



STANFORD RESEARCH SYSTEMS

# DS345 30 MHz Synthesized Function Generator



# DS345

## 30 MHz Synthesized Function Generator

\$1595 (U.S. list)

- **30 MHz direct digitally synthesized source**
- **$10^{-6}$  Hz resolution**
- **12 bit, 40 Msample/s arbitrary waveforms**
- **Low phase noise and distortion**
- **Fast, phase continuous frequency switching**
- **Sine, square, ramp and triangle waveforms**
- **Internally synthesized FM, AM and phase modulation**
- **Arbitrary and burst modulation**
- **Linear and Log sweeps**
- **Flexible triggering - rates from .001 Hz to 20 kHz**
- **Optional IEEE-488 and RS232 interfaces with Arbitrary Waveform Composer software**

Introducing the DS345 30 MHz Synthesized Function Generator from SRS. The affordable solution to all your signal generator needs.

The DS345 uses direct digital synthesis to generate outputs up to 30 MHz with 1  $\mu$ Hz resolution. And thanks to the innovative architecture, the DS345 is a remarkably agile source. The output can be modulated at rates up to 10 kHz, and frequency switching is phase continuous and takes only 25 ns.

The standard waveforms - sine, square, ramp and triangle - may be frequency, amplitude, phase or burst modulated by the internal source. The modulation source is digitally

*Status indicators show activity over the IEEE-488 or RS232 interfaces. An error indicator lights when an improper external reference is applied.*

*Sync provides a TTL pulse synchronous with the Function output. Both outputs are isolated from the chassis ground.*

*Select the output waveform and choose the displayed signal parameter.*



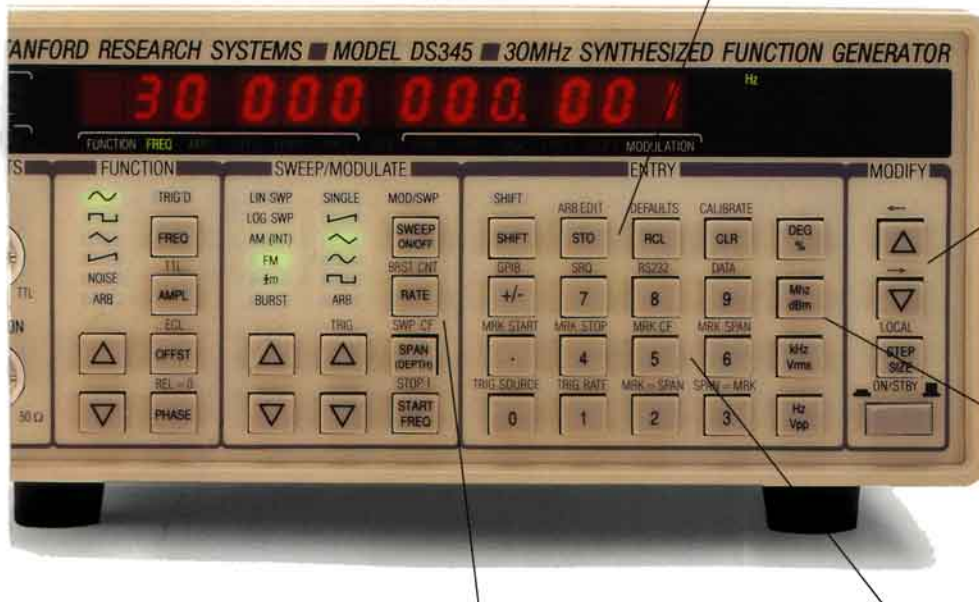
synthesized and provides either standard or arbitrary modulation waveforms. The modulation function is available from the rear panel. The signal output can also be amplitude modulated by an external signal.

The ability to generate fast, high resolution arbitrary waveforms is another advantage of the direct digital design. Patterns are generated at sample rates up to 40 Msamples/s with 12 bits (.025%) of vertical resolution. Records as long as 16k points can be stored in the DS345. Waveforms can be point or vector edited from the front panel, or created and downloaded using the Arbitrary Waveform Composer software package.



*Large, easy to read 12 digit display shows the selected parameter. The parameter type and units are also indicated.*

*Store and recall up to 10 different instrument setups in non-volatile memory.*



*Values may be adjusted with the highlighted digit cursor or incremented and decremented by user defined steps. The cursor position and step size are stored along with each parameter.*

*Units may be entered as engineering values, reducing the number of required keystrokes.*

*Sweeps are specified by choosing either the center frequency and span or the start and stop frequencies. Sweep rate, burst count and trigger rate are easily programmed.*

*Direct keyboard entry simplifies parameter entry. Shifted numeric keys select less commonly used parameters. Back panel functions like marker functions are set and controlled through the front panel.*

Outputs have the low phase noise inherent to direct digital synthesis. Wide-band amplifiers provide low distortion as well as excellent pulse response. The square-wave output can drive 10 Vpp into a 50Ω load with less than a 15 ns risetime. Amplitude and offset are set with 0.2 dB accuracy from 1 μHz to 30 MHz. The amplitude may be entered in Vpp, Vrms or dBm, or set directly to TTL or ECL levels.

Linear and log frequency sweeps are quickly specified by entering the center frequency and span or the start and stop frequencies. Sweep marker outputs are available on the rear panel.

Sweeps and bursts can be triggered from the front panel, the internal rate generator, or the external trigger input. Bursts of any waveform, including arbitrary waveforms, may be triggered.

Parameter values are either entered numerically, adjusted using the cursor, or incremented and decremented by user defined steps. Up to 10 complete instrument configurations may be stored in non-volatile memory for quick setup.

Computer interfacing is simple and direct with the IEEE-488 and RS232 interface option. The Arbitrary Waveform Composer software package is included free with the interface option.

The standard timebase provides 5 ppm frequency accuracy. The optional ovenized oscillator timebase provides .01 ppm stability. Even greater long-term stability can be achieved using an external timebase, such as the SRS FS700 Loran Frequency Standard. The phase relationship between multiple DS345's sharing the same timebase can be adjusted with millidegree resolution.

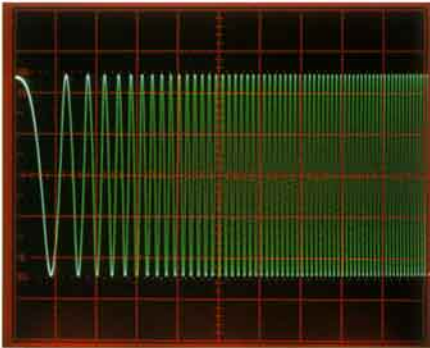
And best of all, the DS345 is priced well below conventional function generators offering far less performance. So why not move up to the DS345 today? For more information, or to place an order, call SRS at (408)744-9040.



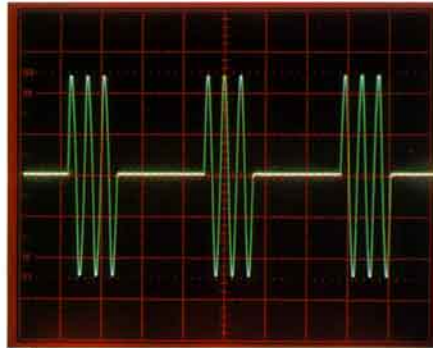
## Powerful Functions

Any function generator can make sine waves. But the DS345 not only makes extremely accurate and pure sine waves, it has extensive built in modulation features. This flexibility allows it to produce frequency, amplitude, phase and burst modulations as well as linear and logarithmic frequency sweeps. And the DS345 offers a choice of synthesized modulating functions - sine, square, ramp, triangle -- even arbitrary waveshapes. The modulation or trigger rate is not limited to a few fixed frequencies, but can be set from .001 Hz to 10 kHz with 2 digits of resolution. Complex functions like pulse modulation and binary or phase shift keying are all at your fingertips.

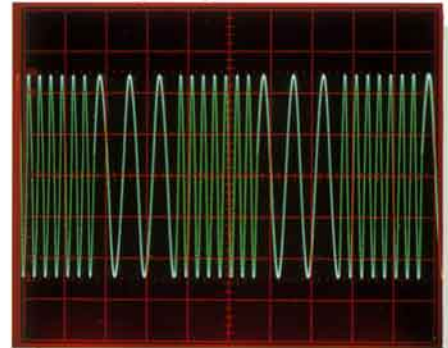
**Linear and Log sweeps**



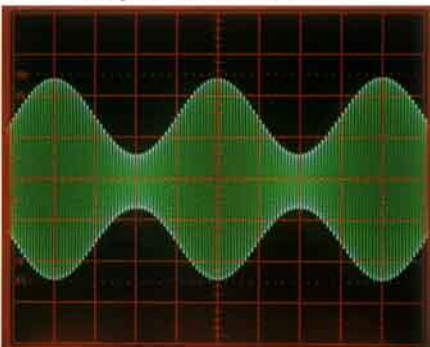
**Burst modulation**



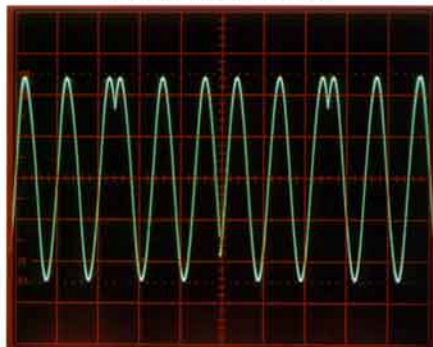
**Frequency modulation**



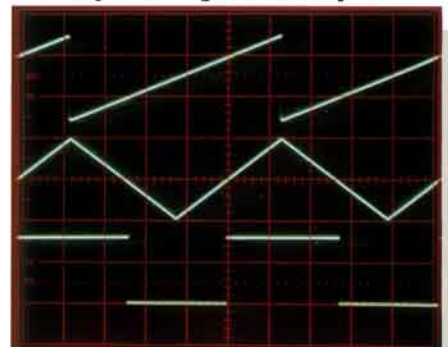
**Amplitude modulation**



**Phase modulation**



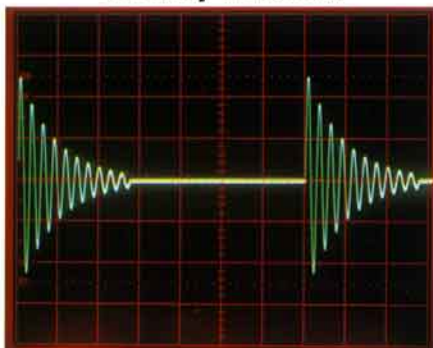
**Ramps, triangles, and squares**



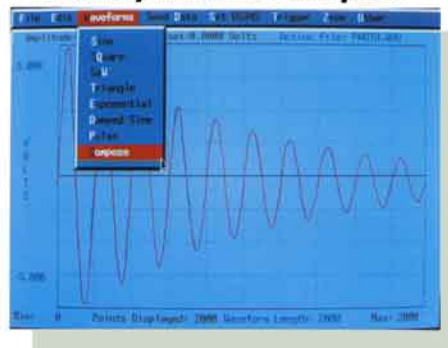
## Create Arbitrary Waveforms

Complex arbitrary waveforms of 8 to 16,300 points are easily generated with sample rates as fast as 40 Msamples/s. Simple waveforms may be entered from the front panel point by point or with vectors. The Arbitrary Waveform Composer software, included with the interface option, provides a friendly window environment for the user to create, edit, and download waveforms to the DS345. Complicated patterns can be quickly generated by combining many waveforms. The software also downloads ASCII files created with other applications. Instrument parameters such as triggering, amplitude, and sample rate are controlled with simple keyboard commands or a mouse.

**Arbitrary waveform**



**Arbitrary Waveform Composer**





# Specifications

## FREQUENCY RANGE

Waveforms	Max Freq	Resolution
Sine	30.2 MHz	1 $\mu$ Hz
Square	30.2 MHz	1 $\mu$ Hz
Ramp	100 kHz	1 $\mu$ Hz
Triangle	100 kHz	1 $\mu$ Hz
Noise	10 MHz	(Gaussian Weighting)

## OUTPUT

Source Impedance	50 $\Omega$
Amplitude Range	10mV to 10Vpp (into 50 $\Omega$ ) 20Vpp into high Impedance
Amplitude Accuracy	$\pm 0.2$ dB ( $\pm 2\%$ ) (sine output)
Amplitude Resolution	0.1% of full scale.
Maximum Offset	$\pm 5$ VDC
Offset Resolution	0.05% of full scale.
Sync Output	TTL levels into 50 $\Omega$ .
Isolation	40V for Function and Sync.

## SINE SPECTRAL PURITY

Spurious Responses	< -55 dBc (non-harmonic)
Phase Noise	< -50 dBc in a 30 KHz band centered on the carrier.
Subharmonic	< -50 dBc
Harmonic Distortion	< -65 dBc DC to 100 kHz < -55 dBc 0.1 to 1 MHz < -40 dBc 1 to 10 MHz < -25 dBc 10 to 30 MHz

## SQUARE WAVE

Rise/Fall Time	<15 ns (10% to 90%)
Asymmetry	1% + 4ns
Overshoot	<5% at full scale output.

## RAMPS, TRIANGLE AND ARBITRARY

Rise/Fall Time	35 ns (10 MHz Bessel Filter)
Linearity	$\pm 0.5\%$ of full scale output
Settling Time	1 $\mu$ s to 0.1% (Full Scale) of final value.

## ARBITRARY WAVEFORMS

Sample Rate	40 MHz/N
Waveform Length	8 to 16,300 points.
Vertical Resolution	12 bits (0.025% of full scale)

## MODULATION AND SWEEPS

Internal Modulation	Frequency, amplitude, phase and burst.
Sweeps	Linear and log sweeps.
Modulation Functions	Sine, ramp, triangle, square and arbitrary.
Modulation Rate	0.001 Hz to 10 kHz
Mod Rate Resolution	2 Digits
Modulation Span	AM: 0 to 100% FM and Sweeps: 30.1 MHz PM: $\pm 7200$ degrees
External Modulation	AM: DC to 50 kHz
Markers	Two adjustable Sweep Markers.

## TIMEBASE

Accuracy	$\pm 5$ ppm (20 to 30 $^{\circ}$ C)
Aging	5 ppm/year
Reference Input	2.5, 5 or 10 MHz input.
Timebase Output	10 MHz, 1 Vpp sine into 50 $\Omega$
Optional Timebase	Ovenized oscillator with .01 ppm stability and $10^{-9}$ per day aging.

## GENERAL

Rear Panel Inputs	Trigger, External AM and Timebase.
Rear Panel Outputs	Trigger, Modulation, Timebase, Blank/Lift, Marker and Sweep.
Interface Option	RS232 and IEEE-488 interfaces. All instrument functions are controllable over the interfaces. Arbitrary Waveform Composer Software (DOS) included at no additional charge.
Power	50 W, 100/120/220/240 VAC, 50/60 Hz.
Dimensions	8.5"x3.5"x13" (W x H x D)
Weight	10 lbs
Warranty	One year parts and labor on materials and workmanship.

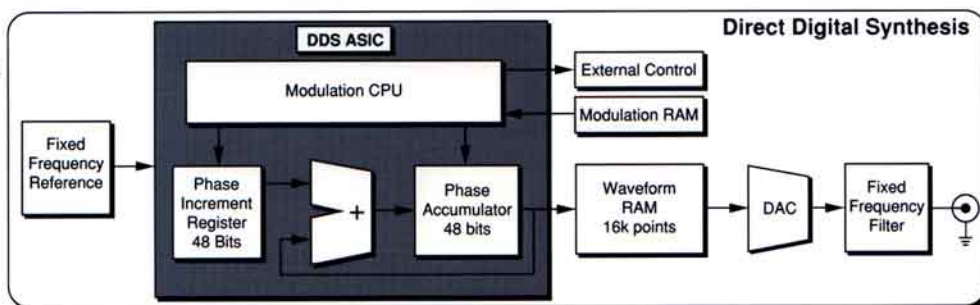




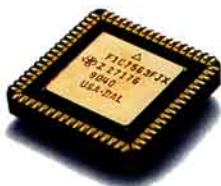
## What is DDS?

Direct Digital Synthesis (DDS) is the third generation in waveform synthesis. First generation frequency synthesizers use a phase-locked loop (PLL) to lock a variable oscillator to a stable reference. Wave-shaping circuits then produce the desired function. The PLL limits the frequency resolution to about  $1:10^6$  and results in high phase jitter and poor frequency switching response. In addition, the wave-shaping circuits produce large amounts of harmonic distortion. Second generation arbitrary function generators use a PLL to create a variable clock that increments an address counter. The counter addresses memory locations in a waveform RAM. The RAM data is converted by a high speed digital-to-analog converter (DAC) to produce an analog waveform. The waveform RAM can be filled with any pattern to produce "arbitrary" functions as well as the usual sine, triangle and ramp. The output is then filtered to remove sampling harmonics. Since the frequency is adjusted by changing the clock rate, the output filter cutoff frequency must also be adjustable. Second generation PLL designs suffer from the same phase jitter, transient response and resolution problems as first generation synthesizers.

Direct digital synthesis also generates addresses that are sent to a waveform RAM to producing data for a DAC. However, unlike previous generations, the clock is a fixed frequency reference. Instead of using a counter to generate addresses, an adder is used. On each clock cycle, the contents of a Phase Increment Register are added to the contents of the Phase Accumulator. The Phase Accumulator output is the address to the waveform RAM. By changing the Phase Increment, the number of clock cycles needed to step through the entire waveform RAM, and thus the frequency, is changed. Frequency jumps can be accomplished phase continuously in only one clock cycle. Additionally, the fixed clock eliminates phase jitter and requires only a simple fixed frequency anti-aliasing filter at the output.



The DS345 uses a custom Application Specific Integrated Circuit (ASIC) to implement the address generation circuitry in a single component. The frequency resolution is equal to the resolution with which the Phase Increment can be set. In the DS345, the phase registers are 48 bits long for an impressive  $1:10^{14}$  frequency resolution. The ASIC also contains a modulation control CPU that operates on the Phase Accumulator, Phase Increment and external circuitry. This allows digital synthesis and control of waveform modulation. The Modulation CPU uses data stored in the Modulation RAM to produce amplitude, frequency, phase and burst modulation, as well as frequency sweeps. All modulation parameters, such as rate, frequency deviation and modulation index, are digitally programmed.



By using DDS, the DS345 has greater flexibility and power than conventional synthesizers and arbitrary waveform generators without the drawbacks inherent in PLL designs.

## Ordering Information

(All prices U.S. list)

### DS345

30 MHz Synthesized Function Generator \$1595

### OPTIONS

-01	RS232 and IEEE-488 interface.	\$495
	Arbitrary Waveform Composer Software (DOS) included at no additional charge.	
-02	High Stability Ovenized Timebase	\$650
-0345RMS	Single Rack Mount Kit	\$85
-0345RMD	Double Rack Mount Kit	\$85



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