigger option which enables the rear panel trigger input and the front panel manual trigger button. The MIX position disables the rear-panel trigger input until a software command is executed, the trigger source then reverts to the rear-panel trigger input.

Manual – Use this button when an external generator is not available. Pressing the Manual button is stimulating the instrument as if an external trigger has been applied.

Trigger Level – Programs the trigger level parameter. Depending on the slope setting, the 2572 will be stimulated to output waveforms when the trigger level threshold has been crossed.

The Modulation Panel 1

The Modulation functions were designed over three separate panels, as shown in Figures 4-10, 4-11 and 4-12. The panels are invoked by pressing the MOD1, MOD2 and MOD3 buttons on the panels menu. These panels provide access to all modulation functions and their respective run modes and parameters. The modulation functions that are available on these panels are: FM (frequency modulation), AM (amplitude modulation), FSK (frequency shift keying), PSK (phase shift keying), Frequency HOP and Sweep. Using ArbConnection, all modulation functions are programmed simultaneously for both channels except for AM where each channel can be programmed separately with a different set of parameters. When modulation run is other than continuous, the instrument generates non-modulated carrier frequency (CW) until a valid stimuli signal is applied.

Each of the modulation panels has a different set of functions and parameters. The modulation Panel 1 has control for selecting the modulation function and for programming the FM function. These

groups are described below. The panel is invoked by pressing the MOD1 button on the panels bar.

Figure 4-10, the Modulation Panel 1

FM

The FM group contains parameters for controlling the sample clock. To turn the FM function on and off, click on the FM button in the Modulation group. The various controls in the FM group are described below.

Mod. Wave

Defines the shape of the modulating waveform. There are two basic options: Standard waveforms and Arbitrary waveforms. If you do not need exotic waveforms, you can use one of the built-in standard wave shapes: Sine, Triangle, Square, or Ramp. These waveforms can be adjusted for their frequency and deviation range. On the other hand, you can select the arbitrary modulating wave option where you can use any shape however, you must load the modulating waveform from an external application, such as the FM composer in ArbConnection. Information on the standard and arbitrary FM functions is given in Chapter 3. Click on the button next to the required modulating waveform shape to select it.

Standard FM Parameters

Allow adjustment of the parameters that are associated with the standard modulating waveform. The controllable parameters are Modulation, Deviation and the Marker Frequencies.

Arbitrary FM Parameters

Allow adjustment of the sample clock of the modulating waveform. The shape of the modulating waveform must be downloaded from an external utility such as ArbConnection and the sample clock is programmed from this location.

To change the FM parameters, point and click on the required parameter. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

The Modulation Panel 2

The modulation Panel 2, as shown in Figure 4-11 has controls for selecting the modulation function and for programming the AM, FSK and PSK functions. Description of the controls in this panel is given below. The panel is invoked by pressing the MOD2 button on the panels bar.

Figure 4-11, the Modulation Panel 2

AM

Although both channels are set to output amplitude modulations simultaneously, each channel can be programmed to be modulated using a unique envelop waveform. There are two sets of identical parameters for each channel, as discussed in the following paragraphs.

CH1/CH2 Mod Wave
There is a list of 4 waveforms that can be selected to modulate the carrier waveform (CW). These are sine, triangle, square and ramp. The frequency and amplitude of the modulating waveforms are programmable

Freq
Programs the frequency of the modulating waveform. Note that the frequency setting must be smaller than the CW frequency for the AM function to operate correctly. Although, two frequency parameters are shown on this panel, the frequency of the modulating waveform is identical for both channels.

Depth
The Depth parameter programs the modulation depth, or index in percent of the un-modulated CW amplitude. The depth is symmetrical about the center of the CW amplitude.

FSK/PSK

The FSK/PSK group contains parameters for controlling the FSK and the PSK functions. To select the required function, click on the FSK or PSK button. The parameters in this group will change automatically to support the selected function.

Control Data
The Control Data button provides access to the data string that controls the sequence of frequency and phase shifting. The various controls in the FSK/PSK group are described below.

"1" Frequency/ "1" Phase
In FSK, the carrier waveform (CW) has two frequencies: an initial frequency which is set by the CW parameter and shifted frequency which is set by the "1" frequency. The control data table has a list of "0" and "1" values that flag when the frequency shifts from CW to shifted frequencies. In FSK, phase of the waveforms is always 0°.

In PSK, the carrier waveform (CW) is constant while the phase shifts between two phases: an initial phase which is set by the start phase parameter and shifted phase which is set by the "1" frequency. The control data table has a list of "0" and "1" values that flag when the phase shifts from start to shifted frequencies. In FSK, the start and the shifted phase values are programmable.

Baud
The baud parameter sets the rate of which the generator steps through the Control Data sequence. The parameters are separate for the FSK and for the PSK.

Marker Index
The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC output must be turned on to get the marker output.

To access the required parameter, click on the button below parameters sub-group until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new reading.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the 2572 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

The Modulation Panel 3 & Digital

The modulation Panel 3, as shown in Figure 4-12 has controls for selecting the modulation function and for programming the Hop and Sweep function. It also has controls for programming the patter output. Description of the controls in this panel is given below. The panel is invoked by pressing the MOD3 button on the panels bar.

Figure 4-12, the Modulation Panel 3

Sweep

The Sweep group contains parameters for controlling sweep options. To turn the Sweep function on and off, click on the ***SWP*** button in Modulation group. The various parameters that control sweep features are described below.

Parameters

Allow adjustment of Sweep Start, Stop and Sweep Time. You can also place a marker at a position programmed by the Mark parameter. To access the required parameter, click on the button below parameters sub-group until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new setting.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the LW120 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

Step
Use these keys to select sweep step from two increment options: linear, or logarithmic.

Direction
Use these keys to program sweep direction. Up select sweep from Start to Stop sample clock setting and Down selects sweep from the Stop to Start sample clock setting. Refer to Chapter 3 of this manual to learn more about sweep operation.

Hop

The Hop group contains parameters for controlling frequency hop options. To turn the HOP function on and off, click on the ***HOP*** button in Modulation group. The various parameters that control frequency hopping features are described below.

Hop Data
The HOP Data button provides access to a table that has a sequence list of frequencies. When hop is enabled, the output steps through the sequence at a rate defined by the Hold parameter.

Fixed Hold
The hold parameter determines how long will certain step of frequency dwell on this specific setting before it will step to the next frequency setting. By selecting the Fixed Hold, the hold time remains constant throughout the entire hop table.

Variable Hold
The hold parameter determines how long will certain step of frequency dwell on this specific setting before it will step to the next frequency setting. By selecting the Variable Hold, the hold time changes automatically from one step to the next, depending on the hold time value that is affixed to the hop step. The values can be programmed in the HOP Data table.

Parameters
Allow adjustment of dwell time and the marker index. The dwell time programs the hold time for the Fixed Hold time option. It has no effect if the variable hold time option has been selected. The marker setting programs a specific step (index) in the control data string to output a pulse at the SYNC output connector. The SYNC output must be turned on to get the marker output.

To access the required parameter, click on the button below parameters sub-group until the LED next to the required parameter turns on. The value that is associated with the lit LED is displayed on the digital display. You can use the dial, keyboard, or the [↑] [↓} keys to adjust the readout to the required setting. After you modify the reading, press Execute to update the 2572 with the new setting.

Note

Normal color of the digital reading is dark blue. If you modify the reading, the color changes to a lighter shade of blue, indicating that the LW120 has not been updated yet with the new parameter. Pressing Execute will update the instrument and will restore the color of the digital readout to dark blue, indicating that the displayed value is the same as the generator setting.

Also note that the digital readout has an autodetect mechanism for the high and low limits. You cannot exceed the limits if you are using the dial but only if you use the keypad. In case you do, the program will not let you download an illegal parameter and you'll be requested to correct your setting.

Digital Pattern

The Digital Pattern group contains parameters for controlling rear panel pattern output. Digital patterns can operate in conjunction with the arbitrary and the sequenced function and are sourced from channel 1 only. The various parameters that control sweep features are described below.

Pattern design
This opens a table that allows programming of the digital patterns. Patterns are 16 bits and are programmed in hex.

State
The state button toggles the pattern output on and off. When the state is on, patterns are routed to the rear panel connector. Note that the channel 1 output connector can also be made active and then both the rear and front outputs generate waveforms and patterns.

Baud
The baud parameter programs the rate of which the patterns step through the sequence that was programmed in the Pattern Design table.

The Utility Panel

The Utility panel, as shown in Figure 4-13, is invoked by pressing the UTIL button. The Utility panel provides access to general instrument setting and information. If authorized, you can also gain access to the calibration panel however, you'll need to have user name and password to go through calibration.

Also available in this panel are some system commands such as Reset Instrument and Clear Error Queue. The Reset Instrument button is needed in places where you get stuck with instrument

programming and want to start from a fresh and know state. The default parameters are described in the programming section of this manual.

There are four groups in the Utility panel: Data base, for monitoring instrument-specific identifications, Filter, for assigning specific filters to the output path and System Commands for accessing certain calibration and data base structures and for sending specific system commands to the instrument. Description of the various controls on the Utility panel is given below.

Figure 4-13, the Utility Panel

Data Base

The data Base group provides access to specific instrument identifications such as: Serial Number, Calibration Date, Options and Firmware Revision. These parameters should be current or there is danger that the instrument is not updated to the latest firmware revision. Compare the listing with that published on the web to check if your instrument is current. Also note that the recommended calibration period is 1 year and therefore, if your calibration date not current, your instrument may not meet spec. information how to calibrate the instrument is given in Chapter 7.

Filter

The Filter group provides access to filters for both channel 1 and 2. The filters can only be used when the instrument is NOT in standard sinewave because the filters are automatically used for sine wave reconstruction and cannot be switch in and out while in this function. There are four filters for each channel. When in Off, the filters are disabled.

System Commands

The System Commands group provides access to system parameters such as Instrument Reset and Query Errors. You can also access the calibration panel from this panel however, entering the calibration panel requires password that is available to service centers only. Information how to access the calibration and data base functions is given in Chapter 7.

The Command Editor

The Command Editor is an excellent tool for learning low level programming of the 2572. Invoke the Command Editor from the System menu at the top of the screen. Dialog box, as shown in Figure 4-14 will pop up. If you press the Download button, the function call in the Command field will be sent to the instrument.

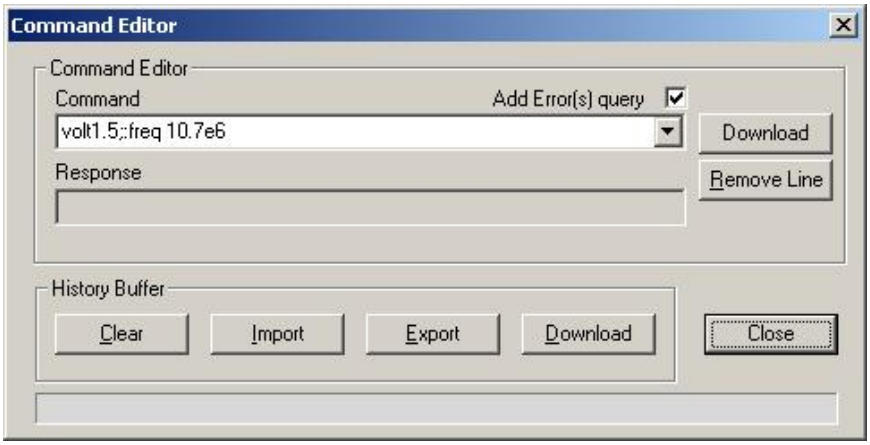

Figure 4-14, the Command Editor

Low-level SCPI commands and queries can be directly sent to the 2572 from the **Command** field and the instrument will respond to queries in the **Response** field. The command editor is very useful while developing your own application. Build your confidence or test various commands using the command editor. This way you can assure that commands or syntax that you use in your application will behave exactly the same way as it responds to the editor commands. A complete list of SCPI commands is available in Chapter 5.

The Wave Composer

Being an arbitrary waveform generator, the 2572 has to be loaded with waveform data before it can start generating waveforms. The waveform generation and editing utility is part of ArbConnection and is called – The Waveform Composer. This program gives you tools to create definitions for arbitrary waveforms. It can also convert coordinates from other products, such as, oscilloscopes and use them directly as waveform data. The program is loaded with many features and options so use the following paragraphs to learn how to create, edit and download waveforms to the 2572 using the Waveform Composer.

To launch the wave composer point and click on the WAVE button in the Panels bar. Figure 4-15 shows an example of the wave composer. The Wave Composer has main sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-15 throughout the description of these sections.

The Commands bar

The commands bar provides access to standard Windows commands such as File and View. In addition, there are ArbConnection-specific commands such as Edit, Wave and System.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the Wave Composer. On the other hand, clicking on Wave and then on Sine, will open a Sine Wave dialog box that lets you program and edit sine wave parameters. The various commands in the Commands bar are listed and described below.

File Commands

The File command has 4 command lines that control waveform files. Also use this command to print the active waveform, or exit the wave composer program. Description of the various commands under File is given below.

New Waveform

The New Waveform (Ctrl+N) command will remove the waveform from the screen. If you made changes to the waveform area and use the New Waveform command, you should save your work before clearing the screen. The New Waveform command is destructive to the displayed waveform.

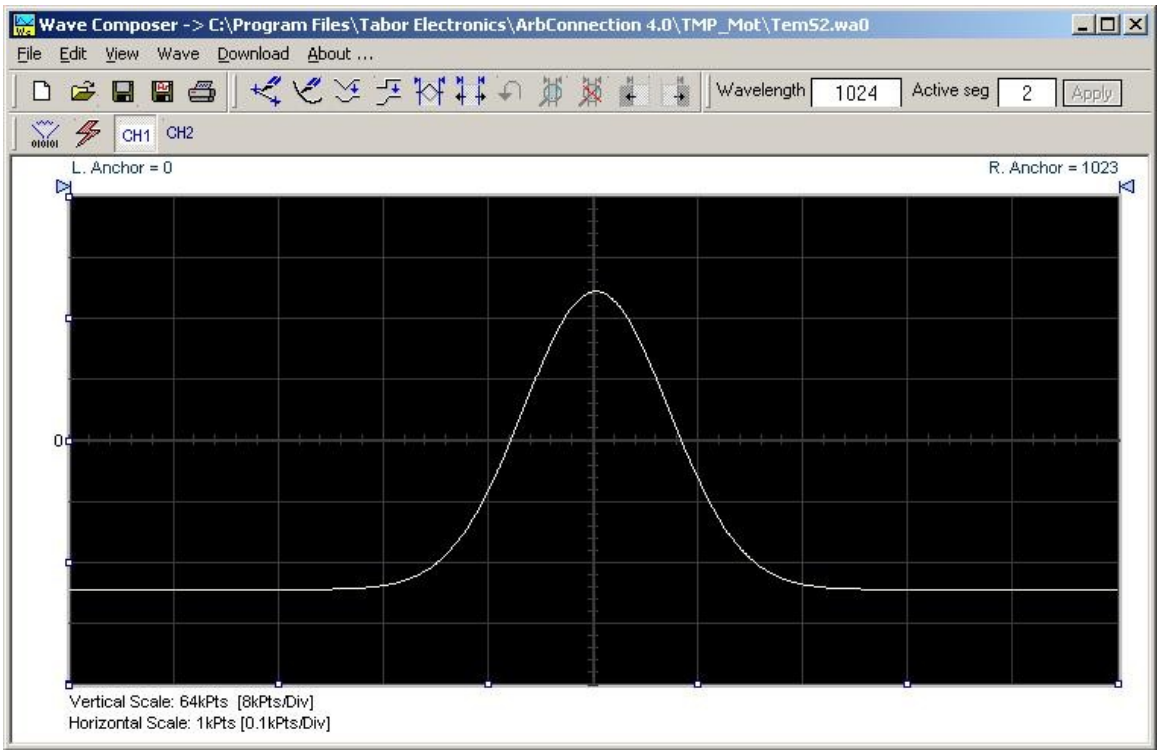

Figure 4-015, the Wave Composer Opening Screen

Open Waveform…

The Open Waveform… (Ctrl+O) command will let you browse your disk for previously saved waveform files and load these waveforms to the waveform area. This command is also very useful for converting waveform files to format that is acceptable by the Wave Composer. The Open Waveform command can convert ASCII. *CSV (comma delimited text), *PRN (space delimited text) and *.0* (LeCroy binary format). The Open dialog box in Figure 4-16 shows the various file extensions that can be opened into the Wave Composer environment. The file that is opened is automatically converted to *.wav format and can later be saved as a standard ArbConnection file.

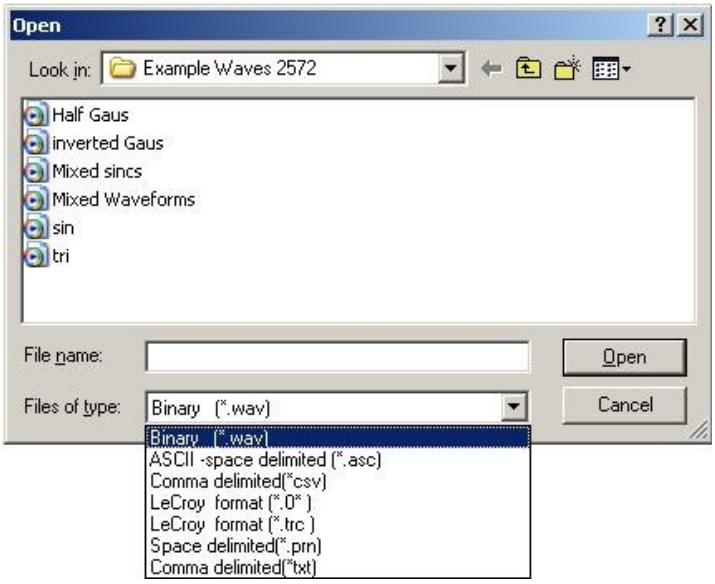

Figure 4-016, the Open Waveform Dialog Box

Save Waveform
The Save Waveform (Ctrl+S) command will store your active waveform in your 2572 directory, as a binary file with an *.wav extension. If this is the first time you save your waveform, the Save Waveform As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save Waveform As…
Use the Save Waveform As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print
With this command you may print the active Waveform Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

Exit
The Exit command ends the current Wave Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, the Wave Composer will prompt you to Save or Abandon changes these changes.

Edit Commands

The Edit commands are used for manipulating the waveform that is drawn on the screen. The editing commands are explained in the following paragraphs.

Autoline
The Autoline command lets you draw straight-line segments. To

draw a line the left mouse button at the start point. Click again at the next point and then click on the right mouse button to terminate this operation.

Sketch
The Sketch command lets you draw free-hand segments. To draw a line using this command click and hold the left mouse button at the start point. Release the mouse button when you want to stop and then click on the right mouse button to terminate this operation.

Smooth
The Smooth command lets you smooth out rough transitions on your waveform. This is done mathematically by multiplying waveform coordinates by the non-linear portion of a cubic parabola.

The Smooth operation is done on segments of the waveform that are bound by anchors. Anchor operation is described later in this chapter. Place the anchors on the left and right of your waveform segment and select the Smooth command. The waveform will change its shape immediately to follow the mathematical pattern of a parabolic curve.

Note that small segments with fast transitions, when combined with parabolic expressions have tendencies to generate even larger transitions. Therefore, make sure you omit such sections of the waveform when you use this operation.

Filter
The Filter used with this command is moving average. This is done by recalculating each point as an average of symmetrical number of adjacent points. When you select the Filter command, a dialog box pops up, letting you program the filter spacing in number of adjacent points. You can filter the entire waveform, or you may chose to filter a segment of the waveform by placing the anchors as boundaries on the left and right of the segment.

Invert
The Invert command lets you invert the entire waveforms, or marked segments of waveforms. The waveform is inverted about the 0-point axis.

Trim Left
The trim left command lets you trim waveforms to the left of the anchor point. This command is grayed out if the left anchor was not moved from its original left position. The waveform is trimmed and the point at the left anchor point becomes the first point of the waveform.

Trim Right
The trim right command lets you trim waveforms to the right of the anchor point. This command is grayed out if the right anchor was not moved from its original right position. The waveform is trimmed and the point at the right anchor point becomes the last point of the waveform.

Unmark
The unmark command removes the anchors from the waveform screen and resets anchor positions to point 0 and the last waveform point.

Undo
The Undo command undoes the last editing operation.

View Commands

The View commands have commands that let you view various sections of the waveform area. The View commands include: Zoom In, Zoom Out, Hide/Show Toolbars and Channel ½ waveforms. Description of the view commands is given in the following.

Zoom In
The zoom in command operates between anchors. Anchors are marked as left and right hand triangles. The default position of the anchors is the start and the end of the waveform. To move an anchor to a new location, click and hold on the triangle and drag the anchor to left or right as required. If you move the left anchor to the right and the right anchor to the left, the area between the anchors will zoom in as you select this command.

Looking at the Waveform Map, as shown in Figure 4-17, you'll see that the white portion is the zoomed area. Click and hold on the white area and move your cursor around and the waveform screen will be updated accordingly.

While zoomed in you can perform Autoline and sketch editing, or zoom-in further by clicking and holding the mouse at one corner and releasing the mouse button at the other corner.

Zoom Out
The zoom out restores the screen to display the complete waveform.

Channel 1

The Channel 1 Waveform command updates the waveform screen with the Channel 1 waveform. If you have not yet generated a waveform for channel 1, the waveform screen will show a dc level at vertical point 0.

Channel 2

The Channel 2 command updates the waveform screen with the Channel 2 waveform. If you have not yet generated a waveform for channel 2, the waveform screen will show a dc level at vertical point 0.

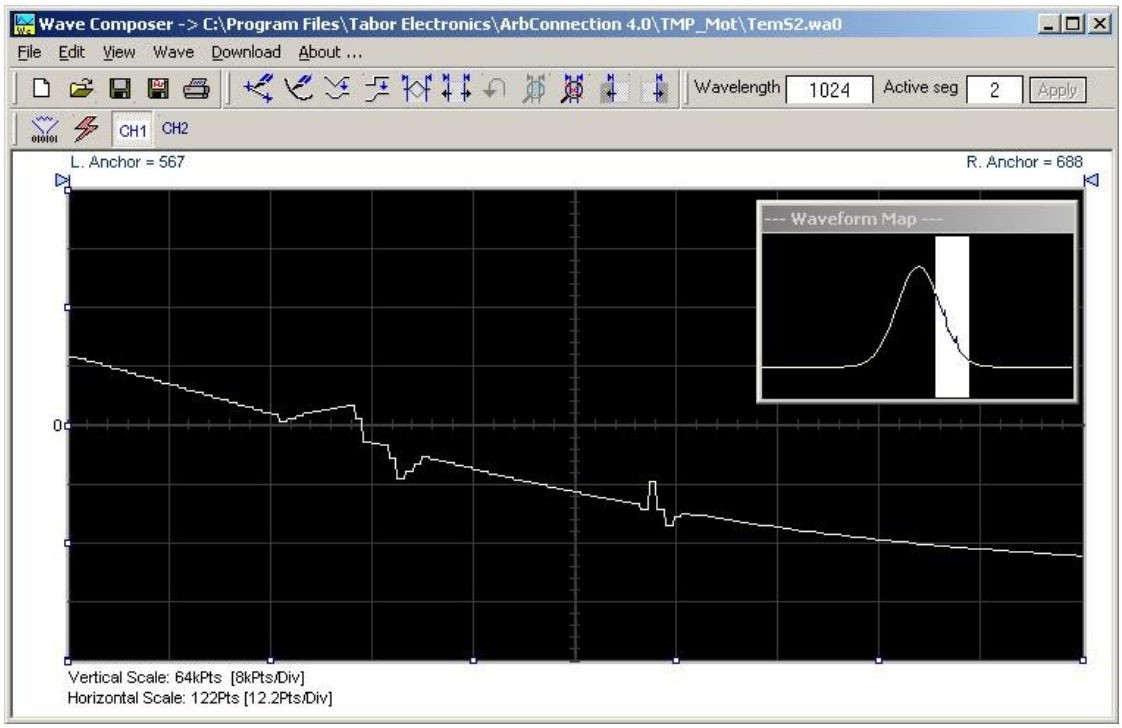

Figure 4-017, Zooming In on Waveform Segments

Wave Commands

The Wave commands let you create waveforms on the screen. The Wave command has a library of 8 waveforms: Sine, Sawtooth, Square, Sinc, Gaussian, Exponent, Pulse, and Noise. It also lets you create waveforms using the Equation Editor. Information how to create waveforms using the Wave commands is given below.

Creating Waveforms From the Built-in Library

You can create any waveform from the built-in library using the Wave command. Clicking on one of the Wave options will open a dialog box. An example of the Sine waveform dialog box is shown in Figure 4-18. This dialog box is representative of the rest of the waveforms, so other waveforms will not be described.

Creating Sine Waveforms

Use the following procedure to create sine waveforms from the built-in library. Click on Wave, then sine… the dialog box as shown in Figure 4-18 will appear. You can now start programming parameters that are available in this box.

Start Point – Defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point. The example shows start point set at point 0.

End Point – Defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point. The example shows end point set at point 499.

Cycles – The Cycles parameter defines how many sine cycles will be created within the specified start and end points. The example below shows five sine cycles.

Amplitude – 14-bit of vertical define 16,384 incremental steps. The Amplitude parameter defines how many of these steps are used for generating the sine. The example is showing sine waveform with maximum peak-to-peak amplitude. Any number below the maximum will generate an attenuated sine.

Start Phase – The start phase parameter defines the angle of which the sine will start. The example shows start phase of 90°.

Power – The example shows sine cubed. Sine to the power of 1 will generate a perfect sine. Power range is from 1 through 9.

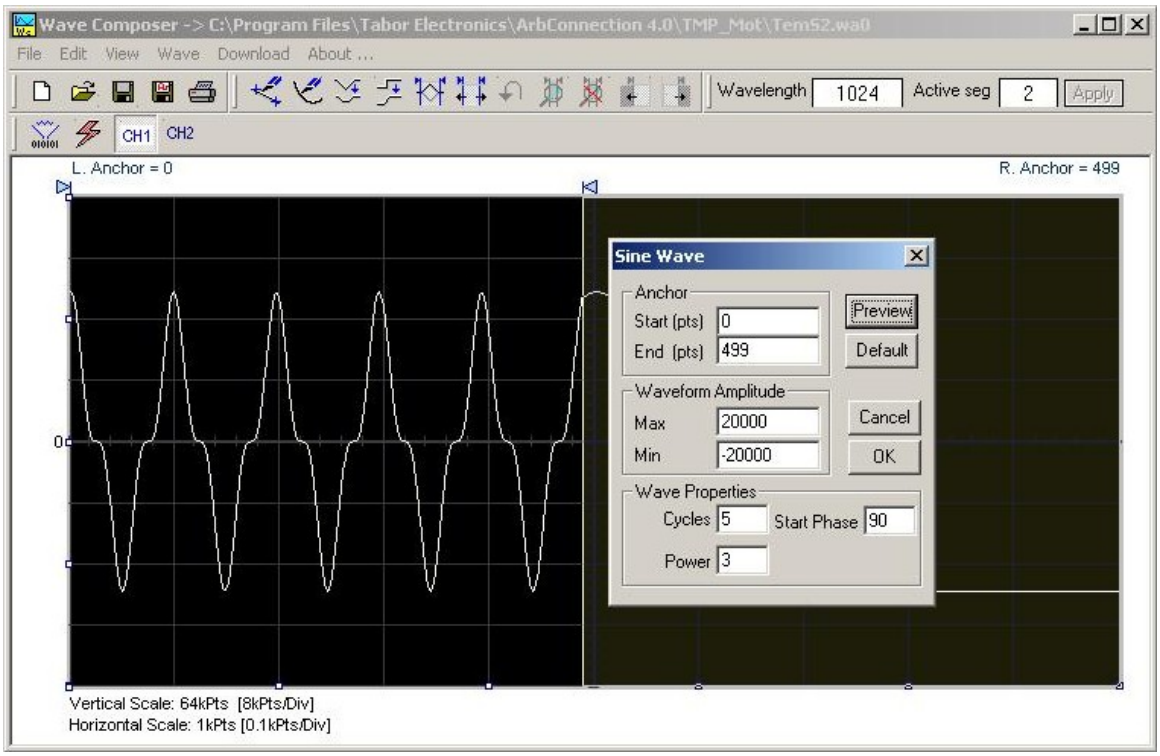

Figure 4-18, Generating Distorted Sine waves from the built-in Library

The Toolbar

The toolbar contains icons for editing the waveform screen, icons for saving and loading waveforms, fields for selecting an active channel and for adjusting segment length and more. The Toolbar is shown in Figure 4-19. For the individual icons, refer to the descriptions above of the Wave Composer Menus.

Figure 4-19, the Toolbar Icons

The Waveform Screen

Waveforms are created and edited on the waveform screen. Figure 4-20 shows an example of a waveform created using the equation editor and the anchors to limit generation of the waveform between points 100 and 900. The various elements of the waveform screen are described below.

The waveform screen has two axes – vertical and horizontal. Both axes are divided into points.

The vertical axis is labeled from –8191 through 8192 for a total of 16,384 point. This number represents 14 bits of vertical resolution and cannot be changed because it is critical to the range of which the 2572 operates.

The horizontal axis, by default has 1000 points (from point 0 to 999). This number can be changed using the Wave Length field in the Toolbar. The maximum length depends on the option installed in your instrument. The wave composer will let you define the horizontal axis to a maximum of 2M words).

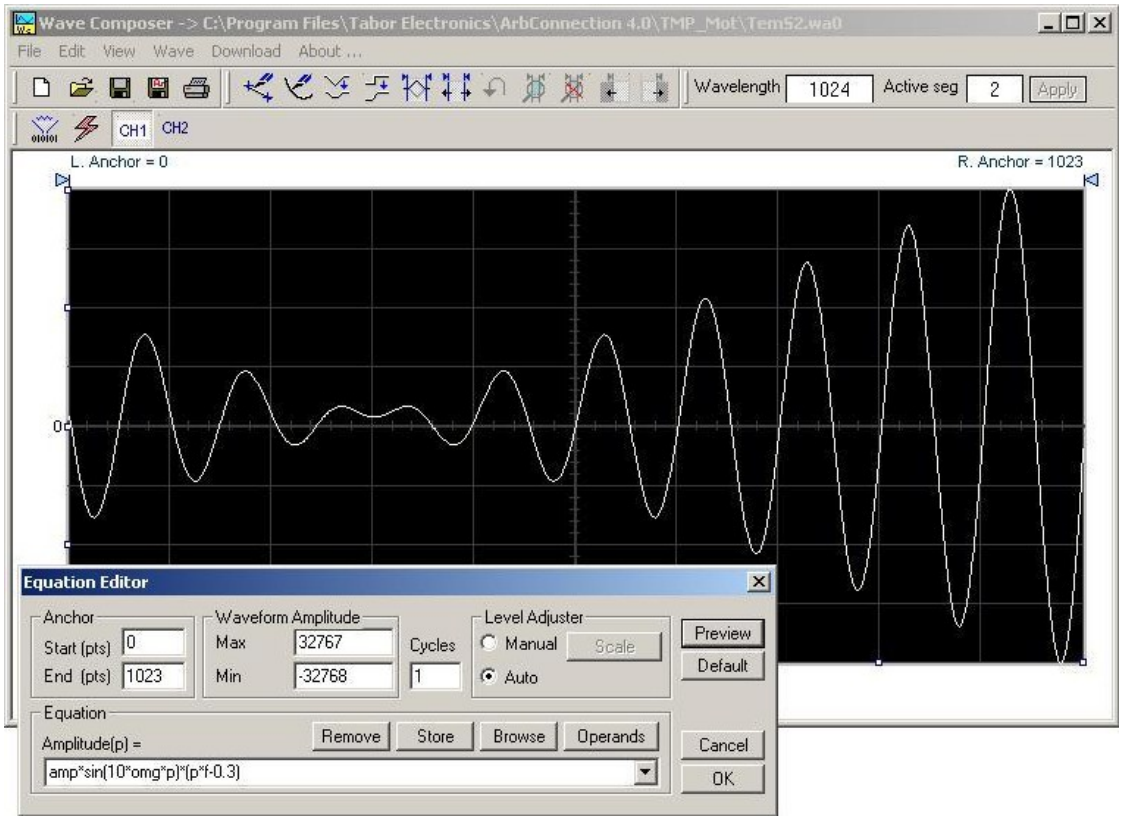

Figure 4-20, the Waveform Screen

Notice on the left top and on the right top there are two triangles pointing to the center of the screen. These are the anchors. The anchors are used as the start and end pointers where your waveform will be created. For example, if you want to create a sine waveform between point 100 and point 500, you place the left anchor at point 100 and the right at point 500 and then generate the sine from the built-in library.

There are two ways to control anchor placements.

1) Click and hold your mouse cursor on the left anchor triangle and then drag the curtain to the left position. Do the same for the right anchor. Notice the X and Y coordinates at the top of the waveform screen and how they change to correspond to your anchor placement.

2) You can also place your anchors in a more precise manner from the waveform library by programming the start and end points for the waveform. An example of anchor placement using the sine dialog box is shown in Figure 4-18.

Finally, when you are done creating and editing your waveform, you can save your work to a directory of your choice. The name at the title will show you the name you selected for storing your waveform and its path.

The FM Composer

The FM Composer looks and feels almost like the waveform composer except there is a major difference in what it does. If you look at the opening screen as shown in Figure 4-21, you'll see that the vertical axis is marked with frequencies. You'll see later that as you draw waveforms on the FM composer screen, these waveforms represent frequency changes and not amplitude changes as are generated by the waveform composer.

The FM composer is a great tool for controlling frequency agility by generating the agility curve as an arbitrary waveform. For example, if you create a sine waveform, the 2572 will generate frequency-modulated signal that will follow the sine pattern. The resolution and accuracy of the modulated waveform is unsurpassed and can only be duplicated by mathematical simulation. The FM composer is loaded with many features and options so use the following paragraphs to learn how to create and download modulating waveforms to the 2572 using the FM Composer.

Invoke the FM Composer from Panels bar. The Wave Composer has three sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-21 throughout the description of these parts.

The Commands bar

The commands bar is exact duplication of the commands bar in the Wave Composer. It provides access to standard Windows commands such as File and View.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the FM Composer. On the other hand, clicking on Wave and then on Square, will open a Square Wave dialog box that lets you program and edit square wave parameters. The various commands in the Commands bar are listed and described below.

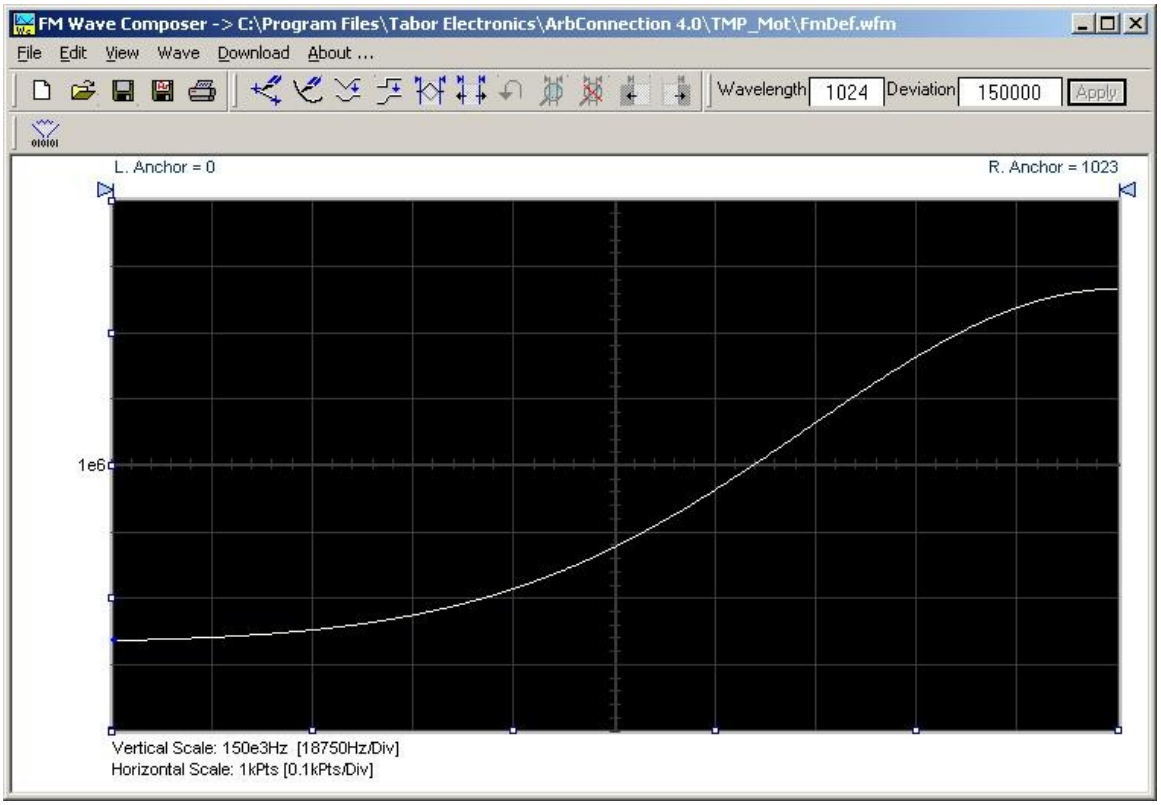

Figure 4-021, The FM Composer opening Screen

File Commands

The File command has 4 command lines that control waveform files. Also use this command to exit the FM composer program. Description of the various commands under File is given below.

New Waveform

The New Waveform command will remove the waveform from the screen. If you made changes to the waveform area and use this

command, you should save your work before clearing the screen. The New Waveform command is destructive to the displayed waveform.

Open Waveform…
The Open Waveform… command will let you browse your disk for previously saved waveform files and load these waveforms to the waveform area. This command is also very useful for converting waveform files to format that is acceptable by the Wave Composer.

Save Waveform
The Save Waveform command will store your active waveform in your 2572 directory, as a binary file with a *.wvf extension. If this is the first time you save your waveform, the Save Waveform As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save Waveform As…
Use the Save Waveform As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print
With this command you may print the active Waveform Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

Exit
The Exit command ends the current FM Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, make sure to Save your work before you use this command.

Wave Commands

The Wave commands let you create waveforms on the screen. The Wave command has a library of 6 waveforms: Sine, Triangle, Square, Exponent, Pulse, and Noise. It also lets you create waveforms using an Equation editor. Information how to create waveforms using the Wave commands is given below.

Creating Waveforms From the Built-in Library
You can create any waveform from the built-in library using the Wave command. Clicking on one of the Wave options will open a dialog box. An example of the Sine waveform dialog box is shown in Figure 4-25. This dialog box is representative of the rest of the waveforms, so other waveforms will not be described.

Creating Sine Waveforms
Use the following procedure to create sine waveforms from the built-in library. Click on Wave, then sine… the dialog box as shown in Figure 4-22 will appear. You can now start programming parameters that are available in this box.

Start Point Anchor – Defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point. The example shows start point set at point 200.

End Point Anchor – Defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point. The example shows end point set at point 499.

Max. Peak Deviation – This parameter defines the forward peak deviation. Note that the forward peak deviation cannot exceed the pre-defined Deviation parameter as shown on the Toolbar. In case you need to exceed the pre-defined peak value you must quit this box and modify the Deviation parameter to provide sufficient range for the forward peak deviation range.

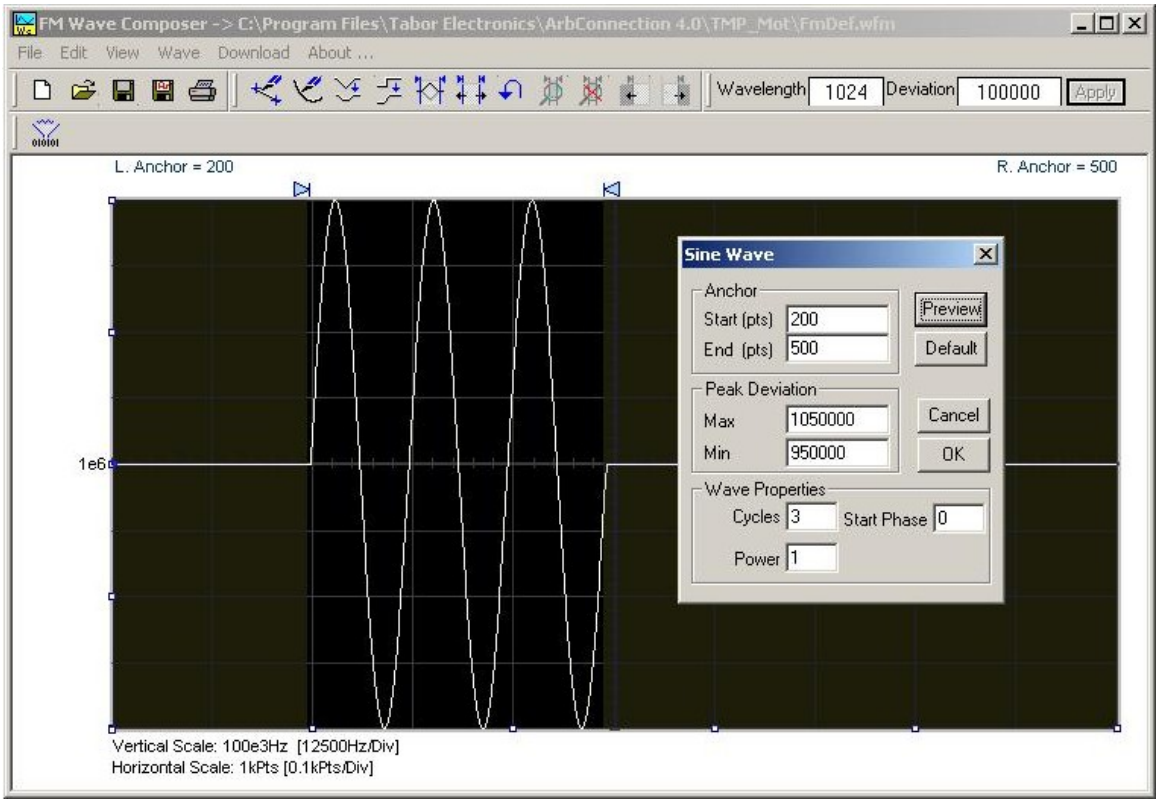

Figure 4-22, Generating Sine Modulation Using the FM Composer

Min. Peak Deviation – This parameter defines the backwards peak deviation. Note that the backwards peak deviation cannot exceed the pre-defined Deviation parameter as shown on the Toolbar. In case you need to exceed the pre-defined peak value you must quit this box and modify the Deviation parameter to provide sufficient range for the backwards peak deviation range.

Cycles – The Cycles parameter defines how many sine cycles will be created within the specified start and end anchor points. The example below shows three sine cycles.

Start Phase – The start phase parameter defines the angle of which the sine will start. The example shows 0° start phase.

Power – Sine to the power of 1 will generate a perfect sine. Power range is from 1 through 9.

Generating Waveforms Using the Equation Editor

One of the most powerful feature within ArbConnection and probably the feature that will be used most is the Equation Editor. The Equation Editor let you write equations the same way as you would do on a blank piece of paper. The equations are then translated to sequential points that form waveforms and are displayed on the waveform screen. The Equation Editor will detect and inform you on syntax errors and, with its self adjusting feature, will automatically adjust your parameters so that none of the points on your waveform will exceed the maximum scale limits.

When you invoke the Equation Editor, the dialog box, as shown in Figure 4-23 will display. Use the following paragraphs to learn how to use this dialog box and how to write your equations.

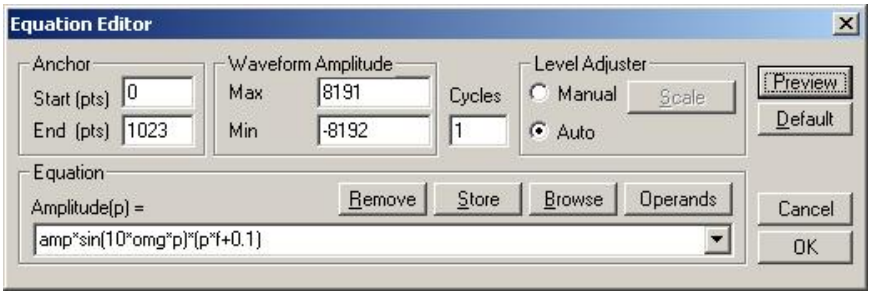

Figure 4-23, the Equation Editor Dialog Box

There are four sub-group parameters in the equation editor plus control buttons and equation field. These parts are described below.

Anchor
The anchors define start and end point of which the equation will be generated. By default the anchors are placed at the start and the end of the horizontal (time) scale however, the equation can be limited to a specific time scale by moving the anchor points from their default locations.

Start – defines the first point where the created wave will start. Note that if you change the start point the left anchor will automatically adjust itself to the selected start point.

End – defines where the created waveform will end. Note that as you change the end point the right anchor will automatically adjust itself to the selected end point.

Waveform Amplitude
The vertical axis of the Wave Composer represents 14-bits of vertical resolution. That means that the equation is computed, resolved and generated with 1/32,768 increments and accuracy. The Waveform Amplitude fields in the Equation Editor are used in two cases: 1) when the “amp” parameter is used in the equation or 2 if the Level Adjuster is set to Auto. Information on these two operations is given later.

Max – defines the positive peak of the vertical axis

Min – defines the negative peak of the vertical axis

Cycles
The Cycles parameter defines how many waveform cycles will be created within the specified start and end anchor points.

Level Adjuster
The Level Adjuster is a convenient tool that helps you adjust the amplitude and offset without modifying your equation. The Level Adjuster mode does not interfere with your calculations and displays the waveform as computed from your equation. The only difference is that your final calculations are stretched or shrunk or offset on the vertical scale to fit the new amplitude and offset boundaries.

For example, look at the equation that is shown in Figure 4-23. This equation will generate the waveform as shown in Figure 4-20.

If you change the Max and Min setting in the Waveform Amplitude fields and press the Adjust key, your waveform will offset immediately without changing the equation. The same way, you can also change amplitude only or both amplitude and offset. If you check the Manual option, you’ll have to click on the Adjust button for the Waveform Amplitude parameters to take effect. The Adjust button name will change to Restore and back to Adjust if you click

on it again. If you check the Auto option, your waveform will be created automatically with the new Amplitude setting.

Equation
The Equation group has four buttons and the equation field. You will be using the Equation field for writing your equations. Equation syntax and conventions are discussed in the following paragraphs. The *Remove* button clears the equation field so you can start typing a new equation. Click on the *Store* button to store your equation if you intend to use it again. The Browse button provides access to waveform pre-stored files in your computer for combining them in new equations. The *Operands* button expands the bottom of the dialog box to show the operands you can use with your equation.

While you type and store equations, they are collected in a history file and can be used again by expanding the history log from the equation field.

Control Buttons
There are four control buttons at the right corner of the dialog box. Use the *Preview* button to preview an image of your equation, or use the *OK* button to place your waveform on the waveform screen and to leave the dialog box on the screen. The *Default* button restores the parameters in the equation editor to their original factory default values. The *Cancel* button will remove the dialog box from the screen and will discard of any waveforms that you previewed with your Equation Editor.

Writing Equations

The Equation Editor lets you process mathematical expressions and convert them into waveform coordinates. As you probably already know, waveforms are made of vertical samples. The number of samples on your waveform is determined by the wavelength parameter. For example, if you have 1024 horizontal points, your equation will be computed along 1024 points as a function of the vertical scale. Each vertical sample is computed separately and placed along the horizontal axis. The points are graphically connected to form a uniform and continuous waveform shape however, if you zoom in on a waveform line, you'll see that the points are connected like a staircase. In reality, the 2572 generates its waveforms exactly as shown on the screen but, if the waveform has many horizontal points, the steps get smaller and harder to see without magnification.

Equations are always computed as a function of the vertical (Amplitude) axis therefore the left side of your equation will always look as Amplitude(p)=, where "p" is the equation variables in units of waveform points. You can write equations with up to 256 characters. If the equation is too long to fit in the visible field, parts to the left or right will scroll off the ends.

Equation Conventions

The following paragraphs describe the conventions that are used for writing an equation. To avoid errors, it is extremely important that you make yourself familiar with these conventions before you plan your waveforms.

Equations are written in conventional mathematical notation. You may only enter the right part of the equation. The only limitation is that the equation must be of a single variable that is directly related to the current horizontal axis setting. Case is not important and spaces are ignored. Numbers are entered in scientific notation. All calculations are done with double-digit precision. For the trigonometric functions, all angles are expressed in radians.

A number of constants are provided: e, which is the base of the natural logarithm; pi, which is the circumference of a unit-diameter circle; per, which equals the programmed horizontal range; f, which equals 1 /per; omg, which equals 2 * pi / per, and numerals in the range of -1E^20 to 1E^20.

There are three classes of precedence: ^ (raise to power) has the highest precedence; (multiply) and / (divide) come second; + and - have the lowest precedence. Parentheses may be used to change the order of precedence. The following table summarize the mathematical expressions and their respective abbreviated commands that can be used with the Equation Editor.

Equation Editor Operands

^	Raise to the power
*	Multiply
/	Divide
+	Add
Ä	Subtract
( )	Parentheses
e	Base of natural Logarithm
pi (π)	Circumference of unit-diameter circle
per	Horizontal wavelength in points
f	I/per
omg (Ω)	2*π / per
amp	Amplitude in units of points or seconds
sin(x)	The sine of x(*)
cos(x)	The cosine of x
tan(x)	The tangent of x
ctn(x)	The cotangent of x
log(x)	The base IO logarithm of x
ln(x)	The natural (base e) logarithm of x
abs(x)	The absolute value of x
-1E^20<>1E^20	Numerals, equation constants

(*)x = argument mathematical expression

After you get familiar with the operands and conventions, you can commence with a few simple equations and see what they do to your waveform screen. Once you'll get the feel, you'll be able to explore your own creativity to generate much more complicated and complex waveforms.

Typing Equations

If you remember from your old high school studies, the simplest curve of Y as a function of X is defined by the equation Y=aX+b. You can use the same “technique” to generate straight lines with the Equation Editor. Assuming first that p=0, try this:

Amplitude(p)=1000

Press [Preview] and see what you get. Of course, you get an uninteresting line that runs parallel to the X-axis. Now, lets give the line some angle by typing:

Amplitude(p)=-2*p+2000

Press [Preview] and see that the line slopes down. It may still be not very interesting however, pay close attention to the convention that is used in this equation. You cannot type: Amplitude(p)=-2p+1000, like you would normally do in your notebook; You must use the * (multiply) sign, otherwise you'll get a syntax error. Now we'll try to generate a simple sine waveform. Try this:

Amplitude(p)=sin(10)

Press [Preview] and… sorry, you still get nothing on the screen. The Wave Composer did not make a mistake! The sine of 10 in radians is exactly what it shows. You are unable to see the result because the line on your screen running across the 0 vertical point.

REMEMBER

The equation must be a function of a single variable and that variable must be directly related to the Horizontal axis Scale setting.

Now try this:

Amplitude(p)=sin(omg*p)

Still no good, but now press the [Adjust] button and here is your sinewave. So what's wrong? Well, if you'll give it a little amplitude it might help so, do it now exactly as follows:

Amplitude(p)=8000*sin(omg*p)

There you go. You should now see a perfect sine waveform with a period of 1000 points. This is because you have asked the Equation Editor to compute the sine along p points (“p” is the equation variable, remember?). If you want to create 10 sine waveforms, you

should multiply p by 10. Try this:

Amplitude(p)=8000*sin(omg*p*10)

Equation Samples

So far, you have learned how to create two simple waveforms: straight lines and trigonometric functions. Let's see if we can combine these waveforms to something more interesting. Take the straight line equation and add it to the sinewave equation:

Amplitude(p)=12000*sin(omg*p*l0)-8*p+4000

Press [Preview]. Your screen should look like Figure 4-24.

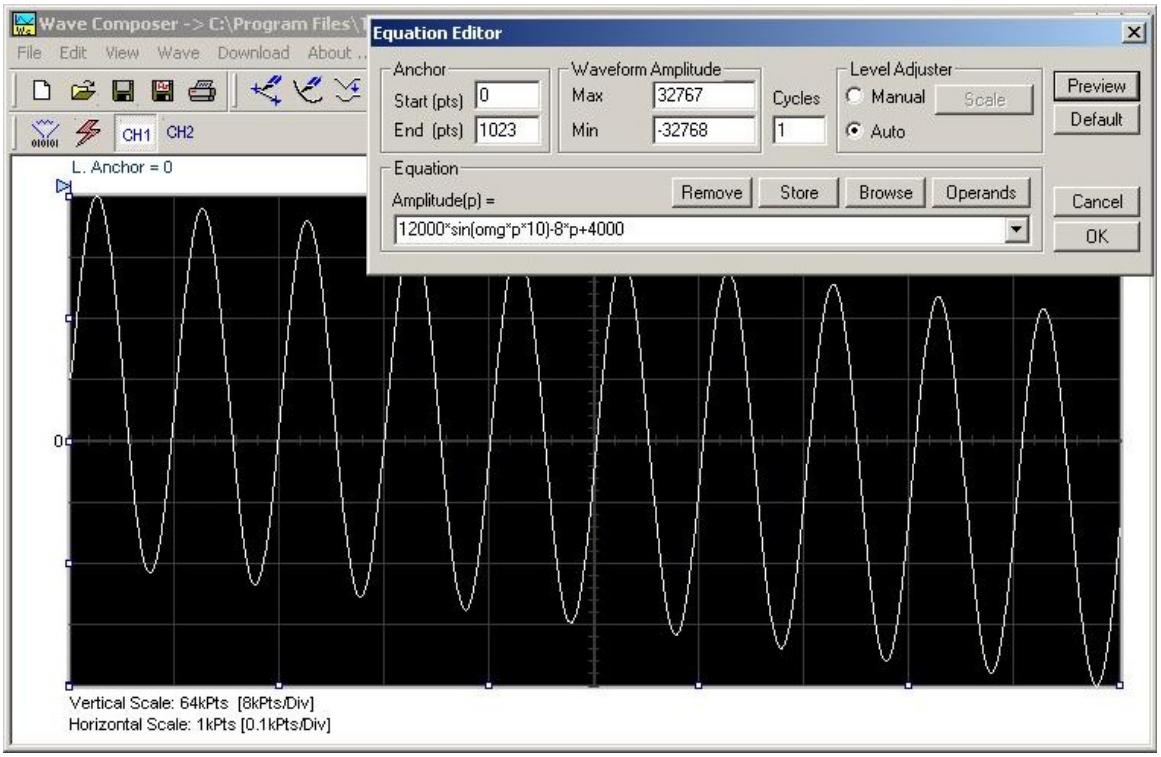

Figure 4-24, an Equation Editor Example

Now let's try to modulate two sine waves with different periods and different start phase. Type this:

Amplitude(p)= 12000*sin(omg*p)*cos(omg*p*30)

Press [Preview]. Your screen should look like Figure 4-25.

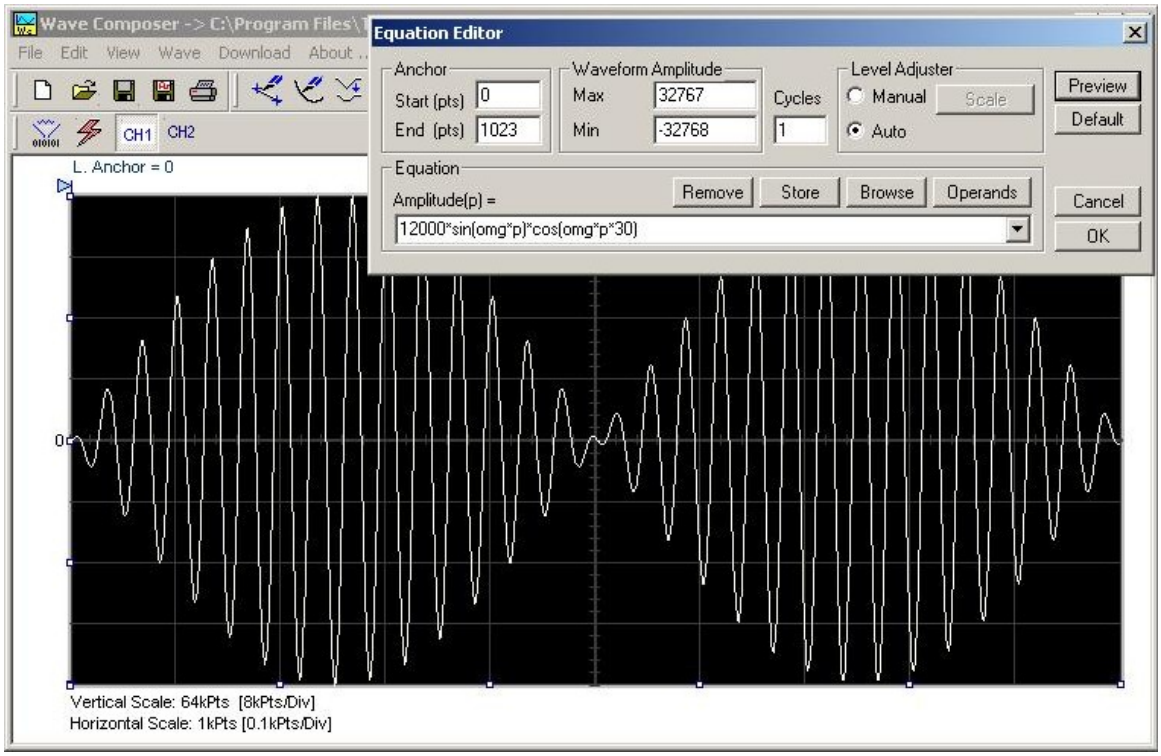

Figure 4-25, Using the Equation Editor to Modulate Sine Waveforms.

In the following example, as shown in Figure 4-26, 20% second harmonic distortion has been added to a standard sinewave. The original waveform had a peak-to-peak value of 24000 points so 19% second harmonic is equivalent to 4500 points. The frequency of the second harmonic is obviously double that of the fundamental, so term +4500*sin(2*omg*p) is added to the original sine wave equation. Use the following equation:

Amplitude(p)=24000*sin(omg*p)+4500*sine(2*omg*p)

Press [Preview]. Your screen should look like Figure 4-26.

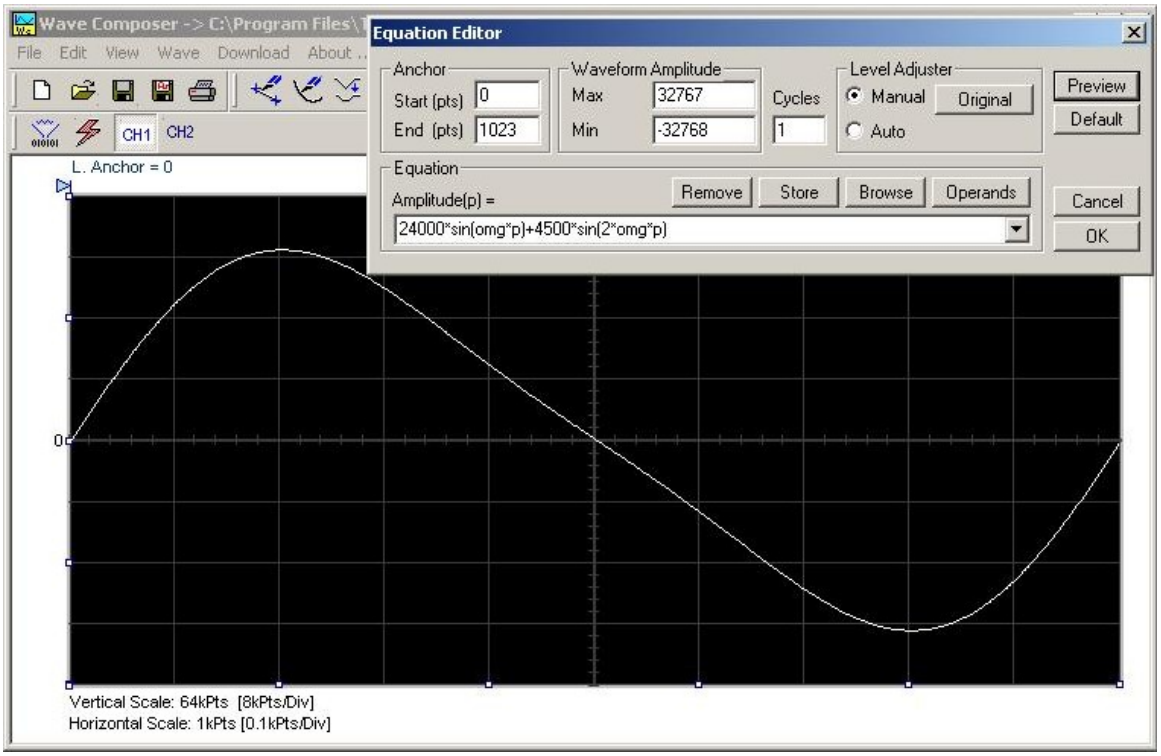

Figure 4-26, Using the Equation Editor to Add Second Harmonic Distortion.

In Figure 4-27 we created 10 cycles of sinewave made to decay exponentially. The original expression for a standard sinewave is multiplied by the term e^(p/-250). Increasing the value of the divisor (200 in this case) will slow down the rate of decay.

Use the following equation:

Amplitude(p)=12000*sin(omg*p*10)*e^(p/-250)

Press [Preview]. Your screen should look like Figure 4-27.

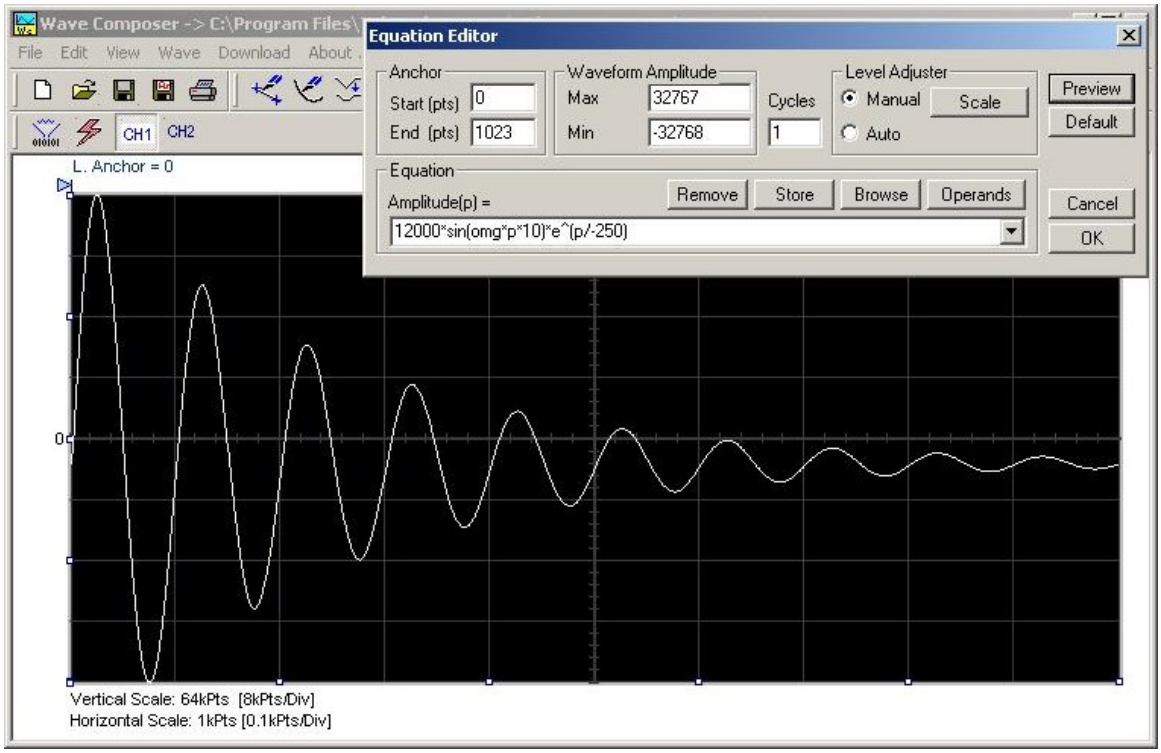

Figure 4-27, Using the Equation Editor to Generate Exponentially Decaying Sinewave

The last example as shown in Figure 4-28 is the most complex to be discussed here. Here, 100 cycles of sinewave are amplitude modulated with 10 cycles of sine wave with a modulation depth of 20%. To achieve this, the upper and lower sidebands are defined separately and added to the fundamental or carrier. The upper sideband is produced by the expression 100*cos(110*omg*p) and the lower sideband by the term 100*cos(90*omg*p).

Use the following equation:

Ampl(p)=6000*sin(100*omg*p)+1200*cos(110*omg*p)-1200*cos(90*omg*p)

Press [Preview]. Your screen should look like Figure 4-28.

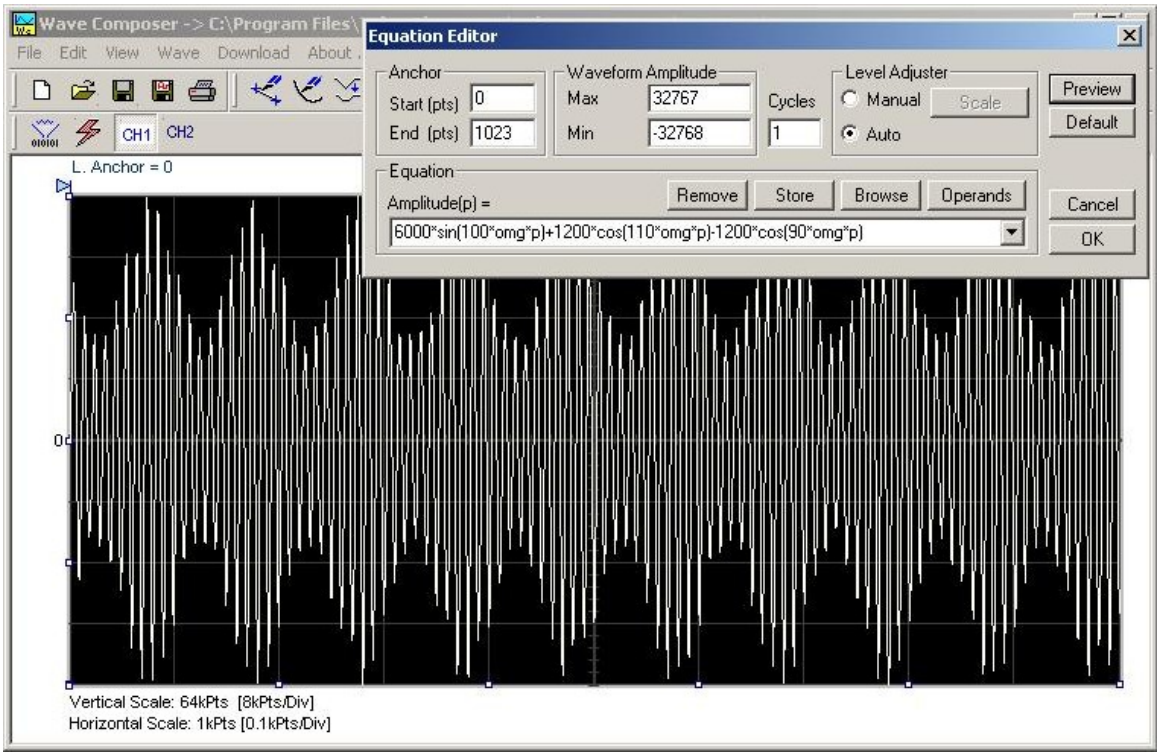

Figure 4-28, Using the Editor to Build Amplitude Modulated Signal with Upper and Lower Sidebands

Combining Waveforms

The last but not least powerful feature allows you to combine waveforms which you previously stored on your hard disc. You can write mathematical expressions that contain waveforms, simple operands and trigonometric functions similar to the example given below. If you want to use waveforms in your equations, you must first generate these waves and store them on your hard disk. You identify waveforms by adding the *.wav extension as shown in the example below.

Amplitude(p)= Sine.wav*sin(omg*p*10)*Noise.wav/1000

The above equation will generate amplitude-modulated waveform with added noise. The following steps demonstrate how to create, store and combine waveforms using this equation.

Step 1 – Create and store sine.wav. Invoke the Wave command and generate a sine waveform. Press OK and then select the Save Waveform As… from the File command. Save this file using the name Sine.wav. note where you store this waveform as you would have to know the path for the next step.

Step 2 – Create and store Noise.wav. From the Wave command select Noise. Click OK and watch your waveform screen draw noisy signal. From the File menu select Save Waveform As… and save this waveform using the name Noise.wav.

Step 3 – Write and compute the original equation:

Amplitude(p)= c:/Sine.wav*sin(omg*p*5)*c:/Noise.wav/10

If you did not make any mistakes, your waveform screen should look as

shown in Figure 4-29

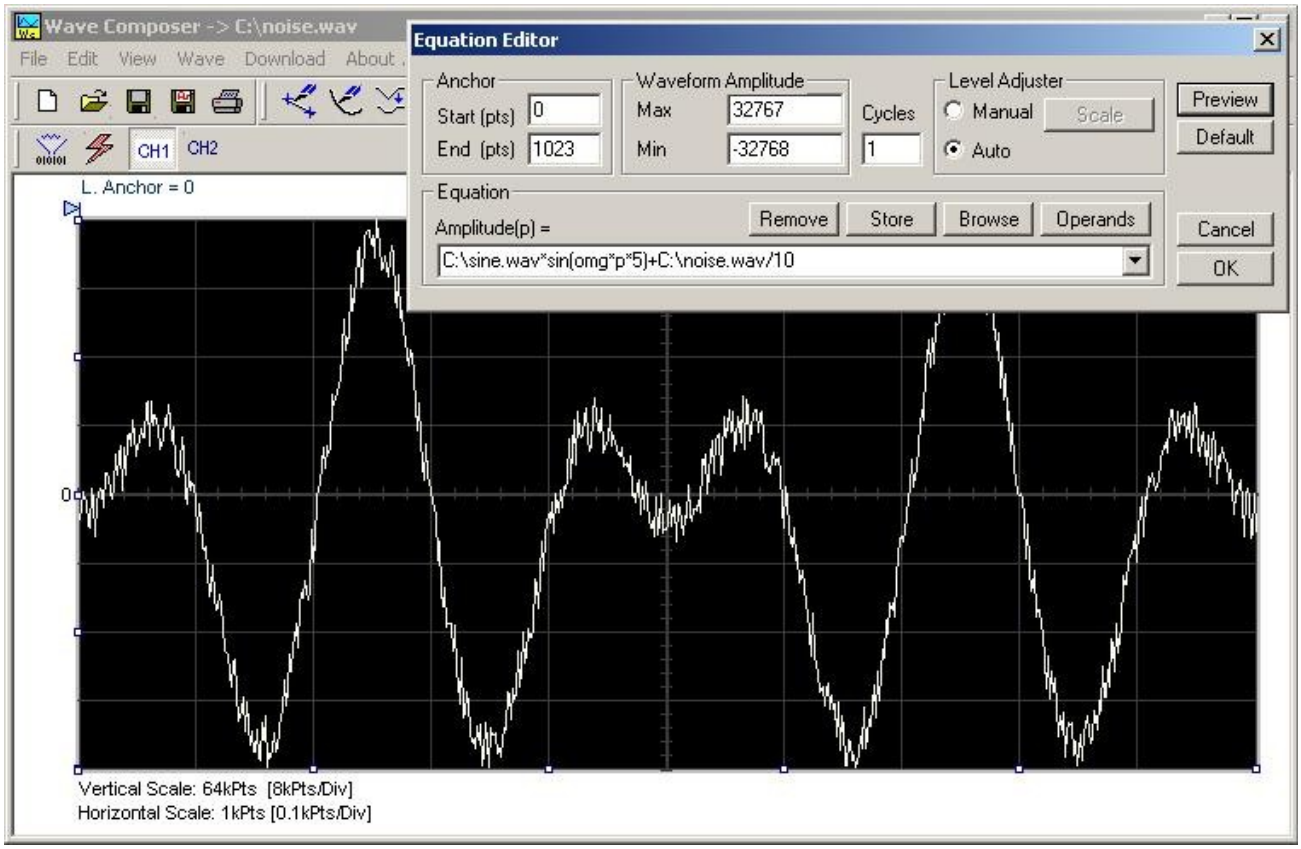

Figure 4-29, Combining Waveforms into Equations

The Pulse Composer

The Pulse Composer is a great tool for creating and editing pulses without the need to think about sample clock, number of points and complex equations. Pulses are created on the screen, simply and efficiently in a special dialog box by typing in the width and level, or by using the “rubber band” method to place straight line segments with the exact amplitude and time duration. The pulse composer can also multiply pulse sections to create pulse duplication along lengthy time intervals.

When you finally have your pulse design on the screen the program determines if the pulse design will fit in one memory segment or use multiple segments and employ the sequence generator for repeatable segments. In either case, bear in mind that if you already have some waveforms stored in memory segments, these will be erased to make room for the new pulse design. If you insist on keeping arbitrary waveforms and still download complex pulses, you can check the “Force pulse to one segment” option and the 2572 will do some extra “muscle flexing” to fit the pulse as required.

To launch the pulse composer point and click on the PULSE button in the Panels bar. Figure 4-30 shows an example of the pulse composer. The Pulse Composer has three main sections: Commands bar, Toolbar and Waveform screen. Refer to Figure 4-30 throughout the description of these sections.

The Pulse Composer Commands bar

The commands bar provides access to standard Windows commands such as File and View. In addition, there are ArbExplorer-specific commands such as Edit, Wave and System.

In general, clicking on one of the commands opens a dialog box with an additional list of commands. Then, clicking on an additional command, may open a dialog box, or generate an immediate action. For example, Clicking on File and then Exit will cause an immediate termination of the Pulse Composer. The various commands in the Commands bar are listed and described below.

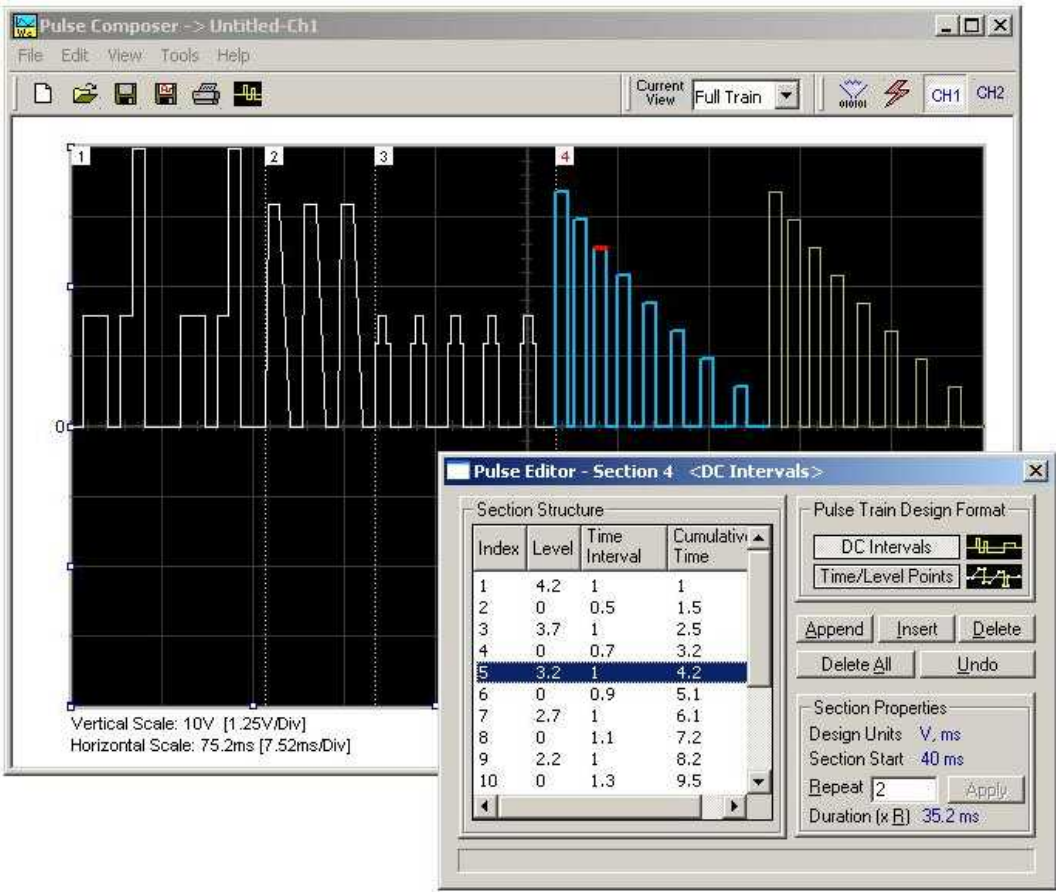

Figure 4-30, the Pulse Composer Screen

File Commands

The File command has 4 command lines that control pulse waveform files. Also use this command to print the active waveform, or exit the pulse composer program. Description of the various commands under File is given below.

New
The New (Ctrl+N) command will remove the waveform from the screen. If you made changes to the waveform area and use the New command, you should save your work before clearing the screen. The New command is destructive to the displayed waveform.

Open…
The Open… (Ctrl+O) command will let you browse through your disk space for previously saved pulse waveform files and load them to the pulse screen area. File extension that can be read to the pulse composer is *.pls.

Save
The Save (Ctrl+S) command will store the active waveform in your 2572 directory with a *.pls extension. If this is the first time you save your waveform, the Save As… command will be invoked automatically, letting you select name, location and format for your waveform file.

Save As…
Use the Save As… command the first time you save your waveform. It will let you select name, location and format for your waveform file.

Print
With this command you may print the active Pulse Window. The standard printer dialog box will appear and will let you select printer setup, or print the waveform page.

Exit
The Exit command ends the current Pulse Composer session and takes you back to the Panels screen. If you made changes to your waveform since it was last saved, the Wave Composer will prompt you to Save or Abandon changes these changes.

Edit Commands

The Edit commands are used for adding or removing pulse train sections. Use these commands to Append, Delete, Insert, or Undo last operation. The editing commands are explained in the following paragraphs.

Append Section
The Append Section command lets you append a new section at the end of the pulse train. Only one new section can be appended at the end of the train. If an empty section already exists, the

append command will alert for an error. New sections are always appended at the end of the pulse train.

Insert Section
The insert Section command lets you insert a new section in between sections that were already designed. Only one new section can be inserted at the middle of the train. If an empty section already exists, the insert command will alert for an error.

Delete Section
The Delete Section command lets you remove sections from the pulse train without affecting the rest of the train. If you use this command from the Edit menu, make sure that the section you want to remove is currently the active section.

Remove all Sections
The Remove all Sections command lets you remove the entire pulse design from the pulse screen and start from a fresh page.

Undo
The Undo command undoes the last editing operation. This command is extremely useful in cases where you unintentionally delete a section from the pulse train and want to restore it to the screen.

View Commands

The View commands have commands that let you view various sections of the pulse area. The View commands include: Pulse Editor, Full Train or individual Sections, Channel 1 and 2 screens and Options. Description of the view commands is given in the following.

Pulse Editor
The view Pulse Editor command invokes a dialog box as shown in Figure 4-31. In general, the pulse editor is used for placing straight line segments on the screen in intervals that define pulse width, rise/fall times and amplitude. Information how to use the pulse editor to create pulse trains is given later in this chapter.

Full Train
The view Full Train shows on the pulse screen all sections of the pulse train. Eventually, when all pulse sections have been designed, the entire pulse train as shown when the Full Train option has been selected, will be downloaded to the instrument as a single waveform.

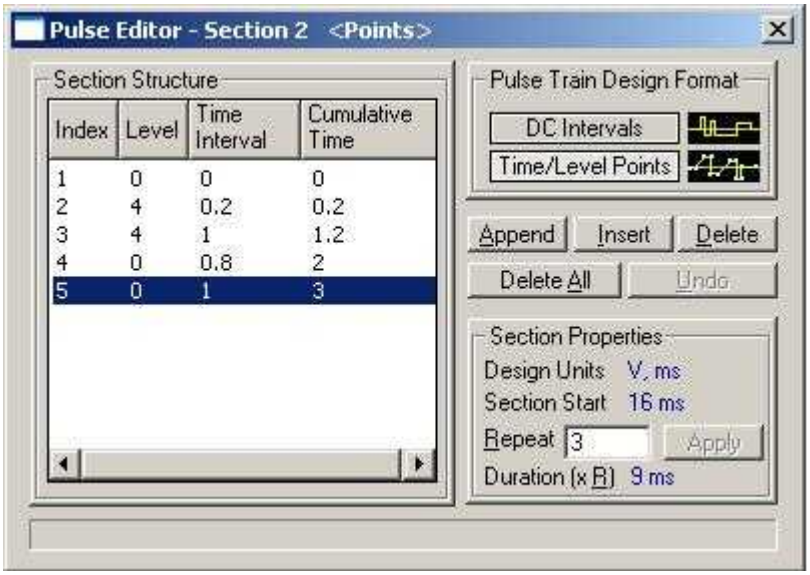

Figure 4-31, the Pulse Editor

Single Section
The view Single Section shows on the pulse screen one section at a time. Eventually, when all pulse sections have been designed, the entire pulse train as shown when the Full Train option has been selected, will be downloaded to the instrument as a single waveform.

Channel 1
The view Channel 1 command updates the waveform screen with the Channel 1 pulse train. If you have not yet generated a waveform for channel 1, the waveform screen will show a clear display.

Channel 2
The view Channel 2 command updates the waveform screen with the Channel 2 pulse train. If you have not yet generated a waveform for channel 2, the waveform screen will show a clear display.

Options
The view options command opens the dialog box as shown in Figure 3-32. Use this dialog box to fine-tune the pulse composer to the way it should deal with operational modes and the waveform memory. Options information options is given later in this chapter.

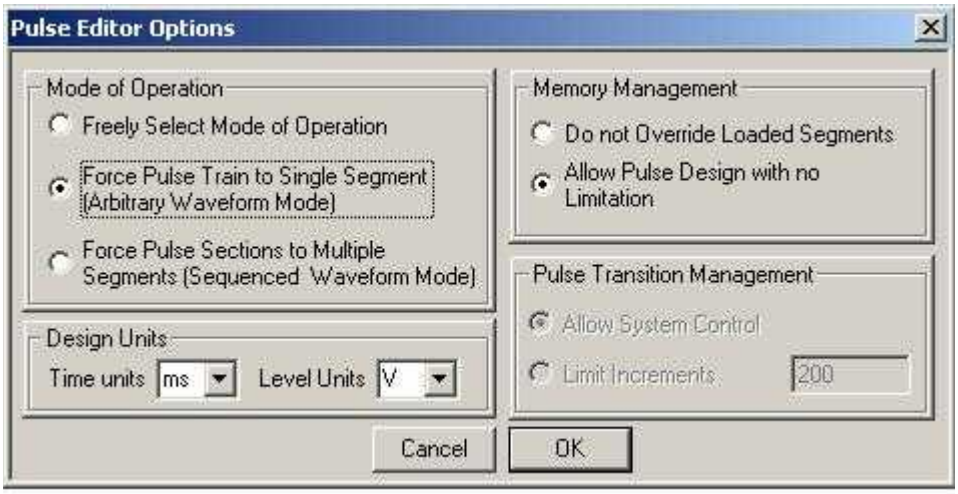

Figure 4-32, the Pulse Editor Options

Tools Commands

The Tools commands let you download pulse trains to either channel 1 or channel 2. You can also clear the entire waveform memory using the Clear memory command.

Note

The Clear Memory command affects the entire waveform memory of the 2572 and therefore, be careful not to erase memory segments that you'll need to use with the arbitrary function.

The Pulse Composer Toolbar

The toolbar contains icons for editing the waveform screen, icons for saving and loading waveforms, fields for selecting an active channel and more. The Toolbar is shown in Figure 4-33. The icons, from left to right operate the following functions: New waveform, Open an existing waveform file, Save pulse train, Save pulse train As, Print the screen and open the pulse editor dialog box. Other icons select the current view on the screen, shows channel 1 and channel 2 waveforms, clear the memory and download the displayed pulse train to the active channel.

Figure 4-33, the Pulse Composer Toolbar Icons

Creating Pulses

As was mentioned above, creating pulses with the pulse editor is simple and intuitive, just as you would draw the pulse on a piece of paper. The pulse editor then processes the information, determines the appropriate mode and converts to waveform coordinates for

downloading to the instrument for it to generate the required pulse shape.

There are a number of terms that will be used throughout the following description; Make yourself familiar with these terms before you proceed with actual design of your pulse.

Pulse Editor
The Pulse Editor is the prime tool for creating pulses. To invoke the pulse editor, point and click on the pulse editor icon on the pulse composer toolbar. You can also invoke the editor by clicking on the Section Number icon as will be shown later in this description. The pulse editor dialog box is shown in Figure 4-31.

Pulse Train
The Pulse Train identifies the entire pulse design. When downloading the waveform to the instrument, the entire pulse train will be downloaded, regardless if part of the pulse train is displayed on the pulse composer screen.

Pulse Section
Pulse train is constructed from 1 or more sections. If the pulse is simple, it can be created using one section only. For more complex pulse train, the train can be divided to smaller sections and each section designed separately for simplicity. Figure 4-34 shows a complex pulse train which was made from five simpler sections and Figure 4-35 shows the design of the fifth section only of the pulse train.

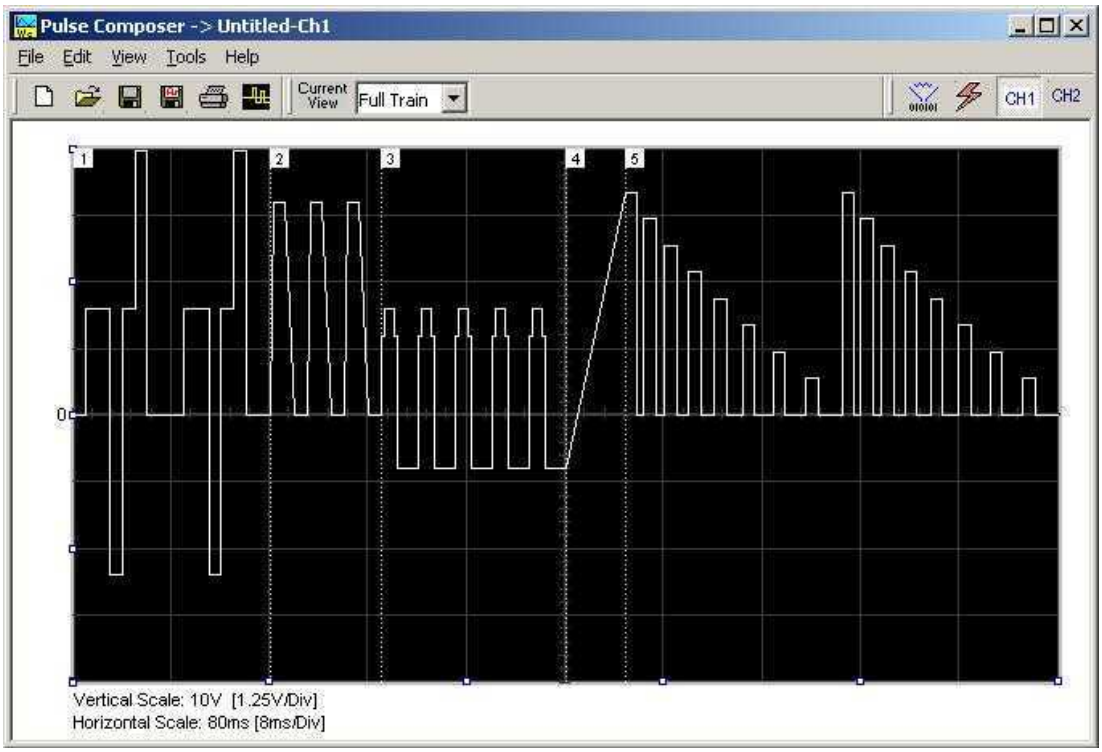

Figure 4-34, Complete Pulse Train Design

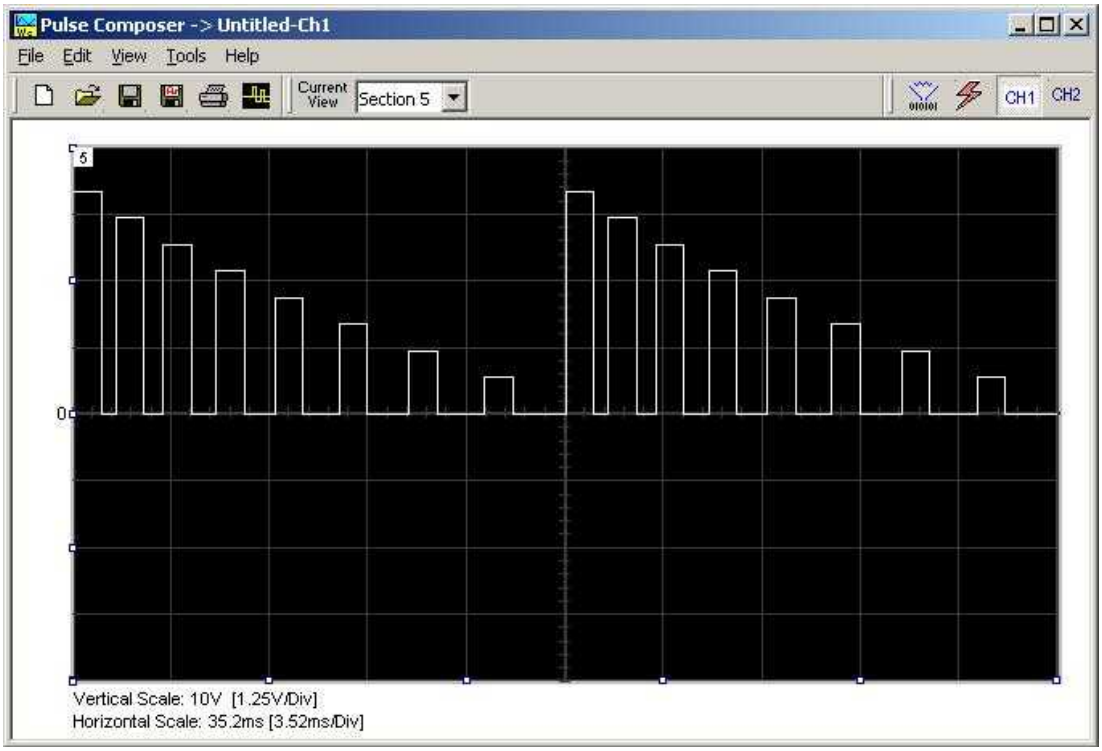

Figure 4-35, Section 5 of the Pulse Train Design

Now that we somewhat understand the terms we use for the pulse design, we start with an example how to design the pulse train as shown in Figure 4-34. If you already have some pulses shown on your pulse composer screen, click on New to start from a fresh page. Another step before you design your pulse train is to set the design parameters in the options menu that will determine the way that the pulse will be distributed in your waveform memory. Click on View→Options and refer to Figure 4-36 throughout the following description.

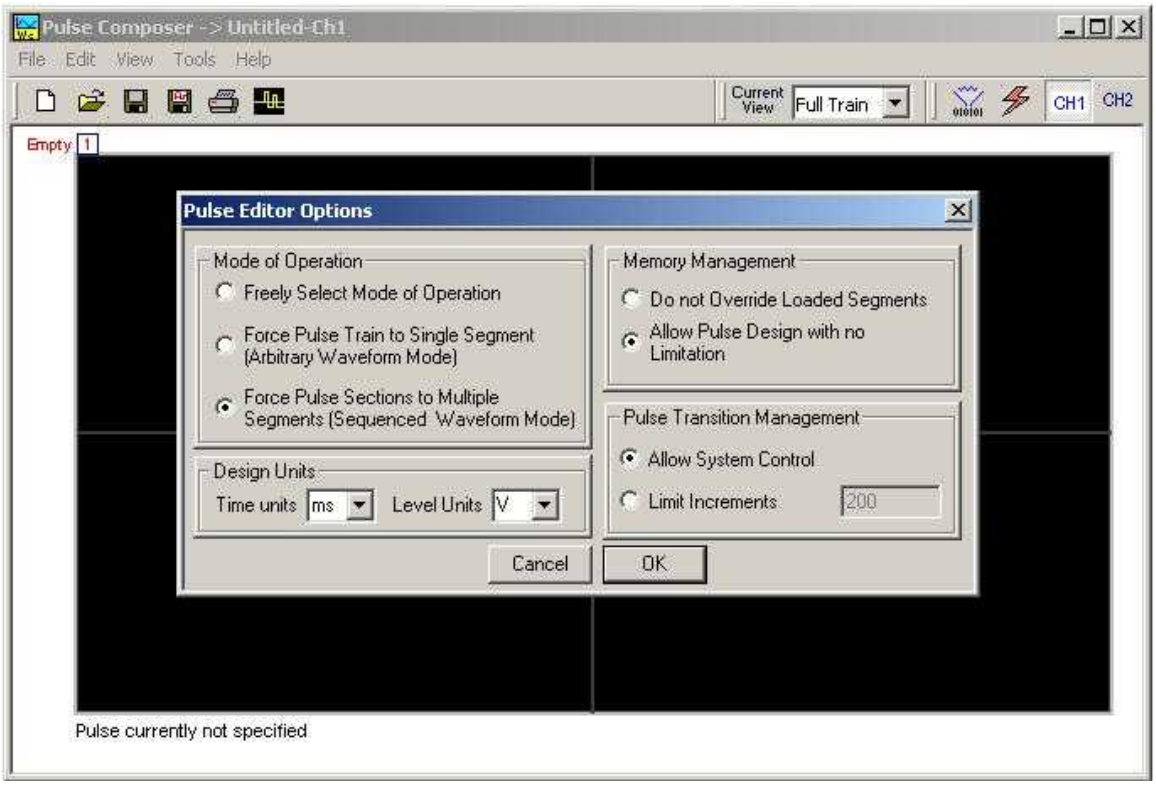

Figure 4-36, Selecting Pulse Editor Options

Setting the Pulse Editor Options

As shown in Figure 4-36, the pulse editor option dialog box is divided to functional groups: Mode of operation, Design Units, Memory Management and Pulse Transition Management. These groups are described below.

Mode of Operation

There are three options in the mode of operation group.

The force pulse train to single segment option is recommended if you are using one pulse section only. In this case, the pulse

waveform will occupy one segment only and the generator will automatically be set to operate in arbitrary mode.

The force pulse sections to multiple segments option will place each section of the pulse train into a different memory segment and the generator will automatically be set to operate in sequenced mode. Select this option for the example we are going to build later.

If you are not sure what to do, select the freely select mode of operation and the generator will do the work for you.

Design Units
As you design your pulse pattern, it will be easier if you design it using the exact units as you would want to output to your load. Select between μs, ms and s for the pulse intervals and mV or V for the amplitude level. Select ms and V for the example we are going to build later.

Memory management
There are two options in the memory management group.

The do not override loaded segments option will make sure that whatever waveforms you already stored for the arbitrary function will stay intact after you save your pulse waveform.

The allow pulse design with no limitations option may overwrite memory segments that you already used previously for the arbitrary function however, this is the recommended option for the program and for the example we are going to build later.

Pulse Transition management
The pulse transition management parameter defines for the program how many waveform points will be used to step from one amplitude level to another amplitude level. The longer the transition time, the program will need more steps to smooth the transition. If you select the limit increments and set a pre-defined number of increments, you manually control how many waveform points will be dedicated for transitions however, if you are not sure what is the optimum number of increments, select the allow system control option for the program to make the transitions efficient in terms of memory usage and slope smoothness.

After you complete setting the pulse editor options, point and click on OK.

Using the Pulse Editor

The prime tool for building pulse patterns on the pulse composer screen is the pulse editor. To invoke the pulse editor, point and click on the pulse editor icon on the tools bar. The editor as shown in Figure 4-37 will show. Refer to this figure for the following descriptions.

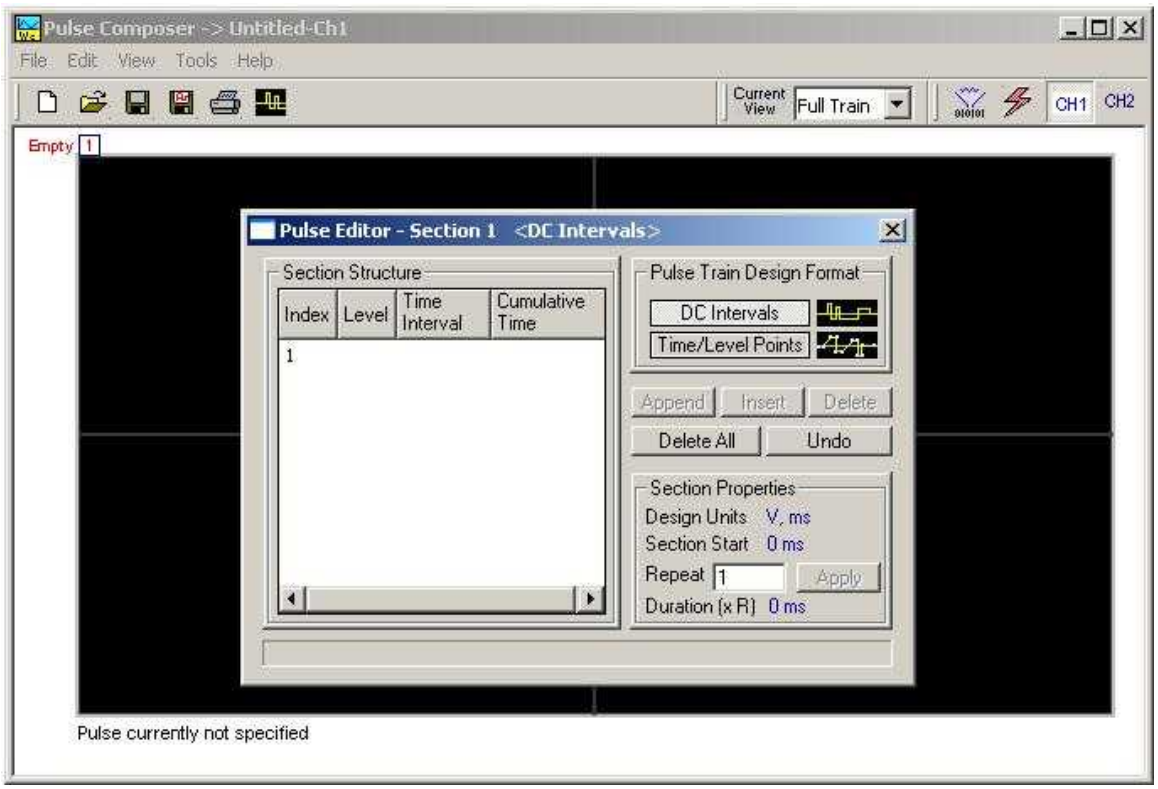

Figure 4-37, Using the Pulse Editor

The Pulse Editor as shown in Figure 4-37 has four groups: Section Structure, Pulse Train Design Format, Section Properties and control buttons. These groups are described below.

Pulse Train Design Format

There are two methods (or formats) that can be use for designing the pulse shape: DC Intervals and Time/Level Points. The design format is unique for the current section and cannot be switched during the section design.

DC Intervals – programs pulse duration using DC levels only. Transition times for this format are at the maximum rate that the

generator can produce. For example, if you want to draw a simple square waveform that has 0V to 3.3V amplitude, 50% duty cycle and 1ms period, you enter the following parameters:

Index = 1, Level = 3.3, Time interval = 0.5 (Cumulative Time = 0.5)
Index = 2, Level = 0, Time Interval = 0.5 (Cumulative Time = 1.0)

Note as you build the segments that the pulse is being drawn on the screen as you type in the parameters. Also note that the Cumulative Time column is updated automatically with the cumulative time lapse from the start of the pulse.

Time/Level Points – programs pulse turning points using level and time markers. This format is a bit more complex to use however, it allows pulse design that require linear transition times. For example, if you want to draw a simple square waveform that has 0V to 3.3V amplitude, 50% duty cycle, 1ms period and 100ns transition times, you enter the following parameters:

Index = 1, Level = 0, Time interval = 0, (Cumulative Time = 0)
Index = 2, Level = 3.3, Time Interval = 0.1, (Cumulative Time = 0.1)
Index = 3, Level = 3.3, Time interval = 0.4, (Cumulative Time = 0.5)
Index = 4, Level = 0, Time interval = 0.1, (Cumulative Time = 0.6)
Index = 5, Level = 0, Time interval = 0.4, (Cumulative Time = 1.0)

Note as you build the segments that the pulse is being drawn on the screen as you type in the parameters and the specified point is marked with a red dot. Also note that the Cumulative Time column is updated automatically with the cumulative time lapse from the start of the pulse.

Section Structure
The term Section Structure is used to define part of the pulse train that share common properties. There are four parameters that can be programmed in this group: Index, Level, Time Interval and Cumulative Time.

Index – Is added automatically as you program pulse segments. The index line is highlighted as you point and click on pulse segments on the pulse editor screen.

Level – Specifies that peak level of the programmed segment. As you build the pulse, the level window is expended automatically to fit the required amplitude range. Note however, there is a limit to the level, which is being determined by the generator's peak to peak specification.

Time Interval – Specifies the time that will lapse for the current index level. You can program the time interval and the cumulative time will be adjusted accordingly.

Cumulative Time – Specifies the time that will lapse from the start of the current pulse section. You can program the cumulative time and the time interval will be adjusted accordingly.

Section Properties

The Section Properties contains a summary of properties that are unique for the current section.

Design Units – Provide information on the units that are used when you draw the pulse segments. These units can be changed in the pulse editor options.

Section Start – Provides timing information for the start of the current section. If this is the first pulse section the value will always be 0. Subsequent sections will show the start mark equal to the end mark of the previous section.

Repeat – Allows multiplication of pulse segments without the need to re-design repetitive parts. After you enter a repeat value, press the Apply button to lock in the repeat multiplier.

Duration – Displays the time that will lapse from the start of the pulse section to the end. The duration shows the total time lapse, including the repeated sections.

Control Buttons

The control buttons allow appending, inserting, and deleting one or all index lines. The Undo button is useful in cases where an error was made and restoration of the last operation is critical.

Pulse Example, Section 1

Now that we are better familiar with the pulse editor and its options, we are ready to start building the first section of the pulse as shown in Figure 4-34. Point and click on the New icon and open the pulse editor. Type in the level and time intervals as shown in Figure 4-38. Note that the pulse segments are being created on the screen as you type the values.

Tips

Use the tab button to edit the Section Structure fields. Use Append to add an index line at the end of the list. Use insert to add a segment above a focused line.

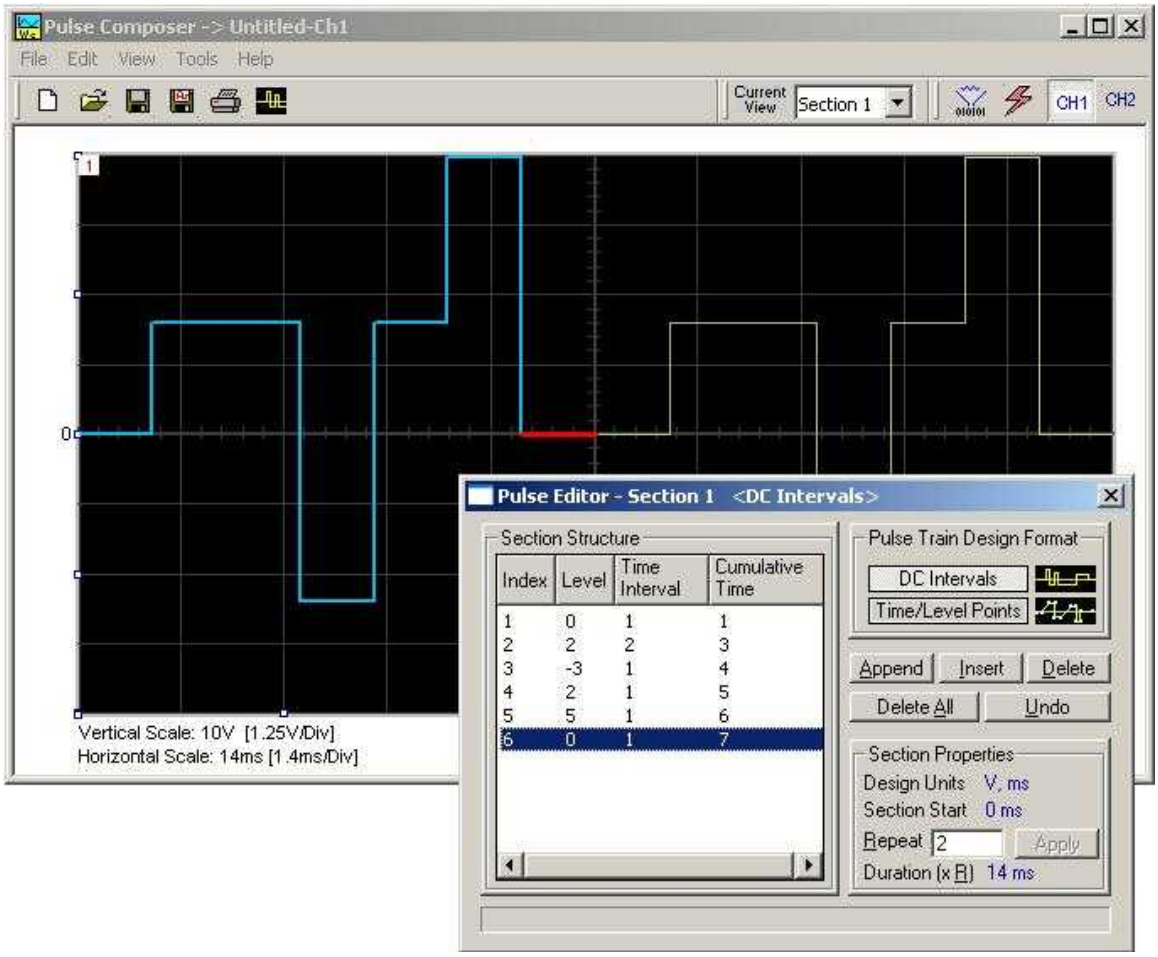

Figure 4-38, Building Section 1 of the Pulse Example

Before we proceed with the design of the next section, pay attention to some values that are now available on the composer screen. On the left bottom corner of the composer, Vertical Scale is showing 10V (1.25V/Div) and Horizontal Scale is showing 14ms (1.4ms/Div). These two values are critical for the integrity of the design because they are later being interpreted by the program and converted to waveform coordinates that the generator can process and output as a pulse shape. These values, may change as you add more sections to the pulse train.

Pulse Example, Section 2

The first pulse section is complete. We are ready now to start building the second section of the pulse as shown in Figure 4-34. Point and click on the Edit command and select the Append Section option. A new section number will appear but it will show empty next to the section identifier.

Before you start entering values to this section, note that there are linear transitions required for this section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. In case you made a mistake and want to switch design formats after you have already typed in some values, the Pulse Editor will show an error alerting you that design format can only be changed for empty section. In this case, the only way to recover is to delete all entries and start from an empty index list. Type the section entries as shown in Figure 4-39.

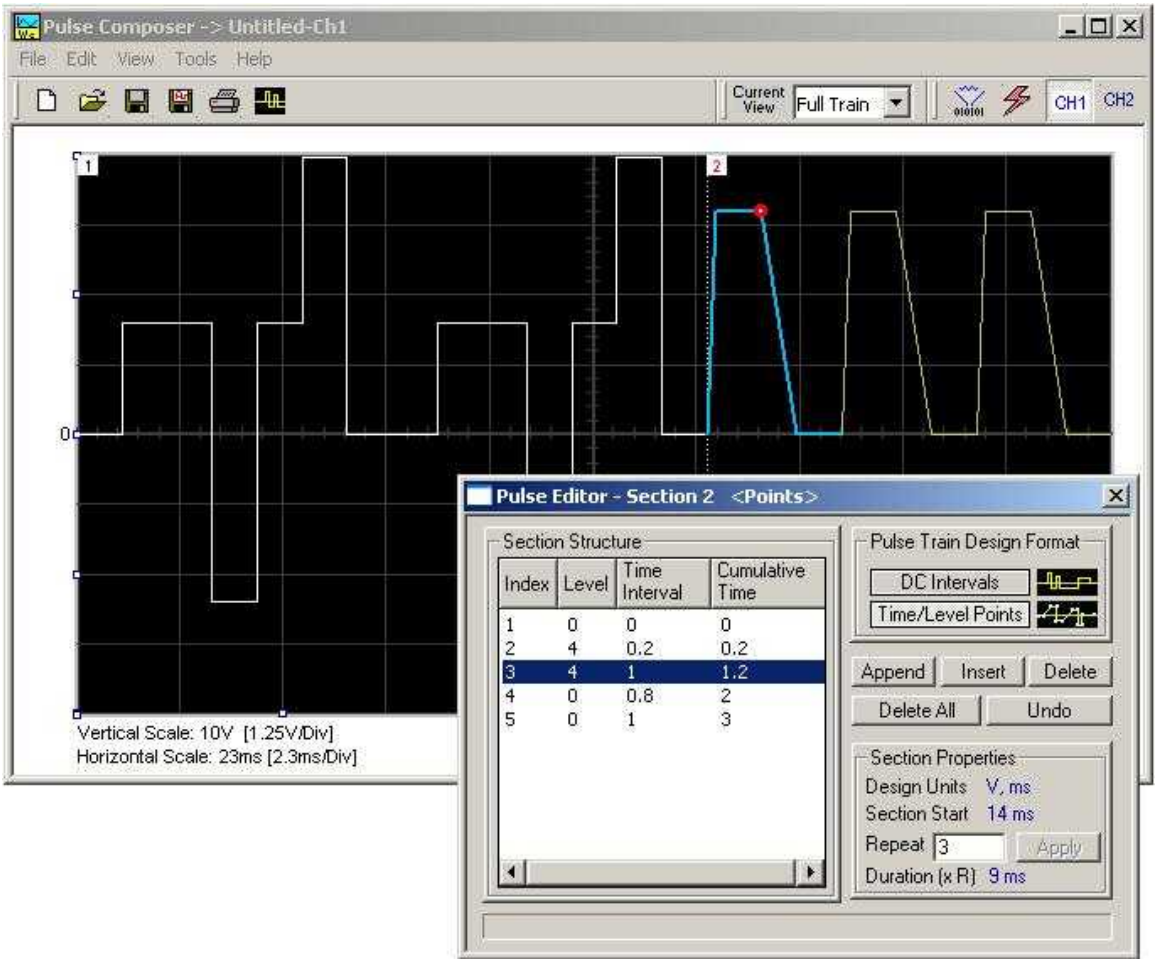

Figure 4-39, Building Section 2 of the Pulse Example

Pulse Example, Section 3

The second pulse section is complete. We are ready now to start building the third section of the pulse as shown in Figure 4-34. Point and click on the Edit command and select the Append Section option. A new section number will appear but it will show empty next to the section identifier.

Before you start entering values to this section, note that there are fast transitions required for this section. Therefore, select the DC Intervals option in the Pulse Train Design Format. You are now ready to start programming values. In case you made a mistake and want to switch design formats after you have already typed in some values, the Pulse Editor will show an error alerting you that design format can only be changed for empty section. In this case, the only way to recover is to delete all entries and start from an empty index list. Type the section entries as shown in Figure 4-40.

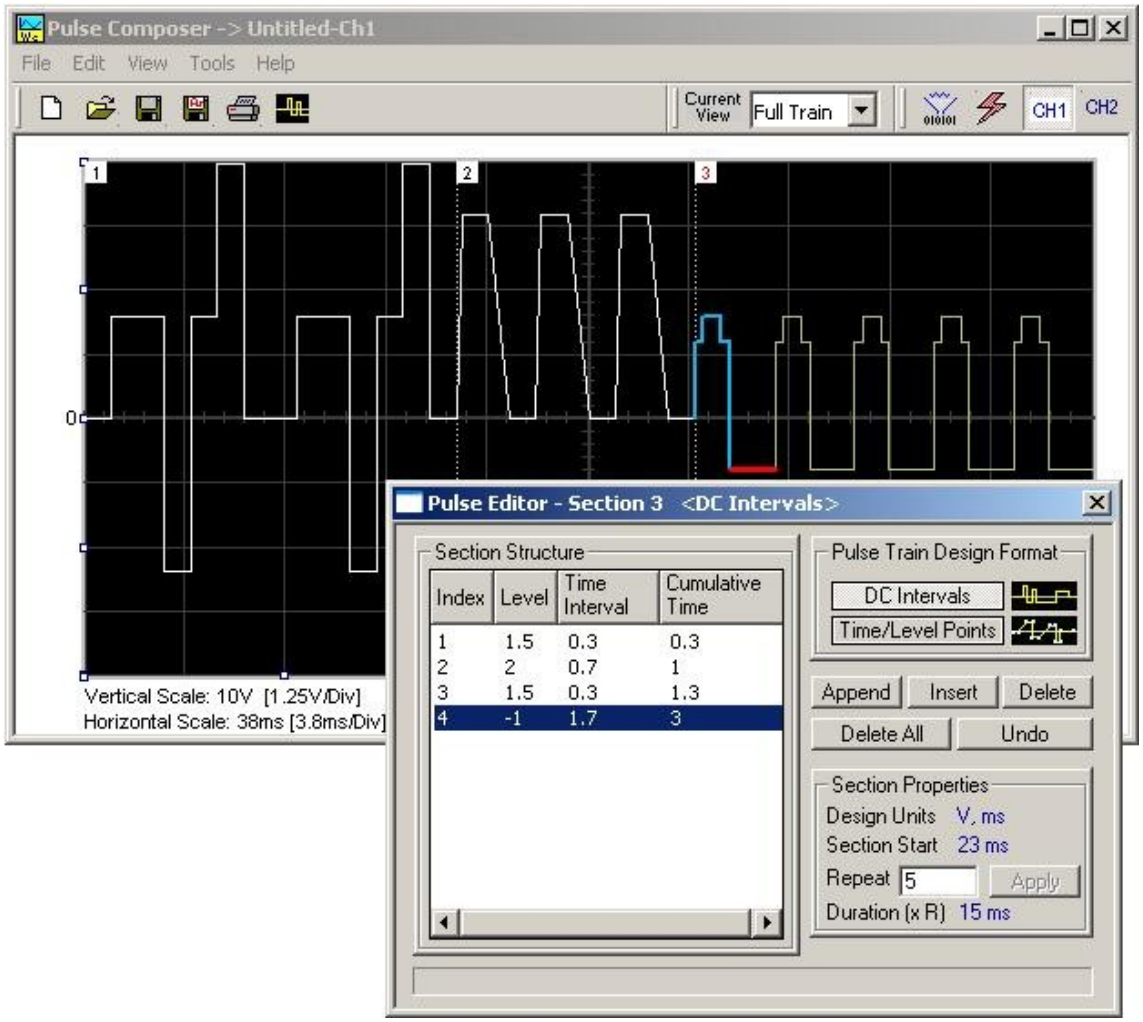

Figure 4-40, Building Section 3 of the Pulse Example

Pulse Example, Section 4

The third pulse section is complete. We are ready now to start building the forth section of the pulse as shown in Figure 4-34. Point and click on the Edit command and select the Append Section option. A new section number will appear and will show empty next to the section identifier.

Before you start entering values to this section, note that there is only one linear transition required for this section that will start from the last point of the previous section and will connect to the start point of the next section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. Type the section entries as shown in Figure 4-41.

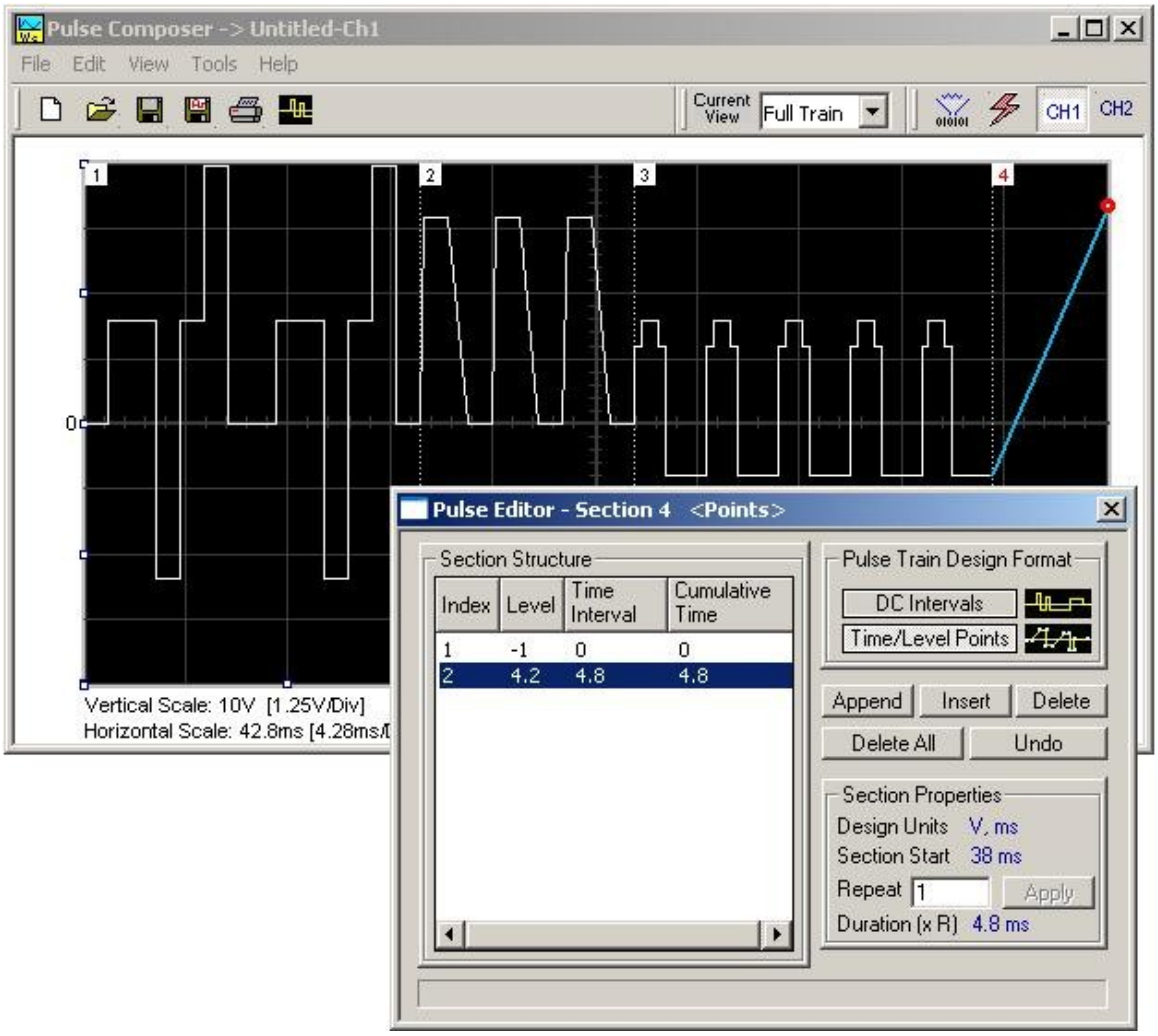

Figure 4-41, Building Section 4 of the Pulse Example

Pulse Example, Section 5

The fourth pulse section is complete. We are ready now to start building the fifth and final section of the pulse as shown in Figure 4-34. Point and click on the Edit command and select the Append Section option. A new section number will appear and will show empty next to the section identifier.

Note that there are fast transitions required for this section that will start from the last point of the previous section and will connect to the start point of the next section. Therefore, select the Time/Level Points option in the Pulse Train Design Format. You are now ready to start programming values. Type the section entries as shown in Figure 4-42.

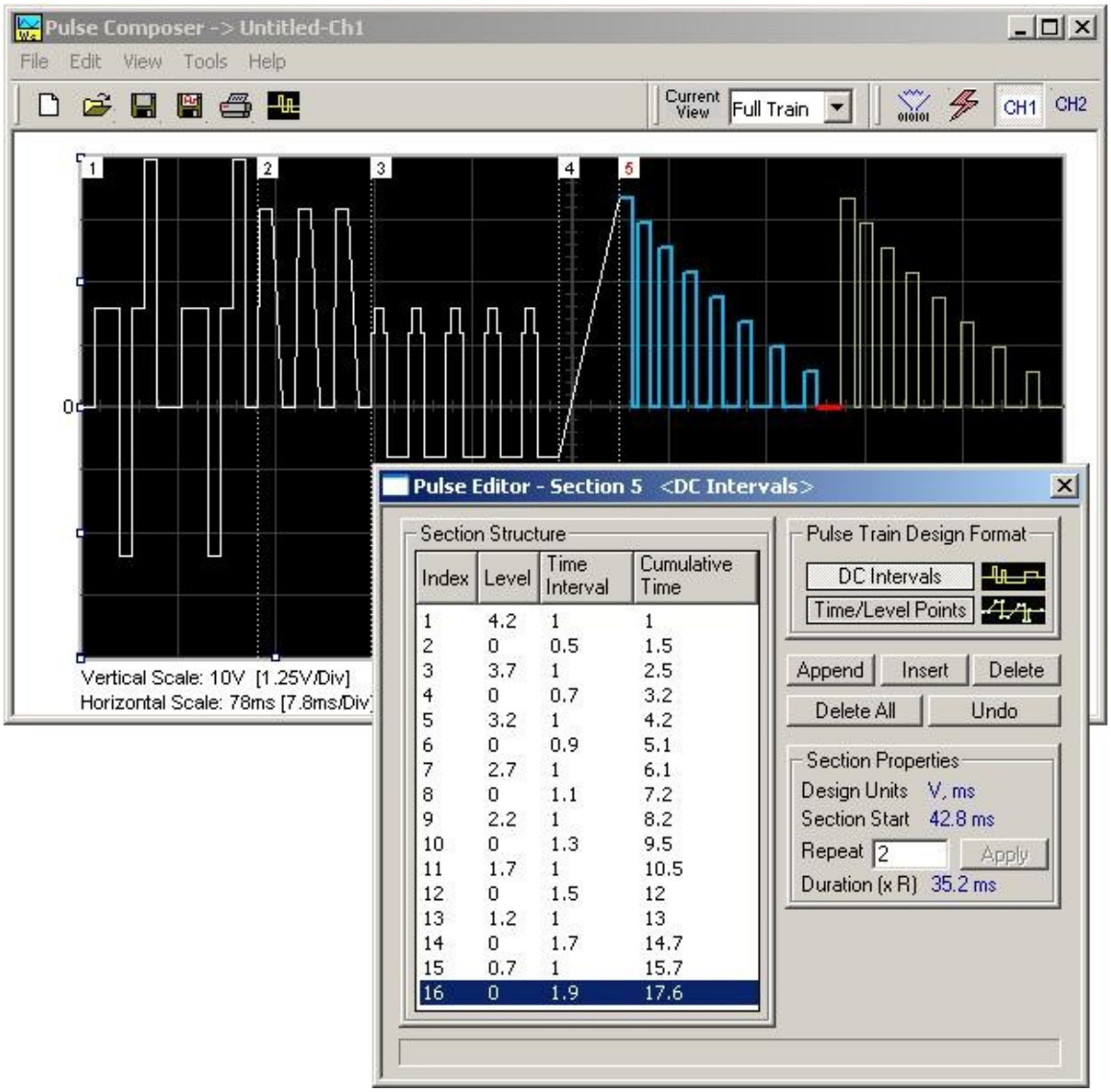

Figure 4-42, Building Section 5 of the Pulse Example

Downloading the Pulse Train

Congratulations for coming that far. If you followed the above description how to build this pulse example, the screen should look exactly as shown in Figures 4-34 and 4-42. If you are happy with the results, the next step is to download what you see on the pulse composer screen to the generator.

One more step before you download the waveform to the instrument is to check the Pulse Train Download Summary as appears after you press the Download icon. You can also view the same information if you select it from the View menu. Refer to Figure 4-43 for information how to interpret your download summary.

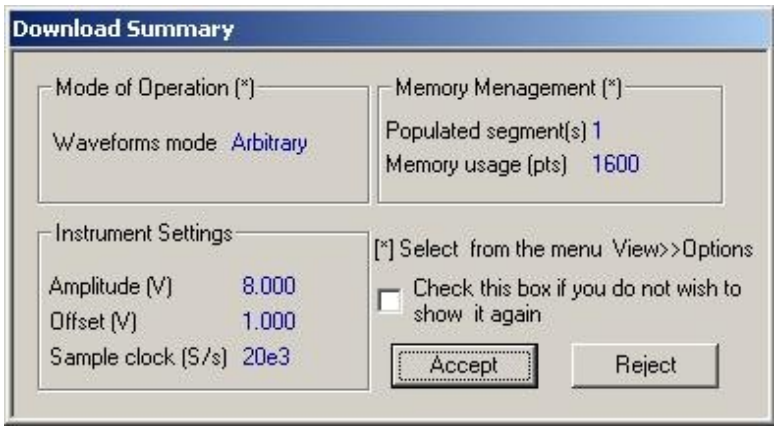

Figure 4-43, the Pulse Editor Download Summary

Interpreting the Download Summary

It is very important for you to understand that when you download a pulse waveform from the pulse composer, parameters and mode of operation may change settings on your generator. The download summary shows what will change and will let you reject the new settings if you do not agree to the changes. Once you press the Accept button, the waveform will be downloaded to the generator and the modes and parameters updated as shown in the dialog box. If you are already familiar with the changes and do not care to see the download summary every time you download a pulse waveform, you can check the box and it will not be shown on your next download. You can restore this summary from the View>>Download Summary command.

Mode of Operation – This describes the new setting of the operating mode. This field could display one of two options: Arbitrary or sequenced. Pay attention to the note (*) that says “Select from the menu View>>Options” Since we checked the Force Pulse Train to Single Segment (see Figure 4-36), the generator determines that the waveform mode be arbitrary and only one segment can be loaded with the pulse train.

Memory management – By selecting the arbitrary mode of operation, the pulse train is forced to a single segment. This summary shows which segment has been populated and how much memory was used to build the required pulse train.

Instrument Settings – Show the amplitude, offset and sample clock settings that will be changed on the generator. The settings in this summary cannot be affected from the pulse editor options settings. These are being computed and modified specifically for the current pulse train pattern and will change from pattern to pattern.

Accept/Reject – These buttons are the final step before you download the pulse train to the instrument. If you are unhappy with the instrument setting and want to change some of the options,

there is still time Point and click on the Reject button and go do your changes. Point and click on the Accept button to complete the download process.

Chapter 5
Remote Programming Reference

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What's in This Chapter

This Chapter lists and describes the set of SCPI-compatible (Standard Commands for Programmable Instruments) remote commands used to operate the 2572. To provide familiar formatting for users who have previously used the SCPI reference documentation, the command descriptions are dealt with in a similar manner. In particular, each sub-system's documentation starts with a short description, followed by a table showing the complete set of commands in the sub-system; finally the effects of individual keywords and parameters are described. Complete listing of all commands used for programming the 2572 is given in Table 5-1.

Introduction to SCPI

Commands to program the instrument over the GPIB are defined by the SCPI 1993.0 standard. The SCPI standard defines a common language protocol. It goes one step further than IEEE-STD-488.2 and defines a standard set of commands to control every programmable aspect of the instrument. It also defines the format of command parameters and the format of values returned by the instrument.

SCPI is an ASCII-based instrument command language designed for test and measurement instruments. SCPI commands are based on a hierarchical structure known as a tree system. In this system, associated commands are grouped together under a common node or root, thus forming subsystems.

Part of the OUTPut subsystem is shown below to illustrate the tree system:

```
:OUTPut
  :FILTer
     [:LPASs] {NONE|25M|50M|ALL}
        [:STATe] OFF | ON
```

OUTPut is the root keyword of the command; FILTer and STATe are second level keywords. LPASs is third level keyword. A colon (:) separates a command keyword from a lower level keyword.

Command Format

The format used to show commands in this manual is shown below:

```
FREQuency {<frequency>|MINimum|MAXimum}
```

The command syntax shows most commands (and some parameters) as a mixture of upper and lowercase letters. The uppercase letters indicate the abbreviated spelling for the command. For shorter program lines, send the abbreviated form. For better program readability, use the long form.

For example, in the above syntax statement, FREQ and FREQUENCY are both acceptable forms. Use upper or lowercase letters. Therefore, FREQ, FREQUENCY, freq, and Freq are all acceptable. Other forms such as FRE and FREQUEN will generate an error.

The above syntax statement shows the frequency parameter enclosed in triangular brackets. The brackets are not sent with the command string. A value for the frequency parameter (such as "FREQ 50e+6") must be specified.

Some parameters are enclosed in square brackets ([]). The brackets indicate that the parameter is optional and can be omitted. The brackets are not sent with the command string.

Command Separator

A colon (:) is used to separate a command keyword from a lower level keyword as shown below:

```
SOUR:FUNC:SHAP SIN
```

A semicolon (;) is used to separate commands within the same subsystem, and can also minimize typing. For example, sending the following command string:

```
TRIG:SLOP NEG;COUN 10;TIM 5e-3
```

is the same as sending the following three commands:

```
:TRIG:SLOP NEG
:TRIG:COUN 10
:TRIG:TIM 5e-3
```

Use the colon and semicolon to link commands from different subsystems. For example, in the following command string, an error is generated if both the colon and the semicolon are not used.

```
OUTP:STATE ON;:TRIG:BURS ON
```

The MIN and MAX Parameters

Substitute MINimum or MAXimum in place of a parameter for some commands. For example, consider the following command:

```
FREQuency {<frequency>|MINimum|MAXimum}
```

Instead of selecting a specific frequency, substitute MIN to set the frequency to its minimum value or MAX to set the frequency to its maximum value.

Querying Parameter Setting

Query the current value of most parameters by adding a question mark (?) to the command. For example, the following command sets the output function to square:

```
SOUR:FUNC:SHAP SQR
```

Query the output function by executing:

```
SOUR:FUNC:SHAP?
```

Query Response Format

The response to a query depends on the format of the command. In general, a response to a query contains current values or settings of the generator. Commands that set values can be queried for their current value. Commands that set modes of operation can be queried for their current mode. IEEE-STD-488.2 common queries generate responses, which are common to all IEEE-STD-488.2 compatible instruments.

SCPI Command Terminator

A command string sent to the function generator must terminate with a <new line> character. The IEEE-STD-488 EOI message is a <new line> character. Command string termination always resets the current SCPI command path to the root level.

IEEE-STD-488.2 Common Commands

The IEEE-STD-488.2 standard defines a set of common commands that perform functions like reset, trigger and status operations. Common commands begin with an asterisk (*), are four to five characters in length, and may include one or more parameters. The command keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands as shown below:

```
*RST; *STB?; *IDN?
```

SCPI Parameter Type

The SCPI language defines four different data formats to be used in program messages and response messages: numeric, discrete, boolean, and arbitrary block.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. Special values for numeric parameters like MINimum and MAXimum are also accepted.

Engineering unit suffices with numeric parameters (e.g., MHz or kHz) can also be sent. If only specific numeric values are accepted, the function generator will ignore values, which are not allowed and will generate an error message. The following command is an example of a command that uses a numeric parameter:

```
VOLT:AMPL <amplitude>
```

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (i.e., FIXed, USER and SEQuence). They have short and long form command keywords. Upper and lowercase letters can be mixed. Query responses always return the short form in all uppercase letters. The following command uses discrete parameters:

```
SOUR:FUNC:MODE {FIXed | USER | SEQuence}
```

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. The generator accepts "OFF" or "0" for a false condition. The generator accepts "ON" or "1" for a true condition. The instrument always returns "0" or "1" when a boolean setting is queried. The following command uses a boolean parameter:

```
OUTP:FILT { OFF | ON }
```

The same command can also be written as follows:

```
OUTP:FILT {0 | 1 }
```

Arbitrary Block Parameters

Arbitrary block parameters are used for loading waveforms into the generator's memory. Depending on which option is installed, the Model 2572 can accept binary blocks up to 1M bytes. The following command uses an arbitrary block parameter that is loaded as binary data:

```
TRAC:DATA#564000<binary_block>
```

Binary Block Parameters

Binary block parameters are used for loading segment and sequence tables into the generator's memory. Information on the binary block parameters is given later in this manual.

SCPI Syntax and Styles

Where possible the syntax and styles used in this section follow those defined by the SCPI consortium. The commands on the following pages are broken into three columns; the KEYWORD, the PARAMETER FORM, and any NOTES.

The KEYWORD column provides the name of the command. The actual command consists of one or more keywords since SCPI commands are based on a hierarchical structure, also known as the tree system. Square brackets ([ ]) are used to enclose a **keyword** that is optional when programming the command; that is, the 2572 will process the command to have the same effect whether the optional node is omitted by the programmer or not. Letter case in tables is used to differentiate between the accepted short form (upper case) and the long form (upper and lower case).

The PARAMETER FORM column indicates the number and order of parameter in a command and their legal value. Parameter types are distinguished by enclosing the type in angle brackets (< >). If **parameter** form is enclosed by square brackets ([ ]) these are then optional (care must be taken to ensure that optional parameters are consistent with the intention of the associated keywords). The vertical bar (|) can be read as "or" and is used to separate alternative parameter options.

Table 5-1, Model 2572 SCPI Commands List Summary

Keyword	Parameter Form (Default in Bold)	Notes
Instrument Control Commands		
:INSTrument		
[:SELect]	**1** | 2	
:OUTPut		
[:STATe]	**OFF** | ON | **0** | 1	
:SYNC		
[:STATe]	**OFF** | ON | **0** | 1	
:POSition	(**0**;0;999999)	
:SOURce	**1** | 2	
:FILTer		
[:LPASs]	**NONE** | 25MHzbessel | 50MHzbessel | 60MHzelp | 120MHzelp	Except in sinewave
[:SOURce]		
:ROSCillator		
:SOURce	**INTernal** | EXTernal	
:FREQuency		
[:CW]	(**1.0E6**;10.0E-3;100.0E6)	
:RASTer	(**1.0E7**;1.5;250.0E6)	
:SOURce	**INTernal** | EXTernal	
:VOLTage		
[:LEVel]		
[:AMPLitude]	(**5.00**;16.0E-3;16.0)	
:OFFSet	(**0.0**;-7.992;7.992)	
:PHASe		
[:OFFSet]	(**0**;0;999999)	
:FUNCtion		
:MODE	**FIXed** | USER | SEQuence | MODulation	
Standard Waveforms Commands		
:SHAPe	**SINusoid** | TRIangle | SQUare | PULSe | RAMP | SINC | GAUSsian | EXPonential | NOISe | DC	
:SINusoid		
:PHASe	(**0.0**;0.0;360.0)	
:TRIangle		
:PHASe	(**0.0**;0.0;360.0)	
:SQUare		
:DCYCle	(**50.0**;0.0;99.99)	
:PULSe		
:DELay	(**10.0**;0.0;99.99)	

Table 5-1, Model 2572 SCPI Commands List Summary (continued)

Keyword	Parameter Form (Default in Bold)	Notes
:WIDth	(**10.0**;0.0;99.99)	
:TRANsition		
[:LEADing]	(**10.0**;0.0;99.99)	
:TRAiling	(**10.0**;0.0;99.99)	
:RAMP		
:DELay	(**0.0**;0.0;99.99)	
:TRANsition		
[:LEADing]	(**60.0**;0.0;99.99)	
:TRAiling	(**30.0**;0.0;99.99)	
:SINC		
:NCYCle	(**10**;4;100)	
:GAUSsian		
:EXPonent	(**20**;10;200)	
:EXPonential		
:EXPonent	(**1**;-100;100)	
:DC		
[:AMPLitude]	(**5**;-16;16)	
Arbitrary Waveforms Commands		
:TRACe		
[:DATA]		
:DEFine	(**1**;1;16k)	
:DELete		
[:NAME]	(**1**;1;16k)	
:ALL		
:SELect	(**1**;1;16k)	
:DIGital		
:DATA		
:RATe	(**10.0E3**;1.0;250.0E6)	
[:STATe]	**OFF** | ON | **0** | 1	
:SEGMent		
[:DATA]		
Sequence Commands		
:SEQuence		
[:DATA]		
:ADVance	**AUTOmatic** | STEP | SINGle | MIX	
:SELect	(**1**;1;100)	
:DELete		

Table 05-1, Model 2572 SCPI Commands List Summary (continued)

Keyword	Parameter Form (Default in Bold)	Notes
:DEFine	<step>,<seg_number>,<repeat>,<adv_mode>,<sync_bit>	
:NAME	(**1**;1;4096)	
:ALL		
:SYNC		
[:TYPe]	**BIT** | LCOMplete	
Modulated Waveforms Commands		
:MODulation		
:TYPE	**OFF** | FM | AM | FSK | PSK | HOPping | SWEep	
:CARRier		
[:FREQuency]	(**1.0E6**;10.0E-3;100.0E6)	
:FM		
:DEViation	(**100.0E3**;10.0E-3;100.0E6)	
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | RAMP | ARB	
:FREQuency	(**10.0E3**;10.0E-3;350.0E3)	
:RASTer	(**1.0E6**;1.0;2.5E6)	
:MARKer		
[:FREQuency]	(**1.0E6**;10.0E-3;100.0E6)	
:DATA		
:AM		
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | RAMP	
:MODulation		
:FREQuency	(**10.0E3**;10.0E-3;100E3)	
:DEPTh	(**50.0**;0.0;100.0)	
:FSK		
:FREQuency		
:SHIFted	(**100.0E3**;10.0E-3;100.0E6)	
:RASTer	(**10.0E3**;1.0;10.0E6)	
:MARKer	(**1**;1;4096)	
:DATA		
:PSK		
:PHASe		
[:STARt]	(**0**;0.0;360.0)	
:SHIFted	(**180.0**;0.0;360.0)	
:MARKer	(**1**;1;4096)	
:DATA		
:RASTer	(**10.0E3**;1.0;10.0E6)	

Table 5-1, Model 2572 SCPI Commands List Summary (continued)

Keyword	Parameter Form (Default in Bold)	Notes
:HOPping		
:DWELl		
:MODe	**FIXed** | VARiable	
[:TIMe]	(**200.0E-9**;200.0E-9;21.0)	
:FIXed		
:DATA		
:VARiable		
:DATA		
:MARKer	(**1**;1;4096)	
:SWEep		
[:FREQuency]		
:STARt	(**10.0E3**;10.0E-3;100.0E6)	
:STOP	(**1.0E6**;10.0E-3;100.0E6)	
:TIMe	(**1.0E-3**;1.4E-6;40.0)	
:DIRection	**UP** | DOWN	
:SPACing	**LINear** | LOGarithmic	
:MARKer		
[:FREQuency]	(**505.0E3**;10.0E-3;100.0E6)	
Run Mode Commands		
:INITiate		
[:IMMediately]		
:CONTinuous	**OFF** | ON | **0** | 1	
:TRIGger		
[:IMMediate]		
:BURSt		
[:STATe]	**OFF** | ON | **0** | 1	
:COUNt	(**1**;1;1000000)	
:GATE		
[:STATe]	**OFF** | ON | **0** | 1	
:SOURce		
[:ADVance]	**BUS** | EXTernal | MIXed	
:SLOPe	**POSitive** | NEGative	
:LEVel	(**1.6**;-5.0;5.0)	
:RETRigger		
[:STATe]	**OFF** | ON | 0 | 1	
:TIMe	(**200.0E-9**;200.0E-9;21.0)	
:DELay		

Table 5-1, Model 2572 SCPI Commands List Summary (continued)

Keyword	Parameter Form (Default in Bold)	Notes
[:STATe]	**OFF** | ON | **0** | 1	
:TIMe	(**0**;200.0E-9;21.0)	
System Commands		
:RESet		
:SYSTem		
:ERRor?		
:VERSion?		
:INFOrmation		
:MODel?		
:SERial?		
*CLS		
*ESE	(**1**;1;255)	
*OPC		
*RST		
*SRE	(**1**;1;255)	
*TRG		
*ESR?		
*IDN?		
*OPT?		
*STB?		

Instrument Control Commands

This group is used to control output channels and their respective state, amplitude and offset settings, as well as the waveform mode. You can also set the phase offset between channels and select filters to re-structure the shape of your waveform. The output frequency and the reference source are also selected using commands from this group. Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-2, Instrument Control Commands Summary

Keyword	Parameter Range	Default
:INSTrument		
[:SELect]	1 | 2	1
:OUTPut		
[:STATe]	OFF | ON | 0 | 1	0
:SYNC		
[:STATe]	OFF | ON | 0 | 1	0
:POSition	0 to1999995	0
:SOURce	1 | 2	1
:FILTer		
[:LPASs]	NONE | 25MHzbessel | 50MHzbessel | 60MHzelp | 120Mhzelp	None
[:SOURce]		
:ROSCillator		
:SOURce	INTernal | EXTernal	INT
:FREQuency		
[:CW]	10.0e-3 to 100.0E6	1e6
:RASTer	1.5 to 250.0E6	1e7
:SOURce	INTernal | EXTernal	INT
:VOLTage		
[:LEVel]		
[:AMPLitude]	16.0e-3 to 16.0	5
:OFFSet	-7.992 to 7.992	0
:PHASe		
[:OFFSet]	0 to 1999991	0
:FUNCtion		
:MODE	FIXed | USER | SEQuence | MODulation	

INSTrument{1|2}(?)

Description
This command will set the active channel for future programming sequences. Subsequent commands affect the selected channel only.

Parameters

Range	Type	Default	Description
1-2	Discrete	1	Sets the active channel

Response
The 2572 will return 1, or 2 depending on the present active channel setting

INSTrument{1|2}(?)

Description
This command will set the active channel for future programming sequences. Subsequent commands affect the selected channel only.

Parameters

Range	Type	Default	Description
1-2	Discrete	1	Sets the active channel

Response
The 2572 will return 1, or 2 depending on the present active channel setting

OUTPut{OFF|ON|0|1}(?)

Description
This command will turn the 2572 output on and off. Note that for safety, the outputs always default to off, even if the last instrument setting before power down was on

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Sets the output on and off

Response
The 2572 will return 1 if the output is on, or 0 if the output is off.

OUTPut:SYNC{OFF|ON|0|1}(?)

Description
This command will turn the 2572 SYNC output on and off. Note that for safety, the SYNC output always defaults to off, even if the last instrument setting before power down was on

Parameters

Range	Type	Default	Description
0-1	Discrete	0	Will set the SYNC output on and off

Response
The 2572 will return 1 if the SYNC output is on, or 0 if the SYNC output is off.

OUTPut:SYNC:POSition<position>(?)

Description
This command will program the 2572 SYNC position. This command is active in arbitrary (USER) mode only.

Parameters

Name	Range	Type	Default	Description
<position>	0 to 2M-4	Numeric (Integer only)	0	Will set the SYNC position in waveform points. The sync position can be programmed in increments of 4 points minimum. The 2M limit depends on the memory option. 1M is standard.

Response
The 2572 will return the present SYNC position value

OUTPut:SYNC:SOURce{1|2}(?)

Description
This command will program the 2572 source of the SYNC output.

Parameters

Range	Type	Default	Description
1-2	Discrete	1	Will set the source for the SYNC output. 1 selelcts channel 1 as the source; 2 selects channel 2 as the source.

Response
The 2572 will return the present SYNC source value

OUTPut:FILTer{ NONE | 25MHzbessel | 50MHzbessel | 60MHzelp | 120Mhzelp}(?)

Description
This command will select which filter is connected to the 2572 output. Observe the following restrictions when you try to use this command:

1) Filter selection is not available when the instrument is set to output the standard sine waveform. In fact, the default waveform shape is sine. Therefore, filter selection will be available for use only after you select a different waveform, or change the output mode to use.
2) Filters are placed before the output amplifier. Therefore, do not expect the filters to remove in-band amplifier harmonics and spurious.

Parameters

Name	Type	Default	Description
None	Discrete	None	Disables all filters at the output path. This option cannot be selected when standard waveform is generated
25MHzbessel	Discrete		Connects a 25MHz Bessel type filter to the output path
50MHzbessel	Discrete		Connects a 50MHz Bessel type filter to the output path
65MHzelp	Discrete		Connects a 25MHz Elliptic type filter to the output path
120Mhzelp	Discrete		Connects a 120MHz Elliptic type filter to the output path

Response

The 2572 will return NONE, 25M, 50M, 60MH, or 120M depending on the type of filter presently connected to the output.

ROSCillator:SOURce{INTernal|EXTernal}(?)

Description

This command will select the reference source for the sample clock generator.

Parameters

Name	Type	Default	Description
INTernal	Discrete	INT	Selects an internal source. The internal source could be either the standard 100ppm oscillator, or the optional 1ppm TCXO
EXTernal	Discrete		Activates the external reference input. An external reference must be connected to the 2572 for it to continue normal operation

Response

The 2572 will return INT, or EXT depending on the present 2572 setting.

FREQuency{<freq>|MINimum|MAXimum}(?)

Description

This command modifies the frequency of the standard waveform in units of hertz (Hz). It has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<freq>	10e-3 to 100e6	Numeric	1e6	Will set the frequency of the standard waveform in units of Hz. Although the display resolution for the frequency setting is 9 digits only, the frequency command can be used with resolutions up to 14 digits. The accuracy of the instrument however, can only be tested to this accuracy using an external reference that provides the necessary accuracy and stability
<MINimum>		Discrete		Will set the frequency of the standard waveform to the lowest possible frequency (10e-3).
<MAXimum>		Discrete		Will set the frequency of the standard waveform to the highest possible frequency (100e6).

Response

The 2572 will return the present frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FREQuency:RASTer{<sclk>|MINimum|MAXimum}(?)

Description

This command modifies the sample clock frequency of the arbitrary waveform in units of samples per second (S/s). It has no affect on standard waveforms.

Parameters

Name	Range	Type	Default	Description
<sclk>	1.5 to 300e6	Numeric	1e7	Will set the sample clock frequency of the arbitrary and sequenced waveform in units of S/s. Although the display resolution for the frequency setting is 9 digits only, the frequency command can be used with resolutions up to 14 digits. The accuracy of the instrument however, can only be tested to this accuracy using an external reference that provides the necessary accuracy and stability
<MINimum>		Discrete		Will set the sample clock frequency to the lowest possible frequency (1.5).
<MAXimum>		Discrete		Will set the frequency of the standard waveform to the highest possible frequency (300e6).

Response

The 2572 will return the present sample clock frequency value. The returned value will be in standard scientific format (for example: 100MHz would be returned as 100e6 – positive numbers are unsigned).

FREQuency:RASTer:SOURce{EXTernal|INTernal}(?)

Description

This command selects the source of the sample clock generator. This command affects both the standard and the arbitrary waveforms.

Parameters

Name	Type	Default	Description
INTernal	Discrete	INT	Selects an internal source.
EXTernal	Discrete		Activates the external sample clock reference input. An external reference must be connected to the 2572, in the range of the internal source, for it to continue normal operation. Observe the input level and limitations before connecting an external signal.

Response

The 2572 will return EXT if an external source is selected, or INT if the internal source is selected.

VOLTage{<ampl>|MINimum|MAXimum}(?)

Description

This command programs the peak to peak amplitude of the output waveform. The amplitude is calibrated when the source impedance is 50Ω.

Parameters

Name	Range	Type	Default	Description
<ampl>	16e-3 to 16e0	Numeric	5	Will set the amplitude of the output waveform in units of volts. Amplitude setting is always peak to peak. Offset and amplitude settings are independent providing that the offset + amplitude does not exceed the specified window.
<MINimum>		Discrete		Will set the amplitude to the lowest possible level (16mV).
MAXimum>		Discrete		Will set the amplitude to the highest possible level (16V).

Response

The 2572 will return the present amplitude value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

VOLTage:OFFSet<offs>(?)

Description

This command programs the amplitude offset of the output waveform. The offset is calibrated when the source impedance is 50Ω.

Parameters

Name	Range	Type	Default	Description
<offs>	-7.992 to 7.992	Numeric	0	Will set the offset of the output waveform in units of volts. Offset and amplitude settings are independent providing that the offset + amplitude does not exceed the specified window.

Response

The 2572 will return the present offset value. The returned value will be in standard scientific format (for example: 100mV would be returned as 100e-3 – positive numbers are unsigned).

PHASe:OFFSet<phase_offs>(?)

Description

This command programs the start phase offset between channels 1 and 2 in units of waveform points. Phase offset resolution when using this command is 1 point.

Parameters

Name	Range	Type	Default	Description
<phase_offs>	0 to 2M-8	Numeric (Integer only)	0	Will set the phase offset between the two cahnnels. Channel 1 trails channel 2 edge. The 2M limit depends on the memory option. 1M is standard.

Response

The 2572 will return the present phase offset value.

FUNCTion:MODE{FIXed|USER|SEQuence|MODulated}(?)

Description

This command defines the type of waveform that will be available at the output connector.

Parameters

Name	Type	Default	Description
FIXed	Discrete	FIX	Selects the standard waveform shapes. There is an array of waveforms that is built into the program. You can find these waveform shapes in the standard waveforms section.
USER	Discrete		Selects the arbitrary waveform shapes. Arbitrary waveforms must be loaded to the 2572 memory before they can be replayed. You can find information on arbitrary waveforms in the appropriate sections in this manual.
SEQuenced	Discrete		Selects the sequenced waveform output. To generate

		a sequence, you must first download waveform coordinates to different segments and then build a sequence table to generate a complex waveform that is using these segments.
MODulated	Discrete	Selects the modulated waveforms. There is an array of built-in modulation schemes. However, you can also build custom modulation using the arbitrary function.

Response

The 2572 will return FIX, USER, SEQ, or MOD depending on the present 2572 setting

Standard Waveforms Control Commands

This group is used to control the standard waveforms and their respective parameters. There is an array of standard waveforms that could be used without the need to download waveform coordinates to the instrument. You can also modify the parameters for each waveform to a shape suitable for your application.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-3, Instrument Control Commands Summary

Keyword	Parameter Range	Default
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | PULSe | RAMP | SINC | GAUSsian | EXPonential | NOISe | DC	**SINusoid**
:SINusoid		
:PHASe	0.0 to 360.0	0
:TRIangle		
:PHASe	0.0 to 360.0	0
:SQUare		
:DCYCle	0.0 to 99.99	50
:PULSe		
:DELay	0.0 to 99.99	10
:WIDth	0.0 to 99.99	10
:TRANsition		
[:LEADing]	0.0 to 99.99	10
:TRAiling	0.0 to 99.99	10
:RAMP		
:DELay	0.0 to 99.99	0
:TRANsition		
[:LEADing]	0.0 to 99.99	60
:TRAiling	0.0 to 99.99	30
:SINC		
:NCYCle	4 to 100	10
:GAUSsian		
:EXPonent	10 to 200	20
:EXPonential		
:EXPonent	-100 to 100	1
:DC		
[:AMPLitude]	-16 to 16	5

FUNCtion:SHAPe{SINusoid|TRIangle|SQUare|PULSe|RAMP|SINC|EXPonential| GAUSsian|NOISe|DC}(?)

Description

This command defines the type of waveform that will be available at the output connector.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine waveform from the built in library.
TRIangle	Discrete		Selects the triangular waveform from the built in library.
SQUare	Discrete		Selects the square waveform from the built in library.
PULSe	Discrete		Selects the pulse waveform from the built in library.
RAMP	Discrete		Selects the ramp waveform from the built in library.
SINC	Discrete		Selects the sinc waveform from the built in library.
EXPonential	Discrete		Selects the exponential waveform from the built in library.
GAUSsian	Discrete		Selects the gaussian waveform from the built in library.
DC	Discrete		Selects the DC waveform from the built in library.
NOISe	Discrete		Selects the noise waveform from the built in library.

Response

The 2572 will return SIN, TRI, SQU, PULS, RAMP, SINC, EXP, GAUS, NOIS, or DC depending on the present 2572 setting

SINusoid:PHASe<phase>(?)

Description

This command programs start phase of the standard sine waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<phase>	0 to 360	Numeric	0	Programs the start phase parameter in units of degrees

Response

The 2572 will return the present start phase value.

TRIangle:PHASe<phase>(?)

Description

This command programs start phase of the standard triangular waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<phase>	0 to 360	Numeric	0	Programs the start phase parameter in units of degrees

Response

The 2572 will return the present start phase value.

SQUare:DCYCle<duty_cycle>(?)

Description

This command programs duty cycle of the standard square waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<duty_cycle>	0 to 99.9	Numeric	50	Programs the square wave duty cycle parameter in units of percent

Response

The 2572 will return the present duty cycle value.

PULSe:DELay<delay>(?)

Description

This command programs delay of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 99.9	Numeric	10	Programs the pulse delay parameter in units of percent

Response

The 2572 will return the present pulse delay value.

PULSe:WIDth<pulse_width>(?)

Description

This command programs pulse high portion of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<pulse_width>	0 to 99.9	Numeric	10	Programs the pulse width parameter in units of percent

Response

The 2572 will return the present width value.

PULSe:TRANsition<rise>(?)

Description

This command programs pulse transition from low to high of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<rise>	0 to 99.9	Numeric	10	Programs the pulse rise time parameter in units of percent

Response

The 2572 will return the present rise time value

PULSe:TRANsition:TRAiling<fall>(?)

Description

This command programs pulse transition from high to low of the standard pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<fall>	0 to 99.9	Numeric	10	Programs the pulse fall time parameter in units of percent

Response

The 2572 will return the present fall time value.

RAMP:DELay<delay>(?)

Description

This command programs delay of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<delay>	0 to 99.9	Numeric	10	Programs the ramp delay parameter in units of percent

Response

The 2572 will return the present ramp delay value.

Ramp:TRANsition<rise>(?)

Description

This command programs ramp transition from low to high of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<rise>	0 to 99.9	Numeric	60	Programs the pulse rise time parameter in units of percent

Response

The 2572 will return the present rise time value

RAMP:TRANsition:TRAiling<fall>(?)

Description

This command programs ramp transition from high to low of the standard ramp waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<fall>	0 to 99.9	Numeric	30	Programs the ramp fall time parameter in units of percent

Response

The 2572 will return the present fall time value.

SINC:NCYCleN_cycles>(?)

Description

This command programs the number of “0-crossings” of the standard SINC pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<N_cycle>	4 to 100	Numeric (Integer only)	10	Programs the number of zero-crossings parameter

Response

The 2572 will return the present number of zero-crossing value.

GAUSsian:EXPonent<exp>(?)

Description

This command programs the exponent for the standard gaussian pulse waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<exp>	4 to 100	Numeric	20	Programs the exponent parameter

Response

The 2572 will return the present exponent value.

EXPonential:EXPonent<exp>(?)

Description

This command programs the exponent for the standard exponential waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<exp>	-100 to 100	Numeric	1	Programs the exponent parameter

Response

The 2572 will return the present exponent value.

DC<amplitude>(?)

Description

This command programs the exponent for the standard exponential waveform. This command has no affect on arbitrary waveforms.

Parameters

Name	Range	Type	Default	Description
<amplitude>	-16 to 16	Numeric	5	Programs the DC amplitude parameter

Response

The 2572 will return the present DC amplitude value.

Arbitrary Waveforms Control Commands

This group is used to control the arbitrary waveforms and their respective parameters. This will allow you to create segments and download waveforms. Using these commands you can also define segment size and delete some or all unwanted waveforms from your memory. Use the commands in this group to turn the digital output on and off and to download data to the digital pattern buffer.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Generating Arbitrary Waveforms

Arbitrary waveforms are generated from digital data points, which are stored in a dedicated waveform memory. Each data point has a vertical resolution of 16 bits (65536 points), i.e., each sample is placed on the vertical axis with a precision of 1/65536. The Model 2572 has the following waveform memory capacity:

1M – standard memory configuration
2M – optional memory expansion

Each horizontal point has a unique address - the first being 00000 and the last depends on the memory option. In cases where smaller waveform lengths are required, the waveform memory can be divided into smaller segments.

When the instrument is programmed to output arbitrary waveforms, the clock samples the data points (one at a time) from address 0 to the last address. The rate at which each sample is replayed is defined by the sample clock rate parameter.

Unlike the built-in standard waveforms, arbitrary waveforms must first be loaded into the instrument's memory. Correct memory management is required for best utilization of the arbitrary memory. An explanation of how to manage the arbitrary waveform memory is given in the following paragraphs.

Arbitrary memory Management

The arbitrary memory in comprised of a finite length of words. The maximum size arbitrary waveform that can be loaded into memory depends on the option that is installed in your instrument. The various options are listed in Chapter 1 of this manual. If you purchased the 2572 with in its basic configuration, you should expect to have 1 Meg words to load waveforms.

Waveforms are created using small sections of the arbitrary memory. The memory can be partitioned into smaller segments (up to 16k) and different waveforms can be loaded into each segment, each having a unique length. Minimum segment size is 16 points. Information on how to partition the memory, define segment length and download waveform data to the 2572 is given in the following paragraphs.

Table 5-4, Arbitrary Waveforms Commands Summary

:TRACe		
[:DATA]		
:DEFine	(**1**;1;16k)	
:DELete		
[:NAME]	(**1**;1;16k)	
:ALL		
:SELect	(**1**;1;16k)	
:DIGital		
:DATA		
:RATe	(**10.0E3**;1.0;250.0E6)	
[:STATe]	**OFF** | ON | **0** | 1	
:SEGMent		
[:DATA]		

TRACe#<header><binary_block>

Description

This command will download waveform data to the 2572 memory. Waveform data is loaded to the 2572 using high-speed binary transfer. A special command is defined by IEEE-STD-488.2 for this purpose. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for sending large quantities of data. As an example, the next command will download to the generator an arbitrary block of data of 1024 points

```
TRACe#42048<binary_block>
```

This command causes the transfer of 2048 bytes of data (1024 waveform points) into the active memory segment. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "4" designates the number of digits that follow.
- "2048" is the even number of bytes to follow.

The generator accepts binary data as 16-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always twice the number of data points in the waveform. For example, 20000 bytes are required to download a waveform with 10000 points. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1.

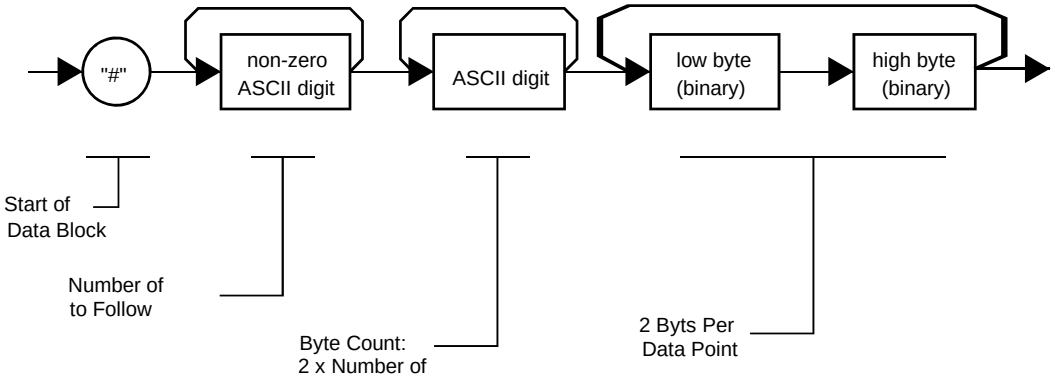

Figure 5-1, Definite Length Arbitrary Block Data Format

Transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as waveform data points and will not cause unexpected termination of the arbitrary block data.

- <binary_block> Represents waveform data.

The waveform data is made of 16-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 16-bit words and rearranged as two 8-bit words before it can be used by the 2572 as waveform data points. The following description shows you how to prepare the data for downloading to the 2572. There are a number of points you should be aware of before you start preparing the data:

1. Each channel has its own waveform memory. Therefore, make sure you selected the correct active channel before you download data to the generator
2. Waveform data points have 16-bit values
3. Data point range is 0 to 65,535 decimal
4. Data point 0 to data point 65,535 corresponds to full-scale amplitude setting.

Figure 5-2 shows how to initially prepare the 16-bit word for a waveform data point. Data has to be further manipulated to a final format that the instrument can accept and process as waveform point.

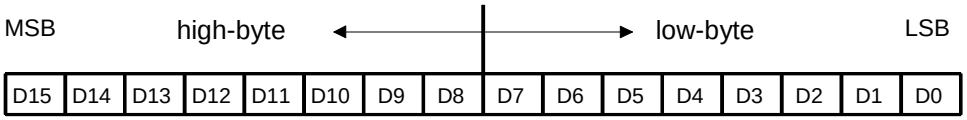

Figure 5-2, 16-bit Initial Waveform Data Point Representation

Figure 5-3 shows the same 16-bit word as in Figure 5-2, except the high and low bytes are swapped. This is the correct format that the 2572 expects as waveform point data. The first byte to be sent to the generator is the low-byte and then high-byte.

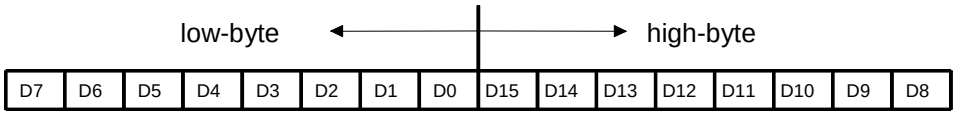

Figure 5-3, 16-bit Waveform Data Point Representation

Parameters

Name	Type	Description
<header>	Discrete	Contains information on the size of the binary block that contains waveform coordinates.
<binary_block>	Binary	Block of binary data that contains information on the waveform coordinates.

TRACe:DEFine<segment_number>,<length>

Description

Use this command to attach size to a specific memory segment. The final size of the arbitrary memory is 1M points (2M optional). The memory can be partitioned to smaller segments, up to 16k segments. This function allows definition of segment size. Total length of memory segments cannot exceed the size of the waveform memory.

NOTE

The 2572 operates in interlaced mode where four memory cells generate one byte of data. Therefore, segment size can be programmed in numbers evenly divisible by four only. For example, 2096 bytes is an acceptable length for a binary block. 2002 is not a multiple of 4, therefore the generator will generate an error message if this segment length is used.

Parameters

Name	Range	Type	Default	Description
<segment_number>	1 to 16k	Numeric (integer only)	1	Selects the segment number of which will be programmed using this command
<length>	16 to 2M	Numeric (integer only)		Programs the size of the selected segment. Minimum segment length is 16 points, the maximum is limited by the memory option that is installed in your instrument either 1M or 2M

TRACe:DEFine<segment_number>,<length>

Description

Use this command to attach size to a specific memory segment. The final size of the arbitrary memory is 1M points (2M optional). The memory can be partitioned to smaller segments, up to 16k segments. This function allows definition of segment size. Total length of memory segments cannot exceed the size of the waveform memory.

NOTE

The 2572 operates in interlaced mode where four memory cells generate one byte of data. Therefore, segment size can be programmed in numbers evenly divisible by four only. For example, 2096 bytes is an acceptable length for a binary block. 2002 is not a multiple of 4, therefore the generator will generate an error message if this segment length is used.

Parameters

Name	Range	Type	Default	Description
<segment_number>	1 to 16k	Numeric (integer only)	1	Selects the segment number of which will be programmed using this command
<length>	16 to 2M	Numeric (integer only)		Programs the size of the selected segment. Minimum segment length is 16 points, the maximum is limited by the memory option that is installed in your instrument either 1M or 2M

TRACe:DELete<segment_number>

Description

This command will delete a segment. The memory space that is being freed will be available for new waveforms as long as the new waveform will be equal or smaller in size to the deleted segment. If the deleted segment is the last segment, then the size of another waveform written to the same segment is not limited. For example, let consider two segments, the first being a 1000-point waveform and the second with 100 points. If you delete segment 1, you can reprogram another waveform to segment 1 with size to 1000 points. If you reprogram segment 1 with 1004 points, the instrument will generate an error and will not accept this waveform. On the other hand, if you delete segment 2, which was the last segment you programmed, then you can reprogram this segment with waveforms having length limited only by the size of the entire memory space.

Parameters

Name	Range	Type	Default	Description
<segment_number>	1 to 16k	Numeric (integer only)	1	Selects the segment number of which will be deleted

TRACe:DELete:ALL

Description

This command will delete all segments and will clear the entire waveform memory. This command is particularly important in case you want to de-fragment the entire waveform memory and start building your waveform segments from scratch.

TIP

The TRAC:DEL:ALL command does not re-write the memory so, whatever waveforms were downloaded to the memory are still there for recovery. The TRAC:DEL:ALL command removes all stop bits and clears the segment table. You can recover memory segments by using the TRAC:DEF command. You can also use this technique to resize, or combine waveform segments.

TRACe:SELect<segment_number>

Description

This command will select the active waveform segment for the output. By selecting the active segment you are performing two function:

1. Successive :TRAC commands will affect the selected segment
2. The SYNC output will be assigned to the selected segment. This behavior is especially important for sequence operation, where multiple segments form a large sequence. In this case, you can synchronize external devices exactly to the segment of interest

Parameters

Name	Range	Type	Default	Description
<segment_ number>	1 to 16k	Numeric (integer only)	1	Selects the active segment number

Response

The 2572 will return the active segment number.

DIGital:DATA<pattern_block>

Description

This command will download digital patterns. Similar to waveform data, the pattern data is downloaded ot a predefined memory segment. Digital patterns are generated from channel 1 segments only. Since this function can be turned on and off regardless of the output mode, one could mix digital and analog data output by generating digital patterns from channel 1 while generating arbitrary waveforms from channel 2. The rate of which the patterns change is defined by the baud parameter. Digital patters are input to the 2572 in 16-bit hex words.

While in arbitrary mode of operation, the digital patterns can be turned on for simultaneous generation of analog signal and its equivalent digital pattern.

Parameters

Name	Type	Description
<pattern_block>	Integer	Contains an array of 16-bit hex pattern data.

DIGital:RATe<baud>(?)

Description

This command will programs the rate of which digital patterns change state at the output connector.

Parameters

Name	Range	Type	Default	Description
<baud>	1.5 to 300e6	Numeric	1e7	Programs the rate for the digital patterns. Note that although the baud range is specified to 300Mpps, the highest baud depends on the quality of the cable and may deteriorate the high limit dramatically. Full rate is possible with the interconnecting circuit connected directly at the rear-panel Digital Pattern output connector.

Response

The 2572 will return the current rate value.

DIGital{OFF|ON|0|1}(?)

Description

This command will toggle the digital pattern output on and off. The command is available for all output functions including standard, arbitrary, sequenced and modulated waveforms however, meaningful output can be controlled in the arbitrary and sequenced function modes only.

Parameters

Range	Type		Description
0-1	Discrete	0	Sets the digital pattern output on and off

Response

The 2572 will return 1 if the output is on, or 0 if the output is off.

SEGment#<header><binary_block>

Description

This command will partition the waveform memory to smaller segments and will speed up memory segmentation. The idea is that waveform segments can be built as one long waveform and then just use this command to split the waveform to the appropriate memory segments. In this way, there is no need to define and download waveforms to individual segments.

Using this command, segment table data is loaded to the 2572 using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for large number of segment. As an example, the next command will generate three segments with 12 bytes of data that contains segment size information.

```
SEGment#212<binary_block>
```

This command causes the transfer of 12 bytes of data (3 segments) into the segment table buffer. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "2" designates the number of digits that follow.
- "12" is the number of bytes to follow. This number must divide by 4.

The generator accepts binary data as 32-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always 4 times the number of segments. For example, 36 bytes are required to download 9 segments to the segment table. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1. The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as segment table data points and will not cause unexpected termination of the arbitrary block data.

The segment table data is made of 32-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 32-bit words and rearranged as six 8-bit words before it can be used by the 2572 as segment table data. Figure 5-4 shows how to prepare the 32-bit work for the segment start address and size. There are a number of points you should be aware of before you start preparing the data:

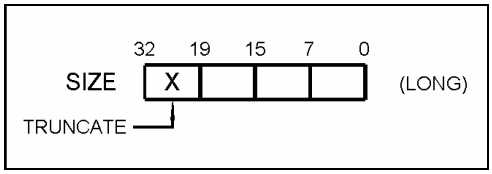

Figure 5-4, Segment Address and Size Example

1. Each channel has its own segment table buffer. Therefore, make sure you selected the correct active channel (with the INST:SEL command) before you download segment table data to the generator
2. Minimum number of segments is 1; maximum number of segments is 16k
3. Maximum segment size depends on your installed option. With the basic 2572 you can program maximum 1M in one segment. With the 2M option, you can use the full size of 2 Meg
4. Segment table data has 32-bit values of which are used for segment size. Therefore, Data for each segment must have 4 bytes
5. The number of bytes in a complete segment table must divide by 6. The Model 2572 has no control over data sent to its segment table during data transfer. Therefore, wrong data and/or incorrect number of bytes will cause erroneous memory partition

Parameters

Name	Type	Description
<binary_block>	Binary	Block of binary data that contains information on the segment table.

Sequenced Waveforms Control Commands

This group is used to control the sequenced waveforms and their respective parameters. This will allow you to create multiple sequence table and modify segment loops and links. Also use these commands to add or delete sequences from your instrument.

Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Generating Sequenced Waveforms
Sequenced waveforms are made of a number of arbitrary waveforms, which can be linked and looped in user-programmable order. Sequenced waveforms are generated from waveforms stored in the 2572 as memory segments. Therefore, before a sequence can be used, download waveform segments to the arbitrary memory using TRAC# or DMA methods. Information on how to partition the memory and how to download waveforms is given in the section entitled **Generating Arbitrary Waveforms**.

An example of how sequenced waveforms work is demonstrated in figure 1-13 through 1-15. The sequence generator lets you link and loop segments in user-defined order. Figure 1-16 shows a sequence of waveforms that were stored in three different memory segments.

There are a number of tools that you can use to build a sequence table. The easiest way is of course to use the ArbConnection program. Information how to use the ArbConnection program is given in a later chapter. In other cases, SCPI programming allows low-level programming of sequence tables.

In general, sequences can be build one step at a time using the SEQ:DEF command. The one step method is slow and tedious however, it allows better control for one who just begins his first sequence programming. Advanced users can download a complete sequence table using the binary sequence download option. The later being much faster for applications requiring large sequence tables. Use the information below to understand sequence commands and how to implement them in your application.

Table 5-5, Sequence Control Commands

Keyword	Parameter Form (Default in Bold)	Notes
:SEQuence		
[:DATA]		
:ADVance	**AUTOmatic** | STEP | SINGle | MIX	
:SELect	(**1**;1;100)	
:DEFine	<step>,<seg_number>,<repeat>,<adv_mode>,<sync_bit>	
:DELete		
:NAME	(**1**;1;4096)	
:ALL		
:SYNC		
[:TYPe]	**BIT** | LCOMplete	

SEQuence#<header><binary_block>

Description

This command will build a complete sequence table in one binary download. In this way, there is no need to define and download individual sequencer steps. Using this command, sequence table data is loaded to the 2572 using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. This command is particularly useful for long sequences that use a large number of segment and sequence steps. As an example, the next command will generate three-step sequence with 16 bytes of data that contains segment number, repeats (loops) and mixed mode flag option.

```
SEQuence#216<binary_block>
```

This command causes the transfer of 16 bytes of data (2-step sequence) to the sequence table buffer. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "2" designates the number of digits that follow.
- "16" is the number of bytes to follow. This number must divide by 8.

The generator accepts binary data as 64-bit integers, which are sent in two-byte words. Therefore, the total number of bytes is always eight times the number of sequence steps. For example, 16 bytes are required to download 2 sequence steps to the sequence table. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1. The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as sequence data and will not cause unexpected termination of the arbitrary block data. Figure 5-5 shows how to prepare the 64-bit word for the sequence step, repeat, mixed mode and sync bit.

The sequence table data is made of 64-bit words however, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 64-bit words and rearranged as six 8-bit words before it can be used by the 2572 as sequence table data. Figure 5-6 shows how to prepare the 64-bit word for the sequence step, repeat and mixed mode flag.

There are a number of points you should be aware of before you start preparing the data:

1. Each channel has its own sequence table buffer. Therefore, make sure you selected the correct active channel (with the INST:SEL command) before you download sequence table data to the generator
2. Minimum number of sequencer steps is 1; maximum number is 4096
3. The number of bytes in a complete sequence table must divide by 8. The Model 2572 has no control over data sent to its sequence table during data transfer. Therefore, wrong data and/or incorrect number of bytes will cause erroneous sequence partition
4. The LSB bit is the only bit used in the mode byte. This bit has an affect on the operation of the sequence only when Mixed Step Advance mode is active. With the LSB bit set to “0”, the sequence generator will advance to the next step automatically. With the LSB bit set to “1”, the sequence generator will advance to the next step only when a valid trigger signal will be sensed at the trigger input.
5. SYNC state bit is valid only when the sequence sync type is BIT

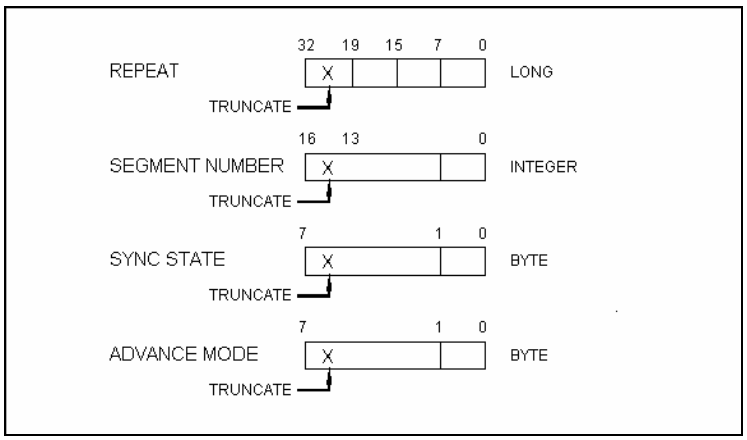

Figure 05-5, 64-bit Sequence Table Download Format

Parameters

Name	Type	Description
<binary_block>	Binary	Block of binary data that contains information on the sequence table.

SEQuence:ADVance(?){AUTOmatic|STEP|SINGle|MIXed}(?)

Description

This command will select the sequence advance mode. The way the instrument advances through the sequence links can be specified by the user.

Parameters

Name	Type	Default	Description
AUTOmatic	Discrete	AUTO	Specifies continuous advance where the generator steps continuously to the end of the sequence table and repeats the sequence from the start. For example, if a sequence is made of three segments 1, 2 and 3, the sequence will generate an infinite

		number of 1,2,3,1,2,3,1,2,3…waveforms. Of course, each link (segment) can be programmed with its associated loop (repeat) number.
STEP	Discrete	In step advance mode, the sequence is advanced to the next waveform only when a valid trigger is received. The output of the 2572 generates the first segment continuously until a trigger signal advances the sequence to the next segment. If repeats were selected for a segment, the loop counter is executed automatically.
SINGle	Discrete	In single advance mode, the generator idles between steps until a valid trigger signal is sensed. This mode operates with trigger mode only. An attempt to select the SING advance mode when the 2572 is in continuous operating mode will generate an error. After trigger, the generator outputs one waveform cycle. Then, the output level idles at a DC level equal to the last point of the last generated waveform. If loops (repeats) were programmed, the output will repeat this segment every time a trigger is received. Only after executing all of the programmed loops will the sequence step to the next assigned segment.
MIXed	Discrete	Mixed mode is a special mode that combines continuous step advance with single step advance in a sequence. There are three conditions for the sequence generator to operate in this mode: 1) The 2572 must be set to operate in continuous mode 2) Select the MIX sequence advance mode 3) Assign the mixed mode bits for each sequence step in your SEQ:DEF command. “0” programs normal advance, “1” programs trigger advance. Step with a “0” bit assigned to it will advance automatically to the next step. If “1” is assigned to a step, the instrument will generate this step and its associated number of repeats continuously and only a valid trigger signal will advance this step to the next step.

Response
The 2572 will return the AUTO, STEP, SING, or MIX depending on the present sequence advance mode setting.

SEQuence:SELect<sequence_number>(?)

Description
This command will select an active sequence to be generated at the output connector. By selecting the active sequence, successive :SEQ commands will affect the selected sequence only

Parameters

Name	Range	Type	Default	Description
<sequence_ number>	1 to 100	Numeric (integer only)	1	Selects the active sequence number

Response

The 2572 will return the active sequence number.

SEQuence:DEFine<step>,<seg_number>,<repeat>,<adv_mode>,<sync_ bit>(?)

Description

This command builds a step in a sequence table. It defines all of the parameters that are associated with the sequence step such as segment number, link, loop, advance mode and sync mode.

Parameters

Name	Range	Type	Description
<step>	1 to 4096	Numeric (integer only)	Programs the step in the sequence table. Steps are indexed from 1 to 1096 and must be programmed in an ascending order; Empty step locations in a sequence table are not permitted.
<seg_number>	1 to 16k	Numeric (integer only)	Assigns a segment to a specific step number. When encountered in the sequence table, the segment number that is associated with the step will be generated.
<repeat>	1 to 1M	Numeric integer only)	Programs the repeat number of loops that a specific step will play before advancing to the next step in the sequence.
<adv_mode>	0-1	Boolean	“0” programs normal advance, “1” programs trigger advance. Step with a “0” bit assigned to it will advance automatically to the next step. If “1” is assigned to a step, the instrument will generate this step continuously and only a valid trigger signal will cause the sequence to advance to the next step. Note that the <adv_mode> parameter has no affect when the sequence advance mode is set to SING
<sync_bit>	0-1	Boolean	“1” programs bit present at a specific sequence step. This feature is required in applications where multiple sync bits are required in a single sequence. Note that normal sync output during sequence mode is LCOM.

NOTE

Although trigger signals are used to advance mixed mode, the mixed mode operates in continuous mode only. The <mode> parameter will be ignored if you will use SING as advance mode for the sequence table.

TIP

Every time you use the SEQ:DEF command while your 2572 is in sequenced operating mode, the instrument attempts to rebuild the sequence table and restart the sequence. Therefore, sending this command in sequenced mode will slow the programming process and the operation of the generator. Using the SEQ:DEF command in FIX or USER mode will greatly speed up programming time.

SEQuence:DELete<sequence_number>

Description

This command will delete a step in a specific sequence table. Before you use this step make sure your sequence number is setup correctly for this operation.

Parameters

Name	Range	Type	Default	Description
<sequence_ number>	1 to 4096	Numeric (integer only)	1	Selects the step number of which will be deleted

SEQuence:DELete:ALL

Description

This command will delete the enire sequence table. Before you use this step make sure your sequence number is setup correctly for this operation.

Modulated Waveforms Control Commands

This group is used to control the modulated waveforms and their respective parameters. Note that the modulation can be turned off to create continuous carrier waveform (CW). The following modulation schemes can be selected and controlled: FM, AM, FSK, PSK, HOP and Sweep. The modulation commands are summarized in Table 5-6. Factory defaults after *RST are shown in the Default column. Parameter range and low and high limits are listed, where applicable.

Table 5-6, modulated Waveforms Commands

Keyword	Parameter Form	Default
:MODulation		
:CARRier		
[:FREQuency]	10.0e-3 to 100.0e6	1e6
:TYPE	**OFF** | FM | AM | FSK | PSK | HOPping | SWEep	OFF
:FM		
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | RAMP | ARB	SINusoid
:FREQuency	10.0e-3 to 350.0e3	10e3
:RASTer	1.0 to 2.5e6	1e6
:DEViation	10.0e-3 to100.0e6	100e3
:MARKer		
[:FREQuency]	10.0e-3 to 100.0e6	1e6
:DATA		
:AM		
:FUNCtion		
:SHAPe	**SINusoid** | TRIangle | SQUare | RAMP	SIN
:MODulation		
:FREQuency	10.0e-3 to 100e3	10e3
:DEPTh	0.0 to 100.0	50
:FSK		
:FREQuency		
:SHIFted	10.0e-3 to 100.0e6	100e3
:RASTer	1.0 to 10.0e6	10e3
:MARKer	1 to 4096	1
:DATA		
:PSK		
:PHASe		
[:STARt]	0.0 to 360.0	0
:SHIFted	0.0 to 360.0	180
:MARKer	1 to 4096	1
:RASTer	1.0 to 10.0e6	10e3
:DATA		
:HOPping		
:DWELl		
:MODe	**FIXed** | VARiable	FIX
[:TIMe]	200.0e-9 to 21.0	100e-9

Table 05-6, Model 2572 SCPI Commands List Summary (continued)

Keyword	Parameter Form	Default
:FIXed		
:DATA		
:VARiable		
:DATA		
:MARKer	1 to 4096	1
:SWEep		
[:FREQuency]		
:STARt	10.0e-3 to 100.0e6	10e3
:STOP	10.0e-3 to 100.0e6	1e6
:TIMe	1.4E-6 to 40.0	1e-3
:DIRection	**UP** | DOWN	UP
:SPACing	**LINear** | LOGarithmic	LIN
:MARKer		
[:FREQuency]	10.0e-3 to 100.0e6	505e3

MODulation:CARRier<frequency>(?)

Description

This command programs the CW frequency. Note that the CW waveform is sine only and its frequency setting is separate to the standard sine waveform. The CW frequency setting is valid for all modulation types.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	1e6	Programs the frequency of the carrier waveform in units of Hz. Note that the CW waveform is sine only and its frequency setting is separate to the standard sine waveform.

Response

The 2572 will return the current carrier frequency value.

MODulation:TYPE{OFF|FM|AM|FSK|PSK|HOPping|SWEep}(?)

Description

This command will select the modulation type. All modulation types are internal, thus external signals are not required for producing modulation.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Modulation off is a special mode where the output generates continuous, non-modulated sinusoidal carrier waveform (CW).
FM	Discrete		This turns on the FM function. Program the FM parameters to fine tune the function for your application.
AM	Discrete		This turns on the AM function. Program the AM parameters to fine tune the function for your application.
FSK	Discrete		This turns on the FSK function. Program the FSK parameters to fine tune the function for your application.
PSK	Discrete		This turns on the PSK function. Program the PSK parameters to fine tune the function for your application.
HOPping	Discrete		This turns on the frequency hopping function. Program the hop parameters to fine tune the function for your application.
SWEep	Discrete		This turns on the sweep function. Program the sweep parameters to fine tune the function for your application.

Response
The 2572 will return OFF, FM, AM, FSK, PSK, HOP, or SWE depending on the present modulation type setting.

FM Modulation Programming

Use the following command for programming the FM parameters. FM control is internal however, there are two types of waveforms that can be used as the modulating waveforms: Standard and Arbitrary. The standard waveforms are built in a library of waveforms and could be used anytime without external control. The arbitrary waveforms must be loaded into a special FM arbitrary waveform memory and only then can be used as a modulating waveform.

FM:FUNCtion:SHAPe(SINusoid|TRIangle|SQUare|RAMP|ARB}(?)

Description
This command will select one of the waveform shapes as the active modulating waveform.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine shape as the modulating waveform
TRIangle	Discrete		Select the triangular shape as the modulating waveform
SQUare	Discrete		Select the square shape as the modulating waveform
RAMP	Discrete		Selects the ramp shape as the modulating waveform
ARB	Discrete		Selects an arbitrary waveform as the modulating shape. The waveform must be designed and downloaded to the FM arbitrary modulating waveform memory before one can use this option. Information on how to create and download FM arbitrary waveforms is given later in this chapter.

Response
The 2572 will return SIN, TRI, SQU, RAMP, or ARB depending on the selected function shape setting.

FM:FREQuency<fm_freq>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<fm_freq>	10e-3 to 350e3	Numeric	10e3	Programs the frequency of the modulating waveform in units of Hz. The frequency of the built-in standard modulating waveforms only is affected.

Response
The 2572 will return the present modulating waveform frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:FREQuency:RASTer<arb_fm_freq>(?)

Description
This command will set the sample clock frequency for the arbitrary modulating waveform. Arbitrary modulating waveforms must be created in an external utility and downloaded to the FM arbitrary waveform memory before this function can be used.

Parameters

Name	Range	Type	Default	Description
<arb_fm_freq>	1 to 2.5e6	Numeric	1e6	Programs the sample clock frequency of the arbitrary modulating waveform in units of S/s.

Response
The 2572 will return the present sample clock of the arbitrary modulating waveform value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:DEViation<deviation>(?)

Description
This programs the deviation range around the carrier frequency. The deviation range is always symmetrical about the carrier frequency. If you need non-symmetrical deviation range, you can use the arbitrary FM composer screen or an external utility to design such waveforms.

Parameters

Name	Range	Type	Default	Description
<deviation>	10e-3 to 100e6	Numeric	100e3	Programs the deviation range around the carrier frequency in units of Hz.

Response
The 2572 will return the present deviation frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:MARKer<frequency>(?)

Description
This function programs marker frequency position. FM marker can be placed inside the following range: (carrier frequency ± deviation frequency / 2). The marker pulse is output from the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	1e6	Programs the marker frequency position in units of Hz.

Response

The 2572 will return the present marker frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FM:DATA#<header><binary_block>

Description

This command will download FM modulating waveform data to the arbitrary FM memory. Arbitrary modulating waveform table data is loaded to the 2572 using high-speed binary transfer in a similar way to downloading waveform data with the trace command. High-speed binary transfer allows any 8-bit bytes (including extended ASCII code) to be transmitted in a message. Remember, downloading data to the arbitrary FM waveform memory is very different than loading arbitrary waveform data. Waveform data programs amplitude domain therefore, every point programs an amplitude level. On the other hand, FM modulating waveform data programs frequency domain therefore, every point sets different sample clock frequency.

```
FM:DATA#3100<binary_block>
```

This command causes the transfer of 10 bytes of data to the arbitrary FM waveform memory. The <header> is interpreted this way:

- The ASCII "#" ($23) designates the start of the binary data block.
- "3" designates the number of digits that follow.
- "100" is the number of bytes to follow. This number must divide by 4.

The generator accepts binary data as 32-bit integers, which are sent in five-byte words. Therefore, the total number of bytes is always three times the number of arbitrary FM waveform points. For example, 100 bytes are required to download 20 arbitrary FM waveform points. The IEEE-STD-488.2 definition of Definite Length Arbitrary Block Data format is demonstrated in Figure 5-1 (refer to the TRACe subsystem). The transfer of definite length arbitrary block data must terminate with the EOI bit set. This way, carriage-return (CR – 0dH) and line feed (LF – 0aH) characters can be used as sequence data and will not cause unexpected termination of the arbitrary block data.

Downloading data to the arbitrary FM waveform memory is very different than loading arbitrary waveform data. Waveform data programs amplitude domain therefore, every point programs an amplitude level. On the other hand, FM modulating waveform data programs frequency domain therefore, every point sets different frequency. The FM modulating waveform data is made of 32-bit words. However, the GPIB link has 8 data bas lines and accepts 8-bit words only. Therefore, the data has to be prepared as 32-bit words and rearranged as five 8-bit words before it can be used by the 2572 as FM modulating waveform data. Figure 4-8 shows how to prepare the 32-bit word for the FM modulating waveform.

There are a number of points you should be aware of before you start preparing the data:

1. The FM function is shared by both channels
2. The number of bytes in a complete FM modulating waveform data must divide by 4. The Model 2572 has no control over data sent to its FM waveform during data transfer. Therefore, wrong data and/or

incorrect number of bytes will cause errors

3. The LSBit on the last byte sets marker position. “0” = sets no marker and “1” sets marker. You can set as many markers as you want.
4. The SYNC output serves as marker output when you have the 2572 set to operate in FM mode. Normal SYNC level is TTL low. The SYNC output is set to TTL high at the position of the marker. This way you can use the SYNC output to mark frequency occurrences during FM operation.
5. Data download is terminated with the MSBit of the last byte set to 1.

The following sequence should be used for downloading arbitrary FM Waveforms:

1. Prepare your FM waveform data points using the following relationship:

   N = Frequency[Hz] x 14.31655765

2. Use an I/O routine such as ViMoveAsync (from the VISA I/O library) to transfer binary blocks of data to the generator.

Parameters

Name	Type	Description
<binary_block>	Binary	Block of binary data that contains information on the arbitrary modulating waveform.

AM modulation Programming

Use the following command for programming the AM parameters. AM control is internal. The commands for programming the amplitude modulation function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

AM:FUNCtion:SHAPe(SINusoid|TRIangle|SQUare|RAMP}(?)

Description

This command will select one of the waveform shapes as the active modulating waveform.

Parameters

Name	Type	Default	Description
SINusoid	Discrete	SIN	Selects the sine shape as the modulating waveform
TRIangle	Discrete		Select the triangular shape as the modulating waveform
SQUare	Discrete		Select the square shape as the modulating waveform
RAMP	Discrete		Selects the ramp shape as the modulating waveform

Response

The 2572 will return SIN, TRI, SQU, or RAMP depending on the selected function shape setting.

AM:FREQuency<am_freq>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<am_freq>	10e-3 to 100e3	Numeric	10e3	Programs the frequency of the modulating waveform in units of Hz. The frequency of the built-in standard modulating waveforms only is affected.

Response
The 2572 will return the present modulating waveform frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

AM:DEPth<depth>(?)

Description
This command will set the modulating wave frequency for the built-in standard modulating waveform library.

Parameters

Name	Range	Type	Default	Description
<depth>	0 to 100	Numeric	50	Programs the depth of the modulating waveform in units of percent.

Response
The 2572 will return the present modulating depth value.

FSK Modulation Programming

Use the following command for programming the FSK parameters. FSK control is internal. The frequency will shift from carrier to shifted frequency setting at a rate determined by the raster value and controlled by a sequence of bits in the FSK data table. The commands for programming the frequency shift keying function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

FSK:FREQuency:SHIFted<shift_freq>(?)

Description
This programs the shifted frequency. The frequency shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<shift_freq>	10e-3 to 100e6	Numeric	100e3	Programs the shifted frequency value in units of Hz.

Response

The 2572 will return the present shifted frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FSK:FREQuency:RASTer<baud>(?)

Description

This allows the user to select FSK word rate. The word rate is the interval of which the bit streams in the FSK data array are clocked causing the output frequency to hop from carrier to shifted frequency values and visa versa.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the rate of which the frequency shifts from carrier to shifted frequency in units of Hz.

Response

The 2572 will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

FSK:FREQuency:MARKer<index>(?)

Description

Programs where on the data stream the 2572 will generate a pulse, designated as FSK marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the FSK data list.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4096	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response

The 2572 will return the present marker position.

FSK:DATA<fsk_data>

Description

Loads the data stream that will cause the 2572 to hop from carrier to shifted frequency and visa versa. Data format is a string of "0" and "1" which define when the output generates carrier frequency and when it shifts frequency to the FSK value. "0" defines carrier frequency,"1" defines shifted frequency. Note that if you intend to program marker position, you must do it before you load the FSK data list.

Below you can see how an FSK data table is constructed. The sample below shows a list of 10 shifts. The 2572 will step through this list, outputting either carrier or shifted frequencies, depending on the data list: Zero will generate carrier frequency and One will generate shifted frequency. Note that the waveform is always sinewave and that the last cycle is always completed.

Sample FSK Data Array

0 1 1 1 0 1 0 0 0 1

Parameters

Name	Type	Description
<fsk_data>	ASCII	Block of ASCII data that contains information for the generator when to shift from carrier to shifted frequency and visa versa.

PSK Modulation Programming

Use the following command for programming the PSK parameters. PSK control is internal. The phase will shift from start to shifted phase setting at a rate determined by the raster value and controlled by a sequence of bits in the PSK data table. The commands for programming the phase shift keying function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

PSK:PHASe:<start_phase>(?)

Description

This programs the start phase of the carrier waveform. The start phase shifts when the pointer in the data array points to “0”.

Parameters

Name	Range	Type	Default	Description
<start_freq>	0 to 360	Numeric	0	Programs the start phase for the carrier waveform in units of degrees.

Response

The 2572 will return the present start phase value.

PSK:PHASe:SHIFted<shift_phase>(?)

Description

This programs the shifted phase. The phase shifts when the pointer in the data array points to “1”.

Parameters

Name	Range	Type	Default	Description
<shift_phase>	0 to 360	Numeric	180	Programs the shift phase for the carrier waveform in units of degrees.

Response

The 2572 will return the present shift phase value.

PSK:PHASe:MARKer<index>(?)

Description

Programs where on the data stream the 2572 will generate a pulse, designated as PSK marker, or index point. The marker pulse is generated at the SYNC output connector. Note that if you intend to program marker position, you must do it before you load the PSK data list.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4096	Numeric (integer only)	1	Programs a marker pulse at an index bit position.

Response

The 2572 will return the present marker position.

FSK:PHASe:RASTer<baud>(?)

Description

This allows the user to select PSK word rate. The word rate is the interval of which the bit streams in the PSK data array are clocked causing the output phase to hop from start to shifted phase values and visa versa.

Parameters

Name	Range	Type	Default	Description
<baud>	1 to 10e6	Numeric	10e3	Programs the rate of which the phase shifts from start to shifted frequency in units of Hz.

Response

The 2572 will return the present baud value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

PSK:DATA<psk_data>

Description

Loads the data stream that will cause the 2572 to hop from start to shifted phase and visa versa. Data format is a string of "0" and "1" which define when the output generates start phase and when it shifts phase to the PSK value. "0" defines start phase,"1" defines shifted phase. Note that if you intend to program marker position, you must do it before you load the PSK data list.

Below you can see how an PSK data table is constructed. The sample below shows a list of 10 shifts. The 2572 will step through this list, outputting either start or shifted phases, depending on the data list: Zero will generate start phase and One will generate shifted phase. Note that the output waveform is always sinewave and that the last cycle is always completed.

Sample PSK Data Array

0 1 1 1 0 1 0 0 0 1

Parameters

Name	Type	Description
<psk_data>	ASCII	Block of ASCII data that contains information for the generator when to shift from start to shifted phase and visa versa.

Frequency Hopping Modulation Programming

Use the following command for programming the frequency hop parameters. Hop control is internal. The frequency will hop from frequency to frequency at a rate determined by the dwell time value and controlled by a sequence of frequencies in the HOP data table.

There are two hop modes: Fixed Dwell, where the rate of which the generator hops from frequency to frequency is constant and Variable Dwell, where the rate of which the generator hops from frequency to frequency is programmable for each hop.

The commands for programming the frequency hopping function are described below. Note that the carrier waveform frequency (CW) setting is common to all modulation schemes.

HOP:DWELl:MODe(FIXed|VARiable}(?)

Description

This selects between fixed or variable dwell-time for the frequency hops. Select the fixed option if you want each frequency to dwell equally on each step. The variable option lets you program different dwell times for each frequency hop. The 2572 output hops from one frequency to the next according to a sequence given in a hope table. The variable dwell time table contains dwell time data for each step however, the fixed dwell time table does not contain and dwell time information and therefore, is you select the fixed option, make sure your dwell time is programmed as required.

Parameters

Name	Type	Default	Description
FIXed	Discrete	FIX	Selects the fixed dwell time frequency hops mode
VARiable	Discrete		Select the variable dwell time frequency hops mode

Response

The 2572 will return FIX, or VAR depending on the selected dwell setting.

HOP:DWELl<dwell_time>(?)

Description

This selects the dwell time for frequency hops when the selected mode is Fixed dwell time hops. The dwell time table in this case does not contain the dwell time per step parameters and therefore, the value which is programmed with this command remains constant for the entire hop sequence.

Parameters

Name	Range	Type	Default	Description
<dwell_time>	200e-9 to 21	Numeric	200e-9	Programs dwell time for the fixed dwell-time frequency hop function. The same dwell time will be valid for each frequency hop. Dwell time is programmed in units of s.

Response

The 2572 will return the present dwell time value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

HOP:FIX:DATA<fix_hop_data>

Description

This command will download the data array that will cause the instrument to hop through the frequency list. The dwell time for each frequency list item is fixed and can be programmed using the HOP:DWEL command. Note that if you intend to program marker position, you must do it first and then load the frequency hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 frequencies. The 2572 will hop through this list, outputting the next frequency each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the frequency step has frequency of 1Hz (1s period), the frequency step will last 1 second although the dwell time is 1ms.

Sample Frequency Hops Data Array

1e+6 2e+6 3e+3 4e+6 5e+5 6e+2 7e+1 8e+6 9e+3 10e+5

Parameters

Name	Type	Description
<fix_hop_data>	Double	Block of binary data that contains information of frequency values.

HOP:FIX:DATA<var_hop_data>

Description

This command will download the data array that will cause the instrument to hop through the frequency list. The dwell time for each frequency list item is variable and is supplied in the variable hop table data array. Note that the HOP:DWEL command has no effect on this sequence. Also note that if you intend to program marker position, you must do it first and then load the frequency hops list.

Below you can see how a hop table is constructed. The file sample below shows a list of 10 frequencies and their associated dwell times. The 2572 will hop through this list, outputting the next frequency each time it hops. Note that the carrier waveform is always sinewave and that the last cycle is always completed even if the dwell time is shorter than the period of the waveform. For example, if you program dwell time of 1ms and the frequency step has frequency of 1Hz (1s period), the frequency step will last 1 second although the dwell time is 1ms.

Sample Frequency Hops Data Array

1e+6 100 2e+6 2000 3e+3 3e4 4e+6 40 5e+5 5e3 6e+2 6000 7e+1 0.7 8e+8e2 6 9e+3 90 10e+51000

In the above example, the first number is the frequency value and the second number is its dwell time. Therefore, only even number of sets can be located in this table.

Parameters

Name	Type	Description
<var_hop_data>	Double	Block of binary data that contains information of frequency hop values and their respective dwell time.

HOP:MARKer<index>(?)

Description

Programs where on the frequency list the 2572 will generate a pulse, designated as Hop marker, or index point. The marker pulse is generated at the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<index>	1 to 4096	Numeric (integer only)	1	Programs a marker pulse at an index frequency hop position.

Response

The 2572 will return the present marker position.

Sweep Modulation Programming

Use the following command for programming the sweep parameters. Sweep control is internal. The frequency will sweep from start to stop frequencies at an interval determined by the sweep time value and controlled by a step type determined by the sweep step parameter.

There are two sweep modes: Linear, where the step of which the generator increments from start to stop frequency is linear and Logarithmic, where the step of which the generator increments from start to stop frequency is logarithmic

The commands for programming the frequency sweep function are described below.

SWEep:STARt<start_freq>(?)

Description

This specifies the sweep start frequency. The 2572 will normally sweep from start to stop frequencies however, if the sweep direction is revered, the output will sweep from stop to start frequencies. The start and stop frequencies may be programmed freely throughout the frequency of the standard waveform frequency range.

Parameters

Name	Range	Type	Default	Description
<start_freq>	10e-3 to 100e6	Numeric	10e3	Programs the sweep start frequency. Sweep start is programmed in units of Hz.

Response

The 2572 will return the present sweep start frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

SWEep:STOP<stop_freq>(?)

Description

This specifies the sweep stop frequency. The 2572 will normally sweep from start to stop frequencies however, if the sweep direction is revered, the output will sweep from stop to start frequencies. The start and stop frequencies may be programmed freely throughout the frequency of the standard waveform frequency range.

Parameters

Name	Range	Type	Default	Description
<stop_freq>	10e-3 to 100e6	Numeric	1e6	Programs the sweep stop frequency. Sweep stop is programmed in units of Hz.

Response

The 2572 will return the present sweep stop frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

SWEep:TIMe<time>(?)

Description

This specifies the time that will take the 2572 to sweep from start to stop frequencies. The time does not depend on the sweep boundaries as it is automatically adjusted by the software to the required interval. At the end of the sweep cycle the output waveform maintains the sweep stop frequency setting except if the 2572 is in continuous run mode where the sweep repeats itself continuously.

Parameters

Name	Range	Type	Default	Description
<time>	1.4e-6 to 40	Numeric	1e-3	Programs the sweep time. Sweep time is programmed in units of s.

Response
The 2572 will return the present sweep time. The returned value will be in standard scientific format (for example: 100ms would be returned as 100e-3 – positive numbers are unsigned).

SWEep:DIRection(UP|DOWN}(?)

Description
This specifies if the 2572 output will sweep from start-to-stop (UP) or from stop-to-start (DOWN) frequencies. Sweep time does not affect the sweep direction and frequency limits. At the end of the sweep cycle the output waveform normally maintains the sweep stop frequency setting but will maintain the start frequency, if the DOWN option is selected except if the 2572 is in continuous run mode where the sweep repeats itself continuously.

Parameters

Name	Type	Default	Description
UP	Discrete	UP	Selects the sweep up direction
DOWN	Discrete		Select the sweep down direction

Response
The 2572 will return UP, or DOWN depending on the selected direction setting.

SWEep:SPACing(LINear|LOGarithmic}(?)

Description
This specifies the sweep step type. Two options are available: logarithmic or linear. In linear, the incremental steps between the frequencies are uniform throughout the sweep range. Logarithmic type defines logarithmic spacing throughout the sweep start and stop settings.

Parameters

Name	Type	Default	Description
LINear	Discrete	LIN	Selects the linear sweep spacing
LOGarithmic	Discrete		Select the logarithmic sweep spacing

Response
The 2572 will return LIN, or LOG depending on the selected spacing setting.

SWEep:MARKer<frequency>(?)

Description
This function programs marker frequency position. Sweep marker can be placed in between the start and the stop frequencies. The marker pulse is output from the SYNC output connector.

Parameters

Name	Range	Type	Default	Description
<frequency>	10e-3 to 100e6	Numeric	505e3	Programs the marker frequency position in units of Hz.

Response

The 2572 will return the present marker frequency value. The returned value will be in standard scientific format (for example: 100mHz would be returned as 100e-3 – positive numbers are unsigned).

Run Mode Commands

The Run Mode Commands group is used to synchronize device actions with external events. These commands control the trigger modes of the Model 2572. The generator can be placed in Triggered, Gated or Burst mode. Trigger source is selectable from an external source, an internal re-trigger generator or a software trigger. Optional nodes were omitted from these commands. The Run Mode settings affect all waveform shapes equally except when using the modulated waveforms. In the case of modulated waveform, the output idles on the carrier waveform until stimulated to output a modulation cycle or burst of cycles. Additional information on the run mode options and how the 2572 behaves in the various run mode options is given in Chapter 3. Factory defaults after *RST are shown in bold typeface. Parameter low and high limits are given where applicable.

Table 5-7, Run Mode Commands

Keyword	Parameter Form	Default
:INITiate		
[:IMMediately]		
:CONTinuous	**OFF** | ON | **0** | 1	ON
:TRIGger		
[:IMMediate]		
:BURSt		
[:STATe]	**OFF** | ON | **0** | 1	OFF
:COUNt	(**1**;1;1000000)	1
:GATE		
[:STATe]	**OFF** | ON | **0** | 1	OFF
:SOURce		
[:ADVance]	**BUS** | EXTernal | MIXed	EXT
:SLOPe	**POSitive** | NEGative	POS
:LEVel	(**1.6**;-5.0;5.0)	1.6
:RETRigger		
[:STATe]	**OFF** | ON | 0 | 1	OFF
:TIMe	(**200.0E-9**;200.0E-9;21.0)	200e-9
:DELay		
[:STATe]	**OFF** | ON | **0** | 1	OFF
:TIMe	(0;200.0E-9;21.0)	200e-9

INITiate:CONTinuous{OFF|ON|0|1}(?)

Description

This command will set the output in continuous operation and interrupted operation. The run mode commands will affect the 2572 only after it will be set to interrupted operation.

Parameters

Name	Type	Default	Description
ON	Discrete	ON	Disables all interrupted modes and forces the continuous run mode
OFF	Discrete		Select the interrupted run mode. While in this switch option, you can program the 2572 to operate in triggered, gated, or counted burst run modes.

Response

The 2572 will return OFF, or ON depending on the selected option.

TRIGger:BURSt{OFF|ON|0|1}(?)

Description

This command will toggle the counted burst run mode on and off. This command will affect the 2572 only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the burst run mode off.
ON	Discrete		Enables the counted burst run mode. Burst count is programmable using the TRIG:BURS:COUN command.

Response

The 2572 will return OFF, or ON depending on the selected option.

TRIGger:BURSt:COUNt<burst>(?)

Description

This function sets the number of cycles when the Burst Mode is on. Use the init:cont off;:trig:burs on commands to select the Burst Mode.

Parameters

Name	Range	Type	Default	Description
<burst>	1 to 1M	Numeric (integer only)	1	Programs the burst count.

Response
The 2572 will return the present burst count value.

TRIGger:GATE{OFF|ON|0|1}(?)

Description
This command will toggle the gate run mode on and off. This command will affect the 2572 only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the gate run mode off.
ON	Discrete		Enables the gated run mode.

Response
The 2572 will return OFF, or ON depending on the selected option.

TRIGger:SOURce:ADVance{EXTernal|BUS|MIXed}(?)

Description
This selects the source from where the 2572 will be stimulated to generate waveforms. The source advance command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the 2572 to interrupted run mode using the init:cont off command.

Parameters

Name	Type	Default	Description
EXTernal	Discrete	EXT	Activates the rear panel TRIG IN input and the front panel MAN TRIG button. Either a front panel button push or a legal signal which will be applied to the rear panel input will stimulate the 2572 to generate waveforms. BUS commands are ignored.
BUS	Discrete		Selects the remote controller as the trigger source. Only software commands are accepted while rear and front panel signals are ignored
MIXed	Discrete		Hardware triggers are ignored until. First output cycle is initiated using a software command. Subsequent output cycles are initiated using one of the following: rear panel TRIG IN, or front panel MAN TRIG button.

Response
The 2572 will return EXT, BUS, or MIX depending on the selected trigger source advance setting.

TRIGger:SLOPe{POSitive|NEGative}(?)

Description

The trigger slope command selects the sensitive edge of the trigger signal that is applied to the TRIG IN connector. The Model 2572 can be made sensitive to either the positive or negative transitions. Positive going transitions will trigger the generator when the POS option is selected. Negative transitions will trigger the generator when the NEG option is selected. In Gated mode, two transitions in the same direction are required to gate on and off the output. The trigger slope command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the 2572 to interrupted run mode using the init:cont off command.

Parameters

Name	Type	Default	Description
POSitive	Discrete	POS	Selects the positive going edge.
NEGative	Discrete		Selects the negative going edge.

Response

The 2572 will return POS, or NEG depending on the selected trigger slope setting.

TRIGger:LEVel<level>(?)

Description

The trigger level command sets the threshold level at the trigger input connector. The trigger level command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the 2572 to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<level>	-5 to +5	Numeric	1.6	Programs the trigger level. The value affects the rear panel input only.

Response

The 2572 will return the present burst count value.

RETRigger{OFF|ON|0|1}(?)

Description

This command will toggle the re-trigger mode on and off. This command will affect the 2572 only after it will be set to INIT:CONT OFF.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the re-trigger mode off.
ON	Discrete		Enables the re-trigger mode.

Response

The 2572 will return OFF, or ON depending on the selected option.

RETRigger:Time<time>(?)

Description

This parameter specifies the amount of time that will elapse between the end of the delivery of the waveform cycle and the beginning of the next waveform cycle. Re-trigger can be initiated from any of the selected advance options. The re-trigger command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the 2572 to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<time>	200e-9 to 21	Numeric	200e-9	Programs the re-trigger period.

Response

The 2572 will return the present re-trigger period value.

TRIGger:DELay{OFF|ON|0|1}(?)

Description

This command will toggle the delayed trigger mode on and off. This command will affect the 2572 only after it will be set to INIT:CONT OFF.

Note: System delay must always be considered when using an external trigger. System delay is measured from a valid trigger input to the transition of the first waveform point. It has a fixed period that adds to the programmed trigger delay value. Consult Appendix A for the system delay specification.

Parameters

Name	Type	Default	Description
OFF	Discrete	OFF	Turns the delayed trigger mode off.
ON	Discrete		Enables the delayed trigger mode.

Response

The 2572 will return OFF, or ON depending on the selected option.

TRIGger:DELayTime<time>(?)

Description

The trigger delay time parameter defines the time that will elapse from a valid trigger signal to the initiation of the first output waveform. Trigger delay can be turned ON and OFF using the trig:del command. The trigger delay time command will affect the generator only after it has been programmed to operate in interrupted run mode. Modify the 2572 to interrupted run mode using the init:cont off command.

Parameters

Name	Range	Type	Default	Description
<time>	200e-9 to 21	Numeric	200e-9	Programs the trigger delay time.

Response

The 2572 will return the present trigger delay time value.

System Command

The system-related commands are not related directly to waveform generation but are an important part of operating the 2572. These commands can reset or test the instrument, or query the instrument for system information.

Table 5-8, System Commands Summary

Keyword	Parameter Form	Default
:RESet (*RST)		
:SYSTem		
:ERRor?		
:VERSion?		
:INFOrmation		
:MODel?		
:SERial?		

RESet, or *RST

Description
This query will reset the 2572 to its factory deafults.

.

SYSTem:ERRor?

Description
This query will interrogate the 2572 for programming errors.

Response
The 2572 will return error code. Error messages are listed later in this manual.

SYSTem:VERSion?

Description
This query will interrogate the 2572 for its current firmware version.

Response
The 2572 will return the current firmware version code.

SYSTem:INFormation:MODel?

Description
This query will interrogate the instrument for its model number.

Response
The generator will return its model number either 2571 or 2572.

SYSTem:INFormation:SERial?

Description
This query will interrogate the instrument for its serial number.

Response
The generator will return its serial number.

IEEE-STD-488.2 Common Commands and Queries

Since most instruments and devices in an ATE system use similar commands that perform similar functions, the IEEE-STD-488.2 document has specified a common set of commands and queries that all compatible devices must use. This avoids situations where devices from various manufacturers use different sets of commands to enable functions and report status. The IEEE-STD-488.2 treats common commands and queries as device dependent commands. For example, *TRG is sent over the bus to trigger the instrument. Some common commands and queries are optional, but most of them are mandatory.

The following is a complete listing of all common-commands and queries, which are used by the 2572

***CLS** - Clear the Status Byte summary register and all event registers.

***ESE** <enable_value> - Enable bits in the Standard Event enable register. The selected bits are then reported to the status byte.

***ESE?** - Query the Standard Event enable register. The generator returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

***ESR?** - Query the Standard Event register. The generator returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

***IDN?** - Query the generator's identity. The returned data is organized into four fields, separated by commas. The generator responds with its manufacturer and model number in the first two fields, and may also report its serial number and options in fields three and four. If the latter information is not available, the device must return an ASCII 0 for each. For example, Model 2572 response to *IDN? is:

Tabor,2572,0,1.0

***OPC** - Set the "operation complete" bit (bit 0) in the Standard Event register after the previous commands have been executed.

***OPC?** - Returns "1" to the output buffer after all the previous commands have been executed. *OPC? is used for synchronization between a controller and the instrument using the MAV bit in the Status Byte or a read of the Output Queue. The *OPC? query does not affect the OPC Event bit in the Standard Event Status Register (ESR). Reading the response to the ***OPC?** query has the advantage of removing the complication of dealing with service requests and multiple polls to the instrument. However, both the system bus and the controller handshake are in a temporary hold-off state while the controller is waiting to read the *OPC? query response.

***OPT?** - Returns the value “0” for a 2572 with no options.

***RST** - Resets the generator to its default state. Default values are listed in Table 5-1.

***SRE** <enable_value> - Enables bits in the Status Byte enable register.

***SRE?** - Query the Status Byte enable register. The generator returns

a decimal value in the range of 0 to 63 or 128 to 191 since bit 6 (RSQ) cannot be set. The binary-weighted sum of the number represents the value of the bits of the Service Request enable register.

***STB?** - Query the Status Byte summary register. The *STB? command is similar to a serial poll but is processed like any other instrument command. The *STB? command returns the same result as a serial poll, but the "request service" bit (bit 6) is not cleared if a serial poll has occurred.

***TRG** - Triggers the generator from the remote interface. This command effects the generator if it is first placed in the Trigger or Burst mode of operation and the trigger source is set to "BUS".

***WAI** – Wait for all pending operations to complete before executing any additional commands over the interface.

The SCPI Status Registers

The Model 2572 uses the Status Byte register group and the Standard Event register group to record various instrument conditions. Figure 5-1 shows the SCPI status system.

An Event Register is a read-only register that reports defined conditions within the generator. Bits in an event register are latched. When an event bit is set, subsequent state changes are ignored. Bits in an event register are automatically cleared by a query of that register or by sending the *CLS command. The *RST command or device clear does not clear bits in an event register. Querying an event register returns a decimal value, which corresponds to the binary-weighted sum of all bits, set in the register.

An Event Register defines which bits in the corresponding event register are logically ORed together to form a single summary bit. The user can read from and write to an Enable Register. Querying an Enable Register will not clear it. The *CLS command does not clear Enable Registers but it does clear bits in the event registers. To enable bits in an enable register, write a decimal value that corresponds to the binary-weighted sum of the bits required to enable in the register.

The Status Byte Register (STB)

The Status Byte summary register contains conditions from the other registers. Query data waiting in the generator's output buffer is immediately reported through the Message Available bit (bit 4). Bits in the summary register are not latched. Clearing an event register will clear the corresponding bits in the Status Byte summary register. Description of the various bits within the Status Byte summary register is given in the following:

Bit 0 - Decimal value 1. Not used, always set to 0.

Bit 1 - Decimal value 2. Not used, always set to 0.

Bit 2 - Decimal value 4. Not used, always set to 0.

Bit 3 - Decimal value 8. Not used, always set to 0.

Bit 4 - Decimal value 16. Message Available Queue Summary Message (MAV). The state of this bit indicates whether or not the output queue is empty. The MAV summary message is true when the output queue is not empty. This message is used to synchronize information exchange with the controller. The controller can, for example, send a query command to the device and then wait for MAV to become true. If an application program begins a read operation of the output queue without first checking for MAV, all system bus activity is held up until the device responds.

Bit 5 - Decimal value 32. Standard Event Status Bit (ESB) Summary Message. This bit indicates whether or not one or more of the enabled ESB events have occurred since the last reading or clearing of the Standard Event Status Register.

Bit 6 - Decimal value 64. Master Summary Status (MSS)/Request Service (RQS) Bit. This bit indicates if the device has at least one condition to request service. The MSS bit is not part of the IEEE-STD-488.1 status byte and will not be sent in response to a serial poll. However, the RQS bit, if set, will be sent in response to a serial poll.
Bit 7 - Decimal value 128. Not used, always set to 0.

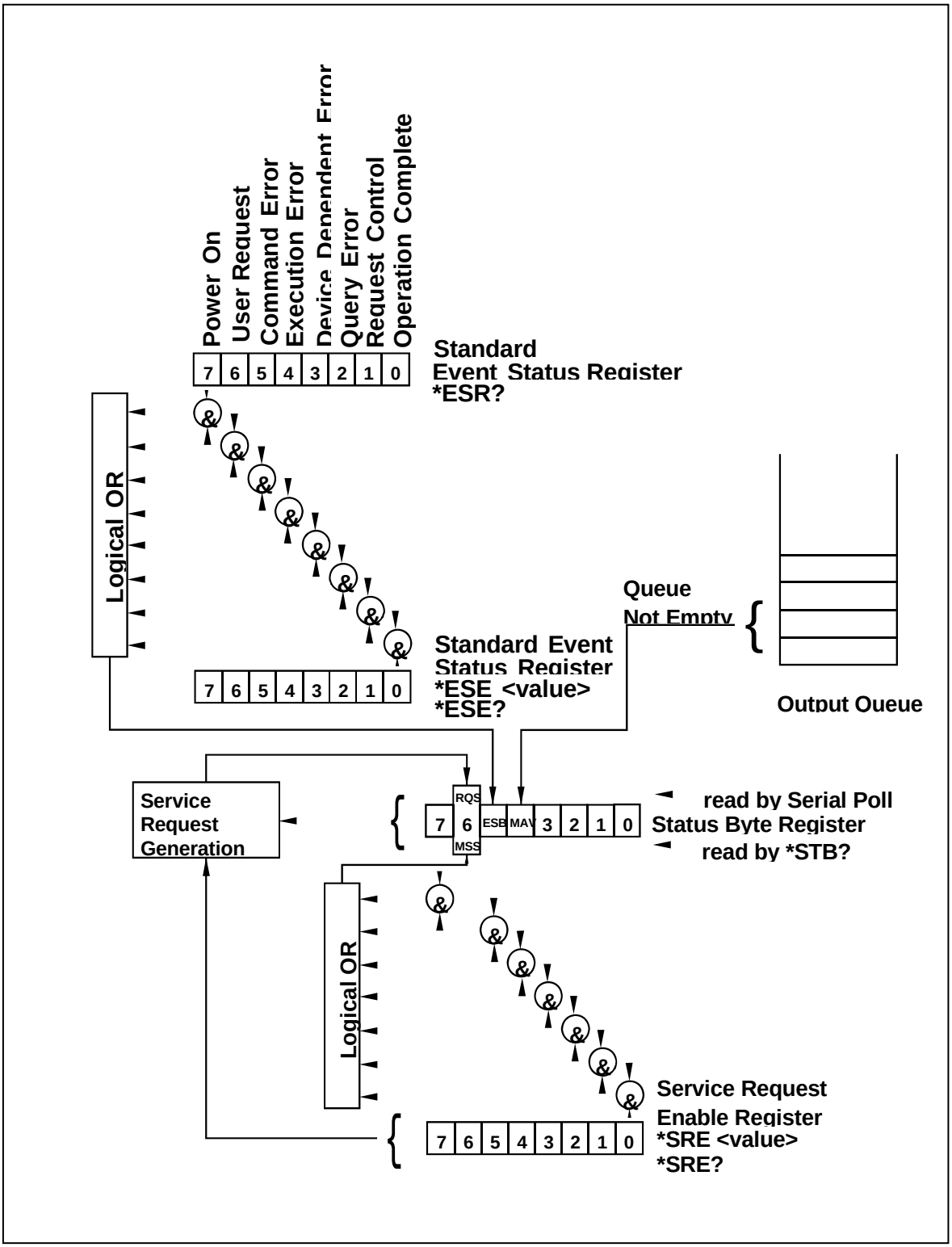

Figure 5-6. SCPI Status Registers

Reading the Status Byte Register

The Status Byte summary register can be read with the *STB? common query. The *STB? common query causes the generator to send the contents of the Status Byte register and the MSS (Master Summary Status) summary message as a single <NR1 Numeric Response Message> element. The response represents the sum of the binary-weighted values of the Status Byte Register. The *STB? common query does not alter the status byte.

Clearing the Status Byte Register

Removing the reasons for service from Auxiliary Status registers can clear the entire Status Byte register. Sending the *CLS command to the device after a SCPI command terminator and before a Query clears the Standard Event Status Register and clears the output queue of any unread messages. With the output queue empty, the MAV summary message is set to FALSE. Methods of clearing other auxiliary status registers are discussed in the following paragraphs.

Service Request Enable Register (SRE)

The Service Request enable register is an 8-bit register that enables corresponding summary messages in the Status Byte Register. Thus, the application programmer can select reasons for the generator to issue a service request by altering the contents of the Service Request Enable Register.

The Service Request Enable Register is read with the *SRE? common query. The response to this query is a number that represents the sum of the binary-weighted value of the Service Request Enable Register. The value of the unused bit 6 is always zero.

The Service Request Enable Register is written using the *SRE command followed by a decimal value representing the bit values of the Register. A bit value of 1 indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Service Request Enable Register is cleared by sending *SRE0. The generator always ignores the value of bit 6. Summary of *SRE commands is given in the following.

***SRE0** - Clears all bits in the register.
***SRE1** - Not used.
***SRE2** - Not used.
***SRE4** - Not used.
***SRE8** - Not used.
***SRE16** - Service request on MAV.
***SRE32** - Service request on ESB summary bit.
***SRE128** - Not used.

Standard Event Status Register (ESR)

The Standard Event Status Register reports status for special applications. The 8 bits of the ESR have been defined by the IEEE-STD-488.2 as specific conditions, which can be monitored and reported back to the user upon request. The Standard Event Status Register is destructively read with the *ESR? common query. The Standard Event Status Register is cleared with a *CLS common command, with a power-on and when read by *ESR?.

The arrangement of the various bits within the register is firm and is required by all GPIB instruments that implement the IEEE-STD-488.2. Description of the various bits is given in the following:

Bit 0 - Operation Complete. Generated in response to the *OPC command. It indicates that the device has completed all selected and pending operations and is ready for a new command.

Bit 1 - Request Control. This bit operation is disabled on the Model 2572.

Bit 2 - Query Error. This bit indicates that an attempt is being made to read data from the output queue when no output is either present or pending.

Bit 3 - Device Dependent Error. This bit is set when an error in a device function occurs. For example, the following command will cause a DDE error:

```
VOLTage 5;:VOLTage:OFFSet 2
```

Both of the above parameters are legal and within the specified limits, however, the generator is unable to generate such an amplitude and offset combination.

Bit 4 - Execution Error. This bit is generated if the parameter following the command is outside of the legal input range of the generator.

Bit 5 – Command Error. This bit indicates the generator received a command that was a syntax error or a command that the device does not implement.

Bit 6 - User Request. This event bit indicates that one of a set of local controls had been activated. This event bit occurs regardless of the remote or local state of the device.

Bit 7 - Power On. This bit indicates that the device's power source was cycled since the last time the register was read.

Standard Event Status Enable Register (ESE)

The Standard Event Status Enable Register allows one or more events in the Standard Event Status Register to be reflected in the ESB summary message bit. The Standard Event Status Enable Register is an 8-bit register that enables corresponding summary messages in the Standard Event Status Register. Thus, the application programmer can select reasons for the generator to issue an ESB summary message bit by altering the contents of the ESE Register.

The Standard Event Status Enable Register is read with the *ESE? Common query. The response to this query is a number that represents the sum of the binary-weighted value of the Standard Event Status Enable Register.

The Standard Event Status Enable Register is written using the *ESE command followed by a decimal value representing the bit values of the Register. A bit value one indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Standard Event Status Enable Register is cleared by setting *ESE0. Summary of *ESE messages is given in the following.

***ESE0** – No mask. Clears all bits in the register.
***ESE1** – ESB on Operation Complete.
***ESE2** – ESB on Request Control.
***ESE4** – ESB on Query Error.
***ESE8** – ESB on Device Dependent Error.
***ESE16** – ESB on Execution Error.
***ESE32** – ESB on Command Error.
***ESE64** – ESB on User Request.
***ESE128** – ESB Power on.

Error Messages

In general, whenever the 2572 receives an invalid SCPI command, it automatically generates an error. Errors are stored in a special error queue and may be retrieved from this buffer one at a time. Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was stored. When you have read all errors from the queue, the generator responds with a 0,"No error" message.

If more than 30 errors have occurred, the last error stored in the queue is replaced with -350, “Queue Overflow”. No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the generator responds with 0,"No error".

The error queue is cleared when power has been shut off or after a *CLS command has been executed. The *RST command does not clear the error queue. Use the following command to read the error queue:

```
SYSTem:ERRor?
```

Errors have the following format (the error string may contain up to 80 characters):

-102,"Syntax error"

A complete listing of the errors that can be detected by the generator is given below.

-100,"Command error". When the generator cannot detect more specific errors, this is the generic syntax error used.

-101,"Invalid Character". A syntactic element contains a character, which is invalid for that type.

-102,"Syntax error". Invalid syntax found in the command string.

-103,"Invalid separator". An invalid separator was found in the command string. A comma may have been used instead of a colon or a semicolon. In some cases where the generator cannot detect a specific separator, it may return error -100 instead of this error.

-104,"Data type error". The parser recognized a data element different than allowed.

-108,"Parameter not allowed". More parameters were received than expected for the header.

-109,"Missing parameter". Too few parameters were received for the command. One or more parameters that were required for the command were omitted.

-128."Numeric data not allowed". A legal numeric data element was received, but the instrument does not accept one in this position.

-131,"Invalid suffix". A suffix was incorrectly specified for a numeric parameter. The suffix may have been misspelled.

-148,"Character data not allowed". A character data element was encountered where prohibited by the instrument.

-200,"Execution error". This is the generic syntax error for the instrument when it cannot detect more specific errors. Execution error as defined in IEEE-488.2 has occurred.

-221,"Setting conflict". Two conflicting parameters were received which cannot be executed without generating an error. Listed below are events causing setting conflicts.

1. Sum of pulse or ramp parameters is more than 100. Corrective action: Change parameters to correct the problem.
2. ampl/2 + |offset| is more than 5. Corrective action: Reduce offset to 0, then change amplitude-offset values to correct the problem.
3. Activating filters when the 2572 is set to output the built-in sine waveform, or activating the built-in sine waveform when one of the 2572 filters is turned on. Corrective action: If in sine, select another function and activate the filter(s).

4. Activating burst mode when the 2572 is set to sequence mode, or activating sequence mode when the 2572 is set to burst mode. Corrective action: Remove the 2572 from burst or sequence and then selected the desired mode.
5. Changing operating mode from triggered to continuous when the 2572 is set to single sequence advance, or changing the operating mode from continuous to triggered when the 2572 is set to automatic sequence advance mode. Corrective action: Observe the 2572 advance mode while setting sequence advance.

-222,”Data out of range”. Parameter data, which followed a specific header, could not be used because its value is outside the valid range defined by the generator.

-224,”Illegal parameter value”. A discrete parameter was received which was not a valid choice for the command. An invalid parameter choice may have been used.

-300,”Device-specific-error”. This is the generic device-dependent error for the instrument when it cannot detect more specific errors. A device- specific error as defined in IEEE-488.2 has occurred.

-311,”Memory error”. Indicates that an error was detected in the instrument’s memory.

-350,”Queue Overflow”. The error queue is full because more than 30 errors have occurred. No additional errors are stored until the errors from the queue are removed. The error queue is cleared when power has been shut off, or after a *CLS command has been executed.

-410,”Query INTERRUPTED”. A command was received which sends data to the output buffer, but the output buffer contained data from a previous command (the previous data is not overwritten). The output buffer is cleared when power is shut off or after a device clear has been executed.

Chapter 6
Performance Checks

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What's in This Chapter

This chapter provides performance tests necessary to troubleshoot the Model 2572 Universal Waveform Generator.

WARNING

The procedures described in this section are for use only by qualified service personnel. Many of the steps covered in this section may expose the individual to potentially lethal voltages that could result in personal injury or death if normal safety precautions are not observed.

CAUTION

ALWAYS PERFORM PERFORMANCE TESTS IN A STATIC SAFE WORKSTATION.

Performance Checks

The following performance checks verify proper operation of the instrument and should normally be used:

1. As a part of the incoming inspection of the instrument specifications;
2. As part of the troubleshooting procedure;
3. After any repair or adjustment before returning the instrument to regular service.

Environmental Conditions

Tests should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Warm-up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model 2572 and allow it to warm-up for at least 30 minutes before beginning the performance test procedure.

Initial Instrument Setting

To avoid confusion as to which initial setting is to be used for each test, it is required that the instrument be reset to factory default values prior to each test. To reset the Model 2572 to factory defaults, use the Factory Rest option in the Utility menu.

Recommended Test Equipment

Recommended test equipment for troubleshooting, calibration and performance checking is listed in Table 6-1 below. Test instruments other than those listed may be used only if their specifications equal or exceed the required characteristics.

Table 6-1, Recommended Test Equipment

Equipment	Model No.	Manufacturer
Oscilloscope (with jitter package)	LT342	LeCroy
Distortion Analyzer	6900B	Krohn Hite
Digital Multimeter	2000	Keithley
Freq. Counter	6020R	Tabor Electronics
Spectrum Analyzer	E4411	HP
Pulse Generator (with manual trigger)	8500	Tabor Electronics

Test Procedures

Use the following procedures to check the Model 2572 against the specifications. A complete set of specifications is listed in Appendix A. The following paragraphs show how to set up the instrument for the test, what the specifications for the tested function are, and what acceptable limits for the test are. If the instrument fails to perform within the specified limits, the instrument must be calibrated or tested to find the source of the problem.

Frequency Accuracy

Frequency accuracy checks tests the accuracy of the internal oscillators. Both channels same the same output frequency and the same reference oscillators and therefore, the accuracy is tested on channel 1 only.

Frequency Accuracy, Internal Reference

Equipment: Counter

Preparation:

1. Configure the counter as follows:
   Termination: 50Ω, DC coupled
2. Connect the 2572 Channel 1 output to the counter input – channel A
3. Configure the 2572, channel 1 as follows:
   Waveform: Squarewave
   Amplitude: 2V
   Output: On
   Frequency: As specified in Table 6-2

Test Procedure:

1. Perform frequency Accuracy tests using Table 6-2

Table 6-2, Frequency Accuracy

2572 Setting	Error Limits	Counter Reading	Pass	Fail
10.0000000Hz	±10µHz			
1.00000000kHz	±1mHz			
100.000000kHz	±100mHz			
1.00000000MHz	±1Hz			
100.0000000MHz	±100Hz			

Frequency Accuracy, External 10MHz Reference

Equipment: 10MHz reference (at least 0.1ppm), Counter

Preparation:

1. Leave counter setting and 2572 connections as in last test
2. Connect the 10MHz reference oscillator to the 2572 rear panel input
3. Configure the 2572 channel 1 as follows:
   Ref Oscillator: External
   Waveform: Squarewave
   Amplitude: 2V
   Output: On
   Frequency: As specified in Table 6-3

Test Procedure

1. Perform frequency Accuracy tests using Table 6-3

Table 6-3, Frequency Accuracy Using External 10MHz Reference

2572 Setting	Error Limits	Counter Reading	Pass	Fail
10.0000000MHz	±1Hz			
50.0000000MHz	±5Hz			

Amplitude Accuracy

Amplitude accuracy checks tests the accuracy of the output amplifier and attenuators. Each channel has its own set of amplifiers and attenuators and therefore, the accuracy is tested on each channel separately. Amplitude path is checked for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Amplitude Accuracy, DAC Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: ACV
2. Connect 2572 Channel outputs to the DMM input
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Output: On
   Amplitude: As specified in Table 6-4

Test Procedure

1. Perform amplitude Accuracy tests on both channels using Table 6-4

Table 6-4, Amplitude Accuracy, DAC output

2572 Amplitude Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
16.00V	5.657V, ±112mV				
10.00V	3.535V, ±59mV				
1.000V	353.5mV, ±7mV				
100.0mV	35.35mV, ±2.1mV				

Amplitude Accuracy, DDS Output

Equipment: DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: ACV
2. Connect 2572 Channel outputs to the DMM input
3. Configure the 2572 as follows:
   Waveform: Modulated
   Modulation: OFF
   CW Frequency: 1kHz
   Output: On
   Amplitude: As specified in Table 6-5

Test Procedure

1. Perform amplitude Accuracy tests on both channels using Table 6-5

Table 6-5, Amplitude Accuracy, DDS output

2572 Amplitude Setting	Error Limits	DMM Reading CH 1	DMM Reading CH 2	Pass	Fail
16.00V	5.657V, ±112mV				
10.00V	3.535 V, ±59mV				
1.000V	353.5 mV, ±7mV				
100.0mV	35.35mV, ±2.1mV				

Offset Accuracy

Offset accuracy checks tests the accuracy of the offset generators. Each channel has its own set of offset generators and therefore, the accuracy is tested on each channel separately. Offset path is checked for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Offset Accuracy, DAC Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: DCV
2. Connect 2572 Channel 1/2 output to the DMM input
3. Configure the 2572 as follows:
   Frequency: 1MHz
   Amplitude: 20mV
   Output: On
   Offset: As specified in Table 6-6

Test Procedure

1. Perform Offset Accuracy tests on both channels using Table 6-6

Table 6-6, Offset Accuracy, DAC Output

2572 Offset Setting	Error Limits	DMM Reading CH 1	DMM Reading CH 2	Pass	Fail
+7.800V	7.800V ±83mV				
+4.000V	4.000V ±45mV				
0.000V	0V ±20mV				
-4.000V	-4.000V ±45mV				
-7.800V	-7.800V ±83mV				

Offset Accuracy, DDS Output

Equipment**:** DMM

Preparation:

1. Configure the DMM as follows:
   Termination: 50Ω feedthrough at the DMM input
   Function: DCV
2. Connect 2572 Channel 1/2 output to the DMM input
3. Configure the 2572 as follows:
   Waveform: Modulated
   Modulation: OFF
   CW Frequency: 1MHz
   Amplitude: 6V
   Output: On

Test Procedure

1. Perform Offset Accuracy tests on both channels using Table 6-7

Table 6-7, Offset Accuracy, DDS Output

2572 Offset Setting	Error Limits	DMM Reading		Pass	Fail
		CH 1	CH 2		
0.000V	0 ±20mV				

Squarewave Characteristics

This tests the characteristics of the square waveform. It includes transition times, aberrations and skew between channels. Each channel has its own set of amplifiers and attenuators and therefore, the characteristics are tested on each channel separately.

Squarewave Checks

Equipment: Oscilloscope, 50 ohms 20dB attenuator feed through

Preparation:

1. Configure the Oscilloscope follows:
   Termination: 50 ohms 20dB attenuator feed through at the oscilloscope input
   Setup: As required for the test
2. Connect 2572 Channel 1/2 output to the oscilloscope input
   Configure the 2572 as follows:
   Frequency: 1MHz
   Waveform: Squarewave
   Amplitude: 10V
   Output: On

Test Procedure

1. Perform Squarewave Characteristics tests on both channels using Table 6-8

Table 6-8, Square wave Characteristics

Parameter Tested	Error Limits	Oscilloscope Reading CH 1	CH 2	Pass	Fail
Rise/Fall Time	<4ns				
Ringing	<5% + 10mV				
Over/undershoot	<5% + 10mV				

Skew Between Channels

Equipment: Oscilloscope, 50 ohms 20dB attenuator feed through

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 50 ohms 20dB attenuator feed through at the oscilloscope 50 ohms input. Use two identical cables to connect with Ch1/2.
   - Setup: As required for the test
2. Connect 2572 Channel 1/2 output to the oscilloscope input
3. Configure the 2572 as follows:
   - Frequency: 1MHz
   - Waveform: Arbitrary
   - SCLK: 250MS/s
   - Amplitude: 6V
   - Output: On

Test Procedure

1. Using ArbConnection prepare and download the following waveform (both channels):
   - Wavelength: 1024
   - Waveform: Square
2. Measure the skew between the channels to be less than 1ns.
3. Program the skew from 1 to 10 and check the phase offset between channels is increased by 4nsec with every offset step.

Test Results	Pass		Fail	

Sinewave Characteristics

This tests the characteristics of the sine waveform. It includes distortions, spectral purity and flatness. Each channel has its own set of amplifiers and attenuators and therefore, the characteristics are tested on each channel separately. Tests are done for both the DAC route (arbitrary and standard waveforms) and the DDS route (CW and modulated waveforms).

Sinewave Distortions, DAC Output

Equipment: Distortion Analyzer, Spectrum Analyzer, and ArbConnection

Preparation:

1. Connect 2572 Channel 1/2 output to the distortion analyzer input. Configure the 2572 as follows:
   SCLK: As required by the test
   Waveform: Arbitrary
   Amplitude: 5V
   Output: On
2. Using ArbConnection prepare and download the following waveform:
   Wavelength: As required by the test
   Waveform: Sinewave

Test Procedure

1. Perform Sinewave distortion tests on both channels using Table 6-9

Table 6-9, Sinewave Distortion, DAC Output Tests

2572 SCLK Settings	Sinewave Points	2572 Frequency	Reading Limits	Distortion		Pass	Fail
				CH 1	CH 2		
4MS/s	4000	1.000kHz	< 0.15%				
40Ms/s	4000	10.00kHz	< 0.15%				
200Ms/s	2000	100.00kHz	< 0.15%				

Sinewave Spectral Purity, DAC Output

Equipment: Spectrum Analyzer

Preparation:

1. Connect 2572 Channel 1/2 output to the spectrum analyzer input. Use 50Ω and 20dB feedthrough termination at the spectrum analyzer input
2. Configure the 2572 as follows:
   Amplitude: 5V
   Output: On
   Frequency: As required by the test

Test Procedure

1. Perform sinewave spectral purity, DAC waveforms tests using Table 6-10

Table 6-10, Sinewave Spectral Purity, DAC Output Test

2572 Freq Settings	Reading Limits	Spectrum Analyzer, Settings & Results				Pass	Fail
		Start	Stop	CH 1	CH 2		
10MHz	>40dBc	1M	100M				
50MHz	>30dBc	10M	200M				
100MHz	>25dBc	10M	250M				

Sinewave Spectral Purity, DDS Output

Equipment: Spectrum Analyzer

Preparation:

1. Connect 2572 Channel 1/2 output to the spectrum analyzer input. Use 50Ω and 20dB feedthrough termination at the spectrum analyzer input
2. Configure the 2572 as follows:
   - Waveform: Modulated
   - Modulation: OFF
   - Amplitude: 5V
   - Output: On
   - CW Frequency: As required by the test

Test Procedure

1. Perform sinewave spectral purity, DDS Waveforms tests on both channels using Table 6-11

Table 6-11, DDS CW Spectral Purity Test.

2572 CW Freq	Reading Limits	Spectrum Analyzer, Settings & Results				Pass	Fail
		Start	Stop	CH 1	CH 2		
10MHz	>40dBc	1M	100M				
50MHz	>30dBc	10M	200M				
100MHz	>25dBc	10M	250M				

Sinewave Flatness, DAC Output

Equipment: Oscilloscope

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect 2572 Channel 1/2 output to the oscilloscope input
3. Configure the 2572 as follows:
   - Amplitude: 6V
   - Output: On
   - Frequency: Initially, 1kHz then, as required by the test

Test Procedure

1. Adjust the vertical controls of the Oscilloscope to get 6 division of display
2. Perform Sine flatness, DAC waveforms tests on both channels using Table 6-12

Table 6-12, Sinewave Flatness, DAC Output Test

2572 Sine Frequency	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
1MHz	6 Divisions	Reference	Reference	X	X
10MHz	6 ±0.15 Divisions				
50MHz	6 ±1.2 Divisions				
100MHz	6 ±1.2 Divisions				

Sinewave Flatness, DDS Output

Equipment: Oscilloscope

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect 2572 Channel 1/2 output to the oscilloscope input
3. Configure the 2572 as follows:
   - Waveform: Modulated
   - Modulation: OFF
   - Amplitude: 6V
   - Output: On
   - CW Frequency: Initially, 1kHz then, as required by the test

Test Procedure

1. Adjust the vertical controls of the Oscilloscope to get 6 division of display
2. Perform Sine flatness, DDS waveforms tests on both channels using Table 6-13

Table 6-13, Sinewave Flatness, DDS Output Test

2572 Sine Frequency	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
1MHz	6 Divisions	Reference	Reference	X	X
10MHz	6 ±0.15 Divisions				
50MHz	6 ±1.2 Divisions				
100MHz	6 ±1.2 Divisions				

Trigger operation Characteristics

This tests the operation of the trigger circuit. It includes tests for the triggered, gated and counted bursts run modes. It also tests the operation of the trigger advance options, the delayed trigger and re-trigger functions, as well as the trigger input level and slope sensitivity. The run modes are common to both channels and therefore the tests are performed on channel 1 only.

Trigger, Gate, and Burst Characteristics

Equipment: Oscilloscope, function generator, counter

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect 2572 Channel 1/2 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 1MHz
   - Run Mode: As required by the test
   - Wave: TTL Square
4. Connect the function generator output to the 2572 TRIG IN connector
5. Configure the 2572 as follows:
   - Frequency: 28MHz
   - Waveform: Sinewave
   - Burst Count: 1e6 counts, each channel
   - Amplitude: 1V
   - Trigger Source: External
   - Output: On

Test Procedure

1. Perform trigger and gate tests using Tables 6-14
2. Configure the counter to TOTB Measurements and perform burst tests using Tables 6-14. Set counter trigger level to 100mV.

Table 6-14, Trigger, gate, and burst Characteristics.

2572 Run Mode	External Trigger Pulse	Oscilloscope Reading		Pass	Fail
		CH 1	CH 2		
Triggered	1MHz, Continuous	Triggered waveform	Triggered waveform		
Gated	1MHz, Continuous	Gated Waveform	Gated Waveform		
Burst	Single shot	Burst, 1e6 waveforms	Burst, 1e6 waveforms		

Mixed Trigger Advance Test

Equipment: Oscilloscope, function generator, ArbConnection

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feedthrough attenuator at the oscilloscope input
   - Setup: As required for the test
   - Run Mode: Single
2. Connect 2572 Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 100kHz
   - Run Mode: Continuous
   - Wave: TTL Square from the main output.
4. Connect the function generator output to the 2572 TRIG IN connector
5. Configure the 2572, channel 1 only, as follows:
   - Frequency: 28MHz
   - Waveform: Sinewave
   - Run Mode: Burst
   - Burst Count: 5 counts, each channel
   - Trigger Delay: On
   - Delay: 5s
   - Amplitude: 5V
   - Trigger Source: Mixed
   - Output: On

Test Procedure

1. Note that no signal is shown on the oscilloscope
2. From ArbConnection, press the MAN TRIG button.
3. Note and record the time that lapsed from when you pressed MANUAL Trigger button until you first see the burst of 5 sine waveforms. Lapsed time should be 5 seconds

Test Results	Pass		Fail	

4. Modify oscilloscope setting to Auto, or Normal and observe that bursts of 5 sine cycles appear at 10μs intervals

Test Results	Pass		Fail	

Delayed Trigger Characteristics

Equipment: Function generator, 50Ω "T" connector, Counter, ArbConnection CAD

Preparation:

1. Configure the Function generator as follows:
   - Amplitude: 1V
   - Frequency: 1MHz
   - Trigger Mode: Triggered.
   - Wave: Squarewave
2. Place the "T" connector on the output terminal of the function generator. Connect one side of the "T" to the 2572 TRIG IN connector and the other side of the "T" to the channel A input of the counter
3. Connect the 2572 output to channel B input of the counter
4. Configure the counter to TI A to B measurements
5. Using ArbConnection prepare and download the following waveform:
   - Wavelength: 100 points
   - Waveform: Pulse, Delay = 0.1, Rise/Fall = 0, High Time = 99.99
6. Configure the 2572, channel 1 only, as follows:
   - SCLK: 200MHz
   - Waveform: Arbitrary
   - Run Mode: Triggered
   - Trigger Level 0V
   - Trigger Delay: On
   - Delay: As required for the test
   - Amplitude: 5V
   - Trigger Source: External
   - Output: On

Test Procedure

1. Perform trigger delay tests using Tables 6-15

Table 6-15, Trigger Delay Tests

2572 Delay Setting	Error Limits	Counter Reading	Pass	Fail
1µs	1µs ±230ns			
1ms	1ms ±50µs			
1s	1s ±50ms			

Re-trigger Characteristics

Equipment: Counter, ArbConnection

Preparation:

1. Configure the counter to pulse width measurements as follows:
   - Function: Pulse Width Measurement
   - Ch A Slope: Negative
2. Connect the counter channel A to the 2572 output
3. Using ArbConnection prepare and download the following waveform:
   - Wavelength: 100 points
   - Waveform: Pulse, Delay = 0.1, Rise/Fall = 0, High Time = 99.99
4. Configure the 2572, channel 1 only, as follows:
   - SCLK 200MHz
   - Waveform: Arbitrary
   - Amplitude: 5V
   - Run Mode: Triggered
   - Trigger Level 0V
   - Re-trigger: On
   - Re-trigger Delay: As required by the test
   - Output: On

Test Procedure

1. Manually trigger the instrument
2. Perform trigger delay tests using Tables 6-16

Table 6-16, Re-Trigger Delay Tests

2572 Delay Setting	Error Limits	Counter Reading	Pass	Fail
1µs	1µs ±85ns			
1ms	1ms ±50µs			
1s	1s ±50ms			

Trigger Slope

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the Oscilloscope follows:
   - Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   - Setup: As required for the test
   - Trigger Source: External
2. Connect 2572 Channel 1/2 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 10kHz
   - Run Mode: Continue
   - Waveform: TTL Output
4. Connect the function generator TTL output to the 2572 TRIG IN connector
5. Connect the function generator main output to the 2nd channel of

the oscilloscope

6. Configure the 2572 as follows:
   - Frequency: 1MHz
   - Waveform: Sine wave
   - Run Mode: Triggered
   - Output: On

Test Procedure

1. Toggle 2572 trigger slope from positive to negative visa versa
2. Verify on the oscilloscope that the 2572 transitions are synchronized with the slope of the trigger

Test Results	Pass		Fail	

Trigger Level

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the Oscilloscope as follows:
   - Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect 2572 Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 10kHz
   - Run Mode: Continuous
   - Waveform: Squarewave.
   - Amplitude: 1V
4. Connect the function generator output to the 2572 TRIG IN connector
5. Configure the 2572 as follows:
   - Frequency: 1MHz
   - Waveform: Sine wave
   - Run Mode: Triggered
   - Trigger level: 0V
   - Ch1 Output: On

Test Procedure

1. Verify that the 2572 outputs triggered waveforms spaced at 0.1ms
2. Modify the function generator offset to +2V and change the 2572 trigger level to +4V. Verify that the 2572 outputs triggered waveforms spaced at 0.1ms
3. Modify the function generator offset to -2V and change the 2572 trigger level to -4V. Verify that the 2572 outputs triggered waveforms spaced at 0.1ms

Test Results	Pass		Fail	

Sequence operation

This tests the operation of the sequence generators. Each channel has its own sequence generator and therefore operations is tested on each channel separately. This also checks the sequence advance options.

Automatic Advance

Equipment: Counter

Preparation:

1. Configure the Counter as follows:
   Function: TOTB Measurement
2. Connect the counter channel B to the 2572 output
3. Configure the 2572 as follows (both channels):
   SCLK 225MS/s
   Waveform: Sequence
   Run Mode: Trigger
   Amplitude: 2V
   Output: On
4. Using ArbConnection prepare and download the following waveform to both channels:
   Segments: 1 to 5
   Wavelength: 128 points
   Waveform: 1 cycle square
5. Using ArbConnection, build and download the following sequence table:
   Step 1: Segment 1, loop 100,000
   Step 2: Segment 2, loop 100,000
   Step 3: Segment 3, loop 100,000
   Step 4: Segment 4, loop 100,000
   Step 5: Segment 5, loop 100,000

Test Procedure

1. From ArbConnection, click on the Manual Trigger button and observe that counter reading is 500,000 counts. Reset counter and repeat the test a few times. Every time the counter reading should be 500,000 counts exactly

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Step Advance

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the Oscilloscope as follows:
   - Termination: 20dB, 50Ω feed through attenuator at the oscilloscope input
   - Setup: As required for the test
2. Connect 2572 Channel 1 output to the oscilloscope input
3. Configure the function generator as follows:
   - Frequency 10kHz
   - Run Mode: Triggered
   - Waveform: Squarewave.
   - Amplitude: Adjust for TTL level on 50Ω
4. Connect the function generator output to the 2572 TRIG IN connector
5. Connect 2572 Ch1 to the Oscilloscope input
6. Configure the 2572 as follows:
   - SCLK 200MS/s
   - Waveform: Sequence
   - Seq Advance: Step
   - Amplitude: 2V
   - Trigger Source: External
   - Output: On
7. Using ArbConnection prepare and download the following waveform to both channels:
   - Segment 1: Sine, 1000 points
   - Segment 2: Triangle, 1000 points
   - Segment 3: Square, 1000 points
   - Segment 4: Sinc, 1000 points
   - Segment 5: Gaussian Pulse, 1000 points
8. Using ArbConnection, build and download the following sequence table:
   - Step 1: Segment 1, loop 1
   - Step 2: Segment 2, loop 1
   - Step 3: Segment 3, loop 1
   - Step 4: Segment 4, loop 1
   - Step 5: Segment 5, loop 1

Test Procedure

1. Press the manual trigger button on the function generator and observe that the waveforms advance through the sequence table repeatedly

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Note

Leave the same setup for the next test

Single Advance

Equipment: Oscilloscope, function generator

Preparation: (Same preparation as for previous step, except change mode to single sequence advance)

1. Change Oscilloscope configuration to single

Test Procedure

1. Press the manual trigger button on the function generator and observe that one cycle waveform advances through the sequence table repeatedly with each external trigger signal. Note that you need to press the Single mode on the oscilloscope for each trigger advance

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Modulated Waveforms Characteristics

This tests the operation of the modulation circuits. It includes tests for the various modulation functions: FM, AM, FSK, PSK, Frequency hops and Sweep. Since the run modes are common to all modulation functions, they are being tested on the FM function only. The tests are performed on each channel.

FM - Standard Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 50µs
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FM
   - Carrier Freq: 1MHz
   - Mod Frequency: 10kHz
   - Deviation: 500kHz
   - Sync: On
   - Output: On

Test Procedure:

1. Verify FM operation on the oscilloscope as follows:
   - Waveform: Sine
   - Frequency: 10kHz
   - Max A: 1.25MHz
   - Min A: 750kHz

Test Results	Pass		Fail	

2. Modify 2572 modulating waveform to triangle, then square and ramp and verify FM waveforms as selected

Test Results	Pass		Fail	

3. Move 2572 marker position to 1.25MHz and verify marker position

Test Results	Pass		Fail	

4. Remove the cable from 2572 channel 1 and connect to channel 2
5. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Triggered FM - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2 ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:
   - Frequency 1kHz
   - Run Mode: Continuous
   - Waveform: Squarewave.
   - Amplitude: 2V
   - Offset: 1V
5. Connect the function generator output connector to the 2572 TRIG IN connector
6. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FM
   - Mod Run Mode: Triggered
   - Carrier Freq: 1MHz
   - Mod Frequency: 10kHz
   - Deviation: 500kHz
   - Sync: On
   - Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:
   Waveform: Triggered sine waves
   Sine Frequency: 10kHz
   Trigger Period: 1ms
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

FM Burst - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:
   Frequency 1kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: Adjust to TTL level on 50Ω
5. Connect the function generator output connector to the 2572 TRIG IN connector
6. Configure model 2572 controls on both channels as follows:
   Waveform: Modulated
   Modulation: FM
   Modulation Run Mode: Burst
   Burst: 5
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:
   Waveform: Burst of 5 Sine waveforms
   Sine Frequency: 10kHz

Burst Period: 1ms
Max A: 1.25MHz
Min A: 750kHz

Test Results	Pass		Fail	

Gated FM - Standard Waveforms

Equipment: Oscilloscope, function generator

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.2 ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure the function generator as follows:
   Frequency 1kHz
   Run Mode: Continuous
   Waveform: Squarewave.
   Amplitude: 2V
   Offset: 1V
5. Connect the function generator output connector to the 2572 TRIG IN connector
6. Configure model 2572 controls on both channels as follows:
   Waveform: Modulated
   Modulation: FM
   Mod Run Mode: Gated
   Carrier Freq: 1MHz
   Mod Frequency: 10kHz
   Deviation: 500kHz
   Sync: On
   Output: On

Test Procedure:

1. Verify triggered FM – standard waveforms operation on the oscilloscope as follows:
   Waveform: Gated sine waveforms
   Sine Frequency: 10kHz
   Gated Period: 1ms
   Max A: 1.25MHz
   Min A: 750kHz

Test Results	Pass		Fail	

Re-triggered FM Bursts - Standard Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FM
   - Modulation Run Mode: Burst
   - Burst Count: 5
   - Carrier Freq: 1MHz
   - Mod Frequency: 10kHz
   - Deviation: 500kHz
   - Sync: On
   - Re-trigger: On
   - Re-trigger Delay: 200µs
   - Output: On

Test Procedure:

1. Verify re-triggered FM burst – standard waveforms operation on the oscilloscope as follows:
   - Waveform: Repetitive burst of 5-cycle sine waveforms
   - Sine Frequency: 10kHz
   - Re-trigger delay: 200µs
   - Max A: 1.25MHz
   - Min A: 750kHz

Test Results	Pass		Fail	

FM - Arbitrary Waveforms

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FM
   - Mod Waveform: Arbitrary
   - Carrier Freq: 1MHz
   - FM SCLK: 2.5MS/s
   - Sync: On
   - Output: On
5. Using ArbConnection prepare, open the FM Composer and download the following waveform:
   - Wavelength: 4000 points
   - Waveform: 4 cycles sinewave
   - Deviation: 0.5MHz

Test Procedure:

1. Verify FM operation on the oscilloscope as follows:
   - Waveform: Sine
   - Frequency: 2.5kHz
   - Max A: 1.25MHz
   - Min A: 750kHz

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

AM

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.5 ms
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   Waveform: Modulated
   Modulation: AM
   Carrier Freq: 1MHz
   Mod Frequency: 1kHz
   Mod Depth: 50%
   Mod Wave Ch1 Sine
   Mod Wave Ch2 Triangle
   Sync: On
   Output: On

Test Procedure:

1. Verify AM operation on the oscilloscope as follows:
   Waveform: Amplitude modulated sine
   Mod depth: 50% ±5%

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2 but observe a triangle modulating wave form.

Test Results	Pass		Fail	

FSK

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div.
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: FSK
   - Carrier Freq: 2MHz
   - Shift Frequency: 4MHz
   - Baud Rate: 10kHz
   - Marker Index: 1
   - Sync: On
   - Output: On
5. Using ArbConnection, prepare and download 10-step FSK list with alternating “0” and “1”

Test Procedure:

1. Verify FSK operation on the oscilloscope as follows:
   - Waveform: Squarewave
   - Period: 0.2ms
   - Max Freq.: 4MHz
   - Min Freq.: 2MHz

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

PSK

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 50µs
   Amplitude: 1V/div.
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   Reset
   Waveform: Modulated
   Modulation: PSK
   Carrier Freq: 10kHz
   Shift Phase: 180 degrees
   Baud Rate: 10kHz
   Sync: On
   Output: On
5. Using ArbConnection, prepare and download 10-step PSK list with alternating “0” and “1”

Test Procedure:

1. Verify PSK operation on the oscilloscope as follows:
   Waveform: Sinewave
   Period: 0.1ms
   Phase: Every 0.1ms change 180 degrees

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Variable Dwell Time Frequency Hops

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.5ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: Hop
   - Hop Mode: Variable
   - Sync: On
   - Output: On
5. Using ArbConnection prepare, open the Hop Table composer and download the following table (both channels):

Frequency	Dwell Time
1.0e6	50e-6
1.2e6	100e-6
1.4e6	150e-6
1.6e6	200e-6
1.8e6	250e-6
2.0e6	300e-6
2.2e6	350e-6
2.4e6	400e-6
2.6e6	450e-6
2.8e6	500e-6

Test Procedure:

1. Verify Hop operation on the oscilloscope as follows:
   - Waveform: Frequency steps, increasing dwell time from 50µs to 500µs
   - Max A: 2.8MHz
   - Min A: 1.0MHz
   - Period: 2750µs

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Fix Dwell Time Frequency Hops

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: 0.5ms
   Sampling Rate: 50MS/s at least.
   Trace A View: Jitter, Type: FREQ, CLK.
   Trigger source: Channel 2, positive slope
   Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   Waveform: Modulated
   Modulation: Hop
   Hop Mode: Fix
   Dwell Time: 50µs
   Sync: On
   Output: On
5. Using ArbConnection prepare, open the Hop Table composer and download the following table (both channels):

   Frequency
   1.0e6
   1.2e6
   1.4e6
   1.6e6
   1.8e6
   2.0e6
   2.2e6
   2.4e6
   2.6e6
   2.8e6

Test Procedure:

1. Verify Hop operation on the oscilloscope as follows:
   Waveform: Frequency steps, fixed dwell time of 50µs
   Max A: 2.8MHz
   Min A: 1.0MHz
   Period: 500µs

Test Results	Pass		Fail	

2. Remove the cable from 2572 channel 1 and connect to channel 2
3. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Sweep

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   - Time Base: 0.2ms
   - Sampling Rate: 50MS/s at least.
   - Trace A View: Jitter, Type: FREQ, CLK.
   - Trigger source: Channel 2, positive slope
   - Amplitude: 1V/div
2. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
3. Connect the 2572 SYNC output to the oscilloscope input, channel 2
4. Configure model 2572 controls on both channels as follows:
   - Waveform: Modulated
   - Modulation: Sweep
   - Start Frequency: 1MHz
   - Stop Frequency: 2MHz
   - Sweep Time: 1ms
   - Sweep Type: Linear
   - Sync: On
   - Output: On

Test Procedure:

1. Verify Sweep operation on the oscilloscope as follows:
   - Waveform: Ramp up
   - Frequency: 1kHz
   - Max A: 2MHz
   - Min A: 1MHz

Test Results	Pass		Fail	

2. Move 2572 sweep marker position to 1.5MHz and verify marker position at the middle of the ramp

Test Results	Pass		Fail	

3. Reverse between Start and Stop frequencies and verify oscilloscope reading as before except the ramp is down

Test Results	Pass		Fail	

4. Change sweep step to logarithmic and verify oscilloscope exponential down waveform with properties as in 3 above

Test Results	Pass		Fail	

5. Remove the cable from 2572 channel 1 and connect to channel 2
6. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

Digital Pattern Generator Characteristics

This tests the operation of the digital pattern generator and the output connector on the rear panel. The output is associated with channel 1. This test requires connection of a special test board to the rear panel connector. This board is available at specific service centers around the world and is not available for individuals. Therefore, if you suspect that there are problems with the digital pattern output, contact your nearest service center for details how to obtain access to the test board.

Digital Patterns

Equipment: Oscilloscope, Digital pattern test board, Dual DC power supply

Preparation:
1. Turn power OFF
2. Connect +3.3V to the test board
3. Chook up the test board on the digital output connector
4. Turn power ON
5. Turn power supply power ON

WARNING

Do not attempt to connect the test board to the 2572 connector while power is ON as this may result in permanent damage to the 2572. Always turn power OFF before connecting or disconnecting the test board to the 2572.

6. Connect 2572 Channel 1 output to the oscilloscope input, channel 1
7. Configure model 2572 channel 1 controls as follows:
   Waveform: Digital
   Pattern Rate: 2pps
8. Using ArbConnection prepare, open the Digital Pattern Stimulation List Table and download the following table:

Index	Stimulation List (Hex)
1	1
2	2
3	4
4	8
5	10
6	20
7	40
8	80
9	100
10	200
11	400
12	800
13	1600
14	3200
15	6400
16	12800

Test Procedure:

1. Watch the LED's on the test board. The 16 MSD LED's light in sequence. Each LED lights for about 0.25 second
2. Set up the oscilloscope and check the output levels. Verify output levels are LVDS

Test Results	Pass		Fail	

3. Turn power off and remove the cable from the 2572

SYNC Output operation

This tests the operation of the SYNC output. There are two parameters being tested, the qualifier and the sync source. The sync output has a fixed TTL level amplitude into an open circuit.

SYNC Qualifier - Bit

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
2. Connect 2572 SYNC output to the oscilloscope input
3. Configure model 2572 as follows:
   Ch1 Waveform: Sine
   Ch1 Output: On
   SYNC: On

Test Procedure:

1. Verify trace on the oscilloscope shows synchronization pulses at 1μs intervals

Test Results	Pass		Fail	

SYNC Qualifier - LCOM

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
2. Connect the 2572 CH1 output to the oscilloscope input (1)
3. Connect the 2572 SYNC output to the oscilloscope input (2)
4. Configure model 2572 channel as follows:
   Waveform: Sine
   Run Mode: Burst
   Burst Count: 10
   Re-trigger On
   Re-trig period: 10μs
   Output: On

Test Procedure:

1. Manually trigger the 2572
2. Verify trace on the oscilloscope shows synchronization pulse having 9μs pulse width. Verify the SYNC is high for the duration of the burst.

Test Results	Pass		Fail	

SYNC Source

Equipment: Oscilloscope

Preparation:

1. Configure the oscilloscope as follows:
   Time Base: As required by the test
   Amplitude: 2V/div
   Trigger Source: Channel 1
2. Connect 2572 SYNC output to the oscilloscope input, channel 1
3. Connect 2572 CH1 output to the oscilloscope input, channel 2
4. Connect 2572 CH2 output to the oscilloscope input, channel 3
5. Configure model 2572 channel 1 and 2 controls as follows:
   Function: Arbitrary
   Output: On
   SYNC: On
6. Using ArbConnection prepare and download the following waveform:
   Ch1: 64 points sine waveform
   Ch2: 100 points sine waveform

Test Procedure:

1. Verify that the trace on the oscilloscope is synchronized with the 2572 channel 1 waveform

Test Results	Pass		Fail	

2. Modify the 2572 SYNC Source from channel 1 to channel 2
3. Verify that the trace on the oscilloscope is synchronized with the 2572 channel 2 waveform

Test Results	Pass		Fail	

Waveform Memory Operation

This tests the integrity of the waveform memory. The waveform memory stores the waveforms that are being generated at the output connector and therefore, flaws in the memory can cause distortions and impurity of the output waveforms. Each channel has its own working memory and therefore each channel is tested separately.

Waveform memory

Equipment: Distortion Analyzer, ArbConnection

Preparation:

1. Connect 2572 Channel 1/2 output to the distortion analyzer input. Configure the 2572 as follows:
   SCLK: As required by the test
   Waveform: Arbitrary
   Amplitude: 5V
   Output: On
2. Using ArbConnection prepare and download the following waveform:
   Wavelength: 1M points (2M with an option installed)
   Waveform: Sine wave
   SCLK 250MHz

Test Procedure

1. Perform Sine wave distortion. It should be less than 0.1%

Test Results	Pass		Fail	

Chapter 7
Adjustments and Firmware Update

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What's in This Chapter

This chapter provides adjustment information for the 2572 dual channel waveform generator. The same procedures are used for the Model 2571 except all references to the second channel should be ignored.

WARNING

The procedures described in this section are for use only by qualified service personnel. Many of the steps covered in this section may expose the individual to potentially lethal voltages that could result in personal injury or death if normal safety precautions are not observed.

CAUTION

ALWAYS PERFORM DISASSEMBLY, REPAIR AND CLEANING AT A STATIC SAFE WORKSTATION.

Performance Checks

Do not attempt to calibrate the instrument before you verify that there is no problem with the functionality of the product. A complete set of specification is listed in Appendix A. If the instrument fails to perform within the specified limits, the instrument must be tested to find the source of the problem.

In case there is a reasonable suspicion that an electrical problem exist within the 2572, perform a complete performance checks as given in Chapter 6 to verify proper operation of the instrument.

Environmental Conditions

The 2572 can operate from 0°C to 50°C. Adjustments should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. Turn on the power to the 2572 and allow it to warm up for at least 30 minutes before beginning the adjustment procedure. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Warm-up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model 2572 and allow it to warm-up for at least 30 minutes before beginning the performance test procedure.

Recommended Test Equipment

Recommended equipment for adjustments is listed in Table 6-1. Instruments other than those listed may be used only if their specifications equal or exceed the required minimal characteristics. Also listed below are accessories required for calibration.

Table 7-1, Recommended calibration for Adjustments

Equipment	Model No.	Manufacturer
Oscilloscope (with jitter package)	LC684	LeCroy
Digital Multimeter	2000	Keithley
Frequency Counter (Rubidium reference)	6020R	Tabor Electronics
Function Generator (with manual trigger)	8020	Tabor Electronics
Accessories	BNC to BNC cables	
	50Ω Feedthrough termination	
	Dual banana to BNC adapter	

Adjustment Procedures

Use the following procedures to calibrate the Model 2572. The following paragraphs show how to set up the instrument for calibration and what the acceptable calibration limits are.

Calibration is done with the covers closed and the 2572 connected through an interface to a host computer. Any interface can be used from the following: USB, LAN, or GPIB. Calibration requires that ArbConnection utility be installed and interfaced to the instrument.

Calibration is performed from the Calibration Panel in ArbConnection. To invoke this panel, one requires a password that is available to service centers only. Contact your nearest Tabor service center for information and permit to obtain your calibration password. Use the following procedure to calibrate the generator:

1. Invoke ArbConnection
2. Click on the UTIL icon on the Panels bar
3. On the Utility Panel click on Calibration and expect to be prompted with the following dialog box

Figure 7-1, Calibration Password

4. Type your User Name Password and click on OK. The Calibration Panel as shown in Figure 2 will appear.

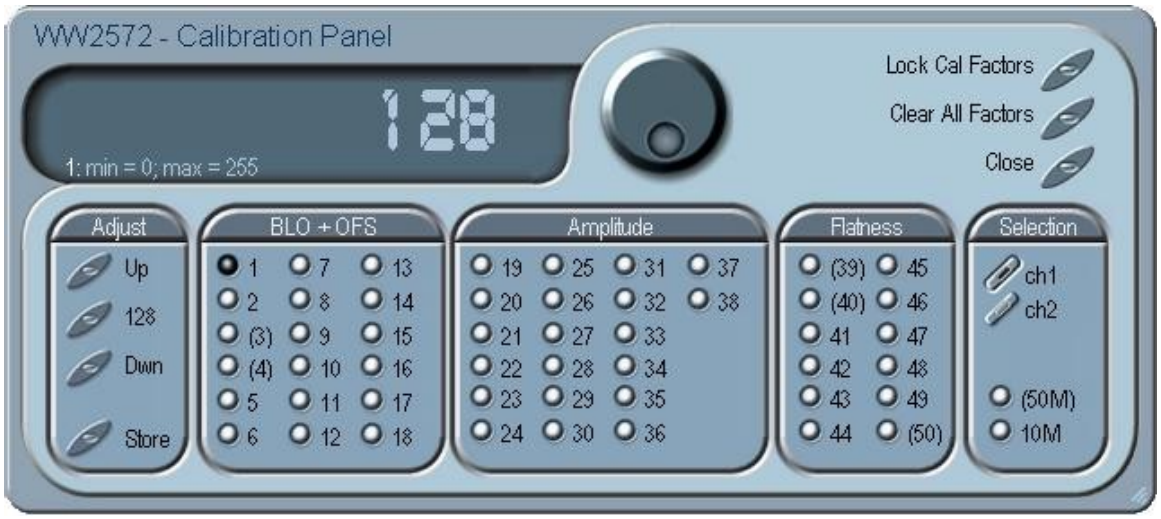

Figure 7-2, Calibration Panel

NOTE

Initial factory adjustments require that the covers be removed from the instrument. Field calibration does not require re-adjustments of these factory settings unless the unit was repaired in an authorized service center. Factory adjustments are enclosed in parentheses to differentiate from normal field calibration setups; bypass these adjustments when performing field calibration.

Calibrations are marked with numbers from 1 to 50 and, except the (50M) and 10M adjustments in the Selection group, should be carried out exactly in the order as numbered on the panel. There are separate adjustments for Channel 1 and Channel 2 so make sure that the output cables are connected to the appropriate channel during the adjustments.

The numbers that are associated with each adjustment are identified as Setup Number at the title of each of the adjustments in the following procedure.

Remote adjustments have the range of 1 through 256 with the center alignment set to 128. Therefore, if you are not sure of the direction, set the adjustment to 128 and add or subtract from this value. If you have reached 1 or 256 and were not able to calibrate the range, there is either a problem with the way you measure the parameter or possibly there is a problem with the instrument. In either case, do not leave any adjustment in its extreme setting but center the adjustment and contact your nearest service center for clarifications and support.

Note in the following procedures that although configuration of the 2572 is done automatically, some of the configuration is shown for reference. There is no requirement to change configuration of the 2572 during the remote adjustment procedure except in places where specifically noted.

Reference Oscillators Adjustments

Use this procedure to adjust the reference oscillators. The reference oscillators determine the accuracy of the output frequency so if you suspect that there is an accuracy issue, proceed with the calibration of the reference oscillators

(Setup 50M)

50MHz Gated Oscillator Adjustment

Equipment: Counter, Function Generator, BNC to BNC cables,

Preparation:

1. Configure the counter as follows:
   - Termination: 50Ω DC
   - Function: TI A -> B
   - Slope B: Negative
2. Connect the 2572 Channel 1 output to the oscilloscope input
3. Connect an external function generator to the rear panel TRIG IN connector
4. Using ArbConnection prepare and download the following waveform:
   - Wavelength: 100 points
   - Waveform: Pulse: Delay = 0.01%, Rise/Fall Time = 0%, High Time = 99.99%
5. Configure the 2572 as follows:
   - Function Mode: Arbitrary
   - Run Mode: Triggered
   - Retrigger Mode: On
   - Retrigger Delay: 20μs
6. Using an external function generator, manually trigger the 2572

Adjustment:

1. Adjust C18 for a period of 20μs, ±5%

Setup 10M

10MHz TCXO Frequency

Equipment: Counter, BNC to BNC cables

Preparation:

1. Configure the counter as follows:
   - Function: Freq A
   - Termination: 50Ω
2. Connect the 2572 Channel 1 output to the counter input.
3. Configure the 2572 as follows:
   - Frequency: 10MHz
   - Ch1 Output: On
   - Ch1 Amplitude 2V
   - Wave: Square

Adjustment:

4. Adjust CAL:SETUP57 for counter reading of 10MHz, ±2Hz

Channel 1 Adjustments

The following procedures pertain to the channel 1 output only. Therefore, make sure that your connections are made to the channel 1 connectors.

Base Line Offset Adjustments

The base line offset adjustments assure that the AC signal is symmetrical around the 0V line. Use this procedure if you suspect that there is a base line accuracy issue.

Setup 1

Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feedthrough termination
3. Configure the 2572 as follows:
   CAL:SERV 1

Adjustment:

4. Adjust CAL:SETUP1 for DMM reading of 0V, ±20mV

Setup 2

Pre-Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CAL:SERV 2

Adjustment

4. Adjust CAL:SETUP2 for DMM reading of 0V, ±5mV

(Setup 3)

Base Line Offset, Low Range, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch1 Amplitude: 510mV

Adjustment

4. Note DMM reading

(Setup 4)

Base Line Offset, High Range, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch1 Amplitude: 1.590V

Adjustment

4. Adjust CAL: SETUP 6 for DMM reading the same as Setup 3
5. Repeat Setup 3 and Setup 4 until the DMM readings are the same +/-10mV.
6. Adjust RV1 for DMM readings of 0V+/-10mV.

Setup 5

Base Line Offset, Amplifier In – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function: DCV
Range: 100mV

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 6V

Adjustment

4. Adjust CAL:SETUP 5 for DMM reading of 0V, ±20mV

Setup 6

Base Line Offset, Amplifier Out – Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation**:**

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude: 1V

Adjustment:

4. Adjust CAL:SETUP 6 for DMM reading of 0V, ±5mV

Setup 7

Base Line Offset, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Output: On
   Ch1 Amplitude: 6V

Adjustment:

4. Adjust CAL:SETUP 7 for DMM reading of 0V, ±20mV

Setup 8

Base Line Offset, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Output: On
   Ch1 Amplitude: 1V

Adjustment:

4. Adjust CAL: SETUP 8 for DMM reading of 0V, ±5mV

Offset Adjustments

The offset adjustments assure that the DC offsets are within the specified range. Use this procedure if you suspect that the offset accuracy is an issue.

Setup 9

Offset (+1V) Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset +1V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 61 for DMM reading of +1V, ± 5mV

Setup 10

Offset (+3V) Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 2V
   Ch1 Offset +3V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 60 for DMM reading of +3V, ± 15mV

Setup 11

+5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset +5V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 59 for DMM reading of +5V, ± 25mV

Setup 12

+7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:

Ch1 Amplitude:	20mV
Ch1 Offset	+7V
Ch1 Output:	On

Adjustment:

4. CAL: SETUP 58 for DMM reading of +7V, ± 35mV;

Setup 13

-1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	DCV
Range:	1 V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:

Ch1 Amplitude:	2V
Ch1 Offset	-1V
Ch1 Output:	On

Adjustment:

4. CAL: SETUP 62 for DMM reading of -1V, ± 5mV

Setup 14

-3V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	DCV
Range:	10 V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:

Ch1 Amplitude:	2V
Ch1 Offset	-3V
Ch1 Output:	On

Adjustment:

4. CAL: SETUP 63 for DMM reading of -3V, ± 15mV

Setup 15

-5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -5V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 64 for DMM reading of -5V, ± 25mV

Setup 16

-7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -7V
   Ch1 Output: On

Adjustment:

4. CAL: SETUP 65 for DMM reading of -7V, ± 35mV

Setup 17

(+) Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate

the 2572 output at the DMM input with the 50Ω Feed through termination

3. Configure the 2572 as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset +1V
   Ch1 Output: On

Adjustment:

4. CAL:SETUP14 for DMM reading of +1V, ±5mV; Note reading

Setup 18

(-) Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch1 Amplitude: 20mV
   Ch1 Offset -1V
   Ch1 Output: On

Adjustment:

4. CAL:SETUP14 for DMM reading of -1V, ±5mV; note reading
5. Repeat steps Setup 17 and Setup 18 until errors are balanced between the steps

Amplitude Adjustments

The amplitude adjustments assure that the AC levels are within the specified range. Use this procedure if you suspect that the amplitude accuracy is an issue.

Setup 19

10V Amplitude - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination

3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP17 for DMM reading of 3.535V ±30mV

Setup 20

3V Amplitude - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP18 for DMM reading of 1.0606V ±7mV

Setup 21

1V Amplitude, Output Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 5

Adjustment:

4. Adjust CAL:SETUP19 for DMM reading of 353.5mV ±3mV

Setup 22

500mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination,

Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 6

Adjustment:

4. Adjust CAL:SETUP20 for DMM reading of 176.7mV ±1.5mV

Setup 23

100mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   CAL:SERV 7

Adjustment:

4. Adjust CAL:SETUP21for DMM reading of 35,35mV ±0.3mV

Setup 24

50mV Amplitude, Amplifier In – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Frequency: 1kHz
Ch1 Output: On
CAL:SERV 8

Adjustment:

4. Adjust CAL:SETUP22 for DMM reading of 17,67mV ±0.15mV

Setup 25

1V Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP23 for DMM reading of 353.5mV ±3mV

Setup 26

500mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP24 for DMM reading of 176.7mV ±1.5mV

Setup 27

100mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination,

Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP25 for DMM reading of 35,35mV ±0.3mV

Setup 28

50mV Amplitude, Output Amplifier Out – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch1 Output: On
   Ch1 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP26 for DMM reading of 17,67mV ±0.15mV

Setup 29

10V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
Ch1 Amplitude:	10V

Adjustment:

4. Adjust CAL:SETUP27 for DMM reading of 3.535V ±30mV

Setup 30

3V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	1V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
Ch1 Amplitude:	3V

Adjustment:

4. Adjust CAL:SETUP28 for DMM reading of 1.0606 ±7mV

Setup 31

1V Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	1V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch1 Output:	On
CAL: SERV	5

Adjustment:

4. Adjust CAL:SETUP29 for DMM reading of 353.5mV ±3mV

Setup 32

500mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   CAL:SERV 6

Adjustment:

4. Adjust CAL:SETUP30 for DMM reading of 176.7mV ±1.5mV

Setup 33

100mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   CAL:SERV 7

Adjustment:

4. Adjust CAL:SETUP31for DMM reading of 35,35mV ±0.3mV

Setup 34

50mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function: ACV
Range: 100mV

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   CAL: SERV 8

Adjustment:

4. Adjust CAL:SETUP32 for DMM reading of 17,67mV ±0.15mV

Setup 35

1V Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP33 for DMM reading of 353.5mV ±3mV

Setup 36

500mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On

Ch1 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP34 for DMM reading of 176.7mV ±1.5mV

Setup 37

100mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP35 for DMM reading of 35,35mV ±0.3mV

Setup 38

50mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch1 Output: On
   Ch1 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP36 for DMM reading of 17,67mV ±0.15mV

Pulse Response Adjustments

The pulse response adjustments assure that the rise and fall times, as well as, the aberrations are within the specified range. Use this procedure if you suspect that the pulse response is an issue.

(Setup 39)

Pulse Response, Amplifier Out

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Square
   Amplitude: 1.5V
2. Connect the 2572 Channel 1 output to the oscilloscope input. Set oscilloscope input impedance to 50Ω
3. Set oscilloscope vertical sensitivity to 20mV

Adjustment:

4. Adjust vertical trace to 6 divisions
5. Adjust RV3 for best pulse response (4ns type, 5% aberrations)

(Setup 40)

Pulse Response, Amplifier In

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Square
   Amplitude: 6V
2. Connect the 2572 Channel 1 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 0.1V

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust C1036 for best pulse response (4ns type, 5% aberrations)

Flatness Adjustments

The flatness adjustments assure that the flatness of the amplifier is within the specified range. Use this procedure if you suspect that the flatness is an issue.

Setup 41

1MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1MHz
   Ch1 Output: On

Adjustment:

4. Adjust the Fine Amplitude of the Oscilloscope to get the signal of 6 divisions on the screen.

Setup 42

10MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 10MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP74 to get the signal of 6 divisions on the screen.

Setup 43

20MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination

3. Configure the 2572 as follows:
   Frequency: 20MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP75 to get the signal of 6 divisions on the screen.

Setup 44

30MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 30MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP76 to get the signal of 6 divisions on the screen.

Setup 45

37.3333333MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 37.3333333MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP77 to get the signal of 6 divisions on the screen.

Setup 46

56MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 56MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP78 to get the signal of 6 divisions on the screen.

Setup 47

56.0000001MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 56.0000001MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP79 to get the signal of 6 divisions on the screen.

Setup 48

80MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 80MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP80 to get the signal of 6 divisions on the screen.

Setup 49

100MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 1 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 100MHz
   Ch1 Output: On

Adjustment:

4. Adjust CAL:SETUP81 to get the signal of 6 divisions on the screen.

(Setup 50)

Frequency Flatness – Modulation

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Modulation ON
   Modulation: Sweep
   Start Freq: 1MHz
   Stop Freq: 100MHz
   Sweep Time: 1ms
   Marker: 1MHz
   Amplitude: 6V
2. Connect the 2572 Channel 1 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 0.1V

Adjustment:

5. Adjust C1016 for the best flatness.

Channel 2 Adjustments

The following procedures pertain to the channel 2 output only. Therefore, make sure that your connections are made to the channel 1 connectors.

Base Line Offset Adjustments

The base line offset adjustments assure that the AC signal is symmetrical around the 0V line. Use this procedure if you suspect that there is a base line accuracy issue.

Setup 1

Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CAL:SERV 3

Adjustment:

4. Adjust CAL:SETUP 3 for DMM reading of 0V, ±20mV

Setup 2

Pre-Amplifier Offset

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CAL:SERV 4

Adjustment:

4. Adjust CAL:SETUP4 for DMM reading of 0V, ±5mV

(Setup 3)

Base Line Offset, Low Range, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch2 Amplitude: 510mV

Adjustment:

Note DMM reading

(Setup 4)

Base Line Offset, High Range, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Mode: Modulation
   Ch2 Amplitude: 1.590V

Adjustment:

4. Adjust CAL: SETUP 12 for DMM reading the same as in Setup 3
5. Repeat Setup 3 and Setup 4 until the DMM readings are the same +/-10mV.
6. Adjust RV2 for DMM readings of 0V+/-10mV.

Setup 5

Base Line Offset, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Mode:	Modulation
Ch2 Output:	On
Ch2 Amplitude:	6V

Adjustment:

4. Adjust CAL:SETUP 11 for DMM reading of 0V, ±20mV

Setup 6

Base Line Offset, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	DCV
Range:	100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Ch2 Output:	On
Mode:	Modulation
Ch2 Amplitude:	1V

Adjustment:

4. Adjust CAL:SETUP 12 for DMM reading of 0V, ±5mV

Setup 7

Base Line Offset, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	DCV
Range:	100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Ch2 Output:	On
Ch2 Amplitude:	6V

Adjustment:

4. Adjust CAL:SETUP 9 for DMM reading of 0V, ±20mV

Setup 8

Base Line Offset, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Output: On
   Ch2 Amplitude: 1V

Adjustment:

4. Adjust CAL:SETUP 10 for DMM reading of 0V, ±5mV

Offset Adjustments

The offset adjustments assure that the DC offsets are within the specified range. Use this procedure if you suspect that the offset accuracy is an issue.

Setup 9

+1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset +1V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 69 for DMM reading of +1V, ± 5mV

Setup 10

+3V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function: DCV
Range: 10 V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset +3V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 68 for DMM reading of +3V, ± 15mV

Setup 11

+5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset +5V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 67for DMM reading of +5V, ± 25mV

Setup 12

+7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset +7V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 66 for DMM reading of +7V, ± 35mV

Setup 13

-1V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feedthrough termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 1 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset -1V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 70 for DMM reading of -1V, ± 5mV

Setup 14

-3VOffset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 2V
   Ch2 Offset -3V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 71for DMM reading of -3V, ± 15mV

Setup 15

-5V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV

Range: 10 V

2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset -5V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 72 for DMM reading of -5V, ± 25mV

Setup 16

-7V Offset Output Amplifier In

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10 V
2. Connect the 2572 Channel 1 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2 Offset -7V
   Ch2 Output: On

Adjustment:

4. CAL: SETUP 73for DMM reading of -7V, ± 35mV

Setup 17

(+)Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2Offset +1V
   Ch2 Output: On

Adjustment:

4. CAL:SETUP16 for DMM reading of +1V, ±5mV; Note reading

Setup 18

(-)Offset, Output Amplifier Out

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: DCV
   Range: 10V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the 50Ω Feed through termination
3. Configure the 2572 as follows:
   Ch2 Amplitude: 20mV
   Ch2Offset -1V
   Ch2 Output: On

Adjustment:

4. CAL:SETUP16 for DMM reading of -1V, ±5mV; note reading
5. Repeat Setup 17 and Setup 18 until errors are balanced between the steps

Amplitude Adjustments

The amplitude adjustments assure that the AC levels are within the specified range. Use this procedure if you suspect that the amplitude accuracy is an issue.

Setup 19

10V Amplitude – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 10V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude: 10V

Adjustment:

4. Adjust CAL:SETUP37 for DMM reading of 3.535V ±30mV

Setup 20

3V Amplitude – Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 3 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP38 for DMM reading of 1.0606V ±7mV

Setup 21

1V Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch2 Output: On
   CAL:SERV 9

Adjustment:

4. Adjust CAL:SETUP39 for DMM reading of 353.5mV ±3mV

Setup 22

500mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate

the 2572 output at the DMM input with the, 50Ω Feed through termination

3. Configure the 2572 as follows:

Frequency:	1kHz
Ch2 Output:	On
CAL:SERV	10

Adjustment:

4. Adjust CAL:SETUP40 for DMM reading of 176.7mV ±1.5mV

Setup 23

100mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Frequency:	1kHz
Ch2 Output:	On
CAL:SERV	11

Adjustment:

4. Adjust CAL:SETUP41for DMM reading of 35,35mV ±0.3mV

Setup 24

50mV Amplitude, Amplifier In - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Frequency:	1kHz
Ch2 Output:	On
CAL:SERV	12

Adjustment:

4. Adjust CAL:SETUP42 for DMM reading of 17,67mV ±0.15mV

Setup 25

1V Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP43 for DMM reading of 353.5mV ±3mV

Setup 26

500mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   Frequency: 1kHz
   Ch2 Output: On
   Ch2 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP44 for DMM reading of 176.7mV ±1.5mV

Setup 27

100mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate

the 2572 output at the DMM input with the, 50Ω Feed through termination

3. Configure the 2572 as follows:

Frequency:	1kHz
Ch2 Output:	On
Ch2 Amplitude	100mV

Adjustment:

4. Adjust CAL:SETUP45 for DMM reading of 35,35mV ±0.3mV

Setup 28

50mV Amplitude, Amplifier Out - Arbitrary

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	100mV

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

Frequency:	1kHz
Ch2 Output:	On
Ch2 Amplitude	50mV

Adjustment:

4. Adjust CAL:SETUP46 for DMM reading of 17,67mV ±0.15mV

Setup 29

10V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:

Function:	ACV
Range:	10V

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:

CW Frequency:	1kHz
Mode:	Modulation
Ch2 Output:	On
Ch2 Amplitude:	10V

Adjustment:

4. Adjust CAL:SETUP47 for DMM reading of 3.535V ±30mV

Setup 30

3V Amplitude - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude: 3V

Adjustment:

4. Adjust CAL:SETUP48 for DMM reading of 1.0606V±7mV

Setup 31

1V Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   CAL:SERV 9

Adjustment:

4. Adjust CAL: SETUP49 for DMM reading of 353.5mV ±3mV

Setup 32

500mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV

Range: 1V

2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   CAL:SERV 10

Adjustment:

4. Adjust CAL: SETUP50 for DMM reading of 176.7mV ±1.5mV

Setup 33

100mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   CAL:SERV 11

Adjustment:

4. Adjust CAL:SETUP51 for DMM reading of 35,35mV ±0.3mV

Setup 34

50mV Amplitude, Amplifier In - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   CAL:SERV 12

Adjustment:

4. Adjust CAL:SETUP52 for DMM reading of 17,67mV ±0.15mV

Setup 35

1V Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: ACV
   - Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   - CW Frequency: 1kHz
   - Mode: Modulation
   - Ch2 Output: On
   - Ch2 Amplitude 1V

Adjustment:

4. Adjust CAL:SETUP53 for DMM reading of 353.5mV ±3mV

Setup 36

500mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   - Function: ACV
   - Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   - CW Frequency: 1kHz
   - Mode: Modulation
   - Ch2 Output: On
   - Ch2 Amplitude 500mV

Adjustment:

4. Adjust CAL:SETUP54 for DMM reading of 176.7mV ±1.5mV

Setup 37

100mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 1V
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude 100mV

Adjustment:

4. Adjust CAL:SETUP55 for DMM reading of 35,35mV ±0.3mV

Setup 38

50mV Amplitude, Amplifier Out - Modulation

Equipment: DMM, BNC to BNC cable, 50Ω Feed through termination, Dual banana to BNC adapter

Preparation:

1. Configure the DMM as follows:
   Function: ACV
   Range: 100mV
2. Connect the 2572 Channel 2 output to the DMM input. Terminate the 2572 output at the DMM input with the, 50Ω Feed through termination
3. Configure the 2572 as follows:
   CW Frequency: 1kHz
   Mode: Modulation
   Ch2 Output: On
   Ch2 Amplitude 50mV

Adjustment:

4. Adjust CAL:SETUP56 for DMM reading of 17,67mV ±0.15mV

Pulse Response Adjustments

The pulse response adjustments assure that the rise and fall times, as well as, the aberrations are within the specified range. Use this procedure if you suspect that the pulse response is an issue.

(Setup 39)

Pulse Response, Amplifier Out

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Square
   Amplitude: 1.5V
2. Connect the 2572 Channel 2 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 20mV

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust RV4 for best pulse response (4ns type, 5% aberrations)

(Setup 40)

Pulse Response, Amplifier In

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Square
   Amplitude: 6V
2. Connect the 2572 Channel 2 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 0.1V

Adjustment:

5. Adjust vertical trace to 6 divisions
6. Adjust C1073 for best pulse response (4ns type, 5% aberrations)

Flatness Adjustments

The flatness adjustments assure that the flatness of the amplifier is within the specified range. Use this procedure if you suspect that the flatness is an issue.

Setup 41

1MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2 output to the Oscilloscope input.

Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination

3. Configure the 2572 as follows:

Frequency:	1MHz
Ch2 Output:	On

Adjustment:

4. Adjust the Fine Amplitude of the Oscilloscope to get the signal of 6 divisions on the screen.

Setup 42

10MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:

Input Impedance:	50 ohms
Range:	100mV

2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:

Frequency:	10MHz
Ch2 Output:	On

Adjustment:

4. Adjust CAL:SETUP82 to get the signal of 6 divisions on the screen.

Setup 43

20MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:

Input Impedance:	50 ohms
Range:	100mV

2. Connect the 2572 Channel 2output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:

Frequency:	20MHz
Ch2 Output:	On

Adjustment:

4. Adjust CAL:SETUP 83 to get the signal of 6 divisions on the screen.

Setup 44

30MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 30MHz
   Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP 84 to get the signal of 6 divisions on the screen.

Setup 45

37.3333333MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 37.3333333MHz
   Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP 85 to get the signal of 6 divisions on the screen.

Setup 46

56MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 56MHz

Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP 86 to get the signal of 6 divisions on the screen.

Setup 47

56.0000001MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 56.0000001MHz
   Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP 87 to get the signal of 6 divisions on the screen.

Setup 48

80MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms
   Range: 100mV
2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 80MHz
   Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP88 to get the signal of 6 divisions on the screen.

Setup 49

100MHz Amplitude

Equipment: 50Ω, 20dB Feed through termination, Oscilloscope

Preparation:

1. Configure the Oscilloscope as follows:
   Input Impedance: 50 ohms

Range: 100mV

2. Connect the 2572 Channel 2 output to the Oscilloscope input. Terminate the 2572 output at the Oscilloscope input with the, 50Ω, 20dB Feed through termination
3. Configure the 2572 as follows:
   Frequency: 100MHz
   Ch2 Output: On

Adjustment:

4. Adjust CAL:SETUP89 to get the signal of 6 divisions on the screen.

(Setup 50)

Carrier Flatness – Modulation

Equipment: Oscilloscope, BNC to BNC cable, 20dB Feedthrough attenuator

Preparation:

1. Configure the 2572 as follows:
   Function: Modulation ON
   Modulation: Sweep
   Start Freq: 1MHz
   Stop Freq: 100MHz
   Sweep Time: 1ms
   Marker: 1MHz
   Amplitude: 6V
2. Connect the 2572 Channel 2 output to the oscilloscope input. Use 20dB Feedthrough attenuator at the oscilloscope input
3. Set oscilloscope input impedance to 50Ω
4. Set oscilloscope vertical sensitivity to 0.1V

Adjustment:

5. Adjust C1061for the best flatness.

Updating 2572 Firmware

WARNING

Only qualified persons may perform Firmware updates. DO NOT even attempt to perform this operation unless you were trained and certified by Tabor as you may inflict damage on the instrument. Always verify with the factory that you have the latest firmware file before you start with your update.

Before you update the firmware of your 2572, check the revision level which is installed in your instrument. Each firmware update was done for a reason and therefore, if you want to update the firmware for a problem in your system, check the readme file that is associated with the update to see if an update will solve your problem. The revision level of your firmware can be displayed as shown in Figure 7-3. To access this screen, select the TOP menu, then select the Utility soft key and scroll down to the System option. Press Enter and the screen will show with the system information. Check both the Software Version and the Version Date as both should match with the latest release.

Figure 7-3, Software Version Screen

NOTE

Firmware updates are performed with the LAN set as the active interface and with the 2572 communicating with the PC through the network.

To update the 2572 firmware, you will have to run the **NETConfig** utility. If you do not have this utility installed on your computer, run the installation procedure from the enclosed CD. You will not be able to update firmware without the NETConfig utility. To invoke this utility, complete the following steps:

1. Turn power **OFF** on your 2572
2. Click on NETConfig shortcut on the desktop or select Start »Programs» Tabor Electronics» NETConfig» NETConfig 1.0

The NETConfig window lists Tabor devices found on your subnet. Figure 7-4 shows an example of this display.

3. Click on the “Use wait message” to select this option as shown in Figure 7-4.

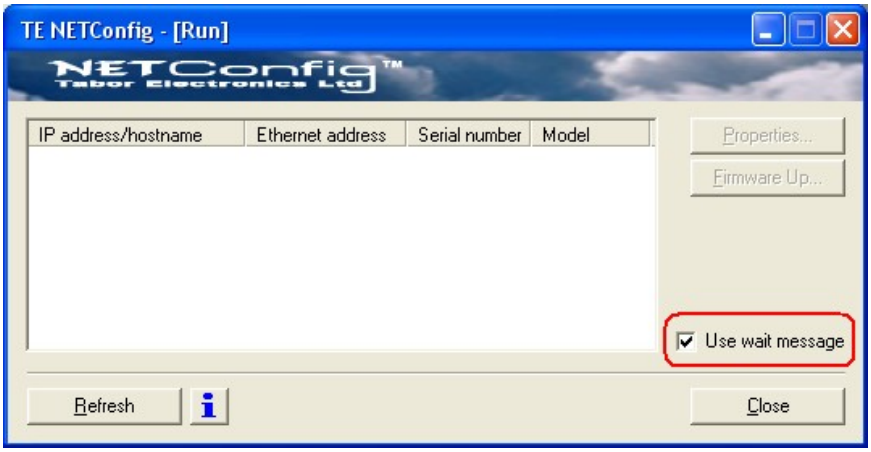

Figure 7-4, The NETConfig Utility

4. Turn power **ON** on your 2572 and observe that the progress bar, as shown in Figure 7-5, is advancing from left to right. Do not do anything on the 2572 until the progress bar completes its travel to the right end.

Tips

If the progress bar is not moving check the following for possible problems:

1. If you are connecting to a LAN network, make sure your

device is connected with standard LAN wire to your wall plug

2. If you use direct connection from your PC to the 2572, your cable should be cross wired. You can get such cable from any computer store near your area

3. If your network is using a managed switch, it is possible that it is configure to break the package with broadcast address and therefore, the only way to use NetConfig is to connect the instrument directly to the PC with a cross wired cable

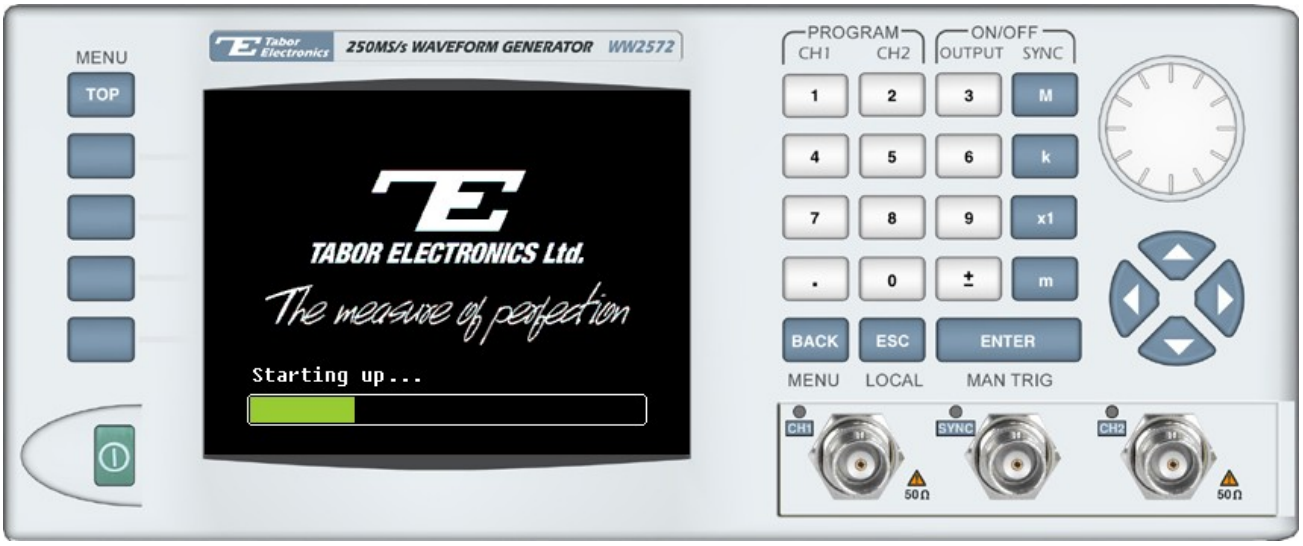

Figure 7-5, Check for Progress Bar Movement

5. As soon as the progress bar reached the far right hand of the bar, click on the Refresh button. If your device was connected and booted correctly, the device address will appear in the device list, as shown in Figure 7-6.

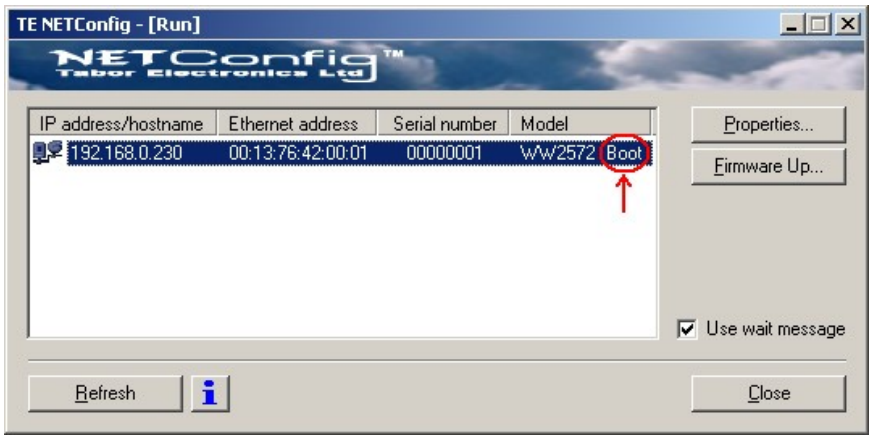

Figure 7-6, WW2572 has been Detected on the LAN Network

NOTES

Click Refresh again if you do not see your device in the list of Ethernet devices. If you cannot detect your device after a few attempts check that you have not lost the connection as described in previous paragraphs.

You can only update instrument(s) that appear in the NETConfig window.

Point and click on the device you want to update. The selected device will now have blue background. Click on the Firmware Up... button. The firmware Update dialog box as shown in Figure 6-7 appears.

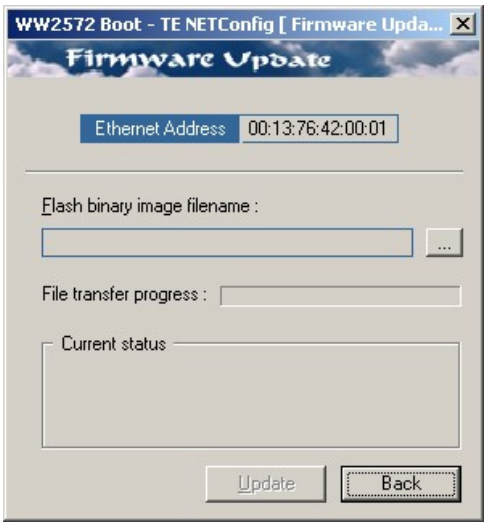

Figure 7-7, The Firmware Update Dialog Box

In the TE NETConfig [Firmware Update] dialog box click on the button to browse and locate the upgrade file. After you select the file its complete path will be displayed in the Flash binary image filename field as shown in Figure 7-8. Make sure the file in the path agrees with that specified by your supervisor. To complete the update process, click on Update and observe the File Transfer Progress bar. The update will complete with a Firmware Update d Successfully message, as shown in Figure 7-9.

Click on Back to close NETConfig Firmware Update dialog box and turn off the power to the 2572. The next time you power up the instrument, the device automatically reboots with the new firmware in effect.

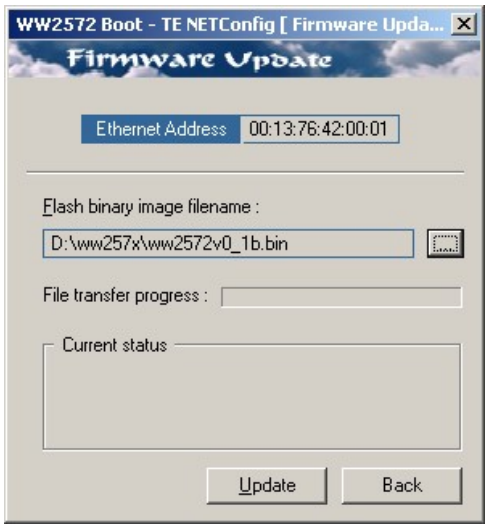

Figure 7-8, Firmware Update Path

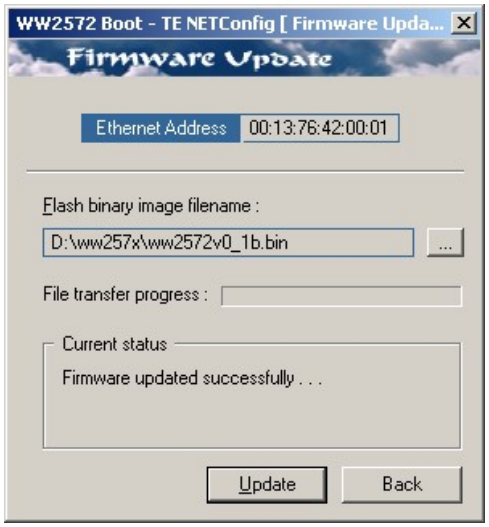

Figure 7-9, Firmware Update Completed

Appendices

Appendix	Title	Page
A	Specifications	A-1

Appendix A
Specifications

Configuration

Output Channels	2, semi-independent

Inter-Channel Dependency

Separate controls	Output on/off, amplitude, offset, filters, standard waveforms, user waveforms and size, sequence table
Common Controls	Sample clock, frequency, reference source, run modes modes, Modulation and SYNC output

Leading Edge Offset

Description	Channel 1 waveform start trails channel 2 waveform start by a programmable number of points.
Offset Units	Waveform points
Range	0 to 2M points limited by the wave number of points minus 8.
Resolution and Accuracy	1 point
Skew Between Channels	Less than 1ns (50Ω cables, equal length)

Multiple Instruments Synchronization

Description	Multiple instruments can be connected together and synchronized to provide multi-channel synchronization. Phase (leading edge) offset between master and slave units is programmable.

Leading Edge Offset

Description	Leading edge of slave output trails the leading edge of the master output by a programmable number of points
Phase Units	Waveform points
Range	0 to 2 Meg points
Resolution and Accuracy	4 point
Initial Skew	<±15ns, depending on cable length and quality, typically with 1 meter coax cables (TBD)

Sample Clock

Range	
Continuous Run Mode	1.5S/s to 250MS/s (300MS/s typical)
All Other Run Modes	1.5S/s to 225MS/s (250MS/s typical)
Resolution	10 digits
Accuracy and Stability	Same as reference
10MHz Reference Clock	
Standard	≥0.0001% (1 ppm TCXO) initial tolerance over a 19°C to 29°C temperature range; 1ppm/°C below 19°C and above 29°C; 1ppm/year aging rate
External	
Frequency	10MHz
Connector	Rear Panel BNC
Impedance	10kΩ ±5%
Level	TTL, 50% ±2% duty cycle

Amplitude Characteristics

Amplitude	32mV to 32Vp-p, output open circuit 16mV to 16Vp-p, into 50Ω
Resolution	4 digits
Accuracy (measured at 1kHz into 50Ω)	
16mV to 159.9mVp-p	±(1% of setting + 5mV)
160mV to 1.599Vp-p	±(1% of setting +10mV)
1.6V to 11.99Vp-p	±(1% of setting + 70mV)
12V to 16Vp-p	±2%
DC Offset Range	0 to ±7.992V
Accuracy	±(1% +1% of amplitude setting +5mV)
Resolution	1mV

Filters

Description	Filters can be switch in and out freely except in standard waveform shape where the filters are automatically used by the instrument to reconstruct the sine shape. Each channel has its own set of filters.
Type	25MHz Bessel 50MHz Bessel 60MHz Elliptic 120MHz Elliptic

Run Modes

Description	Define how waveforms start and stop. Run modes description applies to all waveform types and function, except where noted. Continuous operation is specified across the entire sample clock frequency range. Other run modes are limited to 225MS/s.
Continuous	Continuously free-run output of a waveform. Output can be enabled and disabled from a remote interface only
Triggered	Upon trigger, outputs one waveform cycle. Last

	cycle always completed
Burst	Upon trigger, outputs a single or multiple pre-programmed numbers of waveform cycles. (Does not apply to Sequence Mode). Burst is programmable from 1 through 1M cycles
Gated	Transition enables or disables generator output. Last cycle always completed
Mixed	Same as triggered except first output cycle is initiated by a software trigger. Consequent output requires external triggers through the rear panel TRIG IN connector

Trigger Characteristics

Trigger Sources	
External	Rear panel BNC, or front panel manual trigger button
BUS	Trigger commands from a remote controller only
Mixed	Operates in conjunction with the Mixed Run Mode.

External Trigger Input

Impedance	10kΩ
Trigger Level Range	±5V
Resolution	1mV
Sensitivity	100mV
Damage Level	±12V
Frequency Range	DC to 5MHz
Slope	Positive/Negative transitions, selectable
Minimum Pulse Width	≥10ns
System Delay (Trigger input to waveform output)	6 sample clock cycles+150ns
Trigger Delay (Trigger input to waveform output)	[(0; 200ns to 20s) + system delay]
Resolution	20ns
Error	6 sample clock cycles + 150ns+ 5% of setting
Re-trigger Delay (Waveform end to waveform restart)	200ns to 20s
Resolution	20ns
Error	3 sample clock cycles + 20ns + 5% of setting
Trigger Jitter	±1 sample clock period

Standard Waveforms

Frequency Range	
Sine, Square	100μHz to 100MHz
All other waveforms	100μHz to 32MHz, some are usable above 32MHz
Frequency Resolution	10 digits
Accuracy & Stability	Same as frequency standard

Sine

Start Phase Range	0-359.9°
Start Phase Resolution	0.05°

Triangle

Start Phase Range	0-359.9°
Start Phase Resolution	0.05°

Square	
Duty Cycle Range	0% to 99.9%
Pulse and Ramp Functions	
Delay, Rise/Fall Time, High Time Ranges	0%-99.9% of period (each independently)
Gaussian Pulse Time Constant Range	10-200
Sinc Pulse “Zero Crossings” Range	4-100
Exponential Pulse Time Constant Range	-100 to 100
DC Output Function	
Range	-16V to +16V
Sine Wave Performance	
Description	Sine wave performance is measure at 5Vp-p. Sine Wave Performance applies to STD, ARB and CW sine waveforms
THD	
STD and ARB	0.1% to 20kHz
CW	0.5% to 20kHz
Harmonics	-25dBc, <100MHz -30dBc, <50MHz -43dBc, <10MHz -48dBc, <1MHz
Non-harmonics	-60dBc, <100MHz -65dBc, < 50MHz
Noise, narrow band, 10kHz span around the fundamental	-50dBc, 100MHz -60dBc, 10MHz -70dBc, 1MHz
Flatness	5% to 10MHz 20% to 100MHz
Phase Noise	
100Hz Offset	-70dBc/Hz
1kHz Offset	-85dBc/Hz
10kHz Offset	-92dBc/Hz
100kHz Offset	-112dBc/Hz
1MHz Offset	-140dBc/Hz
Square Wave, Pulse Performance	
Rise/Fall Time (10%-90%)	<4ns, to 10Vp-p; <5ns, to 16Vp-p
Aberration	<(5% +10mV) to 10Vp-p; <7% to 16Vp-p

Arbitrary Waveforms

Vertical Resolution	16 bits
Waveform Segmentation	Permits division of waveform memory into smaller segments.
Number of Memory Segments	1 to 16k
Waveform Segments, size and resolution	4 points size increments from 16 to 1M points (2M optional)
Custom Waveform Creation Software	ArbExplorer software allows instrument control and creation of custom waveforms either freehand, with equations or built-in functions or with imported waveforms

Sequenced Waveforms

Operation	Segments may be linked and repeated in a user-selectable fashion to generate extremely long waveforms. Segments are advanced using either a command or a trigger
Sequences	100
Sequencer Steps	1 to 4096
Segment Loops	1 to 1Meg
Minimum Segment Duration	500ns
Minimum Segment Size in a Sequence	16 points
Advance Modes	
Automatic Sequence Advance	No trigger required to step from one segment to the next. Sequence is repeated continuously per a pre-programmed sequence table.
Stepped Sequence Advance	Current segment is sampled continuously until a trigger advances the sequence to the next programmed segment and sample clock rate.
Single Sequence Advance	Current segment is sampled the specified number of repetitions and then idles at the end of the segment. Next trigger samples the next segment the specified repeat count, and so on.
Mixed Sequence Advance	Each step of a sequence can be programmed to advance either a) automatically (Automatic Sequence Advance), or b) with a trigger (Stepped Sequence Advance)

Modulated Waveforms

General Description

Carrier Waveform (CW)	Sine
Modulation Source	Internal
Inter-Channel Phase Relationship	Channel 2 output is phase offset by 90° relative to channel 1 output
Run Modes	Off (outputs CW), Continuous, Triggered, Delayed Trigger, Re-trigger, Burst and Gated
Run Mode Advance Source	Front panel manual trigger, Rear panel TRIG IN, Software commands
Trigger Delay (Trigger input to modulation output)	0; 200ns to 20s
Resolution	20ns
System Delay	150ns
Error	5% of setting + 150ns
Re-trigger Delay (Modulation end to modulation restart)	200ns to 20s
Resolution	20ns
Error	5% of setting
Trigger Parameters	All trigger parameters such as level, slope, jitter, etc. apply

FM

Modulated Waveform	Sine
Modulating Waveforms	Sine, square, triangle, Ramp
Carrier Frequency Range	10mHz to 100MHz
Modulating Frequency Range	10mHz to 100kHz
Peak Deviation	Up to 50MHz
Marker Position	Programmable at selectable a frequency

ARBITRARY FM

Operation	Operated from and external utility only such as ArbConnection. The modulating waveform can be designed as an arbitrary waveform
Modulated Waveform	Sine
Carrier Frequency Range	10mHz to 100MHz
Modulating Waveform	Arbitrary waveform
Modulating Waveform Sampling Clock	1S/s to 2 MS/s
Number of frequencies	4 to 20000
Marker Output	Programmable at the selected frequencies

AM

Modulated Waveform	Sine
Carrier Frequency Range	10mHz to 100MHz
Envelop Waveform	Sine, square, triangle, Ramp
Envelop Frequency	10mHz to 100kHz
Modulation Depth	0% to 100%

FSK

Shifted Waveform	Sine
Carrier/Shifted Frequency Range	100μHz to 100MHz
Baud Range	1bits/sec to 10Mbits/sec
FSK Data Bits Length	1 to 4096
Marker Output	Programmable marker at a selected step

PSK

Shifted Waveform	Sine
Carrier Frequency Range	100μHz to 100MHz
Carrier/Shifted phase Range	0° to 359.99°
Baud Range	1bits/sec to 10Mbits/sec
PSK Data Bits Length	1 to 4096
Marker Output	Programmable marker at a selected step

FREQUENCY HOP

Hopped Waveform	Sine
Hop Frequency Range	100μHz to 100MHz
Hop Table Size	1 to 4096
Dwell Time Mode	Fixed or Programmable for each step
Dwell Time	200ns to 21s
Dwell Time Resolution	20ns
Marker Position	Programmable on a selected step

Sweep

Swept Waveform	Sine
Sweep Step	Linear or log
Sweep Direction	Up or Down
Sweep Range	10mHz to 100MHz
Sweep Time	1.4μs to 40s
Marker Output	Programmable marker at a selected frequency.

Digital Pattern Output

Connector	Rear panel SCSI-2 type, 68-pin VHDC, channel 1 only
Pattern Width	16-bits, differential
Level	LVDS

Update Frequency	100μpps to 250Mpps (Usable above this frequency however, depends on the cable quality)

Front Panel Outputs

Main Outputs

Connector:	Front panel BNC, each channel Impedance: 50Ω ±1%
Protection	Short Circuit to Case Ground, 10s max
Standby	Output On or Off (Output Disconnected)

Sync Outputs

Connector	Front panel BNC
Level	TTL
Sync Type:	Pulse with Arbitrary and Standard Waves; LCOM in Sequence and Burst Modes (including Burst Modulation); Marker with Modulation Mode only, programmable position.
Sync Source	Selectable from Channel 1 or 2

GENERAL

GPIB Information

Connector	Rear panel 25-pin D connector
GPIB Revision	IEEE-488.2
SCPI Revision	1993.0
Logical Address Settings	1 - 31, configured via front panel programming
DMA	Downloads arbitrary waveform data, arbitrary FM waveform data and sequence table data. DMA support is required by the controller

Ethernet

Connector	Rear panel RJ-45, female
Physical Layer	Twisted pair 10/100Base-T
IP address	Programmed from the front panel or through the USB port
Baud Rate	10/100Mbit/sec with auto negotiation
Protocol	SCPI commands over TCP/IP.

USB

Connector	Type A receptacle
Specifications	Version 1.0/version 2.0
Protocol	SCPI commands over USB

Front Panel Display

Color LCD, 3.5” reflective, 320 x 240 pixels, back-lit

Front Panel Indicator LED's

Output On	Green – Output on / off (Separate for each channel)
SYNC On	Green – SYNC on / off

Power Requirements

Mains Input Range	85 to 265Vac, 47-63 Hz

Maximum Total Module Power	60W

Mechanical

Dimensions	212 x 88 x 415 mm (W x H x D)
Weight	Approximately 3.5 Kg

Environmental

Operating temperature	0 °C - 50 °C
Humidity (non-condensing)	
11 °C - 30 °C	85%
31 °C - 40 °C	75%
41 °C - 50 °C	45%

EMC Certification	CE marked
Safety	EN61010-1, 2nd revision