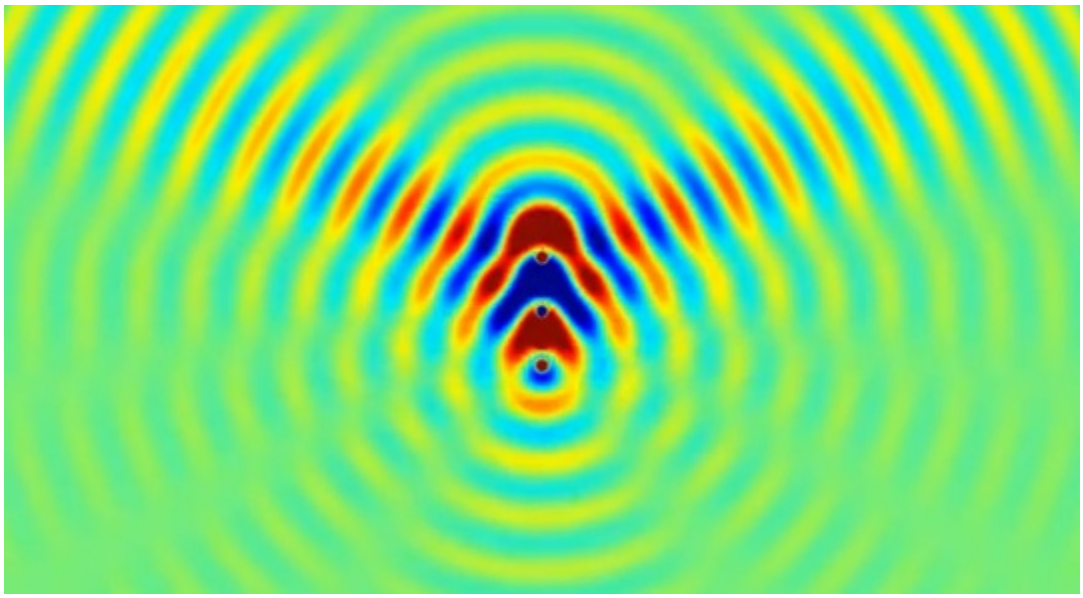
Phased Array Radar

Signal Distribution



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Introduction

Precise Time and Frequency, Inc. manufactures a wide range of frequency references and complementary products such as signal distribution. In many cases specific models have been developed to deal with the particular performance requirements of a specific type of system.

This paper discusses the critical criteria for distribution of frequency and timing reference signals within a highly sensitive phased array radar system, and the distribution solution for meeting these special requirements.

Within such systems the stability of the reference signals is fundamental to obtaining the required system performance. Small slow moving objects are more difficult to detect because:

1. Smaller objects reflect less signal, impacting signal to noise ratio

2. Slow moving objects cause less Doppler effect on the returned signal, requiring a higher sensitivity in order to determine velocity of the object.

Although modern day technology allows for a degree of mitigation of the effects of a poor reference, ultimately the attainable performance will be affected by the quality of the reference deployed and delivered to the individual array elements.

The more noisy the transmitted signal the more difficult it is to determine the difference between a change in reflected signals due to an object, and a change due to noise of the transmitted signal. This can result in at best misleading and at worst false readings.

Finally, system stability (over time and temperature etc.) is one of the most critical aspects of system design. It is possible to calibrate out constant or predictable signal offsets, however clearly this is not possible with random, unpredictable changes.

ptf 1203D-2 for Phased Array Radar Solution

As mentioned above, a Phased Array Radar system requires a highly accurate, stable, and low noise RF reference signal to be fed simultaneously to each element of the radar system in order to detect and track in-range objects.

Not only must the reference be highly accurate, but the phase of the signal between elements must be precisely matched and stable over time in order to attain the highest levels of sensitivity possible. Differential phase shifts between elements will be interpreted as target tracking shifts and result in erroneous speed, heading, and possibly target identification data.

In order to generate the required reference it is necessary to first generate a highly accurate and stable reference frequency, as provided by a unit such as the ptf 3203A GlobalTyme GPS receiver, generating a 10MHz RF signal with high stability and low phase noise, that will result in

a stability of around 2E-11 over 100 seconds, with an accuracy of <2E12 and phase noise at 10Hz offset from the carrier of <125dBc.

Once this signal has been generated, it is then necessary to distribute it to multiple (several hundred) radar elements maintaining the phase alignment of each output to <1ns from the reference input to each output, with a dynamic drift characteristic of <1.5 pico seconds per degree Celsius.

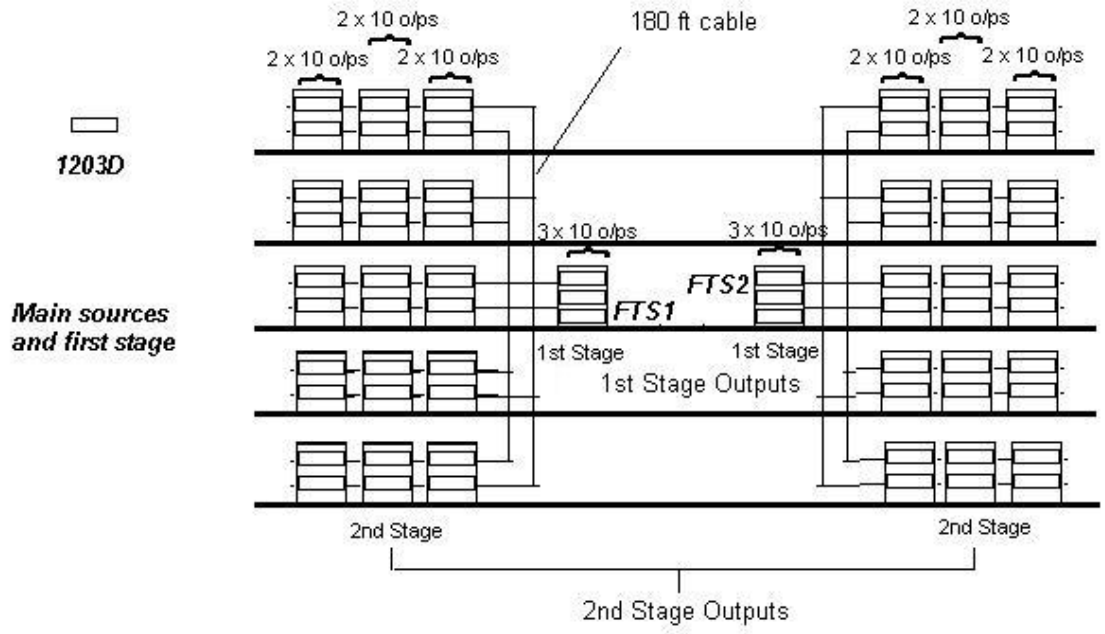
The ptf 1203D-2 RF Distribution amplifier has been developed to provide this outstanding level of performance over a temperature range of 17 to 30 degrees Celsius, and represents a unique product in its class.

In order to generate the required number of outputs, distribution is implemented in two stages as shown in the system block schematic on the next page.

Each model ptf 1203D-2 provides one input channel and 12 output channels reproducing the input signal with a channel to channel skew of <0.25 ns and a phase versus temperature coefficient of <1.3 pico seconds per degree Celsius.

This outstanding performance enables new generation phased array radar systems to perform to unrivalled levels of resolution, previously unattainable with earlier generation equipment.

Phased Array Radar System Distribution



1ns total allocation input to output. Dynamic allocation is +/- 1.5 pico seconds.

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