

# Application Note

**AEROFLEX**  
A passion for performance.

## 2040 series Low Noise Signal Generators



The 2040 series of Low Noise Signal Generators offer a level of performance which breaks new ground in the traditional compromise between price and performance

## Introduction

When designing signal generators there are fundamental trade-offs between the performance and complexity of the design. The simplest signal generators use a single phase locked loop to translate the stability of reference oscillator onto a variable frequency output, but the noise performance obtained is limited by the characteristics of the RF oscillator. If better noise performance is needed then more complex solutions usually have to be used and this leads to higher development and manufacturing costs. The increased complexity can also result in the equipment being larger, heavier, more complex to maintain and often less reliable.

The design of the 2040 series of Low Noise Signal Generators is based on the successful 2030 series and the two product families share many common parts. The 2030 design took account of the future existence of a low noise family and the necessary electrical and software connections were built-in from the start.

## Noise Measurements

Many areas of the synthesizer had to be characterized for phase noise performance during the course of the instrument design and a special noise measurement system based on the use of a frequency discriminator was developed. Unlike more well-known methods of measuring phase noise, the system is capable of making very fast measurements and does not require any calibration routines to be run. The availability of this measuring system ensured that fast, reliable measurements could be made.

## Low Noise Design

One objective in designing the 2030 series was to allow for upward compatibility with the low noise units and this allowed the investment in the main RF sections to be effectively shared between two projects. This resulted in a common RF module giving obvious advantages in terms of economy of production. The solution adopted to achieve the low noise performance of the 2040 series was to add a second, smaller RF module to the basic generator architecture. The objective of the extra circuits is to convert the existing 2030 series voltage controlled oscillator into what is effectively a much better VCO, but still controlled by the same fractional-N system.

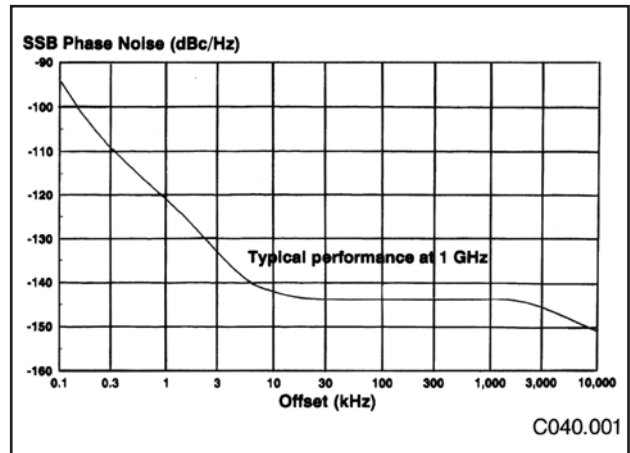
A key element in achieving this is a 135 MHz crystal oscillator which has been designed to have a noise performance of better than -170 dBc/Hz at 20 kHz offset. The output of the 135 MHz crystal oscillator is then used as a low noise reference in the circuitry which derives the final output signal.

## Noise Performance

A novel fractional multiplier system takes the 135 MHz signal and provides an output at 22.5 MHz intervals between 675 and 1350 MHz and achieves a noise performance which is some 16 dB better than would be obtained if a 22.5 MHz crystal had been multiplied by a standard integer multiplier technique.

The low noise multiplied signal is then combined with signal derived from the normal VCO system to provide an overall output with the required resolution (0.1 Hz) and noise. In this way an SSB phase noise specification of better than -140 dBc/Hz can be offered at 1 GHz.

By using parts which are common to the low cost 2030 series the 2040 series benefits by being smaller, lighter and significantly less expensive than conventional low noise synthesizers.



Typical SSB phase noise performance of 2040 series at 1 GHz

### CHINA Beijing

Tel: [+86] (10) 6539 1166  
Fax: [+86] (10) 6539 1778

### CHINA Shanghai

Tel: [+86] (21) 5109 5128  
Fax: [+86] (21) 5150 6112

### FINLAND

Tel: [+358] (9) 2709 5541  
Fax: [+358] (9) 804 2441

### FRANCE

Tel: [+33] 1 60 79 96 00  
Fax: [+33] 1 60 77 69 22

### GERMANY

Tel: [+49] 8131 2926-0  
Fax: [+49] 8131 2926-130

### HONG KONG

Tel: [+852] 2832 7988  
Fax: [+852] 2834 5364

### INDIA

Tel: [+91] 80 5115 4501  
Fax: [+91] 80 5115 4502

### KOREA

Tel: [+82] (2) 3424 2719  
Fax: [+82] (2) 3424 8620

### SCANDINAVIA

Tel: [+45] 9614 0045  
Fax: [+45] 9614 0047

### SPAIN

Tel: [+34] (91) 640 11 34  
Fax: [+34] (91) 640 06 40

### UK Burnham

Tel: [+44] (0) 1628 604455  
Fax: [+44] (0) 1628 662017

### UK Cambridge

Tel: [+44] (0) 1763 262277  
Fax: [+44] (0) 1763 285353

### UK Stevenage

Tel: [+44] (0) 1438 742200  
Fax: [+44] (0) 1438 727601  
Freephone: 0800 282388

### USA

Tel: [+1] (316) 522 4981  
Fax: [+1] (316) 522 1360  
Toll Free: 800 835 2352

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[www.aeroflex.com](http://www.aeroflex.com)  
[info-test@eroflex.com](mailto:info-test@eroflex.com)



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