12 MHz Arbitrary/ Function Generator

- **User Defined Wave Shapes**
- **12 Bit Amplitude Resolution**
- **Up to 8K Horizontal Points**
- **267 ns to 267s Clock Speed**
- **GPIB (IEEE-488) Standard**

Compact and Versatile
Model 275 Programmable Arbitrary/ Function Generator is a light-weight, half-rack instrument for bench or ATE use. The 275 can generate precise sine, triangle, square and user-defined arbitrary waveforms from 0.01 to 10 Vp-p, and dc offsets within a −5 to +5V range into 50Ω. Waveforms can be continuous, gated, triggered or burst. Eleven useful modes include arbitrary waveform hold and ramp-to-start.

User Defined Waveforms
Any regular or irregular waveform may be easily entered into nonvolatile memory with the front panel keyboard or via GPIB. The auto-line feature greatly simplifies entry of waveforms consisting of straight line segments. Enter the line segment end points and program the auto-line command, and the internal microprocessor will automatically compute and store the data values for the remainder of the line segment.

12 Bit Amplitude Resolution
In the ARB modes, 12 bits of amplitude resolution provide unparalleled waveform resolution. Waveforms may be stored in full or partial blocks of 2 to 8,192 horizontal points. Clock speeds from 267 ns to 267 seconds per point provide waveform periods as long as 25 days.

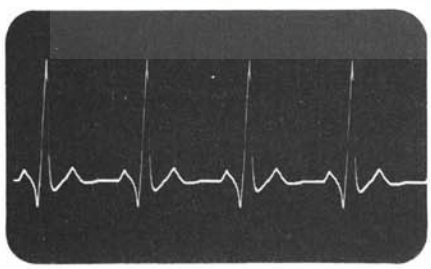
Ease of Programming
The GPIB entry sequence is identical to front panel entry and the ASCII character for GPIB programming appears on most keys on the front panel. This makes it easy to transfer a manual setup to a controller program or vice versa. To help the operator even more, "command recall" can display up to 40 previous

characters entered either at the front panel or by the GPIB. The 275 also features free-format numeric entry, parameter independence until a final execute command, and front panel GPIB address selection (which can, however, be locked out for security).

Protected Outputs
Model 275 outputs are protected against short circuits and external voltages between ± 15V. The main output is further protected against voltage inputs of up to 140 Vac or ± 200 Vdc. If a voltage greater than ± 15V is applied to the main output, the 275 generates an audible alarm, a front panel error message, and a GPIB service request.

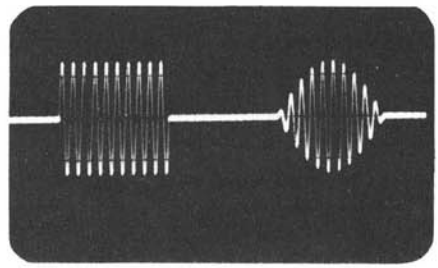
ARB Applications

Medical. Production and R&D applications for the 275 include testing of pacemakers and other medical equipment and simulation of heartbeats, nerve responses, and EEG brainwave patterns. The high resolution of the 275 along with the ability to vary the time between waveforms make it particularly useful in these applications.



Heartbeat Simulation

Doppler. Doppler applications include underwater sound (sonar), radar IF strips, and ultra-sound (used in mechanical defect testing and medical testing). The ability of the 275 to vary time between waveforms (using the trigger-and-hold-on-breakpoint mode and internal triggering) with the cursor makes it ideal for these kinds of applications.

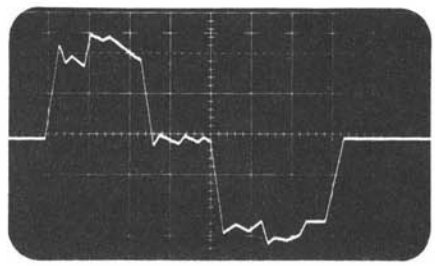


Simulated Doppler Signals

Material Testing. Material testing is a traditional application for ARB geneators. Ramp-to-start, hold-on-trigger, panel lockout, and ARB monitor features make the 275 more useful than previous ARB's for this application.

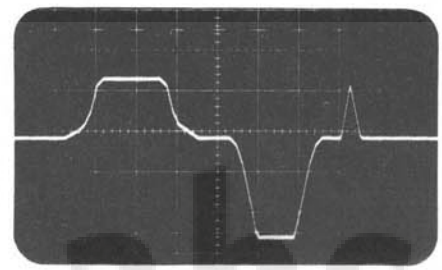
Typical Material Testing Waveform

Electromechanical Switching. Simulation of switcher motors, solenoids and relays require special waveforms which simulate contact bounce. The Model 275 has been used to generate these special types of waveforms.



Contact Bounce Simulation

Computer Disc. Computer peripherals such as disc drives and high speed printers require complex mechanical/electrical interfaces to insure proper alignments for proper data transfer. Disc drive manufacturers are using a modulated magnetic pickup technique to locate certain sync points on the spinning disc platter. The ARB simulates the spinning disc by providing the necessary sync waveforms to the pickup amplifiers. Flexibility of the ARB permits precise timing of waveforms through external triggering, as well as full level control and waveform switching. In the past, initial tune-up of these pickup amplifiers was hazardous, since an actual disc spinning at full speed was required for this precision work.



Typical Disc Sync Waveform

WAVEFORMS (FUNCTIONS)

Programmable sine ∿, triangle △, square ⊓, square comp, dc, external width, arbitrary and filtered arbitrary.

Sine Distortion (THD at 5 Vp-p)
<0.5% 10 mHz to 99.9 kHz. No harmonics above −40 dBc 100 kHz to 999 kHz, −30 dBc 1 MHz to 12 MHz.

Time Symmetry
±1% ±8 ns.

Square Transition Time
<15 ns.

Square Overshoot
<4% at full amplitude.

Triangle Linearity
99% to 100 kHz.

OPERATIONAL MODES (FOR ALL FUNCTIONS INCLUDING ARB)

Continuous
Output continuous at programmed frequency.

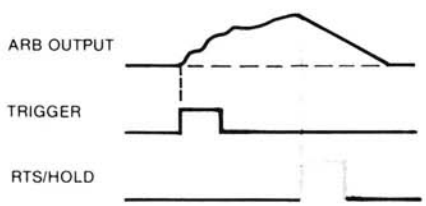
Triggered
Output quiescent until triggered by internal or external signal, GPIB trigger or manual trigger, then generates one cycle at programmed frequency or clock rate.

Gated
As triggered mode except output is continuous for the duration of the gate signal. The last cycle started is completed.

Burst
As triggered mode for programmed number of cycles.
Count Range: 1 to 1,048,200.
Burst Rate: 12 MHz maximum.

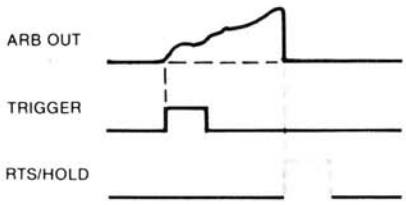
OPERATIONAL MODES (ARB ONLY)

Triggered ARB with Ramp-to-Start
One cycle of ARB waveform is initiated on first trigger input. Second trigger (at TRIG IN or ARB RTS/HOLD IN) causes ARB output to slowly ramp to start address of ARB waveform. If return-to-start (RTS) trigger is not received before stop address is reached, RTS is initiated at stop address.



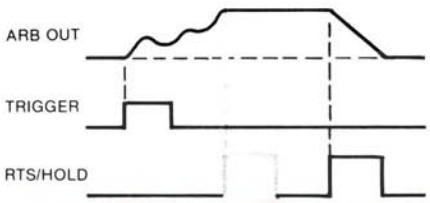
Triggered ARB with Ramp-to-Start

Triggered ARB with Reset
Same as *Triggered ARB with Ramp-To-Start* except the second trigger (or stop address) causes immediate reset to start address.



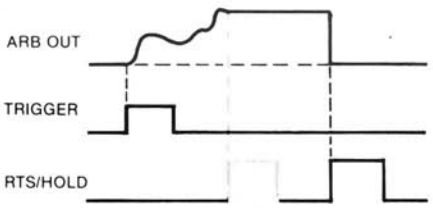
Triggered ARB with Reset

Triggered ARB with Hold and Triggered Ramp-to-Start
One cycle of ARB waveform is initiated on first trigger input. Second trigger causes ARB to hold. Third trigger causes ramp-to-start. If stop address is reached before second trigger then stop address causes hold and next trigger causes RTS.



Triggered ARB with Hold and Triggered Ramp-to-Start

Triggered ARB with Hold and Triggered Reset
One cycle of ARB waveform is initiated on first trigger input. Second trigger causes ARB to hold. Third trigger causes immediate reset to start. If stop address is reached before second trigger, then stop address causes hold and next trigger causes reset.

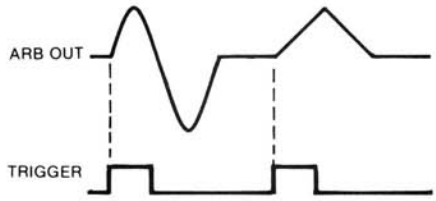


Triggered ARB with Hold and Triggered Reset

Single Step
Same as *Continuous* mode except when Arbitrary function is selected, ARB clock rate is replaced by trigger input so that ARB clock can be supplied externally or with function generator.

Examine
When Arbitrary function is selected, output will be voltage (data value) present at address specified on address program. This allows ARB waveform to be examined one point at a time by specifying address of desired point.

Triggered ARB with Hold on Breakpoint
ARB waveform is initiated upon trigger input and held at programmed breakpoints. Each successive trigger then causes the instrument to advance to the next breakpoint. Start and stop addresses are ignored in this mode after the first trigger.



Triggered ARB with Hold on Break Point

FREQUENCY

Range
10 mHz to 12 MHz for sine, triangle, square, square complement. >15 MHz for external width. ARB range dependent upon clock rate and block size. Clock rate 267 ns to 267s.

Block Size
2 to 2048 points (to 8192 points optional).

Resolution
3 digits.

Accuracy
±2% for non-ARB modes.
±0.2% for ARB modes.

Repeatability (24 hr)
±1% for non-ARB modes, 0.01% for ARB modes.

Jitter
≤0.1% ±100 ps.

Control
Frequency may be controlled by programmed value or external VCG input.
Value: Frequency value is keyboard or GPIB programmable with automatic range selection.
VCG (Voltage Controlled Generator): AC or dc input controls frequency. +0.01 to +12V into 10 kΩ for up to 1200:1 frequency change in each of 9 frequency ranges (ranges must be programmed). Slew rate is limited to 1V/μs.

AMPLITUDE

Range
0.01 to 10 Vp-p into 50Ω (0.02 to 20 Vp-p into ≥50 kΩ) from main output. Absolute peak amplitude plus offset may not exceed 5V into 50Ω (10V into ≥50 kΩ).

Resolution
3 digits or 10 mV when absolute peak amplitude plus offset >0.5V; 3 digits or 1 mV when absolute peak amplitude plus offset ≤0.5V.

Accuracy
±2% of programmed value and:
±5 mV for 0.1 to 1V (peak amplitude + offset <0.5V),
±20 mV for 1.01 to 10V,
±50 mV for all other.

Repeatability (24 hr)
±1% ± 10 mV.

Flatness (At 5 Vp-p)
0.1 dB to 100 kHz, 1.5 dB to 12 MHz.

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MODEL 275 PROGRAMMABLE FUNCTION GENERATORS

OFFSET

Range
DC or offset programmable from −5V to +5V into 50Ω (−10V to +10V into ≥50 kΩ). Absolute peak amplitude plus offset may not exceed 5V into 50Ω (10V into ≥50 kΩ).

Resolution
3 digits or 10 mV when absolute peak amplitude plus offset >0.5V, 3 digits or 1 mV when absolute peak amplitude plus offset ≤0.5V.

Accuracy
±40 mV in dc function.

Repeatability (24 hr)
±20 mV.

OUTPUTS

Function Output
Source of primary waveforms.
Program Control Provides:
Output On, (50Ω source impedance);
Output Off, High Z (>500 kΩ);
Output Off, Low Z (approx 50Ω termination).
Protection: Output protected to 140 Vac or 200 Vdc without internal damage.

Sync Output
Sync signal is at programmed frequency and TTL level.
Level: ≤0.4V to ≥2.4V into 50Ω, ≤0.8V to ≥4.8V into ≥50 kΩ.
Source Impedance: 50Ω.
Timing: Concurrent with function output in square; lags sine and triangle by 90°.
Over/Undershoot: <10% into 50Ω.
Protection: Output protected from short circuit to any voltage between ±15 Vdc input minimum.

ARB Sync Output
0 to +5V into 600Ω, programmable phase control. RCL 4000 initiates positive ARB sync; RCL 4001 initiates negative ARB sync.
Source Impedance: 600Ω.
Protection: Output protected from short circuit to voltage between ±15V.

INPUTS

External Trigger
Trigger of input circuit is programmable for a + or − signal slope and required threshold level.
Level: −10 to +10V.
Resolution: 20 mV.
Accuracy: ±500 mV.
Input Impedance: 10 kΩ.
Maximum Trigger Rate: 12 MHz (15 MHz for External Width).
Minimum Trigger Width: 20 ns.
Minimum Amplitude: 500 mVp-p to 1 MHz, 1 Vp-p to 15 MHz.
Protection: Input protected to ±50V.

VCG In
Voltage control of generator frequency. See frequency.
Range: 0.01 to 12V.
Impedance: 10 kΩ.
Protection: Input protected to ±50V.

ARB RTS/Hold Input
Trig input and RTS/Hold input are internally common. Having two inputs provides processing for independently generated trigger and RTS/Hold signals.
Protection: Input protected from short circuit to any voltage between ±15V.

INTERNAL TRIGGER

Non-ARB Functions
Range: 3.75 mHz to 3.75 MHz.
Resolution: 4 digits.
Accuracy: 0.2%.

ARB Functions
Range: 10 mHz to 3.75 MHz.
Resolution: 3 digits.
Accuracy: 2%.

ARB CHARACTERISTICS

Horizontal Resolution
2048 points standard; 8192 optional.

Vertical Resolution
12 bits (−2048 to +2047).

Auto-line
Draws straight line between two data points.

Programmable Filter (ARB Waveforms)
Non-filtered ARB Waveform: Settling time <1.5μs.
Filtered ARB Waveform: Settling time approximately 0.6 ms.

Programmable Ramp-to-Start Rate
Fast: Approximately 5 ms/bit;
Slow: Approximately 20 ms/bit.

Programmable 3 Digit ARB Clock
Period Ranges from 267s to 267 ns with 0.2% accuracy.

GPIB PROGRAMMING

IEEE 488-1978 compatible. Non-isolated. Double buffered.

Address
0−30, keyboard or internal switch selectable. Internal switch can lock out keyboard selection. Power-up address is internal setting.

Subsets
SH1, AH1, T6, TE0, L4, SR1, RL1, PP0, DC1, C0, E2.

Interface Timing

Frequency	16 ms
Amplitude	13 ms
Offset	14 ms
Mode	6 ms
Function	5 ms
Int/Ext	5 ms
Execute	20 ms to 4 sec

Interface Timing (Cont.)

Store	11 ms
Output	10 ms
Slope	5 ms
Burst Count	10 ms
Rate	35 ms
Recall	185 ms
Reset	185 ms
Start	20 ms
Stop	20 ms
GET Mode	5 ms to 4 sec
Adrs	10 ms
Data	15 ms
Auto-line	20 ms to 2 sec

GENERAL

Stored Settings
Nonvolatile memory stores 75 settings.

Environment
Temperature Range: 20°C ± 10°C for specified operation, operates 0°C to 50°C, −50°C to +75°C for storage.
Warm-up Time: 20 minutes for specified operation.
Altitude: Sea level to 10,000 ft for operation. To 40,000 ft for storage.
Relative Humidity: 95% at 20°C and at sea level (non-condensing).

Dimensions
21.7 cm (8.54 in.) wide (half-rack); 13.3 cm (5.25 in.) high; 39.4 cm (15.5 in.) deep.

Weight
5.9 kg (13 lb) net; 7.2 kg (16 lb) shipping.

Power
90 to 105, 108 to 126, 198 to 231, or 216 to 252 Vrms; 48 to 66 Hz; 1 phase; <40 watts.

OPTIONS

002: Rear Panel Connectors
BNCs relocated to rear panel.

004: Extended Block Size
Extends block size to 8192 points.

ACCESSORIES

Style 12: Single Rack Adapter Kit
Allows any 270 series instrument to be right or left mounted in a standard 19 inch rack. 5¼ inches high.

Style 13: Dual Rack Adapter Kit
Allows any two 270 series instruments to be mounted side-by-side in a standard 19 inch rack. 5¼ inches high.

FACTORY/FOB

San Diego, CA

PRICE

Model 275	**$3750**
Option 002	**$125**
Option 004	**$400**
Style 12	**$75**
Style 13	**$125**