## ELECTRICAL SPECIFICATIONS (CONT.)

| Output Characteristics | | | | | |
|---|---|---|---|---|---|
| Maximum Output | AC only | 20Vp-p/open, 10Vp-p/50Ω | | | |
| | DC only | ±10V/open, ±5V/50Ω | | | |
| Display | Display switchable between open circuit voltage (/OPEN) and voltage into 50Ω load (/50Ω) However, for dBm, value displayed is always for a 50Ω load (/50Ω). For an arbitrary waveform the units are always Vp-p and the displayed voltage corresponds to the data values -511 and +511. | | | | |
| | AC | Vp-p | Max. 3 digits | Minimum Resolution | 0.01mVp-p/open<br>0.01mVp-p/50Ω |
| | | Vrms | Max. 3 digits | | 0.01mVrms/open<br>0.01mVrms/50Ω |
| | | dBV | Max. 3 digits and minus sign | | 0.1dBV/open<br>0.1dBV/50Ω |
| | | dBm | Max. 3 digits and minus sign | | 0.1dBm/50Ω |
| | DC | | Max. 3 digits and minus sign | | 0.1mV/open<br>0.1mV/50Ω |
| AC amplitude range for 0V DC offset | See Table B-1. | | | | |
| AC amplitude resolution and accuracy for 0V DC offset | See Table B-2. | | | | |
| Voltage range, resolution, and accuracy for DC only | See Table B-3. | | | | |
| Minimum AC amplitude, resolution, and DC voltage accuracy for AC + DC | See Table B-4. | | | | |
| Amplitude Frequency Characteristics | In CONT mode, 1kHz reference frequency, 0V DC offset, 50Ω load, and amplitude setting of 100mVp-p to 10Vp-p for waveforms other than ∿ . (rms amplitude for ∿ .) | | | | |
| | ∿ | Up to 1MHz<br>1MHz to 7MHz<br>7MHz to 10MHz<br>10MHz to 20MHz | +0.3dB (RMS)<br>+0.3, −0.5dB (RMS)<br>+0.3, −1.0dB (RMS)<br>+0.3, −2.5dB (RMS) | | |
| | ⊓ (At duty cycle fixed/variable 50%) | Up to 1MHz | ±3% (p-p) | | |
| | ⩘ | Up to 100kHz | ±3% (p-p) | | |
| | ⩘ | Up to 100kHz | ±5% (p-p) | | |
| ∿ Spectrum purity | In CONT mode, 0V DC offset, 50Ω load, and 10.0Vp-p amplitude setting | | | | |
| | Total Harmonic Distortion | 10Hz to 100kHz | 0.3% max | | |
| | Harmonics | 100kHz to 20MHz | −35dBc max | | |
| | Spurious | up to 20MHz | −40dBc max | | |
| ⊓ Waveform Characteristics | 50Ω load, 0V DC offset and 100mVp-p amplitude setting | | | | |
| | Risetime, falltime | 8ns max (15ns max in modes other than CONT mode, when stop level is RESET) | | | |
| | Overshoot, undershoot | 5% max of output p-p amplitude | | | |
| | Duty cycle | (Not during sweep in CONT mode) | | | |
| | | Accuracy for fixed duty cycle (50%) | | up to 100kHz | ±0.3% of period |
| | | | | 100kHz to 1MHz | ±2% of period |
| | | Variable | Range | 5.0% to 95.0% (resolution 0.1%) | |
| | | | Accuracy | ±1% of period (up to 1MHz), jitter 15ns max | |
| Output impedance | 50Ω, unbalance | | | | |
| Connector | BNC receptacle on front panel | | | | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| Sync Output | |
|---|---|
| Output Voltage | TTL Level |
| Output impedance | Approximately 50Ω, unbalanced |
| Connector | BNC receptacle on front panel |

| Gate/Trigger Oscillation | | |
|---|---|---|
| Trigger source | INT (internal) | Synchronizes with sub synthesizer output (positive/negative logic), manual triggering from front panel key, or remote triggering through GPIB |
| External trigger input | EXT (external) | Synchronized through external trigger input terminal (positive/negative logic), manual triggering from front panel key, or remote triggering through GPIB |
| | Input voltage | TTL Level (Input to 74LS14, pulled up by 4.7kΩ) |
| | Minimum pulse width | 50ns |
| | Connector | BNC receptacle on front panel |
| Trigger delay | 200ns max from external trigger input to waveform output<br>100ns max from sub synthesizer SYNC OUT to waveform output | |
| Trigger jitter | 50ns max | |

| External Add Input | | | |
|---|---|---|---|
| (An external signal input is added (summed) to main synthesizer waveform output). | | | |
| Gain of External Add Input | Total set[1] Voltage (Peak) | Gain[2] (/OPEN) | Gain[3] (/50Ω) |
| | 1V to 10V | 1 | 1/2 |
| | 100mV to 1V | 1/10 | 1/20 |
| | 100mV to 10mV | 1/100 | 1/200 |
| | 1mV to 10mV | 1/1000 | 1/2000 |
| Maximum External Input (Vpeak) = 10 - Total Set Voltage/Gain | | | |
| [1] Total Set Voltage = $\frac{\text{Set AC Amplitude (Vp-p)}}{2}$ + \|Set DC Voltage (V)\|<br>Total Set Voltage = \|Set DC Voltage (V)\| when waveform is DC.<br>[2] Gain = $\frac{\text{Main synthesizer output signal value}}{\text{External Add Input Signal value}}$<br>[3] Gain is 1/2 of the /OPEN value with a 50Ω load (/50Ω) | | | |
| Input impedance | Approx. 100kΩ | | |
| Frequency range | DC to 1MHz | | |
| Connector | BNC receptacle on rear panel | | |

| Phase | |
|---|---|
| Range | –360° to 360° |
| Display | Max. 4 digits and minus sign, resolution 0.1 (fixed) |
| Oscillation start phase for burst/trigger/gate oscillation<br>Oscillation will restart at this phase when the ϕ SYNC key is pressed or when the GPIB "SYN" command is given during independent or master operation.<br>In addition, slave unit oscillation will restart at this phase when the ϕ SYNC key of the master unit is pressed or when the GPIB "SYN" command is given. | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| Synchronous Operation | | | |
|---|---|---|---|
| The synchronous operation mode can be selected by connecting the optional cable to PHASE SYNC I/O of multiple units. The master unit can control up to 3 slave units. | | | |
| Synchronous Operation Mode | Mode | Operation | PHASE SYNC I/O connections |
| | Single | Single unit operation | No connection |
| | Master | Transmit clock and ϕ SYNC pulse to slave unit | Connect with the optional synchronous cable (master connector). |
| | Slave | Operate with clock and ϕ SYNC pulse from the master unit | Connect with the optional synchronous cable (slave connector). |
| ϕ SYNC | Generates ϕ SYNC pulse to the PHASE SYNC I/O connector simultaneously when restarting oscillation of both main synthesizer and sub synthesizer during CONT mode. | | |
| Clock and ϕ SYNC pulse delay time/unit | | 10ns max/unit | |
| Delay time from ϕ SYNC pulse to waveform output | Main synthesizer | ∿ , ⊓ (duty cycle fixed/variable 50%) | 120ns max |
| | | Other waveforms | 80ns max |
| | | Jitter | 15ns max |
| | Sub synthesizer | ∿ | 3µs max |
| | | Other waveforms | 2µs max |
| | | Jitter | 350ns max |
| PHASE SYNC I/O connector | 36-pin connector on rear panel | | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| Frequency Sweep | | | | | |
|---|---|---|---|---|---|
| Sweep mode | | Sweep functions | | CONT (continuous sweep) | SINGL (single sweep) |
| | | ⎍ | | ⎍ or ⎍ | ⎍ or ⎍ |
| | | LIN | ⩓ | ⩓ or ⩔ | ⩘ or ⩗ |
| | | | ⩘ | ⩘ or ⩗ | ⩘ or ⩗ |
| | | LOG | ⩓ | ⩓ or ⩔ | ⩘ or ⩗ |
| | | | ⩘ | ⩘ or ⩔ | ⩘ or ⩔ |
| Sweep range | | Upper limit | | Identical to ordinary oscillation | |
| | | Lower limit | ⎍, LIN | 0Hz | |
| | | | LOG | 10.0mHz | |
| Minimum sweep width | | ⎍ , LIN | | 0.1mHz | |
| | | LOG | | 1 octave (2 times) | |
| Sweep time | | Range | | 5ms to 9999s | |
| | | Display | | Maximum 4 digits, minimum resolution 1ms | |
| Range setting | | By setting start/stop frequencies or center/span frequencies | | | |
| Control | | SINGL START | | Starts single sweep | |
| | | CONT START | | Starts continuous sweep | |
| | | SWEEP OFF | | Halts sweep | |
| | | START STATE | | Sets output to the start frequency output state | |
| | | STOP STATE | | Sets output to the stop frequency output state. | |
| | | HOLD/RESM | | Holds and resumes sweep | |
| Other functions | | Set marker frequency and substitute of marker frequency to center frequency | | | |
| Input | Single start input | Input voltage | | TTL Level (Input of 74LS14 is pulled up by 4.7kΩ.) | |
| | | Signal characteristics | | Starts single sweep at the rising edge. | |
| | | Minimum pulse width | | 50ns | |
| | | Connector | | BNC receptacle on rear panel | |
| | Hold input | Input voltage | | TTL Level (Input to 74LS14 is pulled up by 4.7kΩ) | |
| | | Signal characteristics | | Low | Holds sweep |
| | | | | High | Resumes sweep (releases HOLD condition) |
| | | Connector | | BNC receptacle on rear panel | |
| Output | Sweep sync output | Output voltage | | TTL Level (100Ω is connected in series to the output of 74LS14) | |
| | | Signal characteristics | | Low | Indicates that sweep from the start frequency to the stop frequency is in progress. |
| | | | | High | Operation other than above |
| | | Connector | | BNC receptacle on rear panel | |
| | Marker output | Output voltage | | TTL Level (100Ω is connected in series to the output of 74LS14) | |
| | | Signal characteristics | | Low | Indicates that a signal of which frequency is higher than the marker frequency is being output during sweep. |
| | | | | High | Operation other than above. |
| | | Connector | | BNC receptacle on rear panel | |
| | X drive output | Output voltage | | 0V to +10V (/OPEN) | |
| | | Signal characteristics | | 0V → 10V | Frequency increasing |
| | | | | 10V → 0V | Frequency decreasing |
| | | Output impedance | | Approx. 600Ω, unbalanced | |
| | | Load impedance | | 10kΩ minimum | |
| | | Connector | | BNC receptacle on rear panel | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| **Sub Synthesizer** | | | | |
|---|---|---|---|---|
| Waveforms | ∿ , ⊓ , ⊓ , ◿ , ◺ | | | |
| Frequency | Frequency range | 0 to 100kHz | | |
| | Display | Max. 10 digits, resolution 0.1mHz (fixed) | | |
| | Accuracy | Identical to main synthesizer (identical clock source) | | |
| | Setting in terms of period | Range | 10μs to 10000s | |
| | | Display | Max. 6 digits, minimum resolution 100ns | |
| | | Oscillates at a frequency that is the reciprocal of the set period (the reciprocal is rounded to the nearest number below 0.1mHz). | | |
| Output Characteristics | Amplitude range | 20Vp-p/open to 0.2Vp-p/open | | |
| | Display | Units | Display | Display resolution |
| | | Vp-p/open | Max. 3 digits | 0.1Vp-p/open (fixed) |
| | | Vrms/open | Max. 3 digits | 0.1Vrms/open (fixed) |
| | | dBV/open | Max. 3 digits and minus sign | 0.1dBV/open (fixed) |
| | Amplitude resolution | Approx. 78.4mVp-p/open (fixed) | | |
| | Amplitude accuracy | At frequency 1kHz, 5Vp-p/open minimum | | |
| | | ∿ | ±3% (rms) | |
| | | ⊓ , ⊓ , ◿ , ◺ | ±3% (rms) | |
| | ∿ Amplitude vs. frequency characteristics | Referenced to 1kHz, amplitude setting 2Vp-p/open minimum | | |
| | | 10Hz to 50kHz | ±0.3dB (rms) | |
| | | 50kHz to 100kHz | +1.0dB, –2.0dB (rms) | |
| | Total Harmonic Distortion | Amplitude setting 20Vp-p/open | | |
| | | 10Hz to 20kHz | 0.2% max | |
| | | 20kHz to 100kHz | 0.3% max | |
| | Output Impedance | Approx. 600Ω, unbalanced | | |
| | Load Impedance | 10kΩ minimum | | |
| | Connector | BNC receptacle on front panel | | |
| Sync output | Output voltage | TTL Level (100Ω is connected in series to the output of a 74LS14) | | |
| | Connector | BNC receptacle on front panel | | |
| Phase | Range | –360° to 360° | | |
| | Display | Max. 4 digits and minus sign, resolution 0.1° (fixed) | | |
| | Oscillation will enter the resume phase when the ϕ SYNC key is pressed or when the GPIB "SYN" command is given during single or master operation.<br>In addition, oscillation will enter the resume phase when the ϕ SYNC key of the master unit is pressed or when the GPIB "SYN" command is given during slave operation. | | | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| Memory | |
|---|---|
| Memory contents | Main Synthesizer<br>Frequency[1], AC amplitude[2], DC offset[3], waveform, oscillation mode<br>For sweep<br>Frequencies of start[1], stop[1], center[1], span[1], marker[1], sweep time[4], sweep function<br>For trigger<br>Trigger source, stop level, mark wave cycle[4], space wave cycle[4], phase[4]<br>Sub Synthesizer<br>Frequency[1], AC amplitude[5], waveform, phase[4]<br>Others<br>⎍ Duty cycle[4], 50% fixed/variable<br><br>Notes:<br>[1]Frequency display/terms of period display, cursor position and step size parameters saved.<br>[2]Voltage display with no load/display with 50Ω, display unit, cursor position and step size parameters saved.<br>[3]Voltage display with no load/display with 50Ω, cursor position and step size parameters saved.<br>[4]Cursor position and step size parameters saved.<br>[5]Display unit, cursor position and step size parameters saved. |
| Number of memory units | 10 units |
| Battery backup | 30 days or more after full charge (stored at room temperature) |

| Storage of setting parameters at power off | |
|---|---|
| Functions | Parameters in effect prior to power-off are stored and become effective at next power-on. |
| Storage contents | Beep sound on/off, panel lock on/off, GPIB address, delimiter, and ARB waveforms, as well as items included in memory contents. |
| Battery backup | Identical to memory |

## ELECTRICAL SPECIFICATIONS (CONT.)

**Preset**

Sets the parameters listed below.
The modification step size is ±1. The underline indicates the cursor position.

| | |
|---|---|
| Main Synthesizer | |
| Frequency | 1.0000000kHz (1.00000ms) |
| Amplitude | 10.0mVp-p/open<br>(3.54mVrms/open, –42.0dBV/no load, –42.0dBm/50Ω) |
| DC offset | 0.00mV/open |
| Waveform | ∿ |
| Oscillation mode | CONT |
| For sweep | |
| Start frequency | 1.0000000kHz (1.00000ms) |
| Stop frequency | 10.0000000kHz (100.00µs) |
| Center frequency | 5.5000000kHz (181.818µs) |
| Frequency span | 9.0000000kHz (111.111µs) |
| Marker frequency | 5.0000000kHz (200.000µs) |
| Sweep time | 1.000s |
| Sweep function | LIN ∧ |
| For trigger | |
| Trigger source | INT ⩛ |
| Stop level | HOLD |
| Mark wave cycle | 1.0 cycle |
| Space wave cycle | 1.0 cycle |
| Phase | 0.0 deg |
| Sub Synthesizer | |
| Frequency | 1.0000000kHz (1.00000ms) |
| Amplitude | 1.0Vp-p/open (0.4Vrms/open, –8.9dBV/open) |
| Waveform | ∿ |
| Phase | 0.0 deg |
| Others | |
| ⎍ Duty cycle | 50.0% |
| ⎍ Duty cycle 50% fixed/variable | fixed |
| Beep sound | ON |
| Display | |
| Main parameter display of main synthesizer | |

## ELECTRICAL SPECIFICATIONS (CONT.)

| Modification | | | |
|---|---|---|---|
| Operation | By cursor movements with ◀ , ▶ keys (flashing display), and by increments/decrements with the Modify knob | | |
| Increments/decrements with the Modify knob | Step size for cursor movement | ±1 | Increases or decreases the cursor position value by 1. |
| | | ×÷2 | Multiplies or divides the entire value by 2. |
| | | ×÷10 | Multiplies or divides the entire value by 10. |
| | For waveform, oscillation mode, sweep function, trigger source, and stop level, the step size available is ±1 only and the cursor position is not displayed. | | |
| Automatic repeat | Pressing the ◀ , ▶ keys for 0.3s or more causes automatic repeat. | | |
| Non-modifiable parameters | Memory number, GPIB address, delimiter | | |

| Signal Output ON/OFF | | | |
|---|---|---|---|
| Function | Simultaneously controls ON/OFF of FCTN OUT of the main synthesizer and the sub synthesizer. Factory default setting: Signal output ON at power-on. | | |
| Operation | ON/OFF toggles each time the FCTN OUT ON/OFF key is pressed. | | |
| OFF condition | Main synthesizer | FCTN OUT | Signal output will be open circuit. |
| | | SYNC OUT | Identical to ON condition |
| | Sub synthesizer | FCTN OUT | Signal output will be 0V |
| | | SYNC OUT | Signal output will stop oscillation at high level and low level |

| Other Functions | |
|---|---|
| Panel lock | Disables most front panel key entries and operating condition changes. Current parameter values can be displayed. GPIB input and certain BNC inputs are enabled. |
| Main synthesizer main parameter display | Main synthesizer frequency, waveform, oscillation mode, AC amplitude, DC offset, sweep condition are displayed together. |
| Sub synthesizer main parameter display | Sub synthesizer frequency, waveform, amplitude, phase are displayed together. |
| Calibration | Corrects main synthesizer AC amplitude error and offset error. FCTN OUT is OFF and SYNC OUT is undefined during calibration. |
| Beep sound ON/OFF | Controls ON/OFF of beep sound when panel keys are pressed (short beep), or when error has occurred (long beep). |