Errata

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HP References in this Manual

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HEWLETT PACKARD

MODEL 3314A
FUNCTION GENERATOR
OPERATING MANUAL

Manual Part Number 03314-90000
Microfiche Part Number 03314-90050

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THE 3314A FUNCTION GENERATOR

The 3314A is a multi-mode, HP-IB programmable Function Generator featuring Sine, Square and Triangle functions from .001Hz to 19.99MHz. Sophisticated implementation of the operating modes (see below) plus precision control of the trigger signal make the 3314A a flexible, easy to use function generator.

Modes of Operation

FREE RUN Mode. The 3314A output signal is continuous or swept.

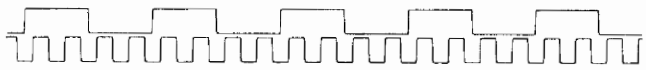
GATE Mode. The 3314A output signal is gated ON or OFF.

N CYCLE Mode. The 3314A output signal is a counted burst of "N" cycles.

1/2 CYCLE Mode. The 3314A output signal is alternate 1/2 cycles.

Fin X N Mode. The 3314A output frequency is locked to and "N" times the reference frequency.

Fin ÷ N Mode. The 3314A output frequency is locked to and "1/N" times the reference frequency.



ARB Mode. The 3314A is redefined as an Arbitrary Waveform Generator capable of producing user defined waveforms.

WHAT'S IN THIS MANUAL

This manual contains six sections to help you operate the 3314A. These sections occur in this order:

Abbreviated Installation Instructions (see page 3)

instructions to get your 3314A operating quickly and safely.

Meet the 3314A (see page 7)

an overview of the 3314A front and rear panels to help you become familiar with major features.

How to use the 3314A Function Generator (Basic Modes) (see page 9)

connection diagrams and annotated key sequences to learn how to use the function generator.

The Waveform Library (see page 21)

sixty oscillograms representing a cross-section of the 3314A's capabilities with the control settings and HP-IB nmemonics.

Detailed Operating Information (see page 41)

alphabetically organized information necessary to realize the full potential of the 3314A.

Remote Operation (see page 79)

information to program the 3314A from the HP-IB, including a Programming Summary (the blue pages).

ABBREVIATED INSTALLATION INSTRUCTIONS

These steps will let you install and make the most basic operational checks. These steps constitute the minimum safety checks that must be made whenever a 3314A is installed. Note that the 3314A is a Safety Class 1 instrument (provided with a protective earth terminal).

WARNING

The 3314A should never be connected to an AC power source without a protective earth terminal. The chassis and all exposed shields are connected to the earth terminal and "floating" or otherwise defeating this safety feature may subject the operator to lethal voltages.

1. Check the 3314A for physical damage. Under no circumstances should a damaged 3314A be connected to power! Refer to "What To Do If Your 3314A Requires Service" located in the Service Manual.

WARNING

The integrity of the protective earth ground may be interrupted on a 3314A that is damaged. Under no circumstances should a damaged 3314A be connected to its AC power source.

2. Check the line voltage select switches on the rear panel. These switches should be set to be compatible with the RMS voltage of your AC power source. The 3314A can operate from AC power sources with voltage deviations from +5% to -10% of the selected value.

CAUTION

Connecting a 3314A to an AC power source with the incorrect voltage selected will destroy the primary fuse.

ABBREVIATED INSTALLATION INSTRUCTIONS (cont)

3. Make sure that the line fuse is compatible with the voltage selected.

Table 1. Line Fuse Selection

Voltage Selected	Fuse Value	-hp- Part Number
110/120V 220/240V	0.8A SLO BLOW 0.4A SLO BLOW	2110-0336 2110-0340

CAUTION

Using the wrong fuse value or fuse type will not protect the circuitry inside the 3314A and may result in damage to your 3314A.

4. Connect the power cord. Please contact your local -hp- Sales Office if you have any questions.

5. Set the LINE switch to the ON position. This switch is located in the upper left hand corner of the front panel. The following actions will occur:

   -a 2 second count down to allow electrical stabilization and test the front panel LEDs

   -a CAL ALL to generate a full complement of calibration constants

   -if the calibration failed, the appropriate error number will be displayed for 1/2 second and the 3314A will try to calibrate itself for another 20 seconds or until a calibration is successful

6. Connect the 3314A to an oscilloscope as shown in Figure 1 and verify that the 3314A's output is a 1kHz, 10mVp-p sinewave. Press the FUNCTION key to cycle the 3314A's function to squarewave, triangle, off and back to sinewave. The FUNCTION key is located in the lower right hand corner of the front panel.

More detailed installation procedures are located in Section 2 of the Service Manual.

ABBREVIATED INSTALLATION INSTRUCTIONS (cont)

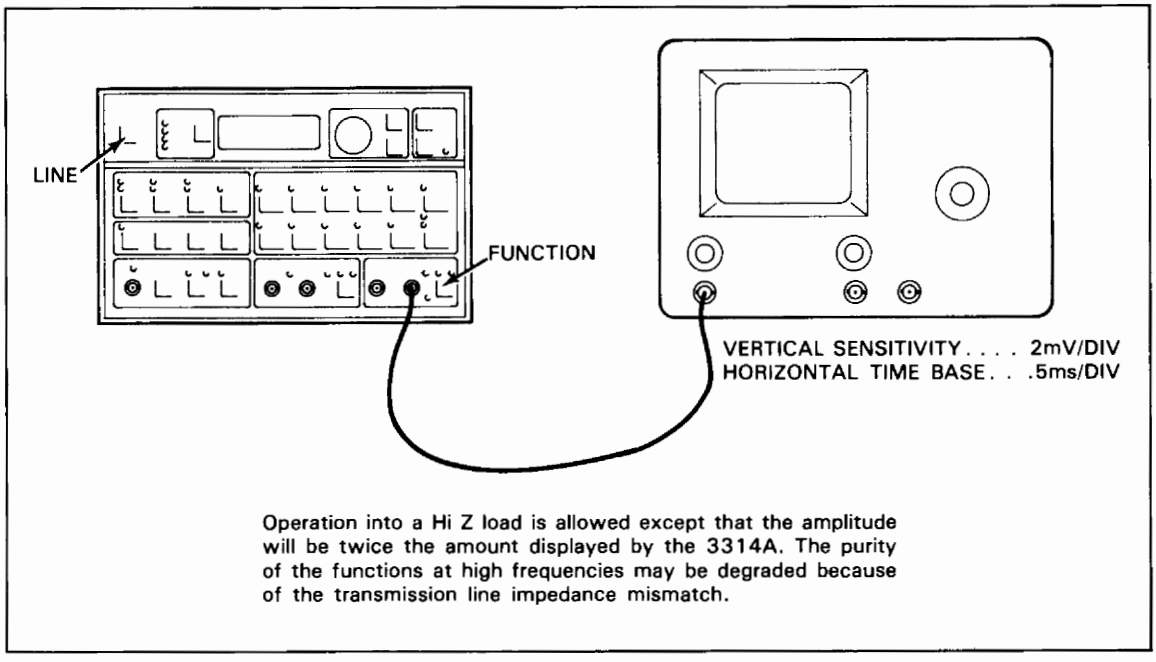


Figure 1. Basic Installation Verification

MEET THE 3314A FUNCTION GENERATOR

Status

s the HP-IB status indicators and the LCL ol of the 3314A from remote to front panel e LCL key is preceded by the BLUE shift plays its HP-IB address for 1/2 second. The t from the front panel and stored in non- The factory setting is 7. See "How to s HP-IB Address" located in the HP-IB sec-

Modify

All variable parameters (selected by keys in the Entry Group) are entered into the 3314A using the Modify knob or the ↑ or ↓ keys. These controls change the value of the displayed operating parameter. The Modify knob has 2 basic operating modes called "Cursor" and "Multi Speed".

CURSOR (a digit is flashing). This mode is useful when making small changes or changes of constant increments. The flashing cursor digit is incremented or decremented by 1 whenever rotation of the Modify knob is sensed. The ← and → keys move the cursor through the display.

MULTI SPEED (no digit is flashing). This mode is useful when making large changes. The least significant digit in the display is incremented or decremented 1, 2, 4, 8, 16 or 32 times faster depending upon how fast you turn the Modify knob.

Range

RANGE UP or DOWN (↑ or ↓) keys multiply or divide the displayed value by 10 until the 3314A's operating limits are reached. This provides an extremely fast method to modify the displayed parameter.

RANGE HOLD inhibits auto-ranging of Frequency (8 ranges), Amplitude (4 ranges), and/or DC Offset (2 ranges) when these parameters are changed with the Modify knob. When in Fin X N and Fin ÷ N, Frequency Range Hold also inhibits auto-acquisition.

Entry

Most of the keys in this group are select keys for variable entries. The top row contains select keys for the more universal parameters. Note that the blue shifted definition of these keys presets the parameter. The second row contains the select keys for the 3314A's sweep capabilities. The SW/TR INTVL key is the select key for the sweep interval (SW INTVL) and for the internal trigger interval (TR INTVL). When ARB is active, the functions of the keys in the second row are redefined.

Function

The **MAIN OUTPUT.** This output has a characteristic output impedance of 50Ω. Although operation into other than 50Ω is allowed, the actual AC amplitude and DC offset will be different from the displayed values and the quality of the functions will be degraded at higher frequencies due to transmission line impedance mismatches.

The **SYNC OUTPUT.** This output has a characteristic output impedance of 50Ω when terminated into ≤50Ω. When terminated into >50Ω, it will deliver TTL compatible levels of 0 to >2.5V. The maximum unloaded voltage is limited to ~3V. The edges of the sync signal are coincident with the peaks of the sine and triangle functions and coincident with the edges of the square function. This relationship is inverted by Function Invert.

nternal Trigger

ımeter sets the period of the internal trig- igger I/O port is an output when INT trig- s output signal is useful as a sync signal and burst operations.

External Modulation

Type	Sensitivity	Range
AM	±1V ~ 100%	0% to > 100%
FM	±1V ~ ±1% of range	0% to ±1% deviation
VCO	10%/Volt	+10% to -80%, useable to -100%

Figure 2. MEET THE 3314A

Mode

The 3314A has 7 basic operating modes. The trigger signal, either the 3314A's internal trigger source or an external signal you supply, is essential to every operating mode except FREE RUN with sweep off.

FREE RUN Mode. The 3314A outputs continuous Sine, Square, Triangle or ARB functions. Continuous functions, sweeps and ARB operations are allowed. See "How to Use the FREE RUN Mode".

GATE Mode. The output is "gated" ON and OFF by the Trigger level. Gated functions, sweeps and ARB operations are allowed. See "How to Use the GATE Mode".

N CYCLE Mode. The 3314A outputs a burst of N complete cycles of the selected function, starting when a Trigger edge is received. The N parameter sets the number of cycles from 1 to 1999. The start/stop phase is set with the Phase parameter from -90° to +90°. See "How to Use the N CYCLE Mode".

1/2 CYCLE Mode. The 3314A outputs alternate 1/2 cycles of the selected funtion when a Trigger edge is received. The start phase of the first 1/2 cycle (and the stop phase of the second 1/2 cycle) is set with the Phase parameter from -90° to +90°. See "How to Use the 1/2 CYCLE Mode".

Fin X N Mode. The 3314A will phase lock to the Trigger (reference) signal and output a frequency "N" times the reference frequency. The N parameter sets "N" from 1 to 1999. The frequency limits for both the 3314A and the reference are from 50Hz to 20MHz. See "How to Use the PHASE LOCK Modes".

Fin + N Mode. The 3314A will phase lock to the Trigger (reference) signal and output a frequency equal to the reference frequency divided by "N". The N parameter sets "N" from 1 to 1999. The frequency limits for both the 3314A and the reference are from 50Hz to 20MHz. See "How to Use the PHASE LOCK Modes".

ARB Mode. The ARB mode redefines the 3314A as an Arbitrary Waveform Generator. The output waveform consists of a series of voltage ramps called vectors. The operator has control over the number of vectors, the length of each vector in time and the height of each vector. Both continuous ARB functions (FREE RUN Mode) and gated ARB (GATE Mode) are allowed. See "How to Use the ARB Mode".

Preset

The Preset key initializes the 3314A to its basic operating state. This feature is especially useful to quickly recover from complex operating states.

Store/Recall

Up to 5, non-ARB front panel control settings can be stored in registers 1 through 5 to be recalled in the future. Register 0 is reserved for the front panel setting at power off. In addition, 6 ARB waveforms can be recalled from ARB registers 0 through 5. ARB waveforms are automatically stored as they are created.

External Trigger

One EXT Trigger is a signal you apply to the Trigger I/O port that satisifies the selectable slope and threshold conditions (note that the Trigger I/O port is an input when EXT Trigger is selected). EXT Triggers are level sensitive for Gate; edge sensitive for Burst, Phase Lock and Sweep operations.

Another EXT Trigger is the MAN key. You will have to press this key twice when in Gate mode, to simulate a complete trigger cycle (both levels). Once is sufficient for all other operations. The minimum signal that will consistently trigger the 3314A is ≥200Vp-p, centered on the 3314's threshold voltage.

There are two EXT Triggers available from the HP-IB, the Group Execute Trigger (GET) and the "MN" programming command.

Status

This group contains the HP-IB status ind
key to switch control of the 3314A from
operation. When the LCL key is precede
key, the 3314A displays its HP-IB address
HP-IB address is set from the front pane
volatile memory. The factory setting is
Change the 3314A's HP-IB Address" loca
tion of this manual.

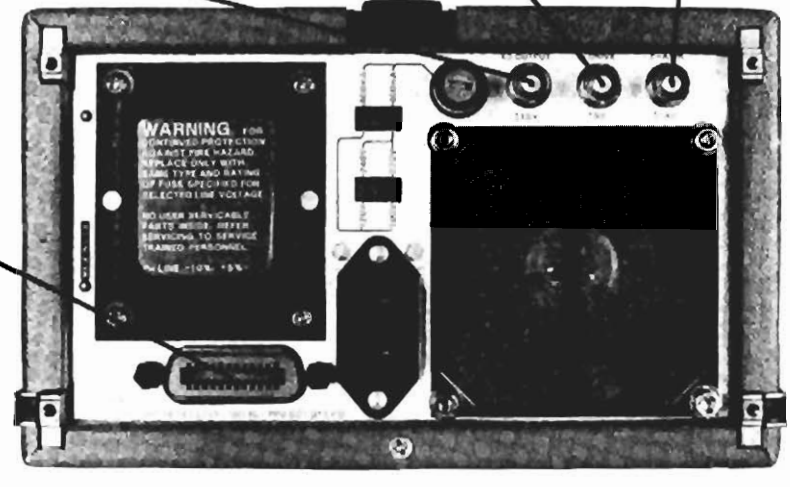
Internal Trigg

The **SW/TR INTVL** parameter sets the perio
ger (note that the Trigger I/O port is an
ger is selected). This output signal is us
during sweeps, gate and burst operations

The **Z Axis** output produces voltage levels to blank (> + 5V) or enhance (< − 5V) the intensity of an oscilloscope display during sweep (intensifies the marker frequency and blanks the retrace) or ARB (intensifies the current vector).

The **X Axis** output produces a voltage ramp from -5V to + 5V whose voltage is proportional to the sweep frequency. This output is useful to drive the X Axis of plotters and oscilloscopes.

The **X3** output (only instruments with Option 001 have this output) is a high voltage, low impedance output whose output voltage is 3 times the displayed amplitude and offset when the Main Output is terminated into 50Ω. This output is capable of sourcing ± 30mA peak current without clipping. The upper frequency limit is 1MHz.

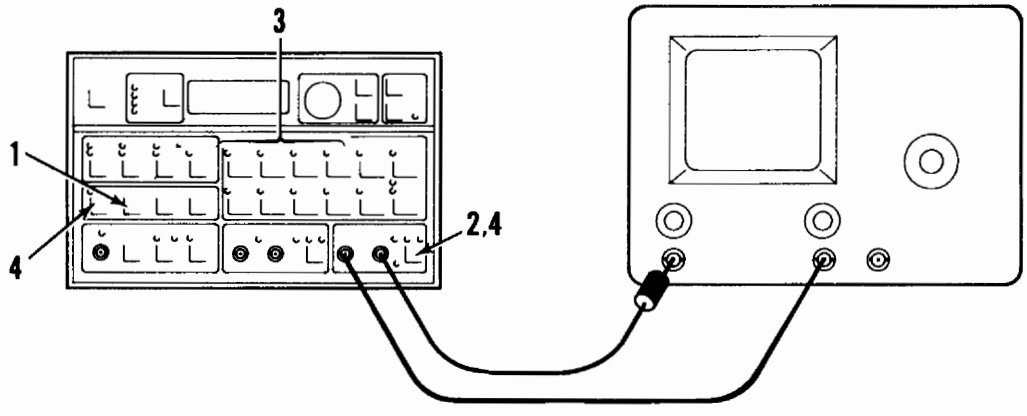


The **HP-IB** is used to control the operation of the 3314A from a remote controller. This connector uses metric fasteners and is not compatible with older cables using english threaded fasteners. Metric fasteners are available from -hp- to upgrade older cables.

Table 2. Error Codes

00	No error (HP-IB function, only)
	--- OPERATOR ERRORS (non-ARB) ---
01	Frequency/Symmetry conflict
02	Bus address entry error
03	Front panel key failure
04	Calibration measurements not performed
05	Allowed in sweep, only
06	Not allowed in sweep
07	Not allowed in log sweep
08	Store 0 not allowed
09	Non-volatile memory lost;battery down
	--- OPERATOR ERRORS (ARB) ---
10	Vector insert not allowed
11	Vector delete not allowed
18	Allowed in ARB, only
19	Not allowed in ARB
	--- PLL ERRORS ---
20	Unstable input frequency (Precludes auto-acquisition when in phase lock modes)
21	Input frequency outside of acquisition range
22	3314A output frequency would be out of range
23	SW/TR INTVL >20ms (Decrease interval to ≤ 20ms)
24	Internal synthesis unlocked
	--- CALIBRATION ERRORS ---
30, 31, 32	Frequency calibration error
34, 35, 36, 37, 38	Amplitude calibration error
	--- HP-IB ERRORS ---
41	Mnemonic invalid
42	Definition number invalid
43	Data invalid
44	Units invalid
45	Range Hold not allowed
46	ARB/SWEEP parameter conflict
47	Not allowed in Manual Sweep
	--- OVERLOAD ---
50	AM or FM/VCO input voltage exceeds normal limits (HP-IB equivalent to the Reduce Input Light)
51	Output voltage exceeds safe operating limits

HOW TO USE THE FREE RUN MODE



50Ω FEEDTHRU TERMINATION (Optional) Not shown on succeeding drawings. Trigger from Channel 2 on the rising edge.

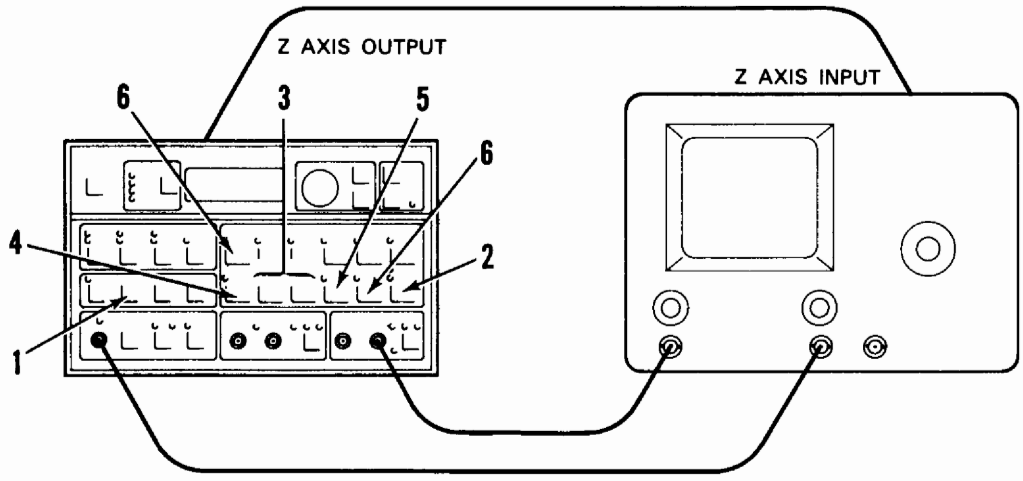
Step	Key	Action
1	PRESET	Sets the 3314A to its basic operating state. This operating state is very useful as the common starting point for all operations. Note that FREE RUN is the active mode after instrument preset.
2	FUNCTION	Press this key to change the function from Sine to Square to Triangle to Function OFF and back to Sine. Note that DC OFFSET is not affected by Function OFF.
3	FREQ AMPTD OFFSET SYM	Use the Modify knob and ↑ or ↓ keys to change the value of these parameters. Note that AMPTD and OFFSET are completely independent parameters and that variable symmetry is not allowed for frequencies ≥ 2MHz.
4	(blue shift) FUNCTION	Function Invert inverts the output signal. Note that DC OFFSET is not inverted and that the inversion is with respect to the SYNC output.

Free Run Summary

Functions: Sine, Square, Triangle, Function Off
Frequency: .001Hz to 19.99MHz in 8 ranges
Amplitude: .00mVp-p to 10.00Vp-p in 4 ranges
Offset: ±.000VDC to ±5.00VDC in 2 ranges
Symmetry: 5% to 95% for frequencies < 2MHz

See waveforms 1 through 10 in the Waveform Library.

HOW TO USE THE FREE RUN MODE (LINEAR SWEEPS)



A 50Ω Feedthru Termination is optional to reduce the sensitivity of the oscilloscope's Z Axis input. Trigger from Channel 2 on the rising edge.

Step	Key	Action
1	PRESET	Sets the 3314A to its basic operating state. This operation state is very useful as the common starting point for all operations. Note that FREE RUN is the active mode after instrument preset.
2	SWEEP	The 3314A's output frequency is now linearly sweeping from the Start Frequency to the Stop Freqeuncy in the time interval set by SW/TR INTVL.
3	START FREQ STOP FREQ	These two keys set the sweep limits. Note that changing one parameter will cause the other to change if the ratio of Stop Frequency to Start Frequency would be <1 or >100. The 3314A will make the other parameter's light flash to alert you to this automatic parameter change.
4	SW/TR INTVL	This parameter sets the sweep time interval. When the INT Trigger is selected, the sweep is from Start Frequency to Stop Frequency in this time. The sweep is repeated after the frequency resets. The reset time is approximately 10% of the sweep interval. When the EXT Trigger is selected, the sweep is from Start Frequency to Stop Frequency in this time. The 3314A will output the Start Frequency until another EXT Trigger is received.
5	MKR FREQ	The Z Axis output signal will intensify the trace when the sweep frequency equals the Marker Frequency.
6	MAN SWEEP FREQ	When manual sweep is ON, the output frequency is limited to frequencies between the Start and Stop Frequencies. The X Axis output tracks these changes. This mode is useful when setting up plotters and other X,Y displays.

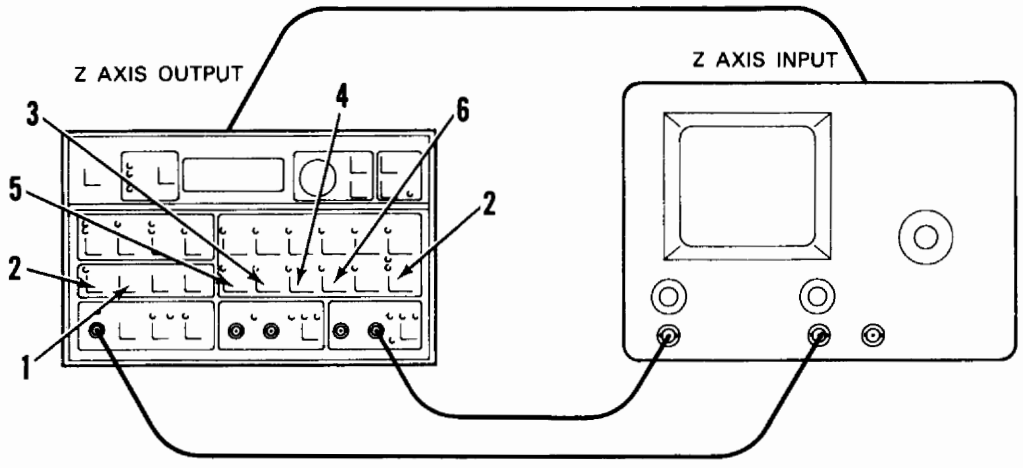
HOW TO USE THE FREE RUN MODE (LINEAR SWEEPS) (cont)

Linear Sweep Summary

Stop Frequency must be ≥ Start Frequency.
Stop Freq ÷ Start Freq ratio is from 1 to 100.
Sweep Interval range is from 7.20ms to 1999s
Sweep is repetitive when INT Trigger is selected.
Sweep started by the Trigger when EXT Trigger is selected.

See Waveforms 11 through 15 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE FREE RUN MODE (LOG SWEEPS)



Trigger from Channel 2 on the rising edge.

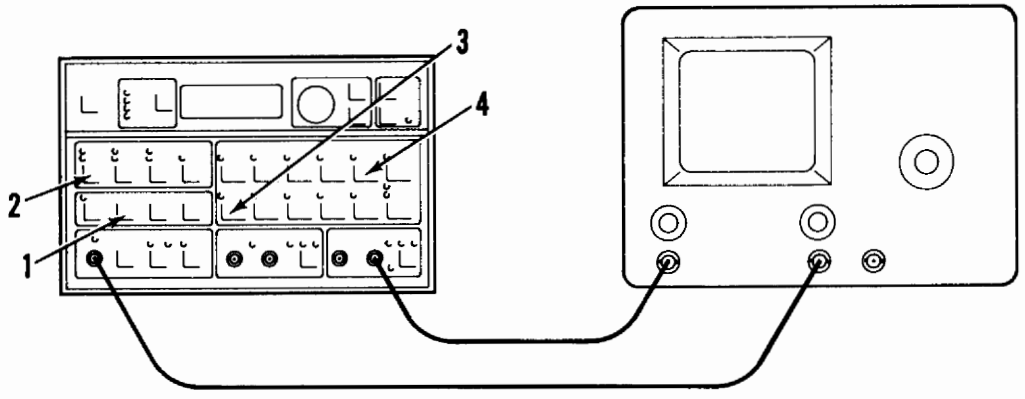
Step	Key	Action
1	PRESET	Sets the 3314A to its basic operating state. This operating state is very useful as the common starting point for all operations. Note that FREE RUN is the active mode after instrument preset.
2	(blue shift) SWEEP	The 3314A'S output frequency is now sweeping logarithmically from the Start Frequency to the Stop Frequency in the time interval set by SW/TR INTVL.
3	START FREQ	Setting the Start Frequency also sets the mantissa of the Stop Frequency (Log sweeps must be decade sweeps). When the Start Frequency is changed, the Stop Frequency automatically tracks these changes. Note that the lower Start Frequency limit is .200Hz.
4	STOP FREQ	Note that the Stop Frequency sets the number of decades swept. The mantissa of the Stop Frequency tracks the Start Frequency.
5	SW/TR INTVL	This parameter sets the sweep time interval exactly as it was implemented in Linear Sweep except that the time is now the time per decade. The lower limit is 40.0ms/decade.
6	MKR FREQ	The Z Axis output signal intensifies the trace when the Sweep Frequency is equal to the Marker Frequency.

Log Sweep Summary

Stop Frequency must be greater than the Start Frequency.
Sweeps are decades, only. 1 decade to 7 decades.
Start Frequency range: .200Hz to 1.999MHz.
Stop Frequency range: 2Hz to 19.99MHz.
Sweep Interval range: 40.0ms to 1999s per decade.

See Waveforms 16 through 20 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE GATE MODE



Trigger from Channel 2 on the rising edge.

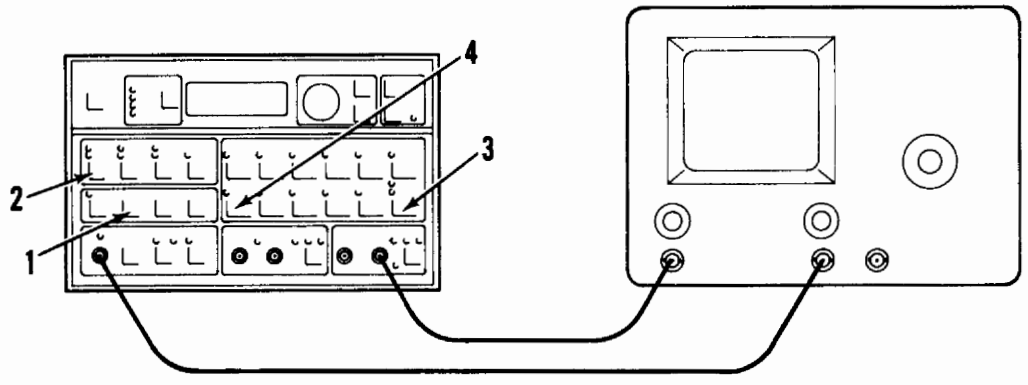
Step	Key	Action
1	PRESET	Presets the 3314A to a common starting point.
2	GEN	This key toggles the mode between Free Run and Gate. The 3314A's output will be ON when the trigger level satisfies the slope and threshold conditions.
3	SW/TR INTVL	Sets the period of the internal Trigger Interval. The internal trigger signal has a 50% duty cycle and the output is gated on for slightly > 1/2 of the Trigger Interval.
4	PHASE	Sets the start and stop phase of the gated signal. The output is gated on immediately after the trigger level is true. The output is gated off after the trigger level is false and the output signal reaches the stop phase.

Gate Summary

Trigger Level gates on and off.
SW/TR INTVL: .002ms to 1999s
Start/Stop Phase: -90° to +90°
Internal Trigger Duty Cycle: slightly >50%
Trigger light indicates the presence of a trigger
SYNC output is also gated

See Waveforms 21 through 25 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE GATE MODE (GATED SWEEPS)



Trigger from Channel 2 on the rising edge.

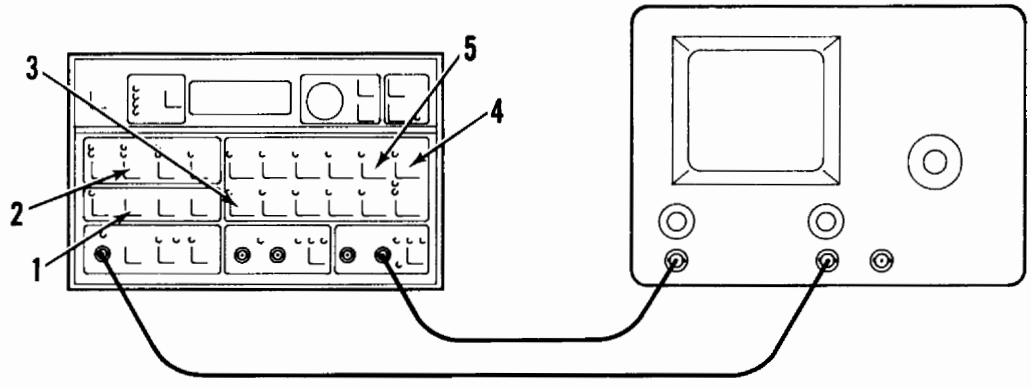
Step	Key	Action
1	PRESET	Presets the 3314A to a common starting point.
2	GEN	This key toggles the mode between Free Run and Gate. The 3314A's output will be ON when the trigger level satisfies the slope and threshold conditions.
3	SWEEP	Gated Sweeps are useful as "self-windowing" signals with sampling Fourier type spectrum analyzers, such as the -hp- 3582A. Self-windowing signals are needed when the analyzer's sampling rate and the stimulus are unrelated.
4	SW/TR INTVL	This parameter sets the Trigger Interval (the time between sweep starts). The actual time the output is gated on (the sweep interval) is ~.9 of the Trigger Interval.

Gated Sweep Summary

SW/TR INTVL: 7.20ms to 1999s
Start/Stop Phase: not meaningful
Internal Trigger Duty Cycle: ~90%
Gated Log Sweeps are not allowed.
Trigger light indicates the presence of a trigger
SYNC output is also gated

See Waveforms 26 through 30 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE N CYCLE MODE



Trigger from Channel 2 on the rising edge.

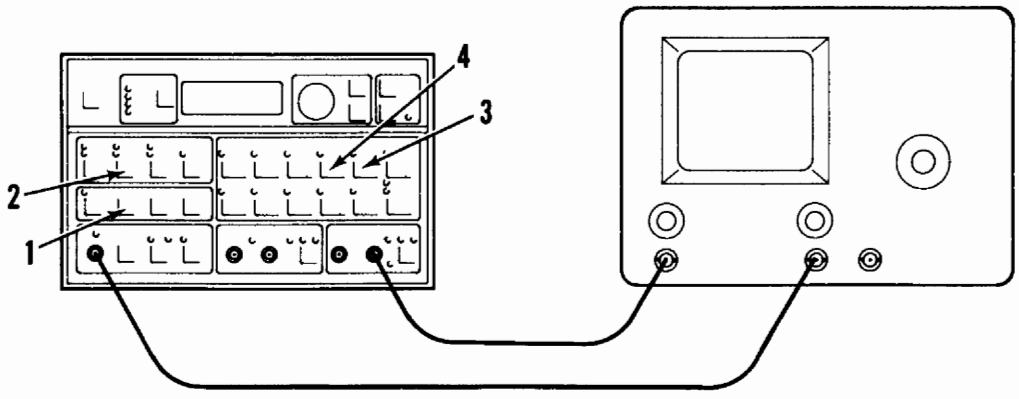
Step	Key	Action
1	PRESET	Presets the 3314A to a common starting point.
2	BST	This key toggles the mode between N CYCLE and 1/2 CYCLE.
3	SW/TR INTVL	The Trigger Interval sets the time between the start of bursts. Note that if this time is shorter than the length of the burst, the output is a continuous signal.
4	N	Use the Modify knob to set the number of cycles in every burst.
5	PHASE	This parameter sets the start and stop phase of the burst.

N Cycle Summary

N range: 1 to 1999
SW/TR INTVL: .002ms to 1999s
Start/Stop Phase: -90° to +90°
SYM range: 5% to 95%

See Waveforms 31 through 35 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE 1/2 CYCLE MODE



Trigger from Channel 2 on the rising edge.

Step	Key	Action
1	PRESET	Presets the 3314A to a common starting point.
2	BST	This key toggles the mode between N CYCLE and 1/2 CYCLE. The 3314A outputs alternate 1/2 cycles whenever a trigger is received.
3	PHASE	This parameter sets the start/stop phase as in N CYCLE except that the start and stop phase alternate by 180°.
4	SYM	Used with the Phase parameter to make pulses with variable overshoot (preshoot) and variable rise (fall) times.

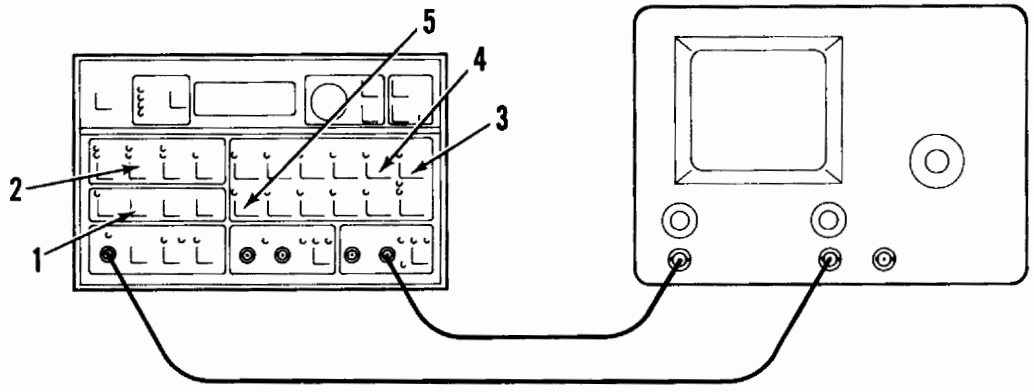
1/2 Cycle Summary

Start/Stop Phase: -90° to +90°
SYM range: 5% to 95%
SW/TR INTVL: .002ms to 1999s

See Waveforms 36 through 40 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

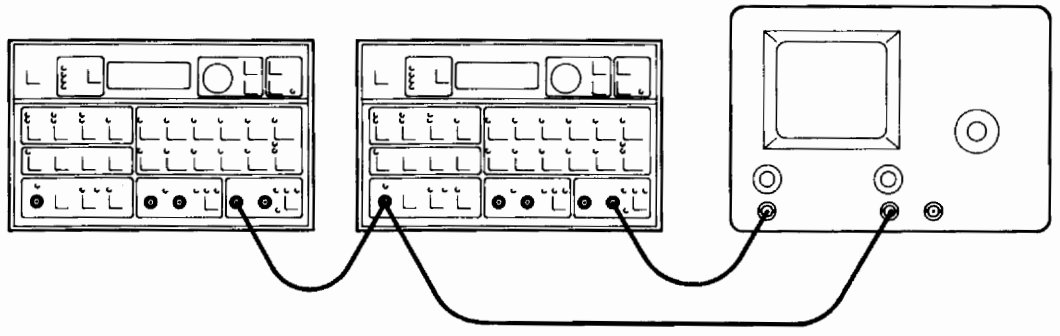
HOW TO USE THE PHASE LOCK MODES

INTERNAL PHASE LOCK



Trigger from Channel 2 if Fin X N.
Trigger from Channel 1 if Fin ÷ N.

EXTERNAL PHASE LOCK



Step	Key	Action
1	PRESET	Presets the 3314A to a common starting point.
2	ϕ LCK	This key toggles the mode between Fin X N and Fin ÷ N. While the light is flashing, the 3314A is measuring the frequency of the reference signal, setting the 3314A's output frequency to an approximation that will be within the capture range of the phase locked loop and then phase locks to the reference. The 3314A has acquired lock when the light is on continuously. When EXT Trigger is selected, the 3314A phase-locks to an external signal you apply to the Trigger Input.
3	N	Use the Modify knob to change the ratio of output frequency to reference frequency. Note that the 3314A has to reacquire lock every time N changes.
4	PHASE	Use the Modify knob to change the phase relationship between the reference and output signal. 1° of phase refers to 1° of the lower frequency signal (either reference or output).
5	SW/TR INTVL	This parameter sets the period of the INTVL "reference" signal when INT Trigger is selected.

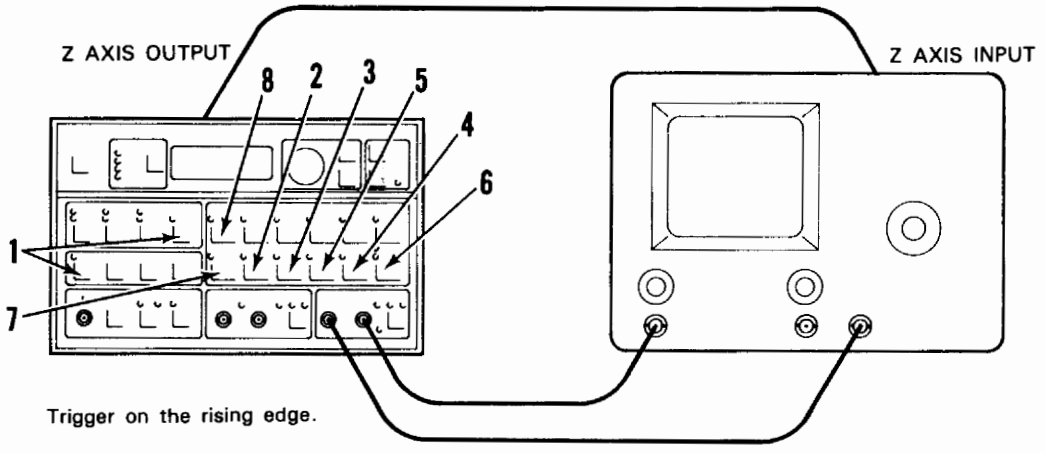
HOW TO USE THE PHASE LOCK MODES (cont)

Phase Lock Summary

N: 1 to 1999
Reference Frequency Limits: 50Hz to 20MHz
3314A Frequency Limits: 50Hz to 19.99MHz
Acquire Time: < 5 seconds under most conditions
Phase Offset Range: -199.9° to +199.9°

See Waveforms 41 through 50 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

HOW TO USE THE ARB MODE



Step	Key	Action
1	(blue shift) ARB	Redefines the 3314A as an ARBitrary Waveform Generator (the shifted function also clears the current waveform to its initial state). An ARB waveform consists of a series of voltage ramps called vectors.
2	V HGT	Use the Modify knob to change the Vector Height of the current vector. The last vector closes the waveform. Its length is programmable but not its height.
3	V LEN	Use the Modify knob to change the Vector length of the current vector. Note that the slope does not change and that the waveform may clip at the peak-to-peak limit set with the AMPTD parameter when V LEN is very large.
4	INS	Each time this key is pressed, another vector is inserted into the waveform.

Repeat steps 2 through 4 to build an ARB waveform. The intensified portion of the oscilloscope display is the current vector.

5	V MKR	Use the Modify knob to change the current vector. Note that the intensified vector on the oscilloscope tracks V MKR.
6	DEL	Each time this key is pressed, the current vector is removed from the ARB waveform. The last vector cannot be removed.
7	Δ t	This parameter changes the period of the unit vector (V LEN = 1). Use the Modify knob to change this parameter.
8	FREQ	Use the Modify knob to change the repetition frequency of the entire ARB waveform. Note the 3314A actually computes a new Δ t.

ARB Mode Summary

The 3314A has 6 ARB waveforms (accessed by RECAL ARB 0 to 5).
There are a maximum of 160 vectors distributed among these 6 waveforms (2 vectors per waveform, minimum). The initialized ARB waveform (also the minimum waveform) is a 2 vector waveform with V HGT = 000, V LEN = 1, V MKR = 1 and Δ t = .200ms.
V HGHT range: -1999 to +1999
V LEN range: 1 to 127
Δ t range: .200ms to 19.99ms
Phase range: -90° to +90° (sets the waveform closure between the peak-to-peak limits set by AMPTD).
AMPTD sets the peak-to-peak limits that the ARB waveform must exist within.

See Waveforms 51 through 60 in the Waveform Library. Error Codes are on the back of the "Meet the 3314A" fold-out.

THE WAVEFORM LIBRARY

This Waveform Library contains 60 oscillograms representing across-section of the 3314A's capabilities. The waveforms are organized into nine basic groups.

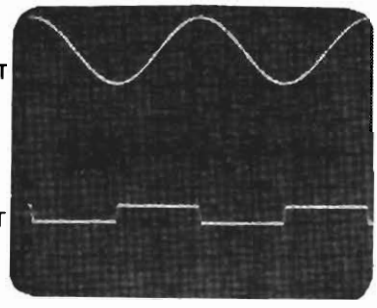
Free Run	Waveforms 1 through 10
Free Run (Linear Sweep)	Waveforms 11 through 15
Free Run (Log Sweep)	Waveforms 16 through 20
Gate	Waveforms 21 through 25
Gated Sweep	Waveforms 26 through 30
N Cycle	Waveforms 31 through 35
1/2 Cycle	Waveforms 36 through 40
Fin X N	Waveforms 41 through 45
Fin + N	Waveforms 46 through 50
ARB	Waveforms 51 through 60

FREE RUN

1. Large Signal With Large DC Offset

PRESET
MODE . . . . . Free Run
FREQUENCY 1MHz
AMPLITUDE 10.00Vp-p
OFFSET . . . . . +5.00Vdc

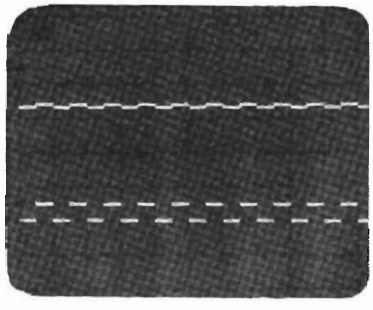
PR MO1 FR1MZ AP10VO OF5VO



2. Small Signal With Large DC Offset

PRESET
AMPLITUDE 400mVp-p
OFFSET . . . . . -3.00Vdc
FUNCTION . . . . . Squarewave

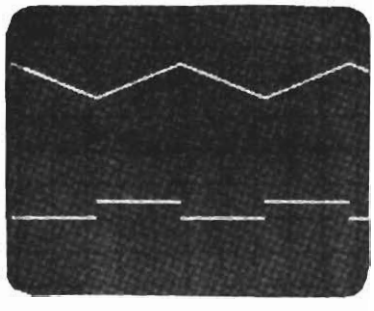
PR AP400MV OF-3VO FU2



3. Large Signal With Small DC Offset

PRESET
AMPLITUDE 5Vp-p
OFFSET 250V
FUNCTION . . . . . Triangle

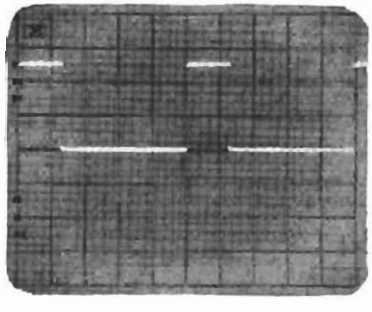
PR AP5VO OF.25VO FU3



4. TTL (Squarewave With DC Offset)

PRESET
AMPLITUDE 5.00Vp-p
OFFSET 2.50V
SYMMETRY 25%
FUNCTION . . . . . Squarewave

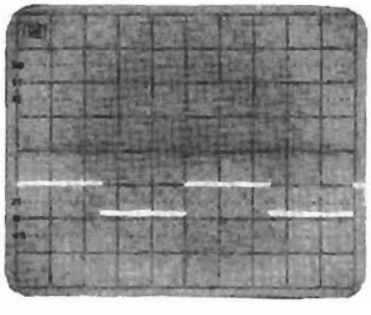
PR AP5VO OF2.5VO SY25PC FU2



5. ECL (Squarewave With DC Offset)

PRESET
AMPLITUDE 85Vp-p
OFFSET . . . . . -1.31V
FUNCTION . . . . . Squarewave

PR AP.85VO OF-1.31VO FU2

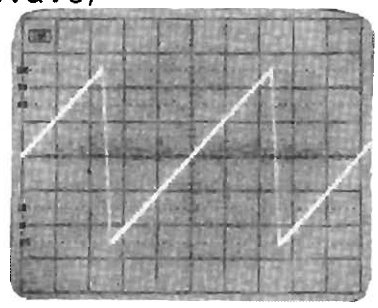


FREE RUN (cont)

6. RAMPS (Variable Symmetry Triangle Wave)

PRESET
AMPLITUDE 10Vp-p
SYM 95%
FUNCTION ..... Triangle

PR AP10VO SY95PC FU3

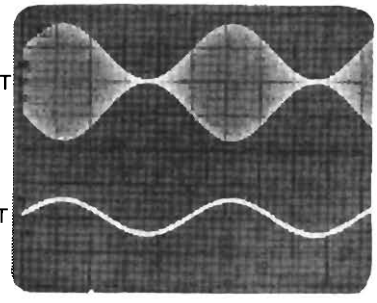


7. 100% Amplitude Modulation

PRESET
FREQUENCY 1MHz
AMPLITUDE 7Vp-p
MODULATION ..... AM

PR FR1MZ AP7VO AM1

Signal at AM input is a 2Vp-p, 1kHz sine wave.

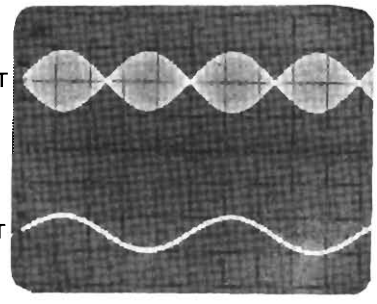


8. AM (Suppressed Carrier)

PRESET
FREQUENCY 1MHz
AMPLITUDE 7Vp-p
MODULATION ..... AM

PR FR1MZ AP7VO AM1

Signal at AM input is a 2Vp-p, 1kHz sine wave with -1Vdc offset.

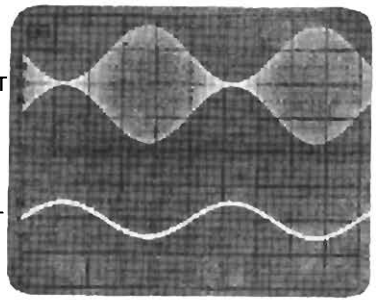


9. AM With Function Invert

PRESET
FREQUENCY 1MHz
AMPLITUDE 7Vp-p
MODULATION ..... AM
FUNCTION INVERT ..... ON

PR FR1MZ AP7VO AM1 FI1

Signal at AM input is a 2Vp-p, 1kHz sine wave.

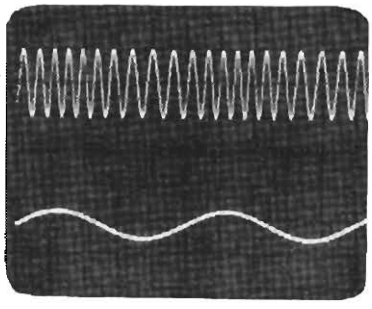


10. VCO

PRESET
MODE ..... Free Run
FREQUENCY 1MHz
AMPLITUDE 10Vp-p
MODULATION ..... VCO
FUNCTION ..... Sinewave

PR MO1 FR1MZ AP10VO VC1 FU1

Modulating signal is a 100kHz, 4Vp-p Sinewave with -1Vdc offset.

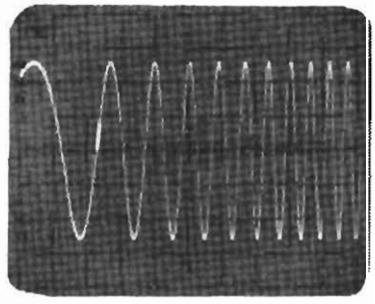


FREE RUN (Linear Sweeps)

11. 100Hz to 1kHz

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 20ms
START FREQUENCY 100Hz
STOP FREQUENCY 1kHz
MARKER FREQUENCY 300Hz
SWEEP TYPE ..... Linear

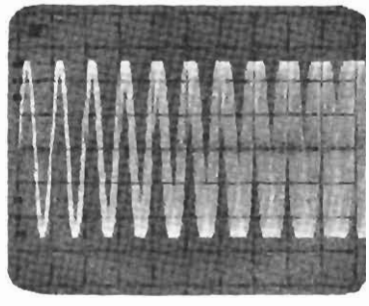
PR AP10VO TI20MS ST100HZ SP1KZ MK300HZ SW1



12. Small Sweep Ratio (1.06:1)

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 100ms
START FREQEUNCY 5kHz
STOP FREQUENCY 5.3kHz
SWEEP TYPE ..... Linear

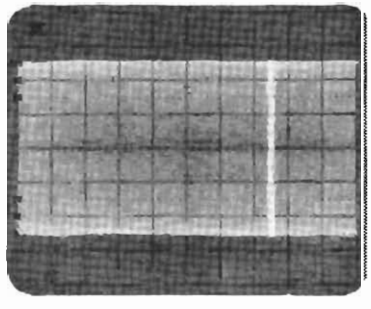
PR AP10VO TI100MS ST5KZ SP5.3KZ SW1



13. Large Sweep Ratio (100:1)

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 10ms
START FREQUENCY 199.9kHz
STOP FREQEUNCY 19.99MHz
MARKER FREQUENCY 15MHz
SWEEP TYPE ..... Linear

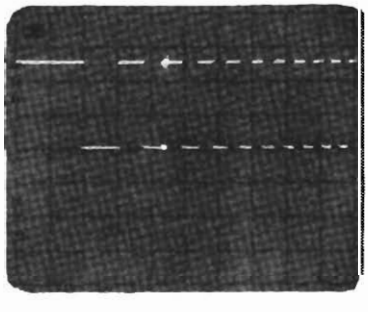
PR AP10VO TI10MS ST199.9KZ SP19.99MZ MK15MZ SW1



14. TTL Level Sweeps

PRESET
AMPLITUDE 5Vp-p
OFFSET ..... +2.5Vdc
START FREQUENCY 21.4Hz
STOP FREQUENCY 2.14kHz
MARKER FREQUENCY 940Hz
SWEEP TYPE ..... Linear

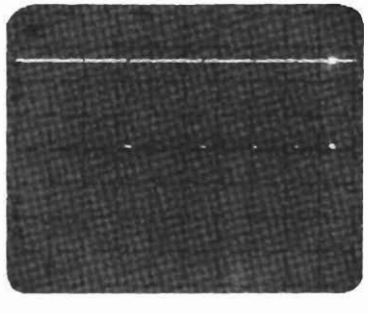
PR AP5VO OF2.5VO ST21.4HZ SP2.14KZ MK940HZ SW1



15. TTL Level, 95% Symmetry Sweep

PRESET
AMPLITUDE 5Vp-p
OFFSET ..... +2.5V
SYMMETRY 95%
START FREQUENCY 10.81Hz
STOP FREQUENCY 1081Hz
MARKER FREQUENCY 1018Hz
SWEEP TYPE ..... Linear

PR AP5VO OF2.5VO SY95PC ST10.81Hz SP1081HZ MK1018HZ SW1



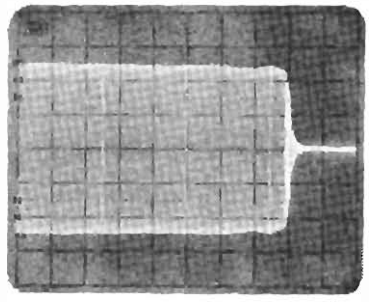
FREE RUN (Log Sweeps)

16. Sweeping a Low Pass Filter

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 40ms/DECADE
START FREQUENCY 510Hz
STOP FREQUENCY 5.1MHz
MARKER FREQUENCY 809kHz
SWEEP TYPE ..... Log

PR AP10VO TI40MS ST510HZ SP5.1MZ MK809KZ SW2

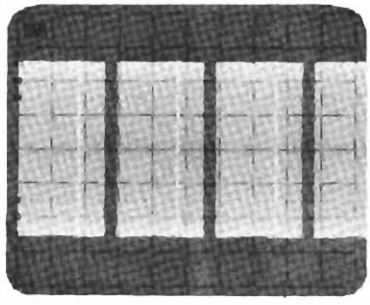
Note: The X Axis control voltage is from the3314A's X Axis output. Note the intensification every decade and at the Marker Frequency.



17. 1 Decade Sweep

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 50ms/DECADE
START FREQUENCY 1999kHz
STOP FREQUENCY 19.99MHz
MARKER FREQUENCY 10MHz
SWEEP TYPE ..... Log

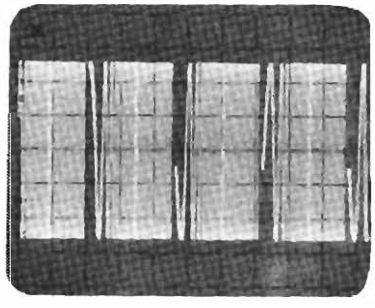
PR AP10VO TI50MS ST1999KZ SP19.99MZ MK10MZ SW2



18. Audio Sweep (20Hz to 20kHz)

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 40ms/DECADE
START FREQUENCY 20Hz
STOP FREQUENCY 20kHz
MARKER FREQUENCY 1kHz
SWEEP TYPE ..... Log

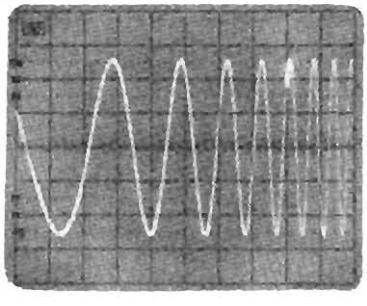
PR AP10VO TI40MS ST20HZ SP20KZ MK1KZ SW2



19. Sub-Audio Sweep (2Hz to 20Hz)

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 1s/DECADE
START FREQUENCY 2Hz
STOP FREQUENCY 20Hz
MARKER FREQUENCY 13Hz
SWEEP TYPE ..... Log

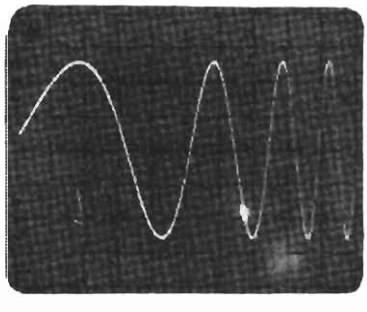
PR AP10VO TI1SN ST2HZ SP20HZ MK13HZ SW2



20. Low Frequency Sweep (.2Hz to 2Hz)

PRESET
AMPLITUDE 10Vp-p
SWEEP INTERVAL 5s/DECADE
START FREQUENCY 2Hz
STOP FREQUENCY 2Hz
MARKER FREQUENCY ..... .935Hz
SWEEP TYPE ..... Log

PR AP10VO TI5SN ST.2HZ SP2HZ MK.935HZ SW2

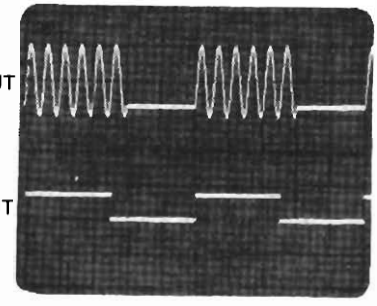


GATE

21. Gated Sinewaves (Start/Stop Phase = -45°)

PRESET
MODE ..... GATE
AMPLITUDE 10Vp-p
PHASE ..... -45°
TRIGGER INTERVAL 10ms

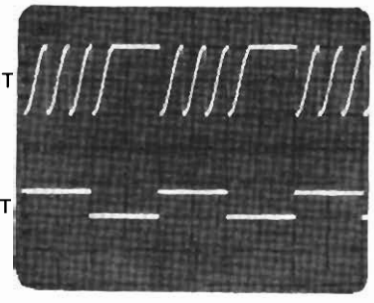
PR MO2 AP10VO PH-45DG TI10MS



22. Gated Sinewaves (SYM = 95%)

PRESET
MODE ..... GATE
FREQUENCY 298Hz
AMPLITUDE 10Vp-p
SYMMETRY 95%
PHASE ..... 90°
TRIGGER INTERVAL 20ms

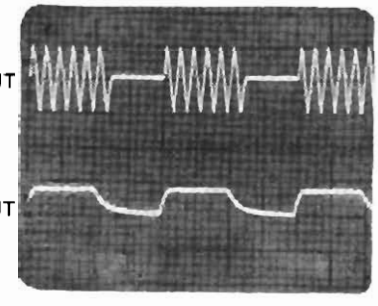
PR MO2 FR298HZ AP10VO SY95PC PH90DG TI20MS



23. High Frequency Gate

PRESET
MODE ..... GATE
FREQUENCY 5MHz
AMPLITUDE 10Vp-p
TRIGGER INTERVAL ..... .002ms
FUNCTION ..... TRIANGLE

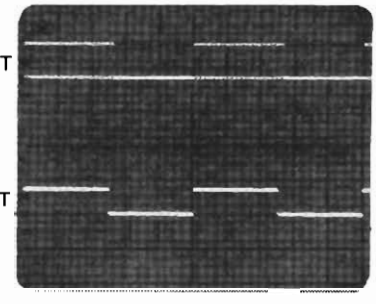
PR MO2 FR5MZ AP10VO TI.002MS FU3



24. Gated TTL Level Pulses

PRESET
MODE ..... GATE
FREQUENCY 15kHz
AMPLITUDE 5Vp-p
OFFSET 2.5Vdc
TRIGGER INTERVAL 2.5ms
FUNCTION ..... Squarewave
INVERT FUNCTION ..... ON

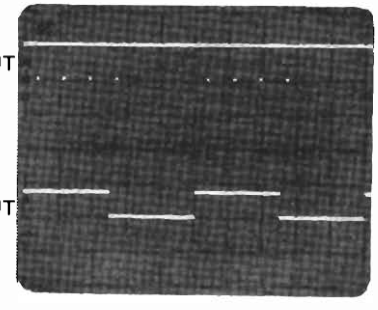
PR MD2 FR15KZ AP5VO OF2.5VO TI2.5MS FU2 FI1



25. Gated TTL Level Pulses

PRESET
MODE ..... GATE
FREQUENCY 2.6kHz
AMPLITUDE 5Vp-p
OFFSET 2.5Vdc
SYMMETRY 95%
TRIGGER INTERVAL 2.5ms
FUNCTION ..... Squarewave

PR MD2 FR2.6KZ AP5VO OF2.5VO SY95PC TI2.5MS FU2

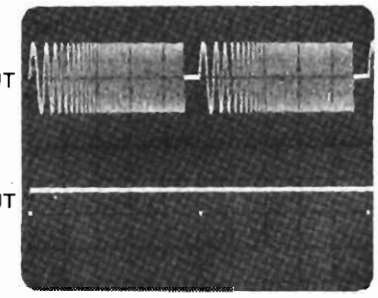


GATED SWEEPS

26. Basic Gated Sweep (10ms)

PRESET
MODE ..... Gate
AMPLITUDE 10Vp-p
SWEEP TYPE ..... Linear

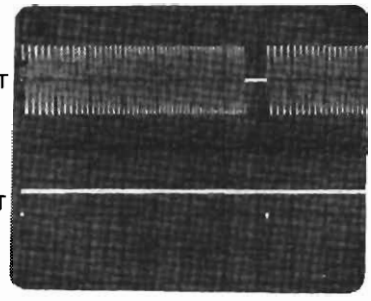
PR MO2 AP10VO SW1



27. Small Ratio Gated Sweep (2:1)

PRESET
MODE ..... Gate
AMPLITUDE 10Vp-p
SWEEP INTERVAL 7.2ms
START FREQUENCY 5kHz
STOP FREQUENCY 10kHz

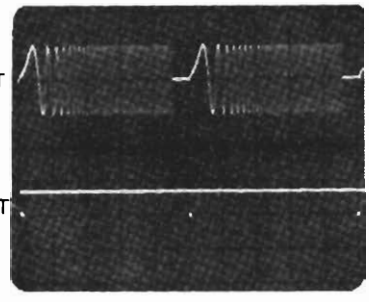
PR MO2 AP10VO TI7.2MS ST5KZ SP10KZ



28. Large Ratio Gated Sweep (100:1)

PRESET
MODE ..... Gate
AMPLITUDE 10Vp-p
SWEEP INTERVAL 10ms
START FREQUENCY 100Hz
STOP FREQUENCY 10kHz

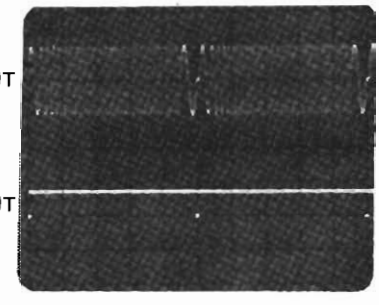
PR MO2 AP10VO TI10MS ST100HZ SP10KZ



29. Audio Chirp

PRESET
MODE ..... Gate
AMPLITUDE 10Vp-p
SWEEP INTERVAL 100ms
START FREQUENCY 100Hz
STOP FREQUENCY 1kHz
SWEEP TYPE ..... Linear

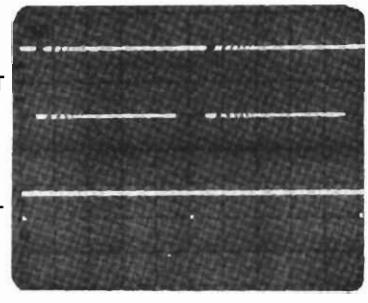
PR MO2 AP10VO TI.1SN ST100HZ SP1KZ SW1



30. Swept Squarewaves

PRESET
MODE ..... Gate
AMPLITUDE 10Vp-p
SWEEP INTERVAL 10ms
START FREQUENCY 100Hz
STOP FREQUENCY 10kHz
SWEEP TYPE ..... Linear
FUNCTION ..... Squarewave

PR MO2 AP10VO TI10MS ST100HZ SP10KZ SW1 FU2

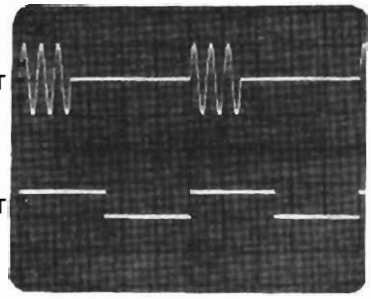


N CYCLE

31. 3 Cycle Burst

PRESET
MODE ..... N CYCLE
AMPLITUDE 10Vp-p
N 3

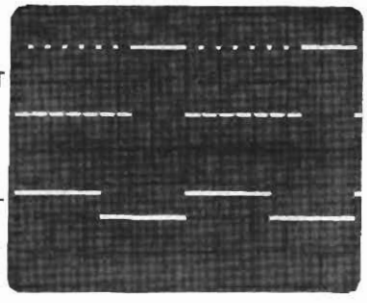
PR MO3 AP10VO NM3EN



32. 7 Cycle Burst

PRESET
MODE ..... N Cycle
AMPLITUDE 10Vp-p
AMPLITUDE 10Vp-p
SYMMETRY 20%
PHASE ..... 90°
N 7

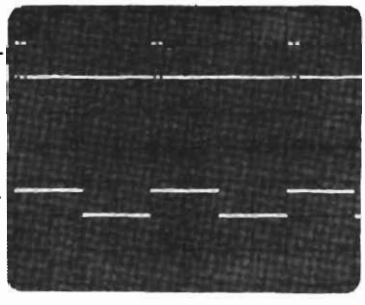
PR MO3 AP10VO SY20PC PH90DG NM7EN



33. 2 Cycle Burst

MODE ..... N Cycle
AMPLITUDE 5Vp-p
OFFSET 2.5Vdc
N 2
TRIGGER INTERVAL 16ms
FUNCTION ..... Squarewave
FUNCTION INVERT ..... ON

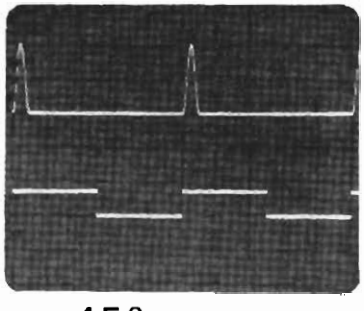
PR AP5VO OF2.5VO NM2EN TI16MS FU2 FI1



34. Haversine

PRESET
MODE ..... N Cycle
AMPLITUDE 10Vp-p
PHASE ..... -90°
N 1
FUNCTION ..... Sinewave

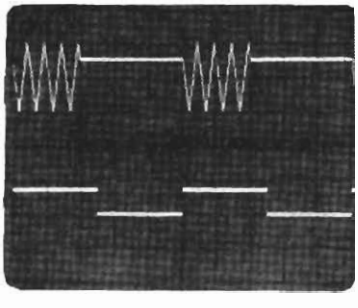
PR MO3 AP10VO PH-90DG NM1EN FU1



35. 4 Cycle Burst With Start/Stop Phase = -45°

PRESET
MODE ..... N Cycle
AMPLITUDE 10Vp-p
PHASE ..... -45°
N 4
FUNCTION ..... Triangle
FUNCTION INVERT ..... ON

PR MO3 AP10VO PH-45DG NM4EN FU3 FI1

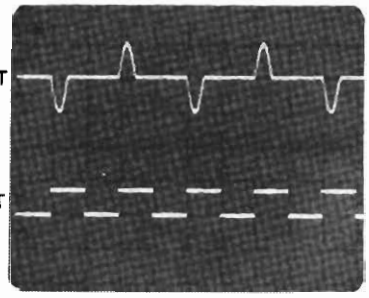


1/2 CYCLE

36. Basic 1/2 Cycle

PRESET
MODE . . . . . 1/2 Cycle
FREQUENCY 200Hz
AMPLITUDE 10Vp-p

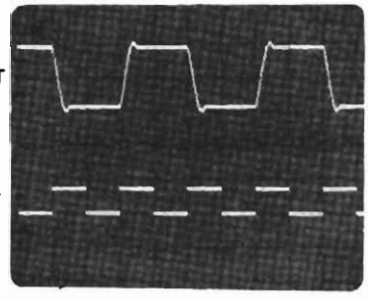
PR MO4 FR200HZ AP10VO



37. Pulses With Overshoot

PRESET
MODE . . . . . 1/2 Cycle
FREQUENCY 200Hz
AMPLITUDE 10Vp-p
PHASE . . . . . -60°

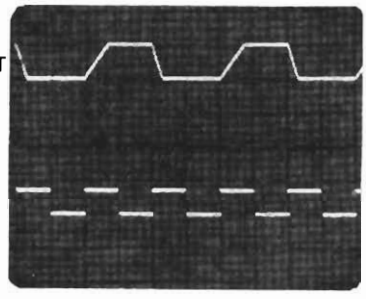
PR MO4 FR200HZ AP10VO



38. Pulses With Varying Rise/Fall Ratios

PRESET
MODE . . . . . 1/2 Cycle
FREQUENCY 200Hz
AMPLITUDE 5Vp-p
OFFSET . . . . . +2.5Vdc
SYMMETRY 70%
PHASE . . . . . 90°
TRIGGER INTERVAL 10ms
FUNCTION . . . . . Triangle

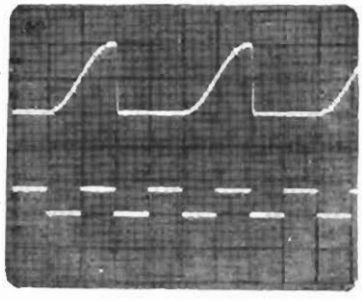
PR MO4 FR200HZ AP5VO OF2.5VO SY70PC PH90DG FU3



39. 1/2 Cycle With 95% Symmetry

PRESET
MODE . . . . . 1/2 Cycle
FREQUENCY 100Hz
AMPLITUDE 10Vp-p
SYMMETRY 95%
PHASE . . . . . 90°
TRIGGER SLOPE . . . . . \ (negative edge)

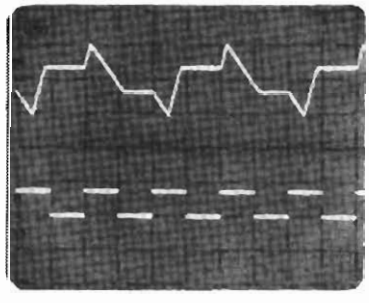
PR MO4 FR100HZ AP10VO SY95PC PH90DG SL2



40. 1/2 Cycle Trianglewaves

PRESET
MODE . . . . . 1/2 Cycle
FREQUENCY 100Hz
AMPLITUDE 10Vp-p
SYMMETRY 28%
PHASE . . . . . 31°
FUNCTION . . . . . Triangle

PR MO4 FR100HZ AP10VO SY28PC PH31DG FU3

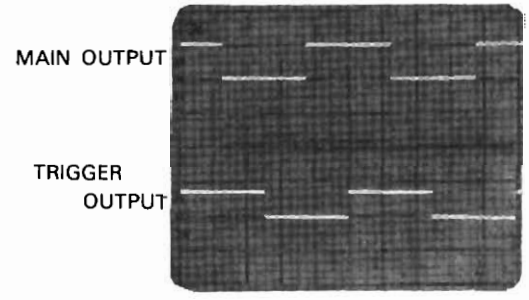


Fin X N

41. Squarewaves in Quadrature

PRESET
MODE ..... Fin X N
AMPLITUDE 5Vp-p
OFFSET 2.5Vdc
PHASE ..... 90°
N 1
TRIGGER INTERVAL 1ms
FUNCTION ..... Squarewave

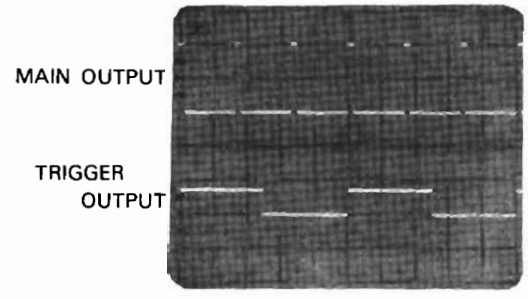
PR MO5 AP5VO OF2.5VO PH90DG NM1EN TI1MS FU2



42. 3 Pulses

PRESET
MODE ..... Fin X N
AMPLITUDE 10Vp-p
SYMMETRY 10%
N 3
FUNCTION ..... Squarewave

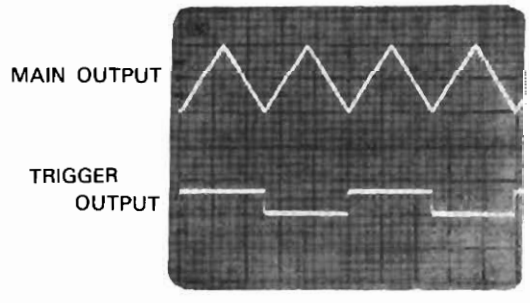
PR MO5 AP10VO SY10PC NM3EN FU2



43. Trianglewaves

PRESET
MODE ..... Fin X N
AMPLITUDE 10Vp-p
N 2
TRIGGER SOURCE ..... EXT
TRIGGER SLOPE ..... \ (negative edge)
TRIGGER THRESHOLD 1V
FUNCTION ..... Triangle

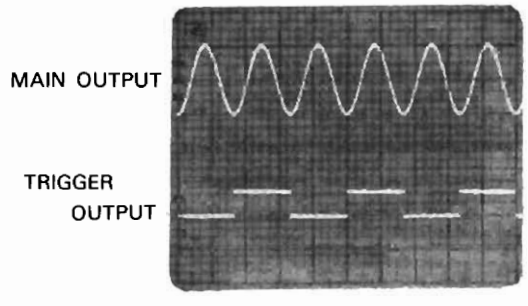
PR MO5 AP10VO NM2EN SR2 SL2 LV1 FU3
External Trigger is a 100kHz, TTL squarewave



44. Sinewaves

PRESET
MODE ..... Fin X N
AMPLITUDE 10Vp-p
N 2
SW/TR INTVL 16.66mS

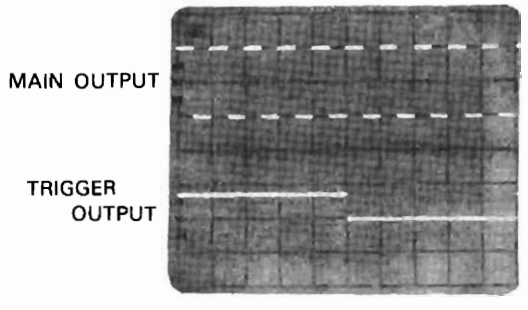
PR MO5 AP10VO NM2EN TI16.66MS



45. Squarewaves

PRESET
MODE ..... Fin X N
AMPLITUDE 10Vp-p
N 10
FUNCTION ..... Squarewave

PR MO5 AP10VO NM10EN FU2

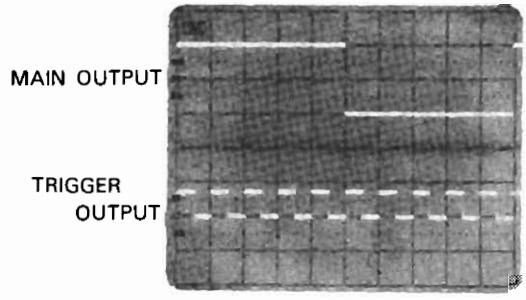


Fin ÷ N

46. Squarewaves

PRESET
MODE . . . . . Fin ÷ N
AMPLITUDE 10Vp-p
N 10
FUNCTION . . . . . Squarewave

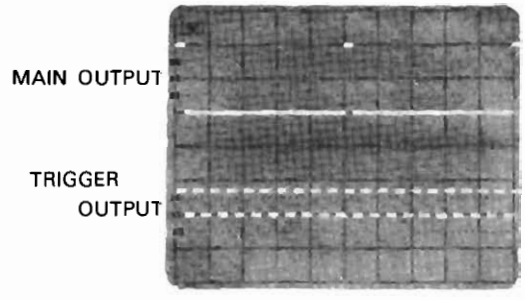
PR MO6 AP10VO NM10EN FU2



47. Pulses

PRESET
MODE . . . . . Fin ÷ N
AMPLITUDE 10Vp-p
SYMMETRY 5%
N 10
FUNCTION . . . . . Squarewave

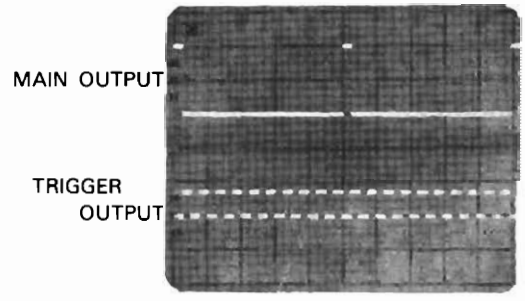
PR MO6 AP10VO SY5PC NM10EN FU2



48. Pulses

PRESET
MODE . . . . . Fin ÷ N
AMPLITUDE 10Vp-p
SYMMETRY 5%
PHASE . . . . . 18°
N 10
FUNCTION . . . . . Squarewave

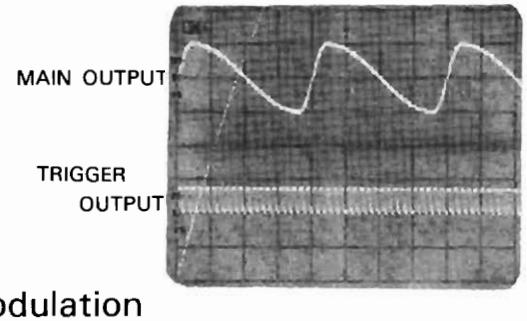
PR MO6 AP10VO SY5PC PH18DG NM10EN FU2



49. Variable Symmetry

PRESET
MODE . . . . . Fin ÷ N
AMPLITUDE 10Vp-p
SYMMETRY 20%
N 20
TRIGGER INTERVAL 002ms
FUNCTION . . . . . Sinewave

PR MO6 AP10VO SY20PC NM20EN TI.002MS FU1

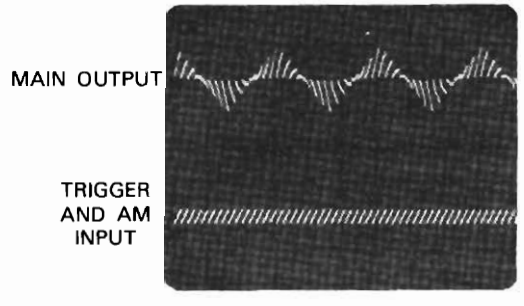


50. Phase Locked Amplitude Modulation

PRESET
MODE . . . . . Fin ÷ N
AMPLITUDE 10Vp-p
N 15
TRIGGER SOURCE . . . . . EXT
TRIGGER LEVEL 0V
TRIGGER SLOPE . . . . . (negative edge)
MODULATION . . . . . AM
FUNCTION . . . . . Triangle

PR MO6 AP10VO NM15EN SR2 LV2 SL2 AM1 FU3

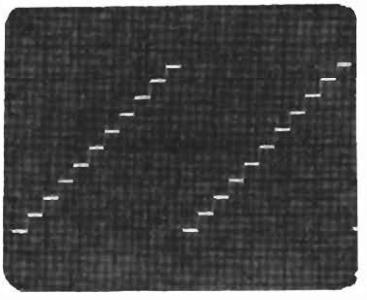
Modulating signal and Trigger input is a 10kHz, 2Vp-p Ramp.



ARB

51. Linear Steps

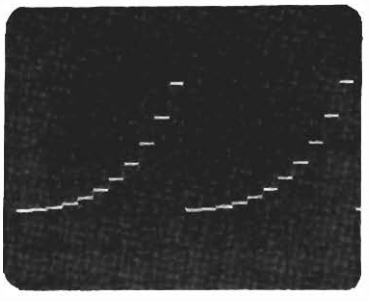
PRESET
MODE ..... ARB
AMPLITUDE 10Vp-p
PHASE ..... -90°



Vector	V HGT=	V LEN=
1	0	9
2	250	1
3	0	9
4	250	1
5	0	9
6	250	1
7	0	9
8	250	1
9	0	9
10	250	1
11	0	9
12	250	1
13	0	9
14	250	1
15	0	9
16	250	1
17	0	9
18	250	1
19	0	9
20	250	1
21	0	9
22	1	1

52. Exponential Steps

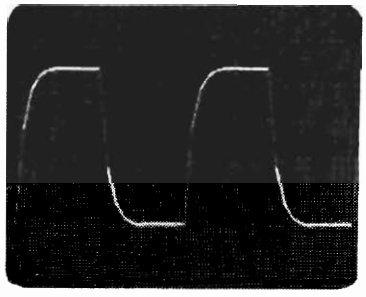
PRESET
MODE ..... ARB
AMPLITUDE 10Vp-p
PHASE ..... -90°



Vector	V HGT=	V LEN=
1	0	9
2	15	1
3	0	9
3	34	1
5	0	9
6	57	1
7	0	9
8	87	1
9	0	9
10	124	1
11	0	9
12	170	1
13	0	9
14	229	1
15	0	9
16	303	1
17	0	9
18	397	1
19	0	9
20	514	1
21	0	9
22	1	1

53. Exponential Charge/Discharge

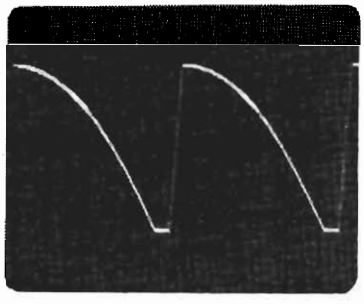
PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p
PHASE . . . . . -90°



Vector	V HGT=	V LEN=
1	1454	1
2	581	1
3	214	1
4	79	1
5	29	1
6	0	5
7	−1454	1
8	−581	1
9	−214	1
10	−79	1
11	−29	1
12	1	5

54. Square Law Response

PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p
PHASE . . . . . -90°
FUNCTION INVERT . . . . . ON

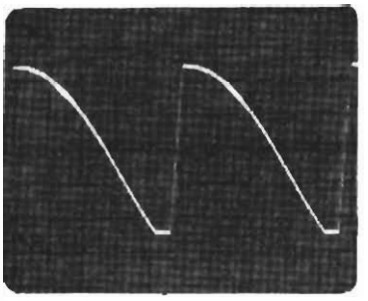


Vector	V HGT=	VLEN=
1	25	1
2	75	1
3	125	1
4	175	1
5	225	1
6	275	1
7	325	1
8	375	1
9	425	1
10	475	1
11	0	1
12	1	1

ARB (cont)

55. Exponential Response

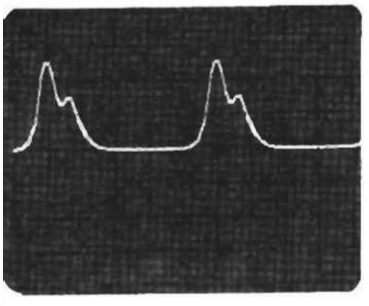
PRESET
MODE ..... ARB
AMPLITUDE 10Vp-p
PHASE ..... -90°
FUNCTION INVERT ..... ON



Vector	V HGT=	V LEN=
1	19	1
2	91	1
3	159	1
4	220	1
5	274	1
6	318	1
7	350	1
8	367	1
9	364	1
10	337	1
11	0	1
12	1	1

56. Carotid Artery Pressure Wave

PRESET
MODE ..... ARB
AMPLITUDE 10Vp-p

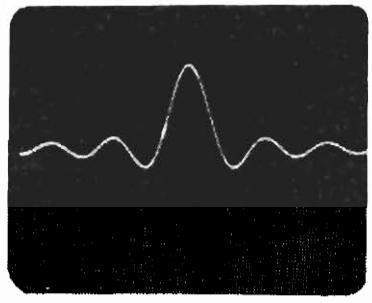


Vector	V HGT=	V LEN=
1	10	2
2	40	2
3	140	2
4	370	2
5	190	1
6	0	1
7	-190	1
8	-300	1
9	-140	1
10	0	1
11	90	1
12	0	1
13	-160	2
14	-120	2
15	-60	2
16	-30	2
17	-10	2
18	0	1
19	0	1
20	1	19

ARB (cont)

57. sin(x)/x

PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p

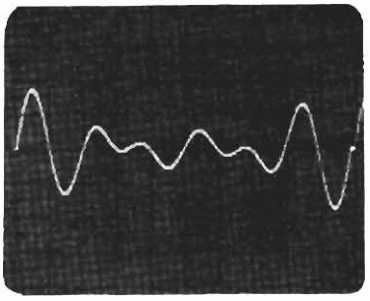


Vector	V HGT=	V LEN=	Vector	V HGT=	V LEN=	Vector	V HGT=	V LEN=
1	3	1	34	−70	1	67	70	1
2	11	1	35	−60	1	68	72	1
3	19	1	36	−41	1	69	66	1
4	24	1	37	−15	1	70	53	1
5	27	1	38	17	1	71	36	1
6	27	1	39	53	1	72	17	1
7	23	1	40	90	1	73	−3	1
8	17	1	41	124	1	74	−20	1
9	8	1	42	154	1	75	−34	1
10	−2	1	43	175	1	76	−43	1
11	−13	1	44	187	1	77	−47	1
12	−22	1	45	186	1	78	−45	1
13	−30	1	46	174	1	79	−38	1
14	−34	1	47	150	1	80	−27	1
15	−34	1	48	115	1	81	−15	1
16	−31	1	49	72	1	82	−1	1
17	−23	1	50	25	1	83	12	1
18	−12	1	51	−25	1	84	23	1
19	1	1	52	−72	1	85	31	1
20	15	1	53	−115	1	86	34	1
21	27	1	54	−150	1	87	34	1
22	38	1	55	−174	1	88	30	1
23	45	1	56	−186	1	89	22	1
24	47	1	57	−187	1	90	13	1
25	43	1	58	−175	1	91	2	1
26	34	1	59	−154	1	92	−8	1
27	20	1	60	−124	1	93	−17	1
28	3	1	61	−90	1	94	−23	1
29	−17	1	62	−53	1	95	−27	1
30	−36	1	63	−17	1	96	−27	1
31	−53	1	64	15	1	97	−24	1
32	−66	1	65	41	1	98	−19	1
33	−72	1	66	60	1	99	−11	1
						100	1	1

ARB (cont)

58. 3 Note Chord (Major Triad)

PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p

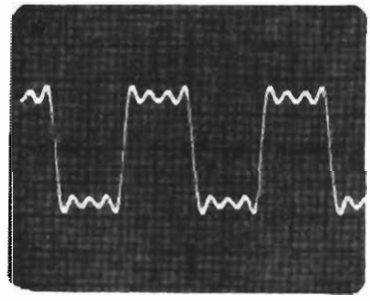


Vector	V HGT=	V LEN=
1	278	1
2	248	1
3	193	1
4	119	1
5	33	1
6	−55	1
7	−134	1
8	−197	1
9	−236	1
10	−249	1
11	−236	1
12	−198	1
13	−142	1
14	−74	1
15	−4	1
16	62	1
17	115	1
18	150	1
19	166	1
20	161	1
21	139	1
22	104	1
23	61	1
24	18	1
25	−21	1
26	−51	1
27	−68	1
28	−72	1
29	−64	1
30	−47	1
31	−24	1
32	−2	1
33	17	1
34	29	1
35	32	1
36	26	1
37	11	1
38	−9	1
39	−31	1
40	−50	1
41	−64	1
42	−69	1
43	−64	1
44	−49	1
45	−25	1
46	3	1
47	33	1
48	61	1
49	81	1
50	92	1
51	92	1
52	81	1
53	61	1
54	33	1
55	3	1
56	−25	1
57	−49	1
58	−64	1
59	−69	1
60	−64	1
61	−50	1
62	−31	1
63	−9	1
64	11	1
65	26	1
66	32	1
67	29	1
68	17	1
69	−2	1
70	−24	1
71	−47	1
72	−64	1
73	−72	1
74	−68	1
75	−51	1
76	−21	1
77	18	1
78	61	1
79	104	1
80	139	1
81	161	1
82	166	1
83	150	1
84	115	1
85	62	1
86	−4	1
87	−74	1
88	−142	1
89	−198	1
90	−236	1
91	−249	1
92	−236	1
93	−197	1
94	−134	1
95	−55	1
96	33	1
97	119	1
98	193	1
99	248	1
100	278	1
101	1	1

ARB (cont)

59. Fourier Series Squarewave [cosF-1/3cos3F + 1/5cos5F]

PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p

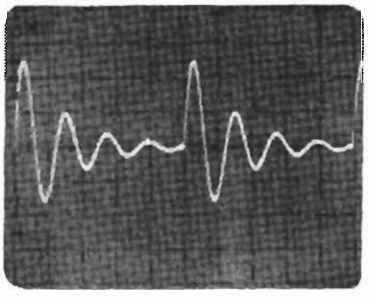


Vector	V HGT=	V LEN=	Vector	V HGT=	V LEN=	Vector	V HGT=	V LEN=
1	8	1	34	55	1	67	−55	1
2	21	1	35	55	1	68	−40	1
3	30	1	36	43	1	69	−9	1
4	31	1	37	23	1	70	35	1
5	25	1	38	0	1	71	87	1
6	12	1	39	−20	1	72	141	1
7	−4	1	40	−33	1	73	190	1
8	−21	1	41	−38	1	74	228	1
9	−33	1	42	−33	1	75	248	1
10	−38	1	43	−21	1	76	248	1
11	−33	1	44	−4	1	77	228	1
12	−20	1	45	12	1	78	190	1
13	0	1	46	25	1	79	141	1
14	23	1	47	31	1	80	87	1
15	43	1	48	30	1	81	35	1
16	55	1	49	21	1	82	−9	1
17	55	1	50	8	1	83	−40	1
18	40	1	51	−8	1	84	−55	1
19	9	1	52	−21	1	85	−55	1
20	−35	1	53	−30	1	86	−43	1
21	−87	1	54	−31	1	87	−23	1
22	−141	1	55	−25	1	88	0	1
23	−190	1	56	−12	1	89	20	1
24	−228	1	57	4	1	90	33	1
25	−248	1	58	21	1	91	38	1
26	−248	1	59	33	1	92	33	1
27	−228	1	60	38	1	93	21	1
28	−190	1	61	33	1	94	4	1
29	−141	1	62	20	1	95	−12	1
30	−87	1	63	0	1	96	−25	1
31	−35	1	64	−23	1	97	−31	1
32	9	1	65	−43	1	98	−30	1
33	40	1	66	−55	1	99	−21	1
						100	−8	1

ARB (cont)

60. Damped Oscillations

PRESET
MODE . . . . . ARB
AMPLITUDE 10Vp-p



Vector	V HGT=	V LEN=
1	383	1
2	332	1
3	263	1
4	184	1
5	98	1
6	13	1
7	-66	1
8	-136	1
9	-193	1
10	-233	1
11	-256	1
12	-262	1
13	-250	1
14	-225	1
15	-187	1
16	-140	1
17	-88	1
18	-35	1
19	17	1
20	64	1
21	104	1
22	134	1
23	154	1
24	163	1
25	161	1
26	149	1
27	129	1
28	103	1
29	72	1
30	38	1
31	5	1
32	-26	1
33	-53	1
34	-75	1
35	-91	1
36	-100	1
37	-102	1
38	-98	1
39	-88	1
40	-73	1
41	-55	1
42	-34	1
43	-14	1
44	7	1
45	25	1
46	40	1
47	52	1
48	60	1
49	63	1
50	63	1
51	58	1
52	50	1
53	40	1
54	28	1
55	15	1
56	2	1
57	-10	1
58	-21	1
59	-29	1
60	-35	1
61	-39	1
62	-40	1
63	-38	1
64	-34	1
65	-28	1
66	-21	1
67	-13	1
68	-5	1
69	3	1
70	10	1
71	16	1
72	20	1
73	23	1
74	25	1
75	24	1
76	23	1
77	20	1
78	16	1
79	11	1
80	6	1
81	1	1
82	-4	1
83	-8	1
84	-11	1
85	-14	1
86	-15	1
87	-15	1
88	-15	1
89	-13	1
90	-11	1
91	-8	1
92	-5	1
93	-2	1
94	1	1
95	4	1
96	6	1
97	8	1
98	9	1
99	10	1
100	10	1
101	0	1

DETAILED OPERATING INFORMATION

This section contains detailed discussions about the following topics:

ARB
CALIBRATION
DATA ENTRY
ERROR CODES
EXTERNAL MODULATION
FUNCTIONS
MODE
OPERATOR ALERTS
OUTPUTS
PRESET
SPECIFICATIONS
STORE & RECALL

ARB

The ARB mode redefines the 3314A as an ARBitrary waveform generator. Arbitrary waveforms are user defined waves made up of a series of voltage ramps called vectors. There are a maximum of 160 vectors distributed among six ARB waves with a minimum of two vectors per wave. The user has control over the length and height of each vector and the number of vectors plus most of the normal wave parameters allowed in the function generator definition.

How to PRESET an ARB Waveform

The BLUE shift ARB key and "AR2" HP-IB command initializes the current ARB wave. Other ARB waves are not affected. The ARB waveform is reduced to two vectors, Height = 0, Length = 1. The ARB wave is reduced by deleting vectors one at a time, beginning with the next to last vector at a rate of ~100 vector deletions per second and then initializing the remaining vectors.

The following ARB parameters are affected when an ARB wave is cleared:

Amplitude 100mVp-p	Number of Vectors 2
Δ t 0.2ms	Vector #1
Frequency 2.5kHz	Vector Height 0
Function . . . . . Triangle	Vector Length 1
Function Invert . . . . . OFF	Vector #2
Mode . . . . . Free Run	Vector Height . . . . . 1F00 *
Modulation . . . . . OFF	Vector Length 1
Offset 0Vdc	Trigger . . . . . Ext, / , 1V
Phase . . . . . 0°	Vector Marker 1

*The last vector is the return to start or close the waveform vector. Its vector height is not programmable! The 3314A displays "1F00" whenever the Vector Marker is set to the last vector and vector height is the displayed parameter.

How ARB Waveforms are Recalled

The ARB key and "AR1" enable the ARB definition of the 3314A. "Arx" (x = 0 through 5) will be displayed for 1/2 second after ARB has been enabled to indicate the active ARB wave. The RCL, ARB and then 0,1,2,3,4 or 5 keys, or "RW0" through "RW5" HP-IB commands, recalls one of six ARB waves. As an ARB wave is built, the current settings are automatically stored in non-volatile

memory. Even if power is lost, the wave parameters remain intact and using the recall ARB wave function will restore the output signal.

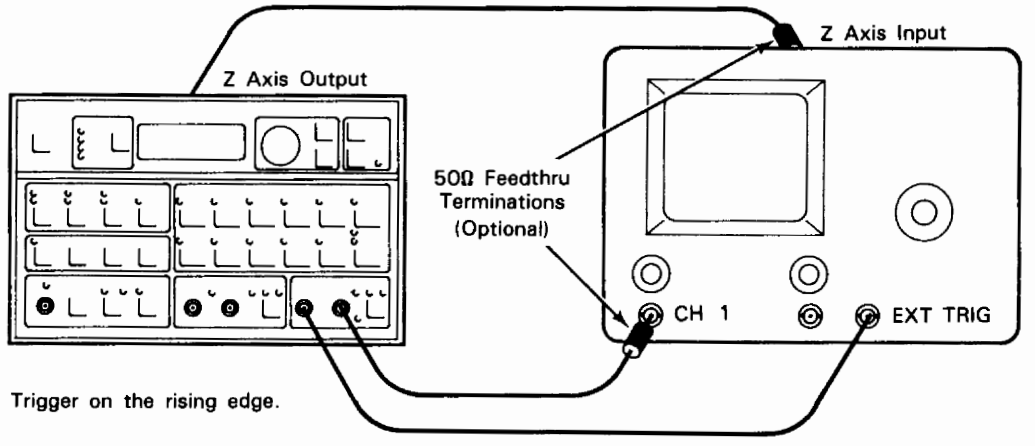
How to Connect an Oscilloscope

The Z Axis output has been designed to intensify the current vector because it is easy to become confused as to which vector is being moldified when ARB waves grow to more than about five vectors. The 3314A is factory set to be compatible with oscilloscopes that intensify the trace when a negative voltage is applied to the Z Axis input. All 3314As have been set at the factory to output a <-5V level during the current vector and 0V during all other vectors. A 50Ω feedthru may be required to reduce the sensitivity of the Z Axis input on certain oscilloscopes.

Definitions

This section contains definitions, descriptions and other pertinent information that is required to operate the ARB portion of the 3314A. The following topics are covered in alphabetical order.

Amplitude
Delete Vector
Δ t
Frequency
Insert Vector
Invert Function
Mode (Free Run or Gate)
Offset
Phase
Preset ARB Wave
Return To Start Vector
Slope
Recall ARB Wave
SYNC Output
Vector Length
Vector Height
Vector Marker



The polarity of the 3314A's Z Axis output is set at the factory to be compatible with oscilloscopes that intensify their display when a negative voltage is applied to their Z Axis input. The Service Manual has instructions for SERVICE TRAINED personnel who are aware of the potential hazards inside the 3314A to change the polarity of the 3314A's Z Axis output. Under no circumstances should any operator remove any screws, covers, shields or other 3314A components.

Figure 3. How To Connect An Oscilloscope

Amplitude. Amplitude sets the peak-to-peak voltage that the ARB wave must exist within (not affected by DC Offset). The peak to peak amplitude also affects the resolution of V HGT (see Vector Height).

Delete Vector. The Delete Vector function deletes 1 vector from the current ARB wave. When a vector is deleted:

-the current vector is deleted (the current vector is the vector pointed to by the Vector Marker and intensified by the Z Axis output).
-the vectors are renumbered.
-the Vector Marker is decremented by 1 and points to the vector that preceded the deleted vector.

The last (return to start) vector cannot be deleted. If the first vector is deleted, the Vector Marker remains pointed at vector number 1.

Δ t. Sets the unit length of all vectors. 0.2ms $\leq \Delta t \leq$ 19.99ms. The length of each vector in time is Δ t (seconds/unit length) times the Vector Length (unit lengths).

ARB (cont)

Frequency. ARB frequency is the repetition rate of the ARB wave and is derived from Δ t. When ARB frequency is changed, a new Δ t is computed. Because of the limited resolution of Δ t, you may not be able to get the exact desired frequency. Δ t programs much faster than ARB Frequency.

$$FREQ = \frac{1}{\Delta t * (V\ LEN_1 + V\ LEN_2 + \ldots V\ LEN_n)}$$

where .200ms $\leq \Delta t \leq$ 1.999ms
or 2.00ms $\leq \Delta t \leq$ 19.99ms

Insert Vector. The Insert Vector function adds 1 vector to the current ARB wave. When a vector is inserted:

-the vector is inserted immediately after the current vector (the current vector is the vector pointed to by the Vector Marker and intensified by the Z Axis output).
-the inserted vector has Vector height = 0, Vector Length = 1.
-the vectors are renumbered.
-the Vector Marker is incremented by 1 and points to the inserted vector.

Invert Function. Invert Function inverts the output signal with respect to the SYNC output. The DC Offset is not affected.

Mode. The only modes allowed in ARB are Free Run and Gate.

-Free Run outputs a continuous signal. All triggers are ignored.
-Gate outputs a continuous signal while the trigger level satisfies the slope and threshold conditions. The output will gate off after the trigger level changes and the waveform is completed.

Offset. DC Offset from -5V to +5V is implemented in ARB exactly as in the Function Generator definition.

Phase. Phase sets the start/finish point of the ARB wave between the peak to peak limits set by Amplitude. The start/finish point is the end point of the last vector. -90° sets the start/finish at the negative amplitude limit; 0° sets the start/finish midway between the limits; and +90° sets the start/finish at the positive amplitude limit.

ARB (cont)

Return To Start Vector. The last vector of every ARB wave must close the waveform. Its Vector Height is not programmable. This vector slews to the Start/Finish point as quickly as possible and remains there until the ARB wave is repeated. "1F00" will be displayed as this vector's height. To reduce the effect of this non-programmable vector, start the ARB wave where its slope = 0 ($\Delta V \div \Delta T = 0$). Use the Phase function to set the Start/Finish point between the peak to peak amplitude.

Slope. $\Delta V \div \Delta T$ (the slope of a vector) is not affected by Vector Length.

$$\Delta V \div \Delta T = \frac{.0008 * V\ HGT * \left(\frac{\text{Amplitude (Vp-p)}}{2} \right)}{\Delta\ t\ \text{(seconds)}}$$

SYNC Output. The SYNC output signal is a TTL low during the last (return to start) vector.

Vector Height. Vector Height sets the end point of every vector except the last vector. Each count in the display sets the end point X volts from the vector's starting voltage.

$$\text{where } X = .0008 * V\ HGT * V\ LEN * \frac{\text{Amplitude (Vp-p)}}{2}$$

The resolution (minimum end voltage step) is:

$$\text{Resolution} = .0008 * V\ LEN * \frac{\text{Amplitude (Vp-p)}}{2}$$

The voltage change can range from 0% (V HGT = 0) to 80% (V HGT = 1999) of the peak to peak amplitude setting in .04% steps, when Vector Length = 1. As the Vector Length increases, the resolution decreases.

Vector Length. The length of a vector in time is determined by Δ t (the unit length of every vector) and Vector Length (variable from 1 to 127 for each vector). To determine each vector's time, multiply its Vector Length by Δ t.

Vector Marker. The Vector Marker points to a single vector (called the current vector). This is the only vector for which V HGT and V LEN can be changed and is the vector intensified by the Z Axis output.

CALIBRATION

The 3314A has amplitude and frequency calibration routines to insure that its performance equals or exceeds the specifications listed in Table 1-1, Specifications in the Service Manual.

NOTE

Specifications apply within 24 hours and 5°C of a CAL ALL performed after a 30 minute initial warm-up.

A 3314A calibration loads new calibration constants into the internal circuitry to insure that the 3314A meets its specifications. In most cases, this requires a measurement routine to generate new data. In cases where accurate correction data is already available, the measurement cycle is not performed. Calibration Disable and Enable refer to the measurement cycle, not the act of calibration.

CALibrate All

A CAL ALL takes ~2 seconds to generate 29 amplitude and frequency calibration constants. The following operations cause the 3314A to completely calibrate itself whether calibration measurements have been disabled or not:

-Power ON (also enables calibration measurements)
-PRESET or "PR" (also enables calibration measurements)
-CAL (BLUE shift RCL) (also enables calibration measurements)
-"CA" (does not enable calibration measurements)

The main signal output will be <15mVp-p at various frequencies, the sync output will be active and "CAL" will be displayed during all calibrations. The 3314A's measurement routine is modified slightly during sweeps to insure accuracy.

Amplitude Calibration

Amplitude calibration occurs whenever the function changes. During an amplitude calibration measurement, the sync output is active (output is a 10kHz, TTL level, squarewave).

Function	Time	Main Output
ALL	<200ms/function	<15mVp-p at 10kHz

CALIBRATION (cont)

The following operations result in an amplitude calibration of the new function:

-FUNCTION key or "FU1", "FU2" or "FU3"
-RECALL 0 through 5 if a new function is recalled
-ARB entry (no measurement) or exit

You cannot force the 3314A to only measure amplitude calibration constants from the front panel while calibration measurements are disabled. From the HP-IB, "CEFUxCD" (where x = the number of the current function), will enable calibration measurements, execute an amplitude calibration and then disable calibration measurements.

Frequency Calibration

Frequency calibrations occur whenever the frequency range changes. During calibration measurements, the sync output is active (output is a TTL level squarewave at the calibration frequency).

Range #	Time	Main Output
8	30 ms	<15mVp-p at the programmed frequency
7	30 ms	<15mVp-p at the programmed frequency
6	30 ms	<15mVp-p at 100kHz
5	30 ms	<15mVp-p at 10kHz
4	30 ms	<15mVp-p at 1kHz
3	100 ms	<15mVp-p at 199.9Hz
2	500 ms	<15mVp-p at *
1	500 ms	<15mVp-p at *

* The 3314A makes 7 measurements at various frequencies to compute the calibration constants for ranges 1 and 2.

The following operations result in a frequency calibration of the new frequency range:

-During frequency entry when a range change occurs
-At mode changes
-RECALL 0 through 5
-Fixed to variable symmetry
-Variable symmetry exit
-Preset symmetry (BLUE shift SYM)
-Preset frequency (BLUE shift FREQ)
-Sweep entry (no measurement) or exit
-ARB entry (no measurement) or exit
-VCO OFF to ON while in ranges 7 or 8

CALIBRATION (cont)

The following operations generate new frequency calibration constants, regardless of calibration measurement disable:

-CAL FREQ (BLUE shift PRESET) (does not enable calibration measurements)
-"CF" (does not enable calibration measurements)

Note: The BLUE shifted function of the PRESET key is not marked on the front panel. Sweep and ARB must be also be OFF.

Calibration Disable, E04

The CAL OFF (BLUE shift STO) key or the "CD" command from the HP-IB, disables all amplitude and frequency calibration measurements. While calibration measurements are disabled, the 3314A will use the calibration constants previously computed and display "E04" (Calibration Not Performed). Since a complete calibration is the only calibration type that generates all 29 constants, it is important to do a CAL ALL (BLUE shift RCL) or "CA", prior to calibration disable and at regular intervals there after. A CAL ALL should be performed every 24 hours or whenever the temperature changes more than 5°C.

The primary advantage for using calibration disable is the time saved when operating via the HP-IB. Note, when operating via the HP-IB with calibration disabled, set Display Errors OFF "DE0". If Display Errors is ON, E04 will be displayed for 1/2 second every time a calibration measurement is not performed. During the time E04 is displayed, all 3314A HP-IB functions are halted.

Calibration Enable

Power ON, the PRESET key, "PR" HP-IB command, the CAL ALL (BLUE shift RCL) key and the "CE" HP-IB command, enable amplitude and frequency calibration measurements. All of these operations cause the execution of a complete calibration, except "CE".

DATA ENTRY

All variables are entered into the 3314A with the MODIFY knob and the RANGE UP or DOWN (↑ or ↓) keys. Variables are entered literally from the HP-IB, see HP-IB Programming for more details.

Modify Knob

The MODIFY knob has 2 distinct modes: a multi speed mode to quickly make large changes and a cursor mode for fine tuning or making constant increments. The 3314A is in cursor when a digit in the display is flashing. The flashing digit is incremented or decremented by 1 every time rotation of the MODIFY knob is sensed. The LEFT and RIGHT ARROW keys move the digit through the display. When no digit is flashing, the 3314A is in the multispeed mode. The display is incremented by 1,2,4,8,16 or 32 depending upon how fast you rotate the Modify knob.

Range Up or Down

The RANGE UP key multiplies the display by 10. The RANGE DOWN key divides the display by 10. If the result would be operation outside the limits of the 3314A, the key and the HP-IB commands "RU" or "RD" are ignored.

Range Hold

Frequency, Amplitude and Offset are implemented in the 3314A with several different hardware configurations, called ranges. Range Hold allows the user to limit the operation to a single hardware configuration. The advantage of Range Hold is that the range of operation without a discrete step is increased. Another advantage from the front panel is the extended range of constant increments. Since the 3314A's output frequency is synthesized in frequency ranges 7 and 8, Range Hold can increase the range of synthesized output frequencies down to 1kHz. The primary disadvantage is reduced resolution in the lower portion of each range.

DATA ENTRY (cont)

Amplitude Range

The 3314A's output level can be set from .00mVp-p to 10.00Vp-p in 4 amplitude ranges. To assert Range Hold from the front panel, press the AMPTD key and then the BLUE shift UP or DOWN ARROW key. To assert Range Hold from the HP-IB, send "APRHx" where x is the Range Number. Note that the amplitude will change when Range Hold is asserted from the HP-IB if the current entry is outside the normal limits or the selected range. Pressing the AMPTD key and then the BLUE shifted UP or DOWN ARROW key or "APRH0" via the HP-IB removes the Range Hold function.

Range Number	Maximum	Minimum	Resolution	Minimum With Range Hold
1	10.00mV	.00mV	.01mV	.00mV
2	100.0mV	10.0mV	.1mV	.0mV
3	1.000V	.100V	1mV	0mV
4	10.00V	1.00V	10mV	00mV

Frequency Range

The 3314A's output frequency can be set from .001Hz to 19.99MHz in 8 frequency ranges. To assert Range Hold from the front panel, press the FREQ key and then the BLUE shift DOWN ARROW key. To assert Range Hold from the HP-IB, send "FRRHx" where x is the Range Number. Note that the frequency will change when Range Hold is asserted from the HP-IB if the current entry is outside the normal limits of the selected range. Pressing the FREQ key and then the BLUE shifted DOWN ARROW key or "FRRH0" via the HP-IB removes the Range Hold function.

Range Number	Maximum	Minimum	Resolution	Minimum With Range Hold
1	1.999Hz	.001Hz	.001Hz	.001Hz
2	19.99Hz	1.50Hz	.01Hz	.01Hz
3	199.9Hz	15.0Hz	.1Hz	.1Hz
4	1.999kHz	150Hz	1Hz	1Hz
5	19.99kHz	1.50kHz	10Hz	10Hz
6	199.9kHz	15.0kHz	100Hz	100Hz
7	1.999MHz	150kHz	1kHz	1kHz
8	19.99MHz	1.50MHz	10kHz	10kHz

DATA ENTRY (cont)

Offset Range

The 3314A's DC Offset can be set from -5V to +5V in 2 offset ranges. To assert Range Hold from the front panel, press the OFFSET key and then the BLUE shifted DOWN ARROW key. To assert Range Hold from the HP-IB, send "OFRHx" where x is the Range Number. Note that the offset will change when Range Hold is asserted from the HP-IB if the current entry is outside the normal limits of the selected range. Pressing the OFFSET key and then the BLUE shifted DOWN ARROW key or "OFRH0" via the HP-IB removes the Range Hold function.

Range Number	Maximum	Minimum	Resolution	Minimum With Range Hold
1	±1.997V	.000V	.002V	.000V
2	±5.00V	2.00V	.01V	.00V

Symmetry

Variable symmetry is not allowed in frequency range 8 and conversely, frequencies ≥2MHz can only be programmed when SYM equals 50% and the SYM light is off. "E01" will be displayed when these two parameters are in conflict.

ERROR CODES

The 3314A constantly monitors several internal functions for out of tolerance operation and checks every operator entry for procedural errors.

Errors While in Local

When an error is detected, "Exx" will be displayed for 1/2 second. If the appropriate bit(s) of the Status Byte are unmasked, that bit is set (=1) and the SRQ message is sent.

Errors While in Remote

"Exx" will be displayed for 1/2 second if Display Errors has not been turned off by "DE0". While "Exx" is displayed, all 3314A HP-IB activity is halted. If the appropriate bit(s) of the Status Byte are unmasked, that bit is set (=1) and the SRQ message is sent.

The HP-IB command "QER" queries errors. The next time the 3314A is addressed to talk after "QER" is received, "ERxx" will be returned, where xx is the error number.

If the appropriate bit of the Status Byte is unmasked, an Error Code will set that bit and set SRQ (Service Request). The affected bits are:

bit #0, indicating an operator error or 3314A failure

bit #1, used as a flag for certain operating conditions

bit #3, indicating an Output Overload condition

ERROR CODES (cont)

Table 3. Error Codes With Status Byte Bit#

Error #	Definition	Status Byte bit #
00	No Error (used via HP-IB, only)	
	--- OPERATOR ERRORS (non-ARB) ---	
01	Frequency/Symmetry conflict	0
02	Bus address entry error	0
03	Front panel failure/Invalid keycode	0
04	Calibration measurement not performed	1
05	Allowed in sweep, only	0
06	Not allowed in sweep	0
07	Not allowed in log sweep	0
08	Store 0 not allowed	0
09	Non-volatile memory lost;battery down	0
	--- OPERATOR ERRORS (ARB) ---	
10	Vector insert not allowed	0
11	Vector delete not allowed	0
18	Allowed in ARB, only	0
19	Not allowed in ARB	0
	--- PLL ERRORS ---	
20	Unstable input frequency	1
21	Input frequency outside of acquisition range	1
22	3314A output frequency would be out of range	1
23	SW/TR INTVL >20ms	1
24	Internal phase locked loop, unlocked	0
	--- FREQUENCY CALIBRATION ERRORS ---	
30	No frequency detected	0
31	Frequency error exceeds correction capability	0
32	Frequency unstable during calibration	0
	--- AMPLITUDE CALIBRATION ERRORS ---	
34	Signal amplitude outside measurement range	0
35	Signal amplitude gain too high	0
36	Signal amplitude gain too low	0
37	Signal amplitude gain exceeds correction capability	0
38	Signal amplitude gain offset exceeds correction capability	0
	--- HP-IB ERRORS ---	
41	Mnemonic invalid	0
42	Definition number invalid	0
43	Data invalid	0
44	Units invalid	0
45	Range Hold not allowed	0
46	ARB/SWEEP parameter conflict	0
47	Not allowed in MAN Sweep	0
	--- OVERLOAD ---	
50	AM or FM/VCO input voltage exceeds normal operating limits	1
51	Output voltage exceeds safe operating limits;	3

EXTERNAL MODULATION

The 3314A modulation capabilities include Amplitude Modulation (AM), Amplitude Modulation Suppressed Carrier (AMSC) and Frequency Modulation (FM). The 3314A can also be used as a Voltage Controlled Oscillator (VCO). All of these operations require an external modulating signal.

Amplitude Modulation

The 3314A's output signal (the carrier) can be amplitude modulated to >100%. The sense of the AM input, along with the carrier, is inverted when Invert Function is asserted.

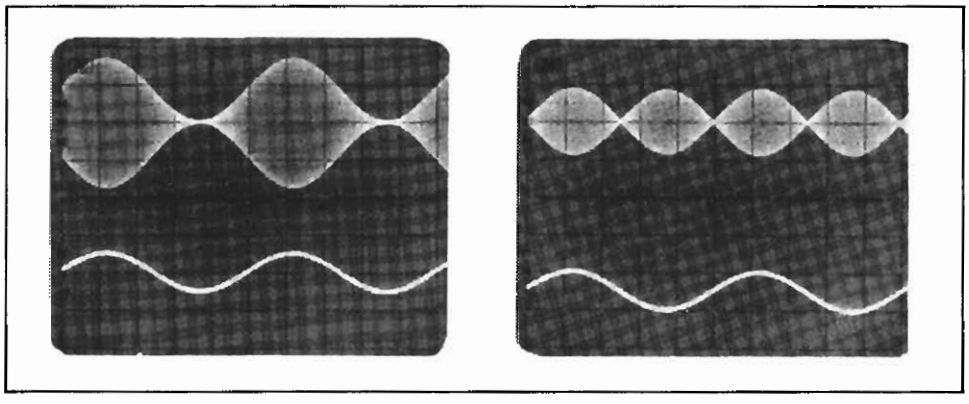


Figure 4. 100% and >100% Amplitude Modulation

AM Input Characteristics. The AM input has these operating characteristics (all values are approximate):

Input Impedance	10kΩ
Input Sensitivity	2Vp-p = 100% (+1V = 2 times carrier ampl) (-1V = 0 times carrier ampl)
Modulation	0 to >100%. Maximum limited by envelope clipping. see AM Input Overload
3dB Bandwidth	DC to 100kHz
Envelope Distortion	see AM Specifications
Carrier Ampl with no input . . .	1/2 Displayed Amplitude

EXTERNAL MODULATION (cont)

The equation defining the relationship of instantaneous modulation voltage to the envelope amplitude is:

$$\text{Venvelope(Vp-p)} = \left(\frac{\text{Vmodulation}}{2} + \frac{1}{2} \right) \times \text{Vcarrier(Vp-p)}$$

where Vcarrier = the 3314A's displayed amplitude and
$-10\text{V} \leq \text{Vmodulation} \leq +10\text{V}$

Observations:

- -The carrier amplitude is 1/2 the displayed value when Vmodulation = 0V.
- -The envelope = 0Vp-p when Vmodulation = -1V.
- -The carrier is 180° out of phase when Venvelope is negative (Vmodulation is more negative than -1V).
- -The Reduce Input light will come on when modulation is ≥100%.

AM Input Overload. The Reduce Input light will come on whenever the AM modulation is ≥100%. AM modulation ≥100% can be sensed from the HP-IB when bit #1 of the Status Byte is unmasked. The Reduce Input light's HP-IB equivalent is "ER50". Envelope distortion occurs when the output clips at approximately 10% over the maximum amplitude allowed in each amplitude range. Note: Amplitude modulation >100% will not necessarily distort the AM envelope. The AM envelope is distorted when distortion sidebands are present, not when the ratio of total sideband power to carrier power is greater than 1. A synchronous AM detector is required to recover the modulating signal undistorted. Note that a non-synchronous detector such as a peak detector, cannot recover the modulating signal, undistorted. The Reduce Input light and "E50" are inhibited while in either of the ϕ Lock modes when the phase locked loop is unlocked.

EXTERNAL MODULATION (cont)

Amplitude Modulation Suppressed Carrier

Note that the Reduce Input light will be ON during Suppressed Carrier operations and should be ignored. The carrier is suppressed whenever the modulating signal is offset by approximately -1VDC (+1V if function invert is asserted). The DC component of the modulating signal controls the amplitude of the carrier from inverted carrier (-2V offset) to suppressed carrier (-1V offset) to normal carrier (+0V offset). The Reduce Input light and "E50" are inhibited while in either of the ϕ Lock modes when the phase locked loop is unlocked.

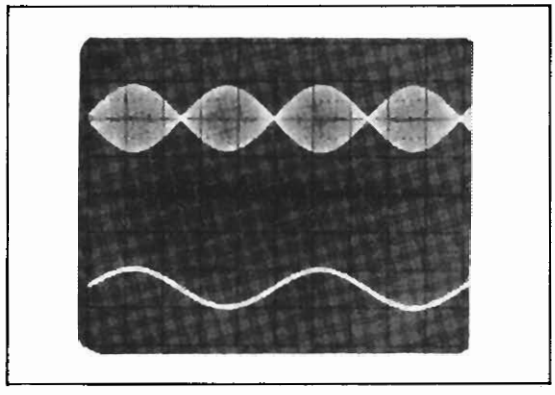


Figure 5. AM Suppressed Carrier

Frequency Modulation

The 3314A's output signal can be Frequency Modulated to deviations of ±1% of the frequency range. The sense of the FM input is not affected by Function Invert. The deviation is constant for all carrier frequencies in the same frequency range as long as the modulating signal is constant.

FM Input Characteristics. The FM input has the following characteristics (all values are approximate):

Input Impedance	10kΩ
Input Sensitivity	2Vp-p = ±1% of freq range (+1Vpeak = +1%) (-1Vpeak = -1%)
Modulation	0 to ±1% deviation
3dB Bandwidth	100Hz to 100kHz (AC coupled)

EXTERNAL MODULATION (cont)

FM Input Overload. The Reduce Input light will be ON when the AC component of the modulating signal exceeds 2Vp-p. The DC component is inconsequential as long as the signal peak is less than ±10V. The Reduce Input light and "E50" are inhibited while in either of the ϕ Lock modes when the phase locked loop is unlocked.

Voltage Controlled Oscillator

The 3314A's output frequency can be controlled over a range of +10% to -100% of the programmed frequency. Note that there must be ≥100 counts in the frequency display.

VCO Input Characteristics. The VCO input has the following input characteristics (all values are approximate):

Input Impedance	10kΩ
Input Sensitivity	10% per Volt (+1V = +10%) (-10V = -100%)
Specified Linear Range	+10% to -80%
Linearity	see VCO Specifications
3dB Bandwidth	DC to 100kHz

VCO Input Overload. The Reduce Input light will be ON when the input signal exceeds +1V or -10V. The Reduce Input light and "E50" are inhibited while in either of the ϕ Lock modes when the phase locked loop is unlocked.

FUNCTIONS

The 3314A outputs Sine, Square and Triangle functions and Arbitrary waveforms (see ARB) with a related signal from the SYNC output. When functions are Off, only DC Offset remains.

Operating Characteristics

These operating characteristics apply to all functions.

Frequency Range	.001Hz to 19.99MHz .001Hz to 1MHz, Opt 001
Amplitude Range	.01mVp-p to 10Vp-p .03mVp-p to 30Vp-p, Opt 001
Variable Symmetry	5% to 95%, Freq < 2MHz
DC Offset	±5VDC, independent of Ampl ±15VDC, Opt 001
Invert Functions	AC component is inverted, DC component not affected
Function OFF	AC component = 0Vp-p, DC component not affected

Haversine. The Haversine function is a special sub-set of the Sine function which is especially suited to driving mechanical systems. To output a Haversine, set the 3314A controls as shown:

Mode	N CYCLE
N	1
Frequency	sets the period of each Haversine
Trigger	Internal
SW/TR INTVL	sets repetition rate of individual Haversines
Phase	-90degrees
Symmetry	changes ratio of rising to falling time without affecting the period
Offset	1/2 of AMPTD (-1/2 of AMPTD if +90°)

MODE

The 3314A is a multi-mode function generator including:

GENERATOR
- Free Run
- Gate

BURST
- N Cycle
- 1/2 Cycle

PHASE LOCK
- Fin X N
- Fin ÷ N

ARB
- see the ARB topic

Free Run

The 3314A output is continuous when in Free Run. Triggers are ignored unless the 3314A is sweeping, when they are used as sweep start signals.

Gate

The 3314A output is controlled by the trigger level. When the trigger level satisfies the trigger slope and threshold conditions, the output is ON. The output will gate OFF at the output signal's first transition through the Stop Phase after the trigger signal changes level.

N Cycle

The 3314A output is a counted burst of N whole cycles. The trigger edge that satifies the trigger slope and threshold conditions will initiate an N cycle burst.

1/2 Cycle

The 3314A output is alternate 1/2 cycles (180°). The trigger edge that satifies the trigger slope and threshold conditions will initiate a 1/2 cycle burst.

MODE (cont)

Fin X N

The 3314A output frequency will be N times the reference frequency. The reference and 3314A frequencies are limited from 50Hz to 19.99MHz.

Lock acquisition by the 3314A is completely automatic unless Frequency Range Hold is asserted. Whenever the reference frequency drifts more than 10%, the 3314A auto-acquisition re-establishes phase lock. When the Fin X N light is flashing, the 3314A is acquiring phase lock. The acquisition procedure used by the 3314A is:

-measure the reference frequency.
-display E20 and stop acquisition if the reference frequency is unstable.
-set the 3314A frequency to N times the reference frequency.
-turn the phase locked loop ON and acquire lock.

The 3314A will not proceed past the measurement step if the reference frequency is changing (see Pre-Tuning the 3314A's Oscillator). The 3314A may be able to acquire phase lock to a changing reference if you try the following:

-while in FREE RUN, set the 3314A frequency to N times the reference frequency.
-set Frequency Range Hold ON.
-change the mode to Fin X N.

At this time, there are 2 primary concerns which will preclude acquiring phase lock.

1. The 3314A's output frequency is limited to +10% and -50% of the displayed value. Note that the Fin X N light will flash when the frequency exceeds ±10%.

2. The reference frequency change must be within the bandwidth of the 3314A's phase locked loop.

MODE (cont)

The approximate bandwidth of the phase locked loop can be determined using this formula:

$$B.W. = .2 \left(\frac{\text{DISPLAYED FREQ}}{2N * A} \right)^{.72}$$

where A = 1 if the EXT REF FREQ is < 2MHz
A = 5 if the EXT REF FREQ is ≥ 2MHz
N = selected N parameter

Note that the 3314A will not update its frequency display unless the loop goes out of lock (the Fin X N light flashes) and Frequency Range Hold is OFF.

Fin ÷ N

The 3314A output frequency is the reference frequency divided by N. The reference and 3314A frequency range is limited from 50Hz to 19.99MHz.

Lock acquisition by the 3314A is completely automatic unless Frequency Range Hold is asserted. Whenever the reference frequency drifts more than 10%, the 3314A auto-acquisition re-establishes phase lock. When the Fin ÷ N light is flashing, the 3314A is acquiring phase lock. The acquisition procedure used by the 3314A is:

-measure the reference frequency.
-display E20 and stop acquisition if the reference frequency is unstable.
-set the 3314A frequency to N times the reference frequency.
-turn the phase locked loop ON and acquire lock.

The 3314A will not proceed past the measurement step if the reference frequency is changing (see Pre-Tuning the 3314A's Oscillator). The 3314A may be able to acquire phase lock to a changing reference if you try the following:

-while in FREE RUN, set the 3314A frequency to the reference frequency divided by N.
-set Frequency Range Hold ON.
-change the mode to Fin ÷ N.

MODE (cont)

At this time, there are 2 primary concerns which preclude acquiring phase lock.

1. The 3314A's output frequency is limited to +10% and -50% of the displayed value.

2. The reference frequency change must be within the bandwidth of the 3314A's phase locked loop.

The approximate bandwidth of the phase locked loop can be determined using this formula:

$$B.W. = .2 \left(\frac{\text{DISPLAYED FREQ}}{2A} \right) .72$$

where A = 1 if the EXT REF FREQ is < 2MHz
A = 5 if the EXT REF FREQ is ≥ 2MHZ

Note that the 3314A will not update its frequency display unless the loop goes out of lock (the Fin ÷ N light flashes) and Frequency Range Hold is OFF.

Pre-tuning The 3314A's Oscillator

The 3314A's phase-lock capability can be greatly extended if you pre-tune its oscillator frequency using the VCO or FM modulation capabilities.

Use the VCO input if you have a signal that is proportional to the reference frequency. You will probably have to turn auto-acquisition off with FREQ Range Hold and set the 3314A's center frequency manually. Any error between the VCO input signal and the reference frequency must be corrected by the 3314A's PLL and hence, must be within the loop bandwidth. The 3314A's output frequency can range +10% to -50% without losing lock.

Note that when the 3314A's output frequency deviates >10% from the displayed frequency, one of the ϕ LCK lights will flash. This does not necessarily indicate an out of lock condition.

OPERATOR ALERTS

The 3314A will automatically re-program certain parameters when an operator selects related functions or in the case of DC Offset, Marker Frequency and ARB Frequency, when the operator tries to program the 3314A to values that are not allowed. This feature helps the operator by not forbidding an operation because of an arbitrary operating rule, or because the functions were selected out of order. Since the operator may not expect these changes, the 3314A has Operator Alerts.

The operator is "Alerted" from the front panel when the 3314A causes the altered parameter's light to flash on and off very quickly.

The operator is "Alerted" from the HP-IB by the SRQ message, only if bit #2 of the Status Byte is unmasked. Note that bit #2 will never be set if masked.

Alerts While Programming DC Offset

The 3314A only allows DC Offsets of:

.xx0Vdc
.xx2Vdc
.xx5Vdc
.xx7Vdc

If you attempt to set the Offset to some other value, .xx3 for example, the 3314A will set the Offset to the closest allowed offset and "Alert" the operator.

Alerts While Programming The Marker Frequency

If you attempt to set the Marker Frequency outside of the limits set by the Start and Stop Frequencies, the 3314A will set the Marker Frequency to the closest sweep end frequency and "Alert" the operator.

Alerts While Changing Modes

When you change from either of the Phase Lock modes to any other mode, the Phase parameter limits change from $\pm 199.9°$ to $\pm 90°$. If the Phase prior to changing modes was $> \pm 90°$, the 3314A will set the phase = 0° and "Alert" the operator.

OPERATOR ALERTS (cont)

Alerts When Entering Linear or Log Sweep

When you enter either sweep type or change from Linear to Log Sweep, the lower time limit changes from .002ms (non-sweeping Trigger Interval) to 7.20ms (Linear Sweep Interval) to 40.00ms (Log Sweep Interval). The 3314A will set the time to the new lower limit and "Alert" the operator.

Alerts When Programming ARB Frequency

ARB Frequency is limited to 1/(multiples of Δ t). If you attempt to set the ARB Frequency to a value that is not allowed, the 3314A will select the closest allowed frequency and "Alert" the operator.

OUTPUTS

The 3314A has the following outputs:

-Main Signal Output
-SYNC Output
-Trigger Output (active when Trigger is internal)
-X Axis/Phase Output
-Z Axis Output
-X3 Output (Option 001)

All of the connectors are of the BNC type. The shields are connected to the 3314A's chassis and protective earth terminal.

Main Signal Output

This fully protected output has a characteristic output impedance of 50Ω. This output must be terminated with a 50Ω load before the displayed amplitude is correct and before the specifications apply. Operation into $>50\Omega$ is allowed with a proportional increase in amplitude and offset. Operation into $<50\Omega$ is allowed with a proportional decrease in amplitude and offset. When operating into other than 50Ω, expect the performance to decrease, especially at higher frequencies because of transmission line mis-matches.

Output Overload "E51". The 3314A main signal output will disconnect itself from externally applied voltages greater than ±15V peak. E51 is displayed while this voltage is present. The 3314A will automatically reconnect itself after the voltage is removed.

SYNC Output

This fully protected output has a characteristic output impedance of $\sim 50\Omega$ when terminated into $\leq 50\Omega$. When terminated into $>50\Omega$, it will deliver TTL compatible levels (0V to >2.5V). The maximum unloaded voltage is limited to ~3V. The SYNC output will disconnect itself from externally applied voltages outside the range of -.5V to +5.5V.

OUTPUTS (cont)

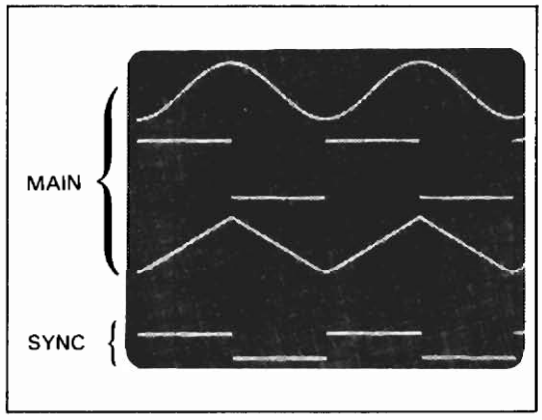


Figure 6. SYNC Output Relationships

Trigger Output

The Trigger port is an output when the selected trigger source is internal. This port provides a squarewave (0V and ~3V) from a 1kΩ source impedance whose edges are related to the internal trigger interval generator. The Trigger port is protected from externally applied voltages up to ±15V.

X Axis/Phase Output

When sweeps are active, this output produces a voltage ramp from -5V to +5V whose voltage is proportional to the sweep frequency.

When sweeps are not active, this output produces a voltage from -3.2V to +5V that is proportional to the magnitude of the Start/Stop Phase or -5V to +5V that is proportional to the Phase offset during phase locked loop operation.

X3 Output (Option 001)

When the Main output is terminated into 50Ω and the X3 Output is terminated into >500Ω, the output amplitude and DC offset will be 3 times the displayed value. This output cannot source more than 30mA peak current without clipping the output waveform.

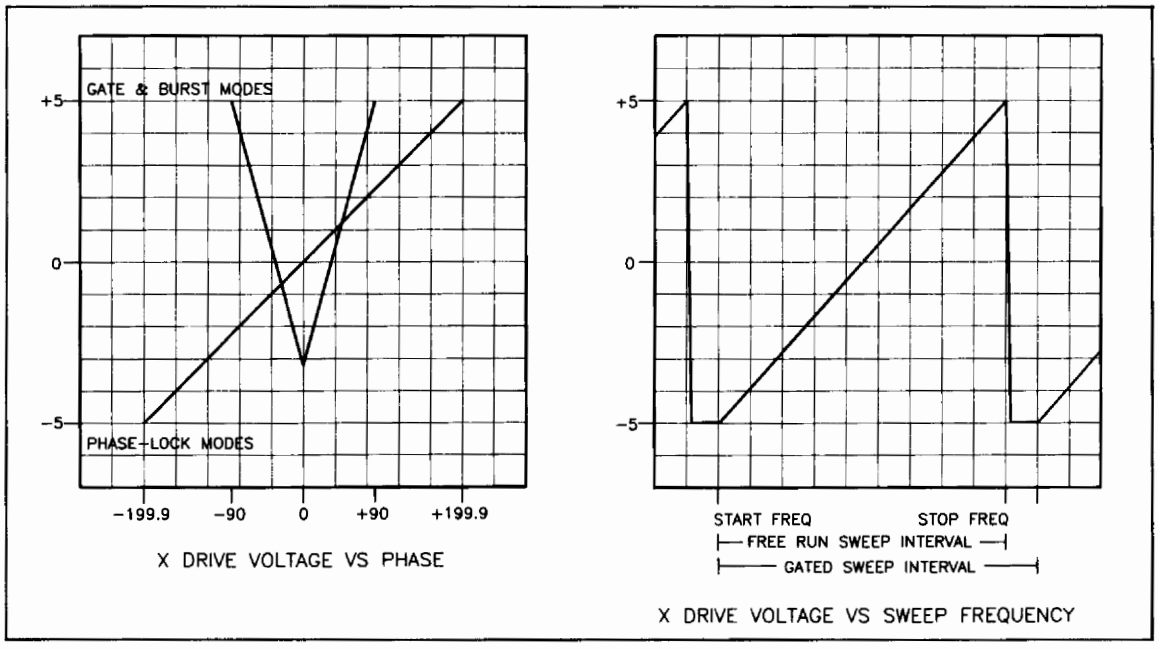


Figure 7. X AXIS Output

Z Axis Output

This output produces three voltage levels to control the intensity of an oscilloscope display. The sense of this output can be inverted by Service Trained Personnel using instructions located in the Service Manual.

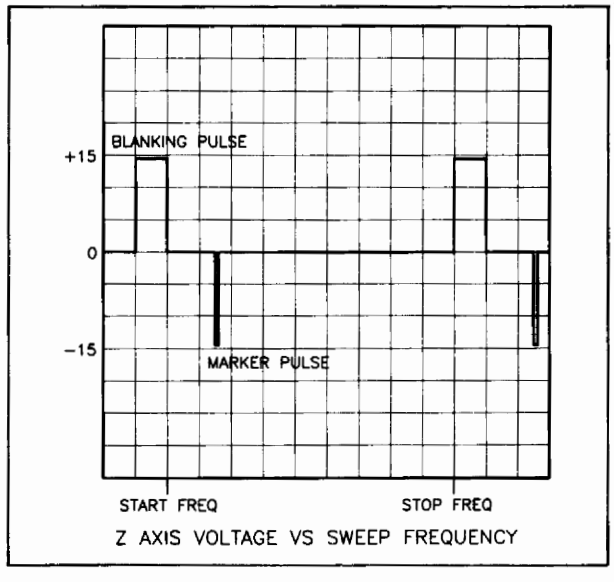


Figure 8. Z AXIS Output

PRESET

The PRESET key and the "PR" HP-IB command reconfigure the 3314A to an initialized state. This configuration is especially useful as a repeatable operating state to begin programming from and as a quick way to recover from complex operating states. The 3314A funcions and their initialized states are:

Function	Preset Condition
Amplitude	100mVp-p (10mVp-p at turn on)
Amplitude Modulation	Off
ARB Mode	Off
ARB Waveforms	not affected
Calibration	Executes a CAL ALL
Data Transfer Mode	not affected
Δ t (ARB)	not affected
Display Errors (HP-IB)	not affected
Frequency	1kHz
Frequency Modulation	Off
Function Invert	Off
Manual Sweep	Off
Marker Frequency	5kHz
Mode	Free Run
N	1
Offset	0VDC
Phase	0 Degrees
PLL Mask (Status Byte)	not affected
Range Hold	Off

Function	Preset Condition
SRQ Mask (Status Byte)	not affected
Start Frequency	1kHz
Status Byte (HP-IB)	not affected
Stop Frequency	10kHz
Storage Registers	not affected
Sweep	Off
Sweep Mask (Status Byte)	not affected
Sweep Interval (Linear)	10ms
Sweep Interval (Log)	40ms
Symmetry	50%
Trigger Interval	10ms
Trigger Slope	/ (positive)
Trigger Source	Internal
Trigger Threshold	1V (TTL)
VCO	Off
Vector Height (ARB)	not affected
Vector Length (ARB)	not affected
Vector Marker (ARB)	not affected

The BLUE shifted ARB key or the "AR2" HP-IB command, intitializes the current ARB waveform. The following ARB parameters are affected:

Function	Initialized Condition
Amplitude	100mVp-p
Δ t	0.2ms
Frequency	2.5kHz
Function	Triangle
Function Invert	Off
Mode	Free Run
Modulation	Off
Offset	0VDC
Phase	0 Degrees
Number of Vectors	2

Function	Initialized Condition
Vector #1	
Vector Height	000
Vector Length	001
Vector #2	
Vector Height	1F00 *
Vector Length	001
Trigger Slope	/ (positive)
Trigger Source	External
Trigger Threshold	1V
Vector Marker	001

*The Vector Height of the last vector is "1F00" to indicate that it is not programmable.

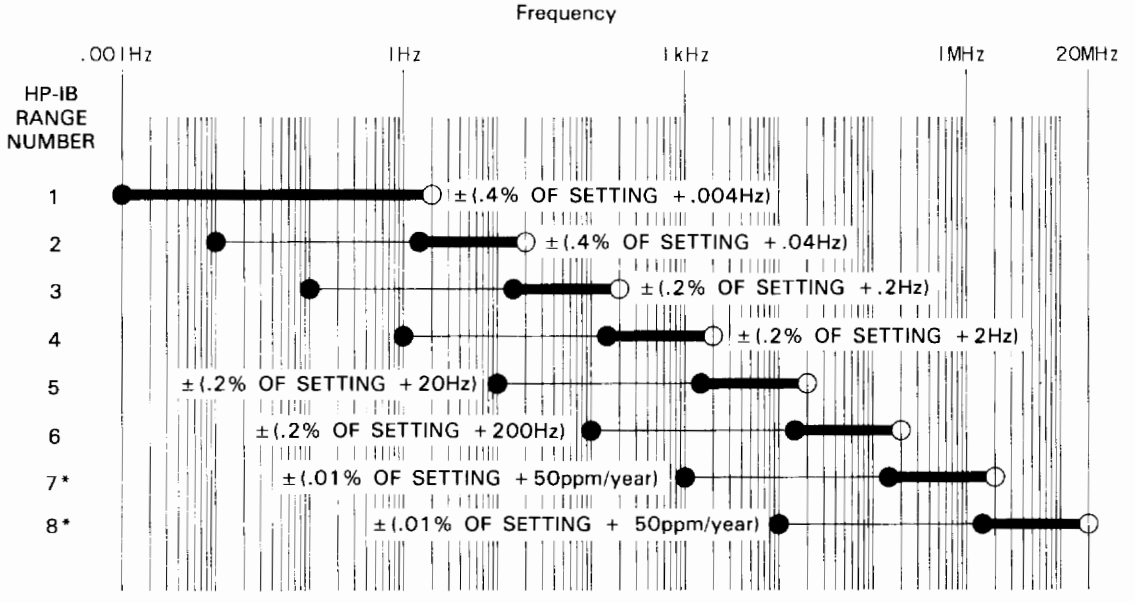
How to COMPLETELY Preset the 3314A

If you hold the PRESET key in while power is cycled Off and then On, the 3314A resets all of its memory. After the normal start up, the 3314A will display "E09" for 1/2 second. This feature should be used whenever you think the 3314A is malfunctioning to clear the non-volatile memory.

SPECIFICATIONS

The specifications listed here are taken from the Service Manual at the time this manual was printed. They may not apply to your instrument if the manuals were not printed at the same time. Refer to the Service Manual to determine the exact specifications that apply to your instrument. This table contains specifications only. The rest of this manual deals with operating characteristics and includes specifications where necessary.

Frequency Accuracy



DENOTES FREQUENCY RANGE USING AUTO-RANGING.

DENOTES EXTENDED FREQUENCY RANGE USING RANGE HOLD.

○ FREQUENCIES UP TO BUT NOT INCLUDING THIS POINT ARE ALLOWED.

* FREQUENCY IS SYNTHESIZED IN RANGES 7 AND 8 IN THE FREE RUN MODE WITH VCO = OFF.

ACCURACY APPLIES IN THE FREE RUN MODE WITH SYMMETRY = 50% (FIXED), AND VCO = OFF AND WITH RANGE HOLD ON OR OFF.

SPECIFICATIONS (cont)

Amplitude

Absolute Amplitude Accuracy:

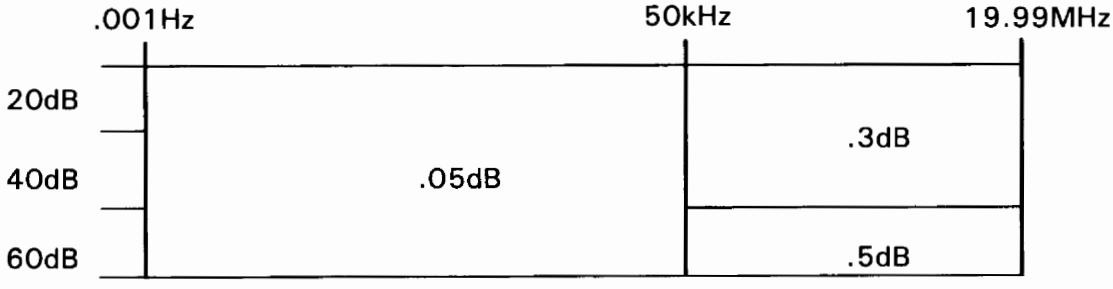
±(1% of display +.035Vp-p), sinewave and squarewave
±(1% of display +.06Vp-p), triangle

Amplitudes: 1.00Vp-p to 10.00Vp-p (Range 4)
Frequency: 10kHz
Auto-Range: ON

Flatness--sine wave:

Relative to 10kHz, 1.00 V to 10.00Vp-p (Range 4)

Step Attenuator Accuracy:



SPECIFICATIONS (cont)

DC Offset

Offset Accuracy:

±(3% of display +10 mVDC +0.5% of AC Amplitude Range)

Frequency: <100kHz
Auto-Range: ON

Residual DC Offset:

< ±.5% of AC Amplitude Range

Setting: OVDC
Frequency: ≤100kHz

Symmetry

Symmetry Accuracy (Fixed):

50% ±0.2%

Fixed Symmetry: 50% (SYM light OFF)
Frequency: 1Hz to 100kHz
Function: square wave

Symmetry Accuracy (Variable)

±0.5% of period:

Frequency: 1Hz to 100kHz
Function: square wave

SPECIFICATIONS (cont)

Phase

Phase Offset--Phase lock Modes:

Accuracy: ±2° (50Hz to 25kHz)

Phase Offset is referenced to the signal output for Fin ÷ N or the trigger input for Fin X N.

Start/Stop Phase--Burst Modes:

Accuracy: ±3° (applies from .001Hz to 1kHz)

Function Characteristics

Sine Harmonic Distortion:

Individual harmonics will be below these levels, relative to the carrier level. Offset = OV. Function Invert = OFF. *Add 4dB for ambient temperature 0 to 5°C or 45 to 55°C.

20Hz	50kHz	1999kHz	19.99MHz
−55dB*	−40dB	−25dB	

Square Wave Rise/Fall Time:

≤9ns, 10% to 90% of a 10 Vp-p output

Square Wave Aberrations:

<5% at 10 Vp-p output

Triangle Linearity:

±0.2% of the p-p voltage

Frequency: .01 Hz to 1kHz, Amplitude = 10 Vp-p
Deviation is from a best fit straight line, from 10% to 90% of each ramp.

SPECIFICATIONS (cont)

Internal Trigger Interval

Period Accuracy: ±(0.01% + 50 ppm/year) of displayed interval (excluding sweep intervals)

Frequency Sweep

Sweep Frequency Accuracy--Manual Sweep:

±(0.2% of Stop Freq +0.1% of Stop Freq Range), Stop Freq Range ≤200kHz
±1% of Stop Freq, Stop Freq in 2MHz Range
±3% of Stop Freq, Stop Freq in 20MHz Range

Modulation

Amplitude Modulation Envelope Distortion:

≤ −40dB

Carrier: = 1MHz, 10Vp-p, sine wave
Modulating Input: 1kHz, sine wave
Index of Modulation: 95%

VCO Linearity:

±0.15% of p-p frequency, .1Hz through 200kHz Range
±1% of p-p frequency, 2MHz Range
±3% of p-p frequency, 20 MHz Range

−8 Vdc to +1 Vdc input (−80% to +10%)
Deviation is from a best fit straight line.

SPECIFICATIONS (cont)

Option 001--Simultaneous X 3 Output

Specifications for Option 001 were not available for this printing.

SPECIFICATIONS (cont)

General

Specifications apply when:

Main signal output is terminated into 50 ±0.1 ohms
Warm-up is ≥30 minutes
Within ±5°C, and 24 hours of last internal calibration
Temperature 0° to 55°C
Relative Humidity ≤95% at 40°C
Altitude ≤ 15,000 ft.

Storage Limits:

Temperature −40°to +75°C
Altitude ≤ 50,000 ft.

Power:

100/120/220/240 V, +5% −10%, 48 to 66 Hz
90 VA maximum

Weight:

7.3 kg (16 lbs) net
10.5 kg (23 lbs) shipping

Dimensions:

132.6 mm (5.22 in) high
212.3 mm (8.36 in) wide
419.0 mm (16.50 in) deep

Accessories Included:

11048C 50 ohm feed through

Accessories:

Transit case for one 3314A; -hp- #9211-2677

STORE & RECALL

The 3314A has 6 registers (0 through 5) where non-ARB front panel settings can be stored. Register 0 is reserved for the front panel setting at power off. Register 1 through 5 are reserved for the operator. In addition to these non-ARB registers are 6 more ARB registers (ARB 0 through ARB 5).

How to Store and Recall Front Panel Settings

You can store the current (non-ARB) settings using the STO key followed by one of the keys in the top row of the Entry key group. The register number where the settings will be stored are located to the upper right of each key. To recall a front panel, use the RCL key followed by one of the Entry keys. RCL 0 will recall the front panel setting when the 3314A last lost power or was turned Off. Note that if a series of power failures occurs, you will still be able to recover the last front panel setting you used.

How to Recall ARB Waveforms

There are 6 ARB waveforms stored in the 3314A. The wave parameters are stored into the proper ARB register as the waveform is created. There is no key or command to store an ARB waveform. To recall a waveform, use the RCL and ARB keys, followed by one of the keys in the Entry Group. The number to the upper right of each key indicates the ARB wave that will be recalled. The 3314A will display "Arx" for 1/2 second to indicate which ARB wave was recalled.

REMOTE OPERATION

This section contains remote (HP-IB) operating information organized into the following topics:

The HP-IB

- What is the HP-IB
- How does the HP-IB operate
- HP-IB specifications summary
- The 12 HP-IB Messages

The 3314A and the HP-IB

- The 3314A's HP-IB capability
- 3314A/HP-IB verification
- Analyzing bus problems

The 3314A's HP-IB Address

- How to view the 3314A's HP-IB Address
- How to change the 3314A's HP-IB Address
- Listen Only

The Clear Message

The Data Message

- Immediate Execution Type Commands
- Function Select Type Commands
- Data Entry Type Commands
- Query Type Commands

The Status Byte

- Bit Definitions
- Masking the Status Byte

The Trigger Message

HP-IB Programming Summary

THE HP-IB

What Is The HP-IB

The Hewlett Packard Interface Bus is an easy to use, high performance bus structure that links the 3314A and other instruments, desktop computers and minicomputers into automated measurement systems. The HP-IB is a worldwide instrumentation interface standard (IEEE Standard 488-1978, ANSI Standard MC 1.1 and IEC Recommendation 625-1).

How Does The HP-IB Operate

All of the active interface circuits are contained within the various HP-IB devices. The interconnecting cable is entirely passive. The cable's role is limited to connecting all of the devices in parallel, so that data can be transferred from one device to another.

Every participating device must be able to perform at least one of these roles: TALKER, LISTENER, or CONTROLLER. A TALKER transmits data to other devices called LISTENERS. Most devices can perform both roles, but not at the same time. A CONTROLLER manages the operation of the bus system by designating which device is to Talk and which device(s) are to Listen at any given time. The 3314A can be a Talker and a Listener, however, it has no Controller capabilities.

The minimum HP-IB system consists of one TALKER and one LISTENER without a CONTROLLER. In this configuration, data transfer is limited to one direction because one device must be manually set to "TALK ONLY" and the other device must be manually set to "LISTEN ONLY". The 3314A can be set to Listen Only, but not to Talk Only.

The full flexibility and power of the HP-IB is realized when a CONTROLLER is added to the system. An HP-IB CONTROLLER participates in the measurement by being programmed to:

- schedule measurement tasks
- set up instruments
- monitor the measurement
- interpret and operate upon the results

THE HP-IB (cont)

HP-IB Specifications Summary

Number of Interconnected Devices:

Up to 15 maximum on one contiguous bus.

Interconnection Path/Maximum Cable Length:

Star or linear bus network; total tranmission path length = 2 metres times number of devices, or 20 metres, whichever is less.

Message Transfer Scheme:

Byte-serial, 8 bit-parallel asynchronous data transfer using a 3 wire handshake.

Data Rate:

One megabyte per second, maximum over limited distances, actual data rate depends upon the capability of the slowest device involved in the transmission. (The 3314A's maximum data rate is approximately 3ms per character when using Data Transfer Mode 2.)

Address Capability:

Primary addresses: 31 talk, 31 listen. Secondary addresses: 961 talk, 961 listen. 1 Talker and 14 listeners, maximum at one time. (The 3314A does not have secondary, extended address capability.)

Control Shift:

In systems with more than one controller, only one can be active at a time. The active controller can pass control to another controller, but only the system controller can assume unconditional control. Only one system controller is allowed. The system controller is hard-wired to assume bus control after a power failure or other catastrophic calamity.

Interface Circuits:

Driver and receiver circuits are TTL compatible.

THE HP-IB (cont)

The 12 HP-IB Messages

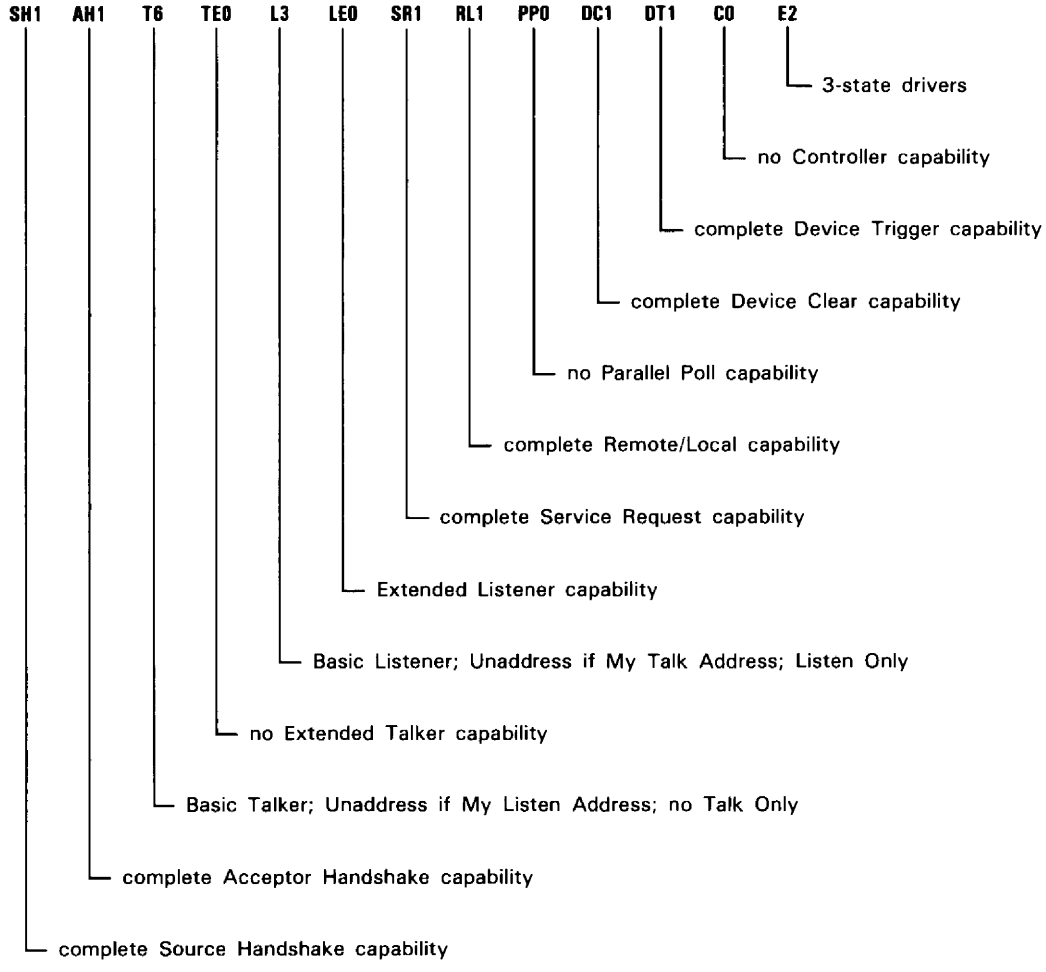
There are 12 specific messages that can be sent via the HP-IB. You may not use all 12, nor does the 3314A respond to all 12, however, knowledge about each is required if you wish to optimize your HP-IB system.

Message	Example (-hp-9845)
CLEAR Causes the 3314A to reconfigure as if the PRESET key had been pressed. (see THE CLEAR MESSAGE)	CLEAR 7 CLEAR 707 OUTPUT 707;"PR"
CLEAR LOCKOUT/SET LOCAL Enables the 3314A's LOCAL key and switches all devices from remote to local	LOCAL 7
DATA This message is used to configure the 3314A. This message is also used to make the 3314A return information requested with query. (see THE DATA MESSAGE)	OUTPUT 707;"CA" OUTPUT 707;"MO2" OUTPUT 707;"FR2MZ" OUTPUT 707;"QER"
LOCAL Switches control of the 3314A from remote to local.	LOCAL 707
LOCAL LOCKOUT Disables the 3314A's LOCAL key to secure the system from casual operator interference.	LOCAL LOCKOUT 7
PARALLEL POLL Controller request that all devices previously programmed to respond, send their Status Bit. The 3314A does not respond.	
PASS CONTROL Shifts system control from one controller to another. The 3314A does not respond.	
REMOTE Switches control of the 3314A from local to remote when it is addressed.	REMOTE 7 REMOTE 707
REQUEST SERVICE When unmasked, one or a combination of 3314A operating conditions can set bus line SRQ true, requesting service from the controller. (see THE STATUS BYTE)	
SERIAL POLL Controller request that the 3314A send its Status Byte. Encoded into the 8 bits are the states of several 3314A operating parameters. (see THE STATUS BYTE)	STATUS 707;S
TAKE CONTROL/ABORT I/O Unconditional assumption of control by the system controller; halts all bus activity. The 3314A becomes unaddressed.	ABORTIO 7
TRIGGER The 3314A responds to a HP-IB Trigger as it would to any other external triggaer to gate the output signal on or off, start N or 1/2 Cycle bursts and start single sweeps. (see THE TRIGGER MESSAGE)	TRIGGER 7 TRIGGER 707 OUTPUT 707;"MN"

THE 3314A AND THE HP-IB

THE 3314A's HP-IB Capability

The 3314A has these capabilities, as defined by IEEE Standard 488-1978:



The 3314A's data transfer rate is approximately 3ms per character when using Data Transfer Mode 2. Data transfer rate is dependent upon the specific Programming Code sent in Data Transfer Mode 1.

THE 3314A AND THE HP-IB (cont)

3314A/HP-IB Verification

Refer to the Controller Operating Manual and find the section describing the HP-IB REMOTE Message. When this message is sent to the 3314A, the REMOTE annunciator should light. If this does not occur, recheck the cabling, the 3314A address and the syntax of the controller statement. Here are 2 examples of the REMOTE Message as implemented by several -hp- controllers:

```
REMOTE 707      -hp- 9826/9835/9845/85 "BASIC"
rem 707         -hp- 9825/9826 "HPL"
```

Analyzing Bus Problems

Hardware and software problems tend to have the same set of symptoms on the HP-IB. In response to the need to quickly find the source of the problem, -hp- developed the 59401A Bus System Analyzer. It simplifies diagnosis of bus problems by allowing the user to see the status of all bus lines, including the actual ASCII characters on the bus data lines. Because the 59401A can drive all bus lines, it can completely exercise another Talker, Listener, or Controller.

THE 3314A's HP-IB ADDRESS

How To View The 3314A's HP-IB Address

The 3314A's HP-IB address is set to 7 at the factory and stored in a non-volatile memory (there are no address switches). To make the 3314A display its address:

1. Press the BLUE shift key and then the LOCAL key. The current address will be displayed for 1/2 second.

How To Change The 3314A's HP-IB Address

Every device on the HP-IB must have a unique address. The 3314A address can be set at any address between 0 and 30, inclusive. When choosing an address, remember that the controller also has an address (usually 21). To change the HP-IB address:

1. Press the RECALL and then the LOCAL key to display the current HP-IB address.

2. Rotate the Modify knob to change the HP-IB address.

3. Press the STORE and then the LOCAL key to execute the entry.

The 3314A's HP-IB address is stored in a non-volatile memory. If the contents of this memory is destroyed, the HP-IB address defaults to 7. The 3314A will display E09 at power on when the contents have not been retained.

The Talk and Listen addresses are ASCII characters. When a device receives one of these characters while ATN is true, it will become addressed. The ASCII character ? will unaddress all devices. The Device address (set from the 3314A front panel) is used by most newer HP-IB controllers which automatically send the Talk and Listen address characters.

THE 3314A's HP-IB ADDRESS (cont)

Listen Only

When the HP-IB address is incremented past 30, the 3314A switches to Listen Only and displays "L-O". In this mode, the 3314A receives every byte of information on the bus, and assumes that the code was intended for its own use. If information is sent to the 3314A that it can not understand, the 3314A will ignore those commands and set the appropriate errors. If the 3314A is addressed to Talk, the bus will "hang up" because the 3314A's Talk capability is overriden by Listen Only. The primary application for Listen Only, is in a HP-IB system with a Talk Only device, such as a card reader.

Device/Listen/Talk Addresses

Use the table that follows if you are using a controller in the command mode or a controller that requires the talk and listen addresses instead of the device address:

Table 5. HP-IB Addresses

Device	Talk	Listen	
0	@	SP	
1	A	!	
2	B	"	
3	C	#	
4	D	$	
5	E	%	
6	F	&	
7	G	'	(3314A factory setting)
8	H	(	
9	I	)	
10	J	*	
11	K	+	
12	L	,	
13	M	-	
14	N	.	
15	O	/	
16	P	0	
17	Q	1	
18	R	2	
19	S	3	
20	T	4	
21	U	5	(usually the controller)
22	V	6	
23	W	7	
24	X	8	
25	Y	9	
26	Z	:	
27	[	;	
28	\	<	
29	]	=	
30	^	>	
Listen Only			

THE CLEAR MESSAGE

The 3314A responds to the device clear message (DCL), the selected device clear message (SDC) and the command "PR" by configuring itself to its initialized state.

Basic Language (-hp-9845) EXAMPLES:

all on 7	CLEAR 7
3314A only	CLEAR 707
3314A only	OUTPUT 707;"PR"

HPL LANGUAGE (-hp-9825) EXAMPLES:

all on 7	clr 7
3314A only	clr 707
3314A only	wrt 707,"PR"

The functions affected by the clear message with the "preset" conditions are:

Function	Preset Condition	Function	Preset Condition
Amplitude	100mVp-p (10mVp-p at turn on)	Range Hold	Off
Amplitude Modulation	Off	SRQ Mask (Status Byte)	not affected
ARB Mode	Off	Start Frequency	1kHz
ARB Waveforms	not affected	Status Byte (HP-IB)	not affected
Calibration	Executes a CAL ALL	Stop Frequency	10kHz
Data Transfer Mode	not affected	Storage Registers	not affected
Δ t (ARB)	not affected	Sweep	Off
Display Errors (HP-IB)	not affected	Sweep Mask (Status Byte)	not affected
Frequency	1kHz	Sweep Interval (Linear)	10ms
Frequency Modulation	Off	Sweep Interval (Log)	40ms
Function Invert	Off	Symmetry	50%
Manual Sweep	Off	Trigger Interval	10ms
Marker Frequency	5kHz	Trigger Slope	/ (positive)
Mode	Free Run	Trigger Source	Internal
N	1	Trigger Threshold	1V (TTL)
Offset	0VDC	VCO	Off
Phase	0 Degrees	Vector Height (ARB)	not affected
PLL Mask (Status Byte)	not affected		

THE DATA MESSAGE

The Data Message is used to send Programming Codes to the 3314A. Programming Codes and front panel key functions have a 1 to 1 relationship in most cases, that is, to change the mode to Gate, the Program Code "MO2" would be sent. MO2 is the remote equivalent of pressing the GEN key in local. Exceptions to this rule are:

Front panel functions not allowed in remote operation:

Shift Cursor Right
Shift Cursor Left
Continuous Tuning (The Modify knob)
HP-IB Address Viewing and Selection
BLUE shift key (shifted functions have their own programming codes)

Remote functions not allowed from the front panel:

Data Transfer Mode Selection
Display Errors (ON or Off)
SRQ Mask
Status Byte Masking
Status Byte

3314A Program Codes have been categorized into 4 distinct groups to help explain them. The 3314A does not distinguish between these categories. The 4 categories are:

Immediate Execute Commands

2 letter commands causing immediate action

Function Select Commands

2 letter prefix plus a qualifier digit that selects a particular state of that function

THE DATA MESSAGE (cont)

Data Entry Commands

2 letter prefix followed by numerical data and then a 2 letter suffix denoting the units and executing the entry

Query Commands

Q followed by a 2 letter command to make the 3314A return the state or exact value of the queried parameter

THE DATA MESSAGE
(Immediate Execute Commands)

The syntax for execution commands is:

OUTPUT------command------EOS

EOS (End of String) = ASCII Line Feed

BASIC LANGUAGE (-hp-9845) EXAMPLES:

```
OUTPUT 707;"CA"
OUTPUT 707;"CACDRU"
```

HPL LANGUAGE (-hp-9825) EXAMPLES:

```
wrt 707,"CA"
707,"CACDRU"
```

The Immediate Execute commands are:

Function	Command
Calibrate ALL	CA
Calibrate Disable	CD
Calibrate Enable	CE
Calibrate Frequency	CF
Delete Vector (ARB)	DV
Insert Vector (ARB)	IV
Manual Trigger	MN
Preset	PR
Range Down	RD
Range UP	RU

THE DATA MESSAGE
(Function Select Commands)

The syntax for function select commands is:

OUTPUT------command------qualifier------EOS

EOS (End Of String) = ASCII Line Feed

BASIC LANGUAGE (-hp-9845) EXAMPLES:

```
OUTPUT 707;"AM1"
OUTPUT 707;"AM1FM0"
```

HPL LANGUAGE (-hp-9825) EXAMPLES:

```
wrt 707,"AM1"
wrt 707,"AM1FM0"
```

THE DATA MESSAGE
(Function Select Commands) (cont)

The function select commands are:

Function and Selection	Command and Qualifier
Amplitude Modulation	AM
OFF	0
ON	1
ARB	AR
OFF	0
ON	1
ON and Initialize	2
Data Transfer Mode	DM
Unbuffered (serial)	0
96 Byte Buffer	1
Display Errors	DE
OFF	0
ON	1
Frequency Modulation	FM
OFF	0
ON	1
Funtion Invert	FI
No inversion	0
Inverted	1
Function Select	FU
AC OFF (DC ONLY)	0
Sine	1
Square	2
Triangle	3
Manual Sweep	MA
OFF	0
ON	1
Mode Select	MO
Free Run	1
Gate	2
N Cycle	3
1/2 Cycle	4
Fin X N	5
Fin / N	6
PLL Mask (bit #5)	PM
Masked (always = 0)	0
= 1 on acquiring lock	1
= 1 on losing lock	2
= 1 on either	3
Range Hold	RH
OFF	0
Range 1	1
Range 2	2
Range 3	3
Range 4	4
Range 5	5
Range 6	6
Range 7	7
Range 8	8

Function and Selection	Command and Qualifier
Recall Front Panel	RC
Register 0	0
Register 1	1
Register 2	2
Register 3	3
Register 4	4
Register 5	5
Recall ARB Wave	RW
Sets ARB ON and recalls	
Wave 0	0
Wave 1	1
Wave 2	2
Wave 3	3
Wave 4	4
Wave 5	5
SRQ MASK (see the text)	
Store Front Panel	SO
Register 1	1
Register 2	2
Register 3	3
Register 4	4
Register 5	5
Sweep	SW
OFF	0
Linear (100:1 max)	1
Log (7 decades max)	2
Sweep Mask (bit #5)	SM
Masked (always = 0)	0
= 1 at sweep start	1
= 1 at sweep stop	2
= 1 at either	3
Trigger Threshold Level	LV
+ 1 Volts	1
0 Volts	2
Trigger Slope	SL
Positive	1
Negative	2
Trigger Source	SR
Internal	1
External	2
VCO	VC
OFF	0
ON	1

THE DATA MESSAGE
(Function Select Commands) (cont)

DATA TRANSFER MODE. There are 2 HP-IB data transfer modes: Unbuffered and Buffered. At turn-on, the 3314A data transfer mode is unbuffered. As each command is accepted by the 3314A, it is executed. The next byte of HP-IB information cannot be accepted until the previous command has been processed. The second mode loads up to 96 bytes of HP-IB data into a buffer. When the EOS (End of String) character is received, the 3314A starts to process the commands in the order they were received. The maximum data rate in the buffered mode is 3ms per character.

DISPLAY ERRORS. All errors are displayed for about 1/2 second immediately after they are detected. While they are displayed, no other programming can occur.

MANUAL SWEEP. Manual Sweep can be turned ON and OFF via the HP-IB, however, the real importance of Manual Sweep is in the local operating mode. Manual Sweep Frequency cannot be set via the HP-IB.

PLL MASK. Bit 5 of the Status Byte is maskable. Depending upon the mask, and the state of the PLL (phase locked loop), bit 5 will be set (1) or reset (0). Before bit #5 will be set, both the Status Byte mask and the PLL mask must be set.

THE DATA MESSAGE
(Function Select Commands) (cont)

SRQ MASK. Each bit of the Status Byte (except bit #6) can be masked (no Service Request) or unmasked (Service Request when = 1) via the HP-IB. Note that a bit cannot be set until after it has been unmasked. This function is not available from the front panel. The Program Codes to Mask/Unmask the Status Byte are:

ML	3	2	1	0	Status Bit Number
@	MASK	MASK	MASK	MASK	
A	MASK	MASK	MASK	UNMASK	
B	MASK	MASK	UNMASK	MASK	
C	MASK	MASK	UNMASK	UNMASK	
D	MASK	UNMASK	MASK	MASK	
E	MASK	UNMASK	MASK	UNMASK	
F	MASK	UNMASK	UNMASK	MASK	
G	MASK	UNMASK	UNMASK	UNMASK	
H	UNMASK	MASK	MASK	MASK	
I	UNMASK	MASK	MASK	UNMASK	
J	UNMASK	MASK	UNMASK	MASK	
K	UNMASK	MASK	UNMASK	UNMASK	
L	UNMASK	UNMASK	MASK	MASK	
M	UNMASK	UNMASK	MASK	UNMASK	
N	UNMASK	UNMASK	UNMASK	MASK	
O	UNMASK	UNMASK	UNMASK	UNMASK	

MH	7	6	5	4	Status Bit Number
@	MASK		MASK	MASK	
A	MASK		MASK	UNMASK	
B	MASK		UNMASK	MASK	
C	MASK		UNMASK	UNMASK	
D	MASK		MASK	MASK	
E	MASK		MASK	UNMASK	
F	MASK		UNMASK	MASK	
G	MASK		UNMASK	UNMASK	
H	UNMASK		MASK	MASK	
I	UNMASK		MASK	UNMASK	
J	UNMASK		UNMASK	MASK	
K	UNMASK		UNMASK	UNMASK	
L	UNMASK		MASK	MASK	
M	UNMASK		MASK	UNMASK	
N	UNMASK		UNMASK	MASK	
O	UNMASK		UNMASK	UNMASK	

SWEEP MASK. Bit 5 of the Status Byte is maskable. Depending upon the mask and the state of the sweep, bit 5 will be set (= 1) or reset (= 0). Before bit #5 will be set, both the Status Byte mask and the Sweep mask must be set.

THE DATA MESSAGE
(Data Entry Commands)

The syntax for data entry commands is:

OUTPUT----prefix----data----units----EOS EOS (End Of String) = ASCII Line Feed

Numeric entries must be in fixed point format. Floating point entries are not allowed and cause Error 41.

BASIC LANGUAGE (-hp-9845) EXAMPLES:

```
OUTPUT 707;"AP1.23VO"
OUTPUT 707;"AP1.23VOFR10.7MZ"
```

HPL LANGUAGE (-hp-9825) EXAMPLES:

```
wrt 707,"AP1.23VO"
wrt 707,"AP1.23VOFR10.7MZ"
```

Function and Units	Command and Units
Amplitude	AP
milli-Volts p-p	MV
Volts p-p	VO
Δ t	DT
milli-Seconds	MS
Seconds	SN
Frequency	FR
Hertz	HZ
kilo-Hertz	KZ
Mega-Hertz	MZ
Marker Frequency	MK
Hertz	HZ
kilo-Hertz	KZ
Mega-Hertz	MZ
N	NM
Enter	EN
Offset	OF
Volts DC	VO
Phase	PH
Degrees	DG

Function and Units	Command and Units
Start Frequency	ST
Hertz	HZ
kilo-Hertz	KZ
Mega-Hertz	MZ
Stop Frequency	SP
Hertz	HZ
kilo-Hertz	KZ
Mega-Hertz	MZ
Symmetry	SY
Percent	PC
Sweep/Trigger Interval	TI
milli-seconds	MS
Seconds	SN
Vector Height	VH
Enter	EN
Vector Length	VL
Enter	EN
Vector Marker	VM
Enter	EN

THE DATA MESSAGE
(Query Commands)

The syntax for query functions is:

OUTPUT------command------EOS EOS (End Of String) = ASCII Line Feed

BASIC LANGUAGE (-hp-9845) EXAMPLES:

```
OUTPUT 707;"QAP"
ENTER 707;A
```

HPL LANGUAGE (-hp-9825) EXAMPLES:

```
wrt 707,"QAP"
red 707,A
```

A query function makes the 3314A return the selected sub-set of the function, or the exact value of the variable queried. The query must be the last command sent to the 3314A. After receiving a query command, the 3314A must be addressed to Talk. The 3314A can only respond to 1 query at a time.

The query commands are:

Function	Command	Function	Command
Amplitude	QAP	Offset	QOF
Amplitude Modulation	QAM	Phase	QPH
ARB Mode	QAR	Start Frequency	QST
ARB Wave Number	QRW	Stop Frequency	QSP
Δ t	QDT	Sweep	QSW
Error Code	QER	Symmetry	QSY
Frequency	QFR	Trigger Interval	QTI
Frequency Modulation	QFM	Trigger Level	QLV
Function Invert	QFI	Trigger Slope	QSL
Function Select	QFU	Trigger Source	QSR
Manual Sweep	QMA	VCO	QVC
Marker Frequency	QMK	Vector Height	QVH
Mode	QMO	Vector Length	QVL
N	QNM	Vector Marker	QVM

THE STATUS BYTE

The Status Byte is an 8 bit word that the 3314A will output when involved in a Serial Poll. The state of each bit (1 or 0) indicates the status of an internal 3314A function. A bit will be set after that bit has been unmasked and the bit condition is satisfied. After the Status Byte is sent (all bits reset to 0), the bit(s) will not be set again if the condition(s) does not change.

Exceptions that will automatically reset a bit immediately after the 3314A sends its Status Byte are:

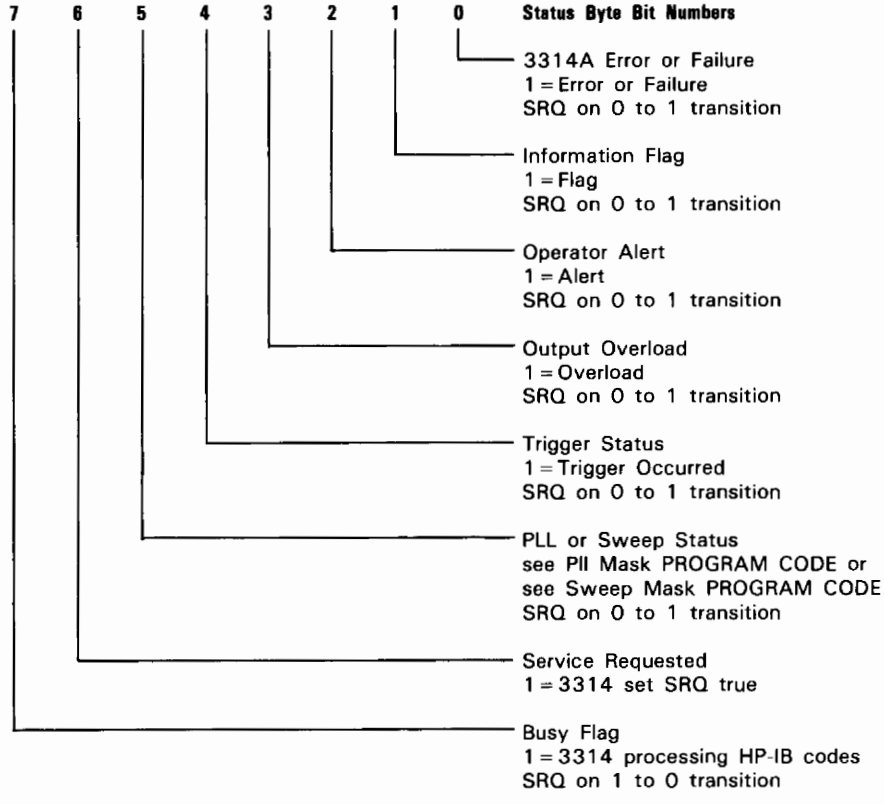
OVERLOAD
TRIGGER when in Gate Mode
BUSY FLAG

BASIC (-hp-9845) EXAMPLE

```
STATUS 707;S
```

HPL (-hp-9825) EXAMPLE

```
rds (707)→S
```



THE TRIGGER MESSAGE

The HP-IB Group Execute Trigger (GET) message, the MN Programming Code (Manual Trigger) and pressing the MAN key cause the same action within the 3314A. In all cases the trigger source must be external (Programming Code SR2) and the 3314A must be addressed to Listen before the 3314A will respond. The 3314A responds to the GET command within 2ms. The 3314A responds to MN within 12ms. Triggers received when the 3314A is actively sweeping or producing ARB waveforms may take up to 50ms.

BASIC LANGUAGE (-hp-9845) EXAMPLES:

all devices on 7	TRIGGER 7
3314A only	TRIGGER 707
3314A only	OUTPUT 707;"MN"

HPL LANGUAGE (-hp-9825) EXAMPLES:

all devices on 7	trg 7
3314A only	trg 707
3314A only	wrt 707,"MN"

Mode	Action
Free Run no sweep	-no action
sweep	-Starts the sweep. The sweep stops and resets to the start frequency, automatically. -Ignored if the 3314A is sweeping.
Gate no sweep	-Gates Output ON if trigger slope is positive or ARB and then sets trigger slope to negative. -Gates Output OFF if trigger slope is negative and then sets trigger slope to positive.
sweep	-Starts the sweep and gates the output ON if the sweep is not active and the trigger slope is positive and then sets the trigger slope to negative. The sweep stops, and the output is gated OFF, automatically.
	-Sets the trigger slope to positive if the sweep is not active and the trigger slope is negative. Used as an arming signal to prepare for the next gate.
	-Ignored while the 3314A is sweeping.
N Cycle	-Gates N Cycles of the output signal ON if the output is OFF. -Ignored while the output is ON.
1/2 Cycle	-Gates alternate 1/2 cycles of the output signal ON.
Fin X N	-This operation is not useable because of the asynchronous nature of the HP-IB.
Fin / N	-This operation is not useable because of the asynchronous nature of the HP-IB.

HP-IB PROGRAMMING SUMMARY

HP-IB Address

The 3314A's HP-IB address is set at the factory to 7. To view the current HP-IB address, press the BLUE shift key and then the LOCAL key. To change the HP-IB address, press the RECALL and then the LOCAL keys, rotate the TUNING KNOB until the desired address is displayed and then press the STORE and LOCAL keys. Listen Only is set by incrementing the address past 30.

3314A Programming Codes

3314A Function	HP-IB Codes		Format Of Returned Data
	Program	Query	
Amplitude	AP	QAP	AP 000000dd.ddVO or
milli-Volt p-p	MV		AP 000000d.dddVO or
Volt p-p	VO		AP 000000.ddddVO or AP 00000.0ddddVO
Ampl Modulation	AM	QAM	AMd
OFF	0		
ON	1		
ARB	AR	QAR	ARd
OFF	0		
ON	1		
ON/Clear Wave	2		
Calibrate All	CA		
Calibrate Disable	CD		
Calibrate Enable	CE		
Calibrate Freq	CF		
Data Transfer Mode	DM		
Unbuffered	1		
96 Byte Buffer	2		
Delete Vector	DV		
Δ t	DT	QDT	DT 00000.0ddddSN or
milli-Seconds	MS		DT 0000.00ddddSN
Seconds	SN		
Display Errors	DE		
OFF	0		
ON	1		
Error Codes		QER	ERdd
Frequency	FR	QFR	FR 00ddddddd.HZ or
Hertz	HZ		FR 000000ddd.dHZ or
kilo-Hertz	KZ		FR 000000dd.ddHZ or
Mega-Hertz	MZ		FR 000000d.dddHZ
Freq Modulation	FM	QFM	FMd
OFF	0		
ON	1		
Function Invert	FI	QFI	FId
OFF	0		
ON	1		
Function	FU	QFU	FUd
OFF	0		
Sine	1		
Square	2		
Triangle	3		
Insert Vector	IV		
Manual Sweep	MA	QMA	MAd
OFF	0		
ON	1		
Manual Trigger	MN		
Marker Frequency	MK	QMK	MK 00ddddddd.HZ or
Hertz	HZ		MK 000000ddd.dHZ or
kilo-Hertz	KZ		MK 000000dd.ddHZ or
Mega-Hertz	MZ		MK 000000d.dddHZ
Mode	MO	QMO	MOd
Free Run	1		
Gate	2		
N Cycle	3		
1/2 Cycle	4		
Fin X N	5		
Fin ÷ N	6		
N	NM	QNM	NM 000000dddd.EN
Enter	EN		
Offset	OF	QOF	OFs0000000d.ddVO or
Volts DC	VO		OFs000000d.dddVO
Phase	PH	QPH	PHs000000ddd.dDG PHASE
degree	DG		
PLL Status Mask (bit 5 of Status Byte)	PM		
Masked	0		
=1 at Lock	1		
=1 at Unlock	2		
=1 either	3		

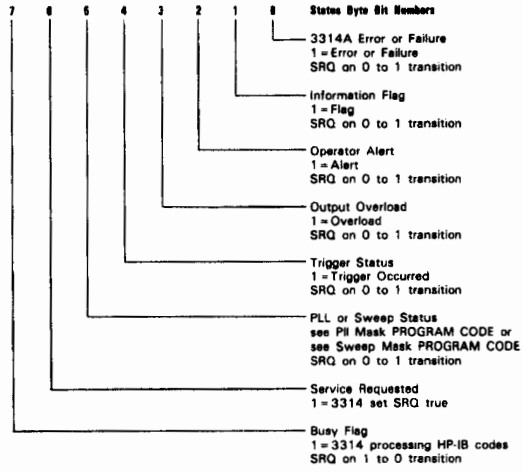
3314A Function	HP-IB Codes		Format of Returned Data
	Program	Query	
Preset	PR		
Range Down	RD		
Range Hold	RH		
OFF	0		
DC Offset	1 to 2		
Amplitude	1 to 4		
Frequency	1 to 8		
Range Up	RU		
Recall (non-ARB)	RC		
Register	0 to 5		
Recall Wave (ARB)	RW	QRW	RWd
ARB ON and recall Wave	0 to 5		
SRQ Mask, bits 0-3	ML		
Mask	@ to O		
SRQ Mask, bits 4-7	MH		
Mask	@ to O		
Start Frequency	ST	QST	ST 00ddddddd.HZ or
Hertz	HZ		ST 000000ddd.dHZ or
kilo-Hertz	KZ		ST 000000dd.ddHZ or
Mega-Hertz	MZ		ST 000000d.dddHZ
Stop Frequency	SP	QSP	SP 00ddddddd.HZ or
Hertz	HZ		SP 000000ddd.dHZ or
kilo-Hertz	KZ		SP 000000dd.ddHZ or
Mega-Hertz	MZ		SP 000000d.dddHZ
Store (non-ARB)	SO		
Register	1 to 5		
Sweep	SW	QSW	SWd
OFF	0		
Linear	1		
Log	2		
Amplitude	AP	QAP	AP 000000dd.ddVO or
Sweep Status Mask (bit 5 of Status Byte)	SM		
Masked	0		
=1 at Start	1		
=1 at Stop	2		
=1 either	3		
Symmetry	SY	QSY	SY 00000000dd.PC
Percent	PC		
Sweep/Trig Interval	TI	QTI	TI 000000dddd.SN or
milli-Seconds	MS		TI 000000ddd.dSN or
Seconds	SN		TI 000000dd.ddSN or
			TI 000000d.dddSN or
			TI 000000.ddddSN or
			TI 00000.0ddddSN or
			TI 0000.00ddddSN
Trigger Level	LV	QLV	LVd
1V Threshold	1		
0V Threshold	2		
Trigger Slope	SL	QSL	SLd
Positive	1		
Negative	2		
Trigger Source	SR	QSR	SRd
Internal	1		
External	2		
VCO	VC	QVC	VCd
OFF	0		
ON	1		
Vector Height	VH	QVH	VHs000000dddd.EN
Enter	EN		
Vector Length	VL	QVL	VL 000000dddd.EN
Enter	EN		
Vector Marker	VM	QVM	VM 000000dddd.EN
Enter	EN		

d = ASCII digits 0 to 9.
s = sign bit, ASCII space or -.
All other characters are exactly as shown.
All returned data is followed by an ASCII carriage return and line feed with HP-IB EOI true, concurrent with the line feed.

HP-IB PROGRAMMING SUMMARY (cont)

Status Byte

Bits of the Status Byte are set (1) only after unmasking that bit and the condition is met. All bits are reset immediately after the Status Byte is sent.



Unmasking The Status Byte

The 3314A will Request Service (SRQ line true) when a bit of the Status Byte is unmasked and the operating condition to set that bit exists. Masking is not affected by PRESET or CLEAR 7. All bits except bit 7 will set SRQ at the 0 to 1 logic transition. Bit 7 will set SRQ at the 1 to 0 logic transition and is useful when using Data Transfer Mode 2, indicating when the 3314A is ready to be programmed again.

ML	3	2	1	0
@	MASKED	MASKED	MASKED	MASKED
A	MASKED	MASKED	MASKED	UNMASKED
B	MASKED	MASKED	UNMASKED	MASKED
C	MASKED	MASKED	UNMASKED	UNMASKED
D	MASKED	UNMASKED	MASKED	MASKED
E	MASKED	UNMASKED	MASKED	UNMASKED
F	MASKED	UNMASKED	UNMASKED	MASKED
G	MASKED	UNMASKED	UNMASKED	UNMASKED
H	UNMASKED	MASKED	MASKED	MASKED
I	UNMASKED	MASKED	MASKED	UNMASKED
J	UNMASKED	MASKED	UNMASKED	MASKED
K	UNMASKED	MASKED	UNMASKED	UNMASKED
L	UNMASKED	UNMASKED	MASKED	MASKED
M	UNMASKED	UNMASKED	MASKED	UNMASKED
N	UNMASKED	UNMASKED	UNMASKED	MASKED
O	UNMASKED	UNMASKED	UNMASKED	UNMASKED

MH	7	6	5	4
@	MASKED		MASKED	MASKED
A	MASKED		MASKED	UNMASKED
B	MASKED		UNMASKED	MASKED
C	MASKED		UNMASKED	UNMASKED
D	MASKED		MASKED	MASKED
E	MASKED		MASKED	UNMASKED
F	MASKED		UNMASKED	MASKED
G	MASKED		UNMASKED	UNMASKED
H	UNMASKED		MASKED	MASKED
I	UNMASKED		MASKED	UNMASKED
J	UNMASKED		UNMASKED	MASKED
K	UNMASKED		UNMASKED	UNMASKED
L	UNMASKED		MASKED	MASKED
M	UNMASKED		MASKED	UNMASKED
N	UNMASKED		UNMASKED	MASKED
O	UNMASKED		UNMASKED	UNMASKED

Error Codes

ER #	Definition	Status Byte Bit #
00	No errors since errors were last queried (HP-IB function, only)	
	--- OPERATOR ERRORS (non-ARB) ---	
01	Frequency/Symmetry conflict	0
02	Bus address entry error	0
03	Front panel key failure	0
04	Calibration measurements not performed	1
05	Allowed in sweep, only	0
06	Not allowed in sweep	0
07	Not allowed in log sweep	0
08	Store 0 not allowed	0
09	Non-volatile memory lost;battery down	0
	--- OPERATOR ERRORS (ARB) ---	
10	Vector insert not allowed	0
11	Vector delete not allowed	0
18	Allowed in ARB, only	0
19	Not allowed in ARB	0
	--- PLL ERRORS ---	
20	Unstable input frequency	1
21	Input frequency outside of capture range	1
22	3314A output frequency would be out of range	1
23	Internal interval > 20ms	1
24	Internal synthesis unlocked	0

ER #	Definition	Status Byte Bit #
	--- FREQUENCY CALIBRATION ERRORS ---	
30	No frequency detected	0
31	Frequency error exceeds correction capability	0
32	Frequency unstable during calibration	0
	--- AMPLITUDE CALIBRATION ERRORS ---	
34	Signal amplitude outside measurement range	0
35	Signal amplitude gain too high	0
36	Signal amplitude gain too low	0
37	Signal amplitude gain out of limit	0
38	Signal amplitude gain offset out of limit	0
	--- HP-IB ERRORS ---	
41	Mnemonic invalid	0
42	Definition number invalid	0
43	Data invalid	0
44	Units invalid	0
45	Range Hold not allowed	0
46	ARB/SWEEP parameter conflict	0
47	Not allowed in Manual Sweep	0
	--- OVERLOAD ---	
50	AM or FM/VCO input voltage exceeds normal operating limits (HP-IB) function only)	1
51	Output voltage exceeds safe operating limits; 3314A has disconnected itself	3

MANUAL CHANGES

-hp- Model 3314A

FUNCTION GENERATOR

Manual Part Number 03314-90000

This supplement contains important information for correcting manual errors and additional information to make this manual more complete.

To use this supplement:

1. Make all ERRATA corrections. Note that these changes are are organized by serial number.

2. Add all the ADDENDA information.

ERRATA

CHANGE NO. 1, applies to all 3314As.

Page 7. Change the minimum external trigger signal that will consistently trigger the 3314A from 200Vp-p to 300mVp-p centered on the selected trigger threshold voltage.

Page 19. Change the first sentence in the ARB Mode Summary to read:

The 3314A has 6 ARB waveforms (accessed by RCL ARB 0 to 5).

Page 21. The last sentence should read:

The waveforms are organized into ten basic groups.

Page 33 through 39. The V HGT of the last vector should read "1F00" for all waveforms.

Page 77. Change the power consumption to read:

95 VA maximum

Page 88. The preset condition of the Status Byte (HP-IB) should be:

Cleared (not affected by "PR") instead of not affected.

Page 93. Change the definition numbers for DATA TRANSFER MODE to:

Data Transfer Mode	DM
Unbuffered (serial)	1
96 Byte Buffer	2

Page 98. The second paragraph should read:

Exceptions that will automatically reset a bit (and send another SRQ message) immediately after the 3314A sends its Status Byte are:

Overload
Trigger when in Gate Mode
Busy Flag (no SRQ)

Page 99. Change the fifth entry in the ACTION column to read:

-Sets the trigger slope to positive if the trigger slope is negative. Used as an arming signal to prepare for the next gate.

Delete:

Ignored while the 3314A is sweeping.

Page 101. "Display Errors" should not be indented.

Delete the second "Amplitude" entry.

CHANGE NO. 2, applies to 3314As with serial numbers 2141A00200 and greater.

Page 4. For instruments with serial numbers greater than 2141A00199, replace Table 1, located on Page 4, with this new Table 1. Instruments with serial numbers from 2141A00101 through 2141A00199 should still use the .4A or .8A fuses.

Table 1. Line Fuse Selection

Voltage Selected	Fuse Value	-hp- Part Number
110/120V	1A SLO BLO	2110-0312
220/240V	0.5A SLO BLO	2110-0202

CAUTION

Using the wrong fuse value or fuse type will not protect the circuitry inside the 3314A and may result in damage to your 3314A.

ADDENDA

Page 45. Add this paragraph at the bottom of the page.

E10. "E10" is displayed when you have used all 160 vectors. Recall that there are only 160 vectors available and these are distributed among six ARB waves. If five ARB waves contain the minimum (2 vectors each), you can have up to 150 vectors in the remaining ARB wave.

Page 46. Add the sentence to the end of the "INSERT VECTOR" topic.

If the Vector Marker is pointing to the last vector, a new vector #1 is inserted.

Page 47. Add this paragraph to the bottom of the page.

Note that the Vector Marker is automatically incremented when either the V HGT or the V LEN keys are pressed twice. This feature is very useful to quickly review or edit the ARB wave.

Page 87. Add this sentence to the end of the MAIN SIGNAL OUTPUT topic.

The output voltage is limited to ±15V peak before clipping will occur.

Page 88. Add this sentence to the end of the X3 OUTPUT topic.

The output voltage is limited to ±15V peak. You can not output a 30Vp-p AC signal with any DC Offset without clipping.

Page 78. Add this sentence to the end of the first paragraph.

All 12 registers are non-volatile, that is, all the stored information is retained, even after a power failure.

Page 66. Add this sentence to the bottom of the page.

It is not necessary to send the prefix over and over if you are programming only one 3314A parameter. In the program example that follows, frequency is being changed from 1 to 2 to 3MHz.

```
OUTPUT 707;" FR 1 MZ"
OUTPUT 707;" 2 MZ"
OUTPUT 707;" 3 MZ"
```