

NOVATECH INSTRUMENTS, INC.

170MHz Four Channel Signal Generator Model 409B



The 409B is a 170MHz Four Channel Direct Digital Synthesized Signal Generator in a small table top case. The 409B generates four output signals simultaneously up to 171MHz in 0.1Hz steps under RS232 control. The frequencies of the four outputs can be set independently and can be offset by a controllable phase. The RS232 interface uses simple text commands to control the module and allows non-volatile storage of all settings. The 409B is equipped with a ± 1.5 ppm on-board VCTCXO clock and can accept an external clock source up to 500MHz. On board RAM allows high speed agile frequency, phase and amplitude modulation and hopping. Up to 32k points can be stored in the Table Mode for arbitrary phase, amplitude and frequency profiles.

Specifications:

OUTPUTS

TYPES: Four Sine simultaneously (four independent, phase-synchronous outputs.)

IMPEDANCE: Sine: 50 Ω ; LVCMOS: 50 Ω .

RANGE: 0.1Hz to 171MHz in 0.1Hz steps (Sine out, int. clock).

SINE AMPLITUDE: approximately 1V_{pp} (+4dBm) into 50 Ω . Programmable from 0/1024 to 1023/1024 of Full Scale (10-bits), or by scale factors of 1/2, 1/4, or 1/8.

PHASE: Each channel 14-bits programmable.

FLATNESS: ± 3 dB from 1kHz to 150MHz referenced to amplitude at 35MHz, full scale.

LVCMOS AMPLITUDE (consult factory for availability)

V_{oh} ≥ 2.4 V and V_{ol} ≤ 0.4 V when series terminated. Rise and fall times < 1.5 ns with < 15 pF load. (> 1 MHz, < 125 MHz)

CONTROL

All output frequencies (32-bits), amplitudes (10-bits) and phases (14-bits) are independently controlled by an RS232 serial port at 19.2kbaud. All settings can be saved in non-volatile memory.

ACCURACY AND STABILITY

Accuracy: $\leq \pm 1.5$ ppm at 10 to 40 $^{\circ}$ C. Stable to an additional ± 1 ppm per year, 18 to 28 $^{\circ}$ C. (Internal Clock)

EXTERNAL CLOCK IN

LEVEL: 0.2 to 0.5V_{rms} Sine or Square Wave. 50 Ω .

FREQUENCY: 10MHz to 125MHz with PLL clock multiplier of 4 to 20 enabled. Direct input of 1MHz to 500MHz.

SPECTRAL PURITY (Typ. 50 Ω load, internal clock, full-scale output)

Phase Noise: < -120 dBc, 10kHz offset, 5MHz out.

Spurious: < -60 dBc below 10MHz (typ. 300MHz span)

< -60 dBc below 40MHz

< -55 dBc below 80MHz

< -50 dBc below 160MHz

Harmonic: < -65 dBc below 1MHz

< -55 dBc below 20MHz

< -45 dBc below 80MHz

< -35 dBc below 160MHz

(channel-channel isolation: < -60 dBc)

TABLE MODE

On-board 4Mb static ram holds up to 32,768 profile points in table mode allowing a different output in 100 μ s increments.

POWER REQUIREMENTS

+4.75 to +5.25V @ < 750 mA. AC-adaptor provided.

SIZE

39mm H, 107mm W, 172mm L, not including connectors.

CONNECTORS

BNC for Outputs and EXT CLK IN. 2.5mm center positive for +5VDC power. DE9 for Serial Control.

OPTIONS

Model 409B-AC adds two rear-panel SMA connectors for external control of output update and table timing (see AN002). 409B/01 converts channels 2 and 3 to variable pulse width AC MOS and LVPECL outputs (50MHz maximum, see AN003).

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Table Mode Details.

The Model 409B contains on-board static RAM capable of storing up to 32,768 profile points. Each point contains phase, frequency, amplitude and dwell time information. The on-board microcomputer reads this RAM and programs the DDS ASIC per the profile point data. The profile can be set to loop continuously or to hold at the last point, until interrupted by a subsequent command. The table mode is toggled on and off by an 'M t' command from the serial port and executes customer provided profile points. 'M 0' always turns off the table and returns to single tone mode. The 409B starts execution of the profile immediately upon a receipt of 'M t' following an 'M 0'.

The command sequence is of this form (comments after the ';' are not sent to the 409B, but are here for explanation purposes):

```
M 0 ;turns off running table mode
t0 0000 aabbccdd,eeff,gghh,ii ;F0 profile point 0
t1 0000 aabbccdd,eeff,gghh,ii ;F1 profile point 0
t0 0001 aabbccdd,eeff,gghh,ii ;F0 profile point 1
t1 0001 aabbccdd,eeff,gghh,ii ;F1 profile point 1
...
t0 3fff aabbccdd,eeff,gghh,ii ;F0 profile point 0x3fff
t1 3fff aabbccdd,eeff,gghh,ii ;F1 profile point 0x3fff
M t ;begin execution of table
```

; '0000' two byte RAM address, T0 and T1 must be paired with same address

; 'aabbccdd' four bytes frequency, hexadecimal, MSB first, 4 bytes. 0.1Hz resolution on LSB

; 'eeff' phase offset, hexadecimal, MSB first, only 14-bits active, top two bits are ignored

; 'gghh' amplitude scale, MSB first, only 10-bits active. Amplitude is scaled per above.

; 'ii' dwell time, MSB first, in increments of 100µs. 0x00=loop back to start, 0xff=hold present setting.

Each T0-T1 pair must have the same dwell.

The ', ' (comma) in each record is used as a delimiter and must be included as shown. The inputs are not case sensitive. Subsequent 'M t' commands will toggle the execution of the table on and off. Upon execution of the table, the output will always begin with address 0000 and progress until it encounters an 0xff or 0x00 in a dwell position. The last record in a table mode will be executed for 100µs if the dwell is set to 00.

The current values stored in RAM can be read back by the "Dn aaaa" command. N=0 or 1 and "aaaa" is the address.

The RAM table is backed-up by a "supercap" for a minimum of 10 minutes.