



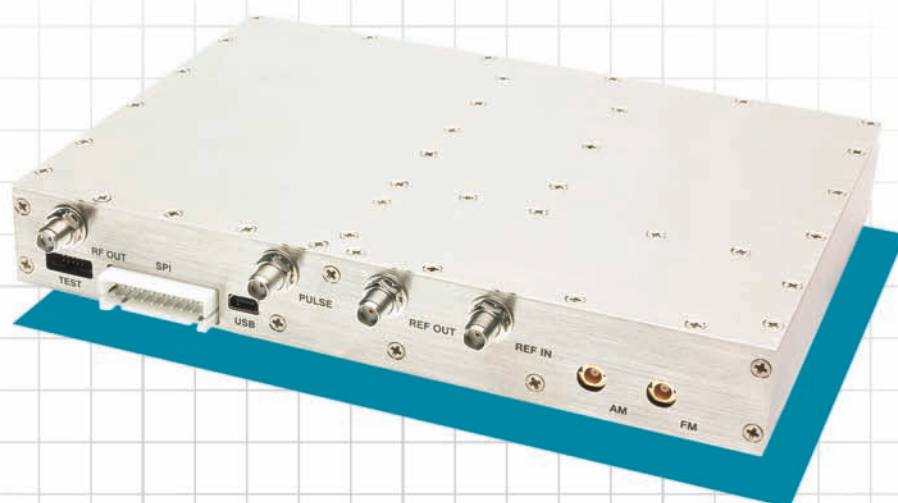
Phase Matrix, Inc.™

PRELIMINARY SPECIFICATIONS

# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

Models FSW-0010  
FSW-0020



**Features:**

- 0.1 to 10 GHz and 0.2 to 20 GHz Coverage
- 0.001 Hz Resolution
- Power Calibration and Control
- 100  $\mu$ s Frequency Switching
- -150 dBc/Hz at 100 kHz Offset

# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

Models FSW-0010  
FSW-0020

### Features

- Wide frequency coverage
- Sub-Hz resolution
- Microsecond switching speed
- Instrument-grade spectral purity
- Output power control
- Freq. and power sweep, list mode
- Multiple modulation options
- Compact size



The QuickSyn™ synthesizer is easily deployed.

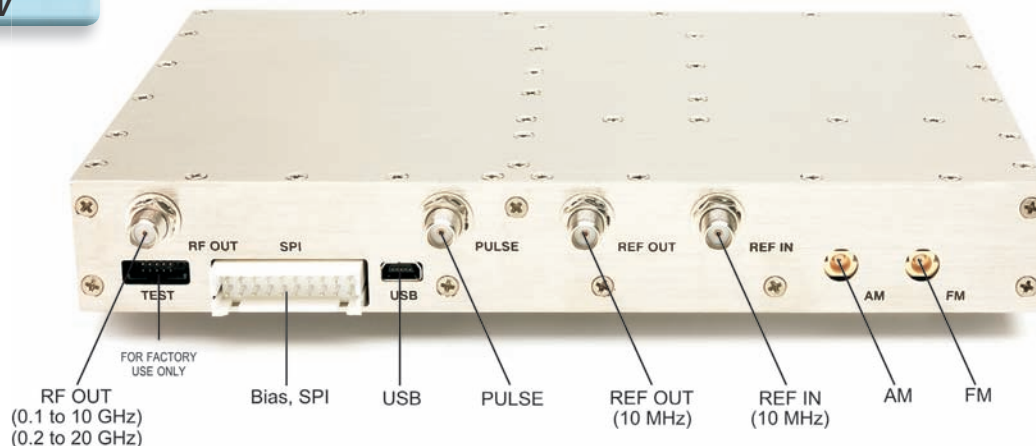
### Technology

QuickSyn™ microwave synthesizers deliver instrument-grade performance, increased functionality, and efficient power consumption at a reduced size and low cost. The synthesizers employ a patented, revolutionary phase-refining technology that provides a unique combination of fast-switching speed and low phase-noise characteristics.

Model FSW-0010 and FSW-0020 cover the frequency ranges of 0.5 to 10 GHz and 0.5 to 20 GHz respectively (extendable down to 0.1 GHz and 0.2 GHz). QuickSyn™ synthesizers utilize

a fundamental VCO to achieve the desired output frequency. In contrast to frequency multiplication schemes, this approach eliminates possible spectrum contamination from subharmonic products. The use of the advanced direct digital synthesis approach, enables a very fine frequency resolution of 0.001 Hz. The VCO noise is suppressed by utilizing an ultra low noise reference oscillator in conjunction with a low-noise locking mechanism. Microphonic effects are also greatly reduced due to the use of a low-mass VCO and very wide PLL filter bandwidth.

### Front View



# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

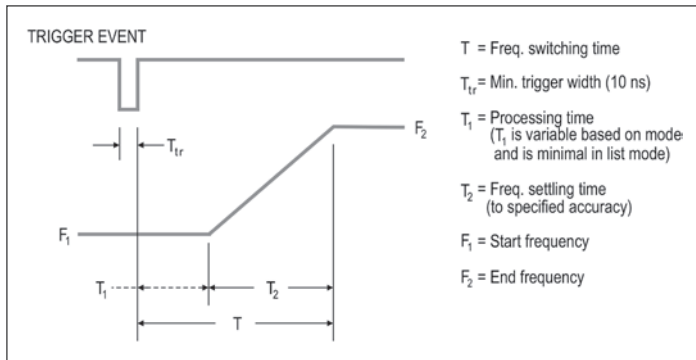
Models FSW-0010  
FSW-0020

Specifications and ordering information subject to change without notice.

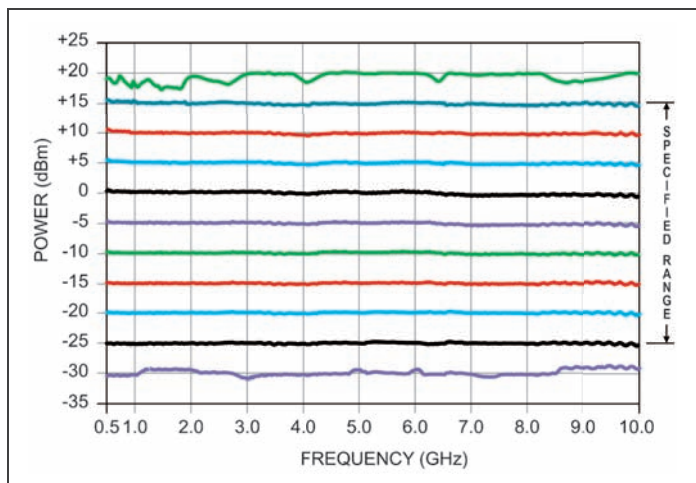
### Specifications

#### FREQUENCY

| DESCRIPTION                                                                   | SPECIFICATION (FSW-0010 / FSW-0020)                                        |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Frequency Range ❶                                                             | 0.5 to 10 GHz / 0.5 to 20 GHz                                              |
| Frequency Resolution                                                          | 0.001 Hz                                                                   |
| Frequency Stability                                                           | Same as reference                                                          |
| Frequency Switching Time (full band step, to $\pm 50$ kHz of final frequency) |                                                                            |
| Standard Unit                                                                 | 1 ms (in all modes)                                                        |
| With Option 3                                                                 | 100 $\mu$ s (triggered list mode)<br>200 $\mu$ s (individual SPI commands) |
| List Mode                                                                     | 32,000 points, separate control of freq., power, and RF output mute.       |



Frequency Switching Speed



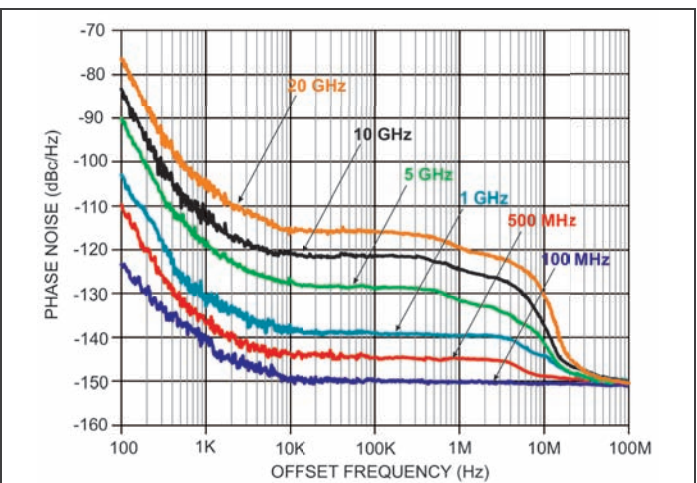
Output Power of an FSW-0010

#### OUTPUT POWER

| DESCRIPTION           | SPECIFICATION (FSW-0010 / FSW-0020) |
|-----------------------|-------------------------------------|
| Power                 | +15 dBm / +13 dBm                   |
| Power Control Range ❷ | -25 to +15 dBm / -10 to +13 dBm     |
| Power Resolution      | 0.01 dB                             |
| Power Accuracy        | $\pm 2.0$ dB                        |
| Power Mute            | -65 dBm max. / -50 dBm max.         |
| Output Return Loss    | -10 dB max.                         |

#### SPECTRAL PURITY ❸

| DESCRIPTION           | SPECIFICATION (FSW-0010 / FSW-0020)                                                                              |
|-----------------------|------------------------------------------------------------------------------------------------------------------|
| Harmonics             | -40 dBc max.                                                                                                     |
| Non-Harmonic Spurious | -70 dBc max. / -60 dBc max.                                                                                      |
| Phase Noise           | dBc / Hz                                                                                                         |
|                       | 0.1 GHz ❶ 0.5 GHz 1 GHz 5 GHz 10 GHz 20 GHz<br>typ (max.) typ (max.) typ (max.) typ (max.) typ (max.) typ (max.) |
| 100 Hz                | -123 (-117) -109 (-103) -103 (-97) -89 (-83) -83 (-77) -77 (-71)                                                 |
| 1 kHz                 | -142 (-136) -138 (-132) -132 (-126) -118 (-112) -112 (-106) -106 (-100)                                          |
| 10 kHz                | -148 (-142) -144 (-139) -138 (-133) -128 (-123) -122 (-117) -116 (-111)                                          |
| 100 kHz               | -150 (-144) -144 (-139) -138 (-133) -128 (-123) -122 (-117) -116 (-111)                                          |
| 1 MHz                 | -152 (-150) -146 (-141) -140 (-135) -132 (-127) -126 (-121) -120 (-115)                                          |
| Floor                 | -153 (-150) -151 (-147) -150 (-147) -150 (-147) -150 (-147) -150 (-147)                                          |



Phase Noise

# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

Models FSW-0010  
FSW-0020

Specifications and ordering information subject to change without notice.

### Specifications (continued)

| MODULATION                 |                                     |
|----------------------------|-------------------------------------|
| DESCRIPTION                | SPECIFICATION (FSW-0010 / FSW-0020) |
| Pulse Modulation ③         |                                     |
| On/Off Ratio               | 80 dB min.                          |
| Repetition Frequency Range | DC to 5 MHz                         |
| Min. Pulse Width           | 100 ns                              |
| Rise/Fall Time (10 to 90%) | 10 ns                               |
| Pulse Overshoot            | 10%                                 |
| Input Level                | CMOS (+5 V = RF on, 0 V = RF off)   |
| Absolute Max. Input Level  | +6 V                                |
| Input Impedance            | 100 kΩ (pulled up to +5 V)          |
| Amplitude Modulation (AM)  |                                     |
| Rate Range                 | DC to 100 kHz                       |
| Modulation Depth ④         | 40 dB min. / 20 dB min.             |
| Sensitivity                | see note ⑤                          |
| Input Level                | ± 1 V (2 V p-p)                     |
| Absolute Max. Input Level  | ± 2 V (4 V p-p)                     |
| Input Impedance            | 50 Ω                                |
| Frequency Modulation (FM)  |                                     |
| NB 1 Mode Rate Range       | 100 Hz to 10 kHz                    |
| NB 2 Mode Rate Range       | 10 kHz to 100 kHz                   |
| WB Mode Rate Range         | 50 kHz to 1 MHz                     |
| Phase Mode Rate Range      | DC to 100 kHz                       |
| Sensitivity                | see note ⑤                          |
| Deviation                  | see note ⑥                          |
| Input Level                | ± 1 V (2 V p-p)                     |
| Absolute Max. Input Level  | ± 2 V (4 V p-p)                     |
| Input Impedance            | 50 Ω                                |

| REFERENCE                          |                                     |
|------------------------------------|-------------------------------------|
| DESCRIPTION                        | SPECIFICATION (FSW-0010 / FSW-0020) |
| Internal Reference                 |                                     |
| Output Frequency                   | 10 MHz nom.                         |
| Output Power                       | +5 ± 2 dBm                          |
| Reference Mute                     | -60 dBm max.                        |
| Output Impedance                   | 50 Ω                                |
| Frequency Temp. Stability          | ± 0.5 ppm (over 0° to 50° C)        |
| Aging (after 30 days of operation) | ± 1.25 ppm for 10 years             |
| Locking Range                      | ± 2.0 ppm                           |
| Output Impedance                   | 50 Ω                                |
| External Reference                 |                                     |
| Input Frequency ⑦                  | 10 MHz                              |
| Input Power                        | +5 ± 5 dBm                          |
| Absolute Max. Input Level          | +15 dBm                             |
| Input Impedance                    | 50 Ω                                |

| ELECTRICAL                                 |                                     |
|--------------------------------------------|-------------------------------------|
| DESCRIPTION                                | SPECIFICATION (FSW-0010 / FSW-0020) |
| Supply Voltage                             | +12.0 to +12.6 V DC                 |
| Absolute Max. Supply Voltage               | +15 V DC                            |
| Total Power Consumption (warm up)          | 24 W max. / 28 W max.               |
| Total Power Consumption (normal operation) | 18 W nom. / 22 W nom.               |

### GENERAL & ENVIRONMENTAL SPECIFICATIONS

| DESCRIPTION         | SPECIFICATION                     |
|---------------------|-----------------------------------|
| Temperature Range ⑧ |                                   |
| Operating           | 0° to +55° C                      |
| Non-Operating       | -40° to +70° C                    |
| Warm-up Time        | 15 minutes                        |
| Relative Humidity   | 0 to 95% (non-condensing)         |
| Shock / Vibration   | Tested to MIL-PRF-28800 F Class 3 |
| EMI/RFI             | Complies w/REO 2, MIL-STD-461C    |

QuickSyn™

MICROWAVE FREQUENCY SYNTHESIZERS

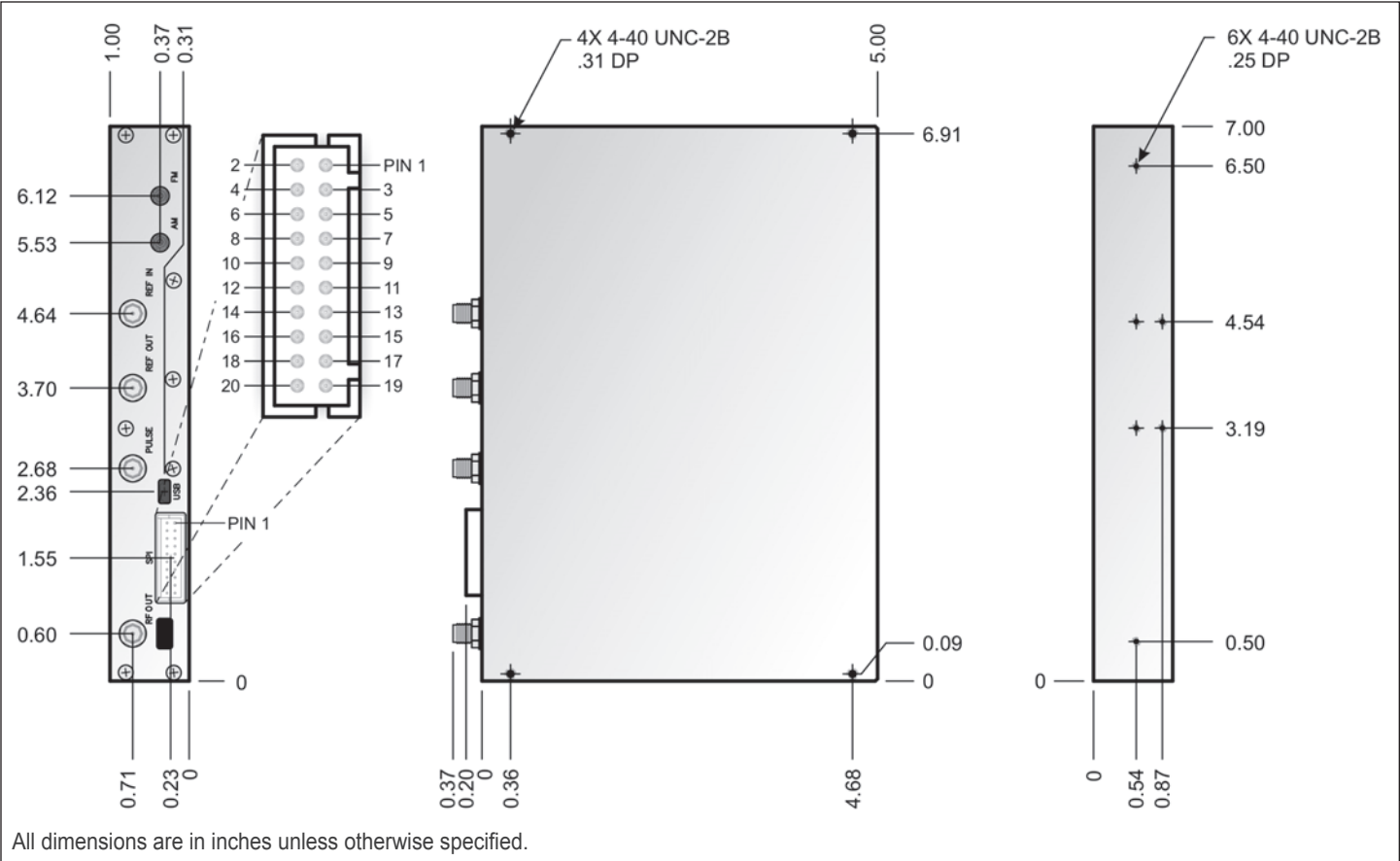
Models FSW-0010  
FSW-0020

Specifications and ordering information subject to change without notice.

Specifications (continued)

| MECHANICAL SPECIFICATIONS |                                        |
|---------------------------|----------------------------------------|
| DESCRIPTION               | SPECIFICATION                          |
| Size (W x L x H)          | 5 x 7 x 1 in. (12.7 x 17.78 x 2.54 cm) |
| Weight                    | 2.1 lb. (0.95 kg)                      |
| Connectors                | See table                              |

| CONNECTOR TABLE (see front view on first page) |                                                      |                                          |
|------------------------------------------------|------------------------------------------------------|------------------------------------------|
| LABEL                                          | FREQUENCY                                            | TYPE                                     |
| RF OUT                                         | 0.1 to 10 GHz (FSW-0010)<br>0.2 to 20 GHz (FSW-0020) | SMA-F                                    |
| PULSE                                          | DC to 5 MHz                                          | SMA-F                                    |
| REF OUT                                        | 10 MHz                                               | SMA-F                                    |
| REF IN                                         | 10 MHz                                               | SMA-F                                    |
| AM                                             | DC to 100 kHz                                        | MCX-F                                    |
| FM                                             | DC to 1 MHz                                          | MCX-F                                    |
| SPI                                            | n/a                                                  | 20 pin, 0.1 in. spaced double-row header |
| USB                                            | n/a                                                  | Mini-B receptacle (USB 2.0)              |



# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

Models FSW-0010

FSW-0020

### Programming

#### SPI INTERFACE

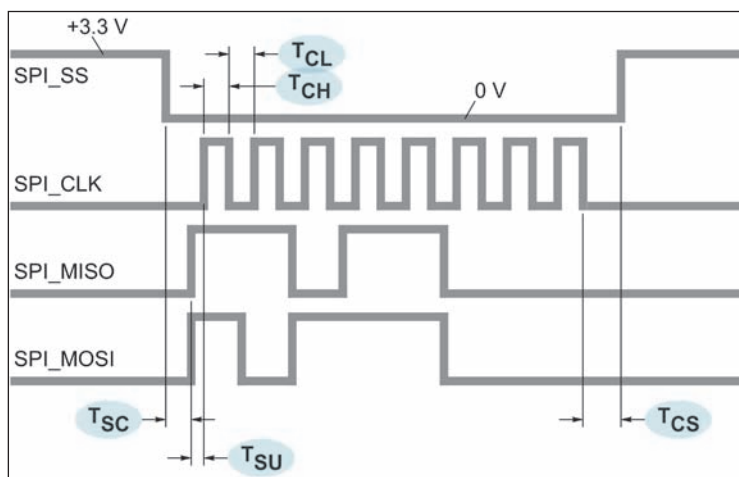
| SIGNAL   | PIN                | DESCRIPTION                                                                                                                                                                                                         |
|----------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SPI_CLK  | 11                 | SPI clock. Supplied by the controlling computer (not the synthesizer). The controlling computer is the SPI master; the synthesizer is the SPI slave.                                                                |
| SPI_SS   | 13                 | SPI Slave Select. This signal is an active low input to the synthesizer. It frames command communications. For each command, SPI_SS goes low before the first bit is sent and goes high after the last bit is sent. |
| SPI_MISO | 7                  | Master In/Slave Out. Status and other returned information from the synthesizer to the controlling computer.                                                                                                        |
| SPI_MOSI | 9                  | Master Out/Slave In. Command data from the controlling computer to the synthesizer.                                                                                                                                 |
| TRIGGER  | 17                 | Rising edge active input. When enabled, the trigger signal of +3.3 V can initiate freq. change or step through lists or sweeps.                                                                                     |
| LOCK     | 15                 | Output indicates the synthesizer is locked on its current setting (+3.3 V locked, 0 V unlocked).                                                                                                                    |
| REF_LOCK | 16                 | Output indicates the synthesizer has detected an external reference signal and locked on that signal (+3.3 V locked, 0 V unlocked).                                                                                 |
| RESET    | 18                 | Internally pulled up to +3.3 V with 100 kΩ resistor. Active “low” signal, which has a minimum width of 1 ms, will reset the synthesizer to a default state.                                                         |
| PWR_+12V | 3, 4               | External +12V DC supply.                                                                                                                                                                                            |
| GND      | 8, 10, 19, 20      | Ground.                                                                                                                                                                                                             |
| N/C      | 1, 2, 5, 6, 12, 14 | Do not use. Reserved for factory use.                                                                                                                                                                               |

#### PROGRAMMING

See QuickSyn™ Communications Specification located on the Phase Matrix website ([www.phasematrix.com](http://www.phasematrix.com))

#### SPI TIMING

| DESCRIPTION                   | SPECIFICATION                         |
|-------------------------------|---------------------------------------|
| $T_{SC} > 25 \text{ ns}$      | Slave select low before first CLK     |
| $T_{CS} > 25 \text{ ns}$      | CLK low before slave select high      |
| $T_{SU} > 15 \text{ ns}$      | Data stable before rising edge of CLK |
| $T_{CH} > 25 \text{ ns}$      | Minimum CLK high time                 |
| $T_{CL} > 25 \text{ ns}$      | Minimum CLK low time                  |
| $F_{CLK} \leq 12 \text{ MHz}$ | Maximum CLK frequency                 |



# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

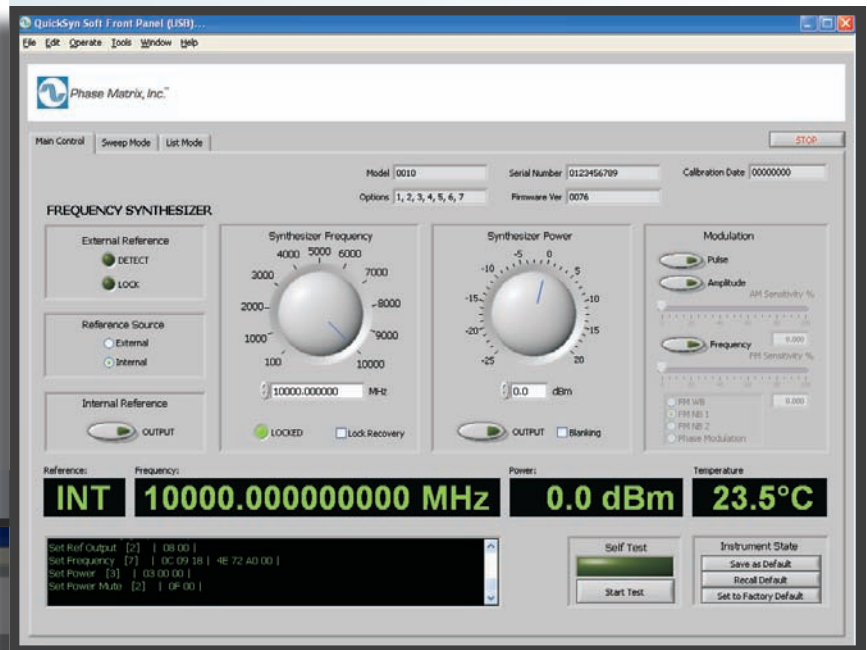
Models FSW-0010

FSW-0020

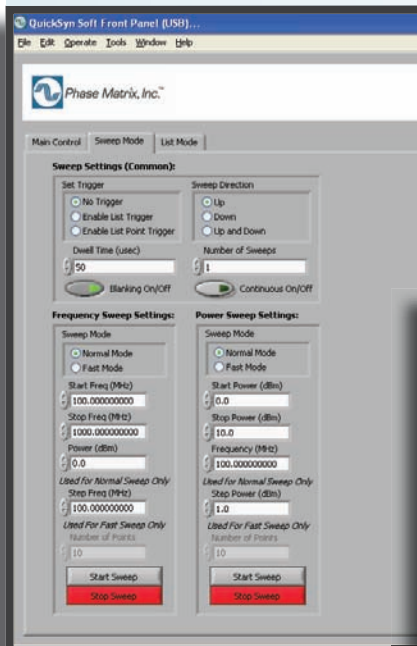
### Software User Interface

A simple software user interface allows utilization of a number of sophisticated functions such as precise frequency and power control, RF output and reference mute, blanking, independent frequency and power sweeps, list mode, modulation, and many others. Software is available for order as part of a QuickStart kit. See the ordering information section of this document for more information.

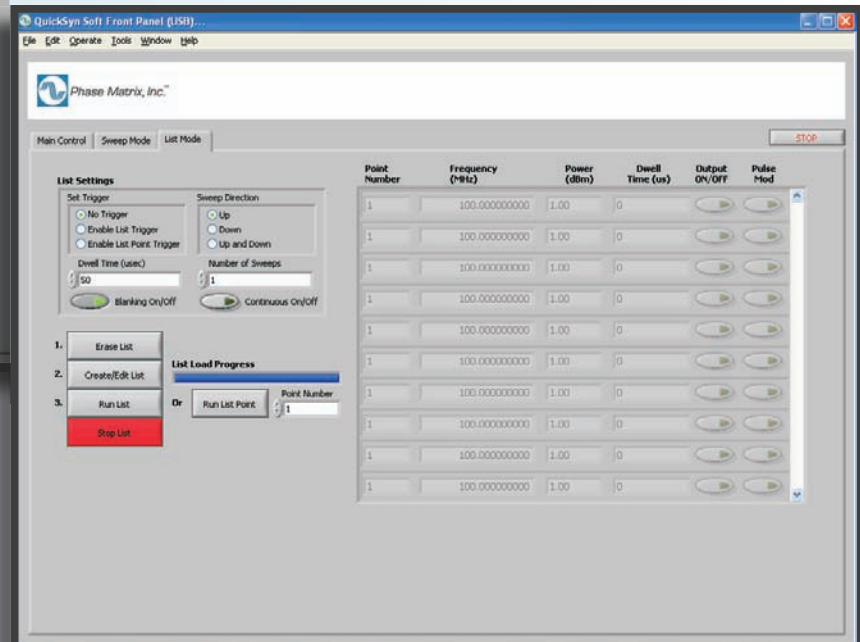
#### Main Control



#### Sweep Mode



#### List Mode



# QuickSyn™

## MICROWAVE FREQUENCY SYNTHESIZERS

Models FSW-0010

FSW-0020

**ORDERING INFORMATION**

|          |                                                                                                                                  |
|----------|----------------------------------------------------------------------------------------------------------------------------------|
| Models   | FSW-0010, FSW-0020                                                                                                               |
| Options  |                                                                                                                                  |
| Option 1 | 0.1 GHz output frequency extension ❶ (FSW-0010)<br>0.2 GHz output frequency extension ❶ (FSW-0020)                               |
| Option 2 | Power control, -25 to +15 dBm (FSW-0010)<br>Power control, -10 to +13 dBm (FSW-0020)                                             |
| Option 3 | Fast-switching<br>100 $\mu$ s (to $\pm$ 50 kHz in ext. triggered list mode)<br>200 $\mu$ s (to $\pm$ 50 kHz regular SPI control) |
| Option 4 | USB interface                                                                                                                    |
| Option 5 | Pulse modulation                                                                                                                 |
| Option 6 | Amplitude modulation ❷                                                                                                           |
| Option 7 | Frequency and phase modulation                                                                                                   |

**Accessories**

|    |                                                |
|----|------------------------------------------------|
| 01 | Cable, AM/FM (BNC-M to MCX-M)                  |
| 02 | Cable, USB                                     |
| 03 | Cable, DC bias                                 |
| 04 | Test report                                    |
| 05 | SPI mating connector                           |
| 06 | QuickStart kit                                 |
|    | CD, user interface software & QuickStart guide |
|    | Cable, AM/FM (BNC-M to MCX-M)                  |
|    | Cable, USB                                     |
|    | Cable, DC bias                                 |
|    | SPI mating connector                           |
|    | QuickStart AC/DC adapter                       |

**Notes:**

- ❶ Frequency extension down to 0.1 GHz (FSW-0010) and 0.2 GHz (FSW-0020) are available as option 1. Output power between 0.1 and 0.5 GHz is limited at +10 dBm.
- ❷ Available with option 2 only.
- ❸ Measured at maximum specified power.
- ❹ Measured with power set at mid range. AM is clipped when available power (min. or max.) is reached.
- ❺ AM and FM sensitivity is dependent on synthesizer output frequency and is controllable by software.
- ❻ The amplitude of the FM input signal must be adjusted to obtain the desired deviation according to the output frequency range.
- ❼ External reference frequency input to be within  $\pm$  2 ppm max. of actual internal reference frequency.
- ❽ Adequate heat skinking must be provided in order to prevent permanent damage.

**Warranty**

Phase Matrix, Inc. has a proven commitment to quality and reliability in instrumentation. This commitment is demonstrated in the QuickSyn™ series of synthesizers with a full one-year standard warranty. Parts, labor, and even shipping are all included at no cost to you.

Phase Matrix, Inc. designs and manufactures RF and microwave test-and-measurement (T&M) instruments, sub-systems, and components. Our array of instruments includes traditional benchtop frequency counters, modular (VXI) pulsed-frequency counters, modular (VXI and PXI) synthetic instruments, including downconverters, upconverters/synthesizers and local oscillators that are designed for both commercial and military applications. In addition, we produce instrument-grade, fast-switching synthesizer modules that can be used in various instruments or subsystems. We also manufacture a line of narrowband and broadband microwave components, ranging from VCOs to complex custom-built assemblies for military instrumentation and telecommunications applications.

Data sheet PN: DS\_FSW-0010-0020 Rev. 8

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