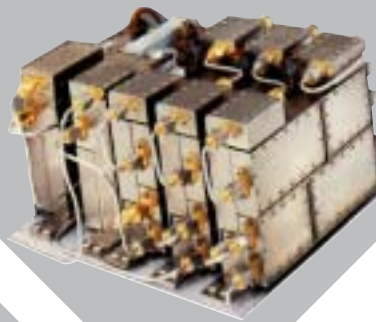


# FS5000

**F R E Q U E N C Y  
S Y N T H E S I Z E R S**



*Ultra-fast Switching < 200 nsec*

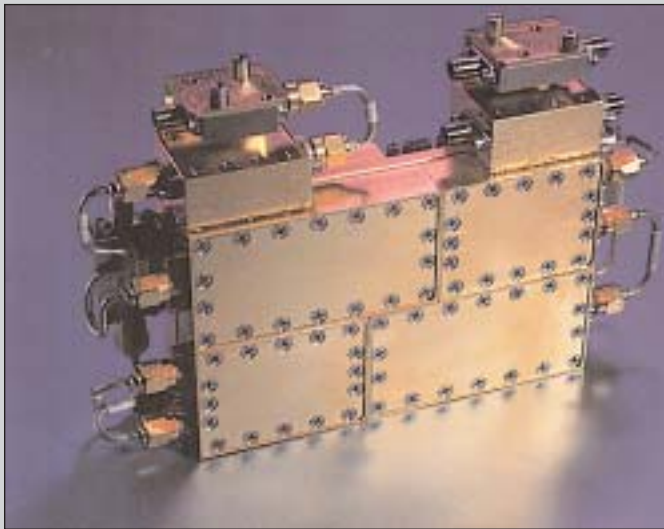
*Wide & Narrow Band*

*Exceptionally Clean*

**An Ideal Source for:**

- *Agile Radar and Radar Simulators*
- *Radar Upgrades*
- *Fast Antenna and RCS Measurements*
- *Electronic Warfare Systems*
- *Ultra Fast ATE*

- ◆ Truly modular construction.
- ◆ Wide frequency coverage from a single unit.
- ◆ Amplitude leveling.
- ◆ Hop rates faster than 1 Megahop/sec. .
- ◆ Wide variety of standard & custom interface options.
- ◆ High performance modulation : Chirp, Pulse, AM, FM.
- ◆ Highest spectral purity.
- ◆ Insensitive to vibration: proven in airborne applications..
- ◆ Locks to standard 10 MHz references.



**A**eroflex/Comstron's FS5000 stands at the pinnacle of a family of frequency synthesizers that exemplify cutting edge performance. The FS5000 is faster, cleaner, smaller, and more rugged than the previous performance leader, Comstron's FS2000.

Construction is truly modular - blind-mate GPO connectors couple submodules to form modules. This miniaturized construction method makes it easy to build customized implementations of the architecture. FS5000 products are thus ideally suited to support airborne radar and EW systems where light weight, small size, super-agility, and spectral purity are of paramount importance. The FS5000 is also available as a rack mountable instrument with full keyboard control as well as computer control interfaces.

Radar and radar upgrade applications include advanced multi-mode radars, frequency agile radar upgrades, improved subclutter visibility supporting MTI functions, ground penetrating radars, and multiple channel receivers.

The frequency generation technique used by the FS5000 is Direct Analog Frequency Synthesis, implemented in a patented, iterative, modular, architecture. Based on mixing, adding, and dividing fixed frequencies using wide-band mixers, ultra-fast switches and switched filter banks, this technique is singular in providing, simultaneously, the attributes of fast switching speed, high spectral purity, and wide frequency range. Direct Analog Frequency Synthesis also is inherently rugged and reliable - there are no loops to unlock and no vibration sensitive oscillators.

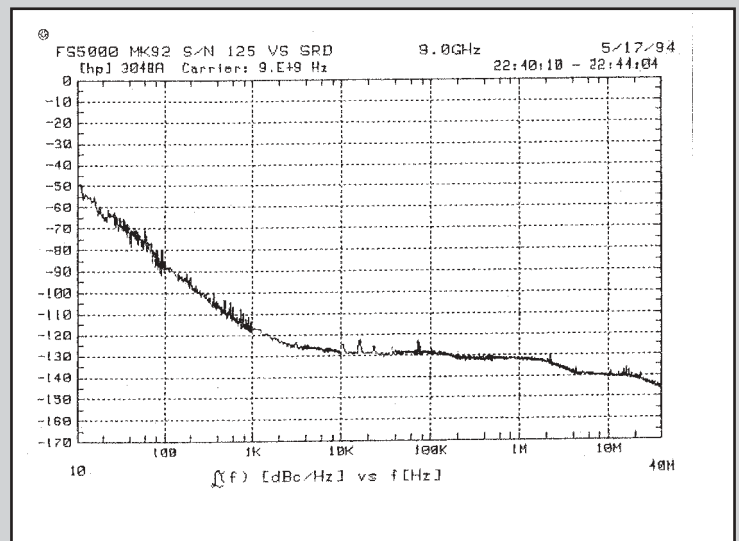
The FS5000's fundamental frequency generation range is 4.8 to 13.5 GHz, an order of magnitude higher than the FS2000. Synthesis at X band microwave frequencies allows for wide bandwidths, small size, and superior spectral purity. The output frequency can be extended to 26.5 GHz using one doubler, which increases spurious signals and phase noise by only 6 dB.

FS5000 technology consequently provides not only superb frequency agility, but also spectral purity rivaling low noise fixed frequency references. At X-band the FS5000 delivers 200 nS frequency switching time, phase noise of -120 dBc at 10 kHz offset, spurious signals better than -70 dBc, and harmonics suppressed to better than -50 dBc. Modular FS5000 synthesizers with specialized low noise references are available with improved phase noise of -130 dBc at 10 KHz offset and spurious signals better than -80 dBc at X band. The programming and digital interface for the FS5000 are fully compatible with Comstron's FS2000 family of synthesizers.

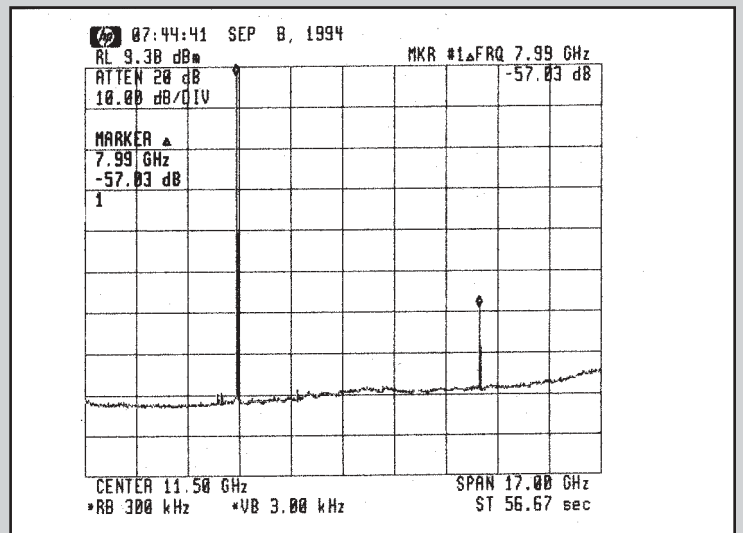
Comstron develops and manufactures the specialized components used in implementation of the FS5000 architecture. Thick film hybrid microcircuits, fabricated in the Company's Boca Raton, Florida facility, contribute to the unmatched performance and reliability found in the FS5000. Wide-band switched filter banks, and ultra-fast switches are manufactured by Comstron tailored to FS5000 specifications.

Standard kits to support frequently used frequency ranges are available in compact packages.

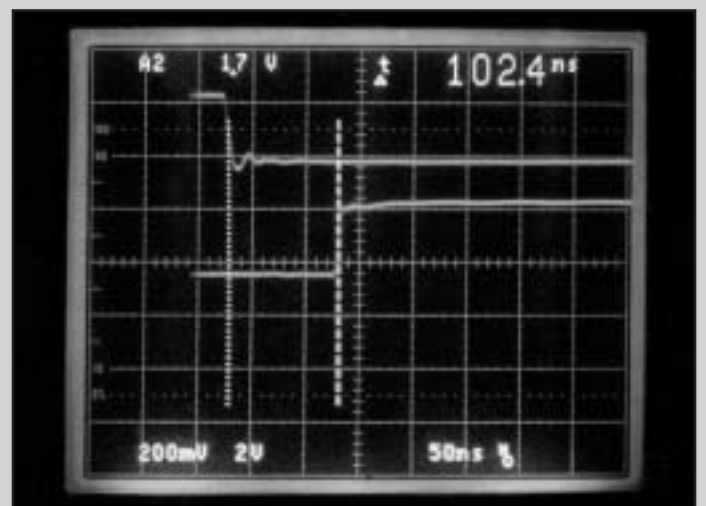
The instrument realization is housed in a 3U rack mountable chassis with display, keyboard, IEEE-488 interface, and parallel BCD interface for fast switching control. These are designated 'B' series and plug into standard power mains, both U.S. and International. The 'B' series is supported by a number of standard options which tailor the unit to specific system or laboratory requirements. OEM versions are typically supplied with modules mounted on plates and require external regulated power - exact configuration is application dependent. Typical examples are given in this brochure. OEM versions can be supplied to meet a broad spectrum of performance and physical requirements ranging from commercial to full military airborne.



Actual Phase Noise Plot at 9 GHz of Modular Radar Upgrade System



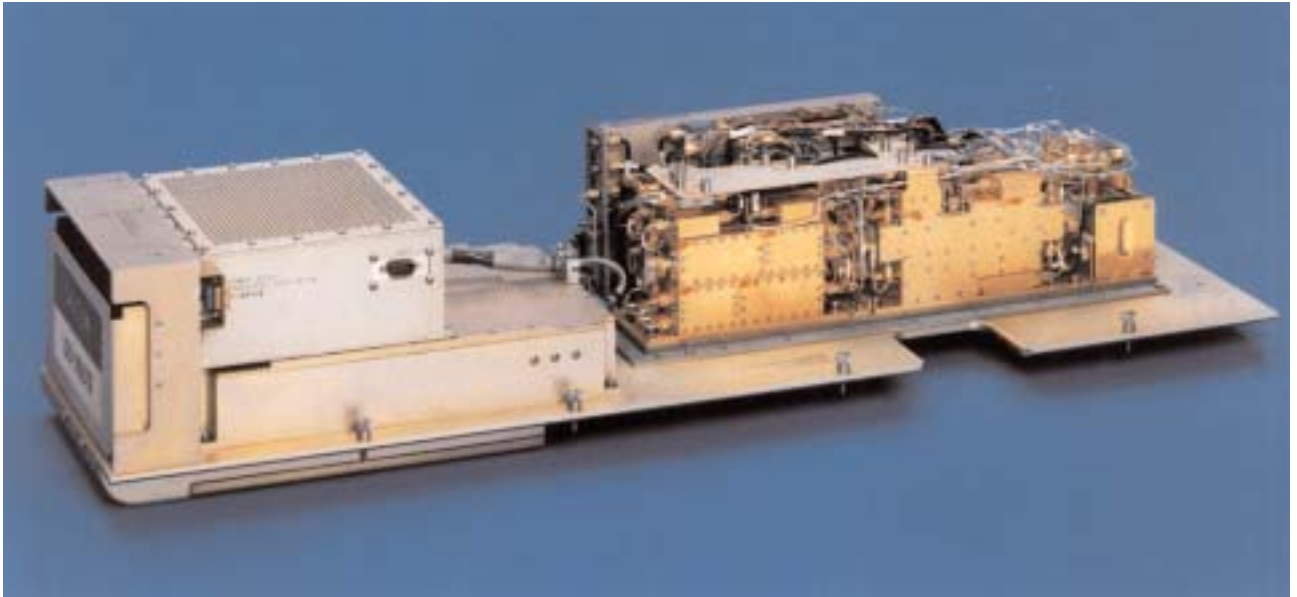
8.0 GHz output spectrum showing 2nd harmonic at 16 GHz, no sub-harmonic at 4.0 GHz and spurious signals better than -80 dBc.



Actual oscilloscope photo showing 6.5 to 13.5 GHz step in 103 nanoseconds

The Leader In High Speed Frequency Synthesizers

COMSTRON

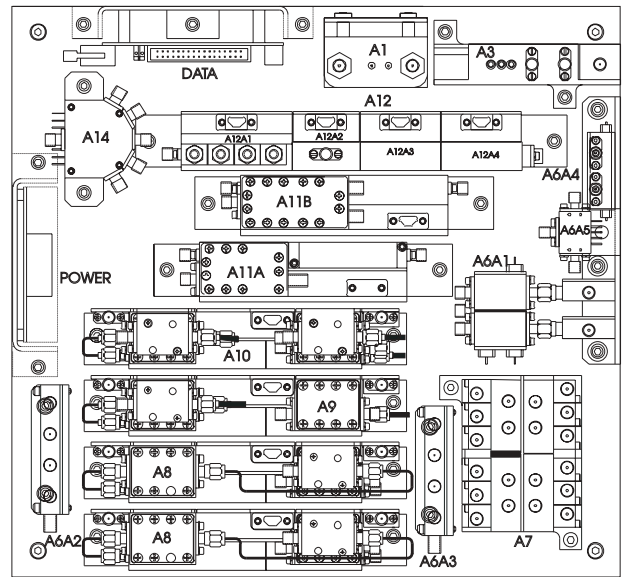


FS5000 technology has been developed to support the most stringent airborne requirements. The architecture as well as its implementation has been specifically geared to furnishing military qualified, high reliability units. The architecture developed around direct analog frequency synthesis is inherently insensitive to vibration - there are no VCOs or sensitive phase locked loops. The components and modules supporting the architecture have also been selected for their rugged and temperature stable qualities. All elements of the architecture have components which can be qualified to MIL-STD-883. The architecture has been implemented using the most appropriate technology presently available. In order to support the need for miniaturization and low power drain, much of the implementation is carried out as application specific hybrid microcircuits. These are designed and produced by the Aeroflex Circuit Technology division, supported by a 25,000 square foot, MIL-STD-1772 qualified, microelectronics production facility.

FS5000 technology permits a truly modular approach to the design of specialized frequency synthesizers. The architecture itself is iterative and

modular, therefore implementations are naturally so. Specific frequency ranges and step sizes are produced by using standard and semi-custom modules configured to support the precise requirement. This architectural approach is adaptable to a wide range of applications, and also accrues all of the advantages of standardization. Reliability, service, logistics, and development economy are all substantially enhanced by using FS5000 architecture and technology. The FS5000 is the signal source of choice for implementing advanced radar systems but also for upgrading existing radars. The above paragraph shows an upgrade to an agile fire control radar. The upgrade consists of a down converter, an instantaneous frequency measurement (IFM) module, a control processor, and an FS5000 agile synthesizer. The principle of the upgrade subsystem is to measure the agile radar pulse frequency at transmission and accurately set the receiver local oscillator (LO) before the return pulse has arrived. The LO must be accurate with respect to frequency, have low phase noise and low spurious content - attributes for which the FS5000 is ideally suited. Aeroflex/Comstron produced the complete upgrade subsystem including real-time control and self-calibration capabilities.

The FS5000 P1 OEM plate illustrated shows a typical modular configuration. Electrical connections for power and programming as well as RF output are located to promote interface accessibility. The placement of standard modules allows for proper channeling of airflow for cooling. The location of module input and output connections are in easily accessible locations. This feature aids in service and trouble shooting. Future expansion or enhancement of this basic synthesizer is possible with the capability to add or replace modules or upgrade existing modules. Additional information on standard modular sets of OEM plate (P) series configurations is provided below.



## TECHNICAL SPECIFICATIONS

### MODULAR CONFIGURATIONS\*

	P1	P2	P3	P4
FREQUENCY RANGE	0.5 - 18 GHz	4.8 - 8.0 GHz	8.0 - 13.5 GHz	4.8 - 13.5 GHz
RESOLUTION	100 kHz	500 kHz	500 kHz	500 kHz
OUTPUT LEVEL	+13 dBm	+10 dBm	+10 dBm	+13 dBm
FLATNESS	± 3 dB	± 1.5 dB	± 1.5 dB	± 3 dB
INTERNAL REFERENCE	100 MHz	100 MHz	100 MHz	100 MHz
STABILITY (per 24 HRS)	5 X 10 <sup>-8</sup>	5 X 10 <sup>-8</sup>	5 X 10 <sup>-8</sup>	5 X 10 <sup>-8</sup>
SWITCHING SPEED	< 200 nS	< 200 nS	< 200 nS	< 200 nS
SPURIOUS	-64 dB	-70 dB	-70 dB	-70 dB
HARMONICS	-50 dB	-50 dB	-50 dB	-50 dB
PHASE NOISE (dBc/Hz)				
10 Hz	-55	-60	-56	-56
100 Hz	-84	-90	-86	-86
1 kHz	-102	-110	-103	-103
10 kHz	-113	-120	-115	-115
100 kHz	-115	-122	-117	-117
1 MHz	-116	-123	-120	-120
10 MHz	-130	-136	-132	-132
40 MHz	-132	-138	-134	-134
POWER REQUIREMENTS				
+15 V	1.0 A	0.8 A	0.8 A	0.8 A
+5.2 V	11.0 A	7.0 A	7.0 A	8.0 A
-6.0 V	5.2 A	2.5 A	3.0 A	3.5 A
FREQUENCY CONTROL (PARALLEL BCD, TTL)	21 BITS	14 BITS	18 BITS	19 BITS
DIMENSIONS				
HEIGHT	4.3" (10.923 cm)	4.3" (10.923 cm)	4.3" (10.923 cm)	4.3" (10.923 cm)
WIDTH	11.75" (29.845 cm)	8.5" (21.59 cm)	8.5" (21.59 cm)	8.5" (21.59 cm)
LENGTH	11" (27.94 cm)	11" (27.94 cm)	11" (27.94 cm)	11" (27.94 cm)
WEIGHT	20 lbs (9.07 kg)	18 lbs (8.16 kg)	18 lbs (8.16 kg)	18 lbs (8.16 kg)
TEMPERATURE RANGE				
OPERATING	0° TO 50° C	0° TO 50° C	0° TO 50° C	0° TO 50° C
STORAGE	-20° TO +85° C	-20° TO +85° C	-20° TO +85° C	-20° TO +85° C

\* This table comprises a partial list of available Modular FS-5000 configurations. Contact the Factory for information on other available configurations and specifications. Modular FS5000 synthesizers with specialized low noise references are available with improved phase noise of -130 dBc at 10 kHz offset at X band as well as improved spurious and harmonics.

# TECHNICAL SPECIFICATIONS

## STANDARD CHASSIS CONFIGURATION

### Frequency Range and Resolution:

Model Number	Frequency Range (GHz)	Frequency Resolution
FS5000B-F	4.8 to 13.5	0.5 MHz
FS5000B-X	4.8 to 20	1 MHz
FS5000B-13	0.3 to 13.5	0.5 MHz
FS5000B-18	0.3 to 18.0	1 MHz
FS5000B-20	0.3 to 20.0	1 MHz
FS5000B-26.5	0.3 to 26.5	1 MHz

### Switching Speed:

<200 nanoseconds

### Output Power:

+10 dBm (50 Ohms) nominal

### Flatness:

± 2 dB (± 5° C of calibration temperature).

### Amplitude Setting:

Within 2 dB of final level < 200 nanoseconds

### Reference Oscillator:

Internal: 100 MHz Quartz Oscillator,  $5 \times 10^{-8}$  per day after 30 days in normal operating environment

### External Tuning Input

± 2 VDC, Pull Range ± 100 Hz per Volt Nominal at 1 GHz

### Frequency Accuracy and Stability:

Same as Reference Oscillator.

### Remote Programming Control Interfaces:

20 bits parallel BCD 1,2,4,8 (1 MHz resolution)  
 Optional 44 bits parallel BCD 1,2,4,8 (1Hz resolution)  
 IEEE-488-1978

### Phase Coherence

Frequency steps of 50 MHz from 4.8 to 13.5 GHz.  
 100 MHz steps from 13.5 GHz to 26.5 GHz. (Finer steps possible as special option - contact factory)

### Spectral Purity

#### Phase Noise

Absolute SSB Phase Noise in dBc/Hz (includes noise of internal reference)

Frequency Offset	Carrier Frequency (GHz)				
	0.5	1.0	3.0	8.0	18.0
10 Hz	-86	-80	-71	-60	-55
100 Hz	-105	-85	-99	-90	-84
1 kHz	-110	-95	-110	-110	-102
10 kHz	-130	-120	-124	-120	-113
100 kHz	-140	-132	-128	-122	-115
1 MHz	-142	-139	-132	-123	-116
10 MHz	-143	-148	-140	-136	-130
100 MHz	-143	-150	-150	-138	-132

#### Spurious and Harmonic Signals

Frequency Range(GHz)	Spurious (dBc)	Sub-Harmonics (dBc)	Harmonics (dBc)
0.3 - 2.4	-80	None	-50
2.4 - 4.8	-76	None	-50
4.8 - 13.5	-70	None	-50
13.5 - 20	-64	-60	-50
20 - 26.5	-64	-50	-50

#### Operating Temperature

0° to 50° C

#### Storage Temperature

-20° to 85° C

#### Power Requirements

FS5000B-18:120/220/240 VAC ± 10%, 48 to 440 Hz, 320 Watts, 380 VA

#### Dimensions

16.75" W x 5.22" H x 23.88" D  
 (42.55 x 13.66 x 60.66 cm)

#### Weight

FS5000B-18: 55 lbs (24.9 kg)



## AVAILABLE OPTIONS\*

1 Hz frequency resolution (Limits switching speed to 1 microsecond for steps less than .500 MHz - Does not affect spectral purity or phase noise)
FM Chirp (Wideband FM)
FM Normalized
40GHz Frequency Doubler, +10 dBm, SMA (F) Input, K (F) Output, Rack Mount Unit (Dimensions: 2.2" H x 19" W x 6" D, Weight: <2 lbs)
10 MHz Phase Lock Capability. Internal reference can be phase locked to 10 MHz Signal at 0 dBm ±2 dB. (Provides External 10 MHz +2 dBm ±2 dB)
19 Inch Standard Equipment Rack Mounting Slides.

\* Contact factory for additional special options

### FREQUENCY MODULATION OPTION

#### Sensitivity

1.0 volt peak for full scale deviation.  
 The amplitude of the FM input signal must be adjusted to obtain the desired deviation according to the output frequency range.

#### Source

External Only  
 Input Impedance: 50 Ohms  
 Modes: DC and AC

#### Rate

DC Mode: DC to 5 MHz  
 AC Mode: 50 Hz to 5 MHz

#### Frequency Stability

AC Mode - The FM Oscillator is phase locked to the synthesizer reference. Consequently, the carrier has the same stability as in CW Mode.

DC Mode - The FM Oscillator Phase Lock is unlocked to introduce the DC or very low frequency FM signal. The oscillator is thus free running.

#### Linearity

<10% for maximum deviation

#### FM Deviation

Frequency (MHz)	Deviation (MHz) (min.)	Rate (MHz/m s)
300 - 600	±8.0	22.0
600 - 1200	±15.0	44.0
1200 - 2400	±30.0	88.0
2400 - 4800	±60.0	175.0
4800 - 13500	±120.0	350.0
13500 - 18000	±240.0	700.0
20000 - 26500	±240.0	700.0

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