RF SUISSE

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Lightning Safety Considerations when Designing a Frequency Reference Distribution System

Designing a frequency reference distribution system poses some challenges. Besides ground loops and interference prevention lightning protection is a major issue which is quite often overlooked.

For this discussion we assume that a real accurate frequency reference is required which eliminates the use of free running references even though they are not plagued by lightning issues unless connections have to be made outdoors. Locking the frequency reference to a more long term accurate standard is commonly done with connecting it to a GPS receiver.

A common set-up consists of the following components which may be consolidated or in several enclosures.

- GPS antenna
- GPS receiver
- Frequency reference
- reference frequency distribution
- reference frequency “consumers”

To achieve good GPS performance the GPS antenna should always be installed outdoors where it is exposed to the elements including static charges and lightning. At the high receive frequency (~1.3GHz) it is pretty difficult to incorporate lightning protection devices in the coaxial feed line from the antenna to the GPS receiver without adding losses and even the best lightning arrestors will not completely take care of the problem. If the GPS receiver is located inside the building this poses a serious risk.
A solution to this problem is to mount the GPS receiver close to the antenna with the nice side effect that the losses are a lot lower and distribute the 1PPS signal via a fibre-optic link to the frequency reference. Now only the power supply of the GPS receiver has to be lightning protected which can be done in 2 ways. Either the GPS receiver is supplied with a battery, charged by a solar cell or the mains supply is routed outside the building with a mains lightning arrestor close to the ground. This way no metallic connection goes to the inside of the building thus eliminating the lightning risk.

Another potential risk factor is the distribution of the reference frequency, especially if it has to cover several buildings or has to be routed outdoors. The coaxial cables used are made of metal which can also conduct static energy and lightning. If there is such a risk the better way to distribute the signal is also via fibre-optic links. In addition to the lightning protection this also eliminates ground loops, makes the reference system less likely to catch interfering signals or radiate the reference frequency.

The final set-up can be done in several ways. The GPS receiver and frequency reference can be combined into one enclosure and mounted closer to the GPS antenna with a 10MHz fibre-optic cable going inside. This however requires that the installation point of the box isn't exposed to fast changes in temperature as all references are sensitive to these fast changes. The time constant should be in hours which requires to mount the unit in a well insulated additional enclosure. It also has to be noted that in case of a lightning incident the entire expensive reference generator will be ruined.

The best and most secure set-up is the following:

- GPS antenna mounted outdoors on a well grounded post
- GPS receiver with optical 1PPS output installed close to the antenna but under the roof
- GPS receiver supply via battery and solar cell or a well protected mains supply (see above).
- Indoor frequency reference with optical 1PPS input
- coaxial or fibre-optic distribution of the reference frequency depending on noise and EMI requirements

A disadvantage of the fibre-optic distribution of the reference frequency is that the output signal usually has a pretty elevated noise floor. To overcome this problem a fibre-optic receiver with integrated clean-up oscillator should be used as a lot of modern

instruments do no longer use their internal oscillators for this purpose.

Product for this application:

RS-GPSANTxx	Active GPS antennas
RS-GPSPPS4	GPS receiver with optical 1PPS output
RS-MRGGT10-PPF-xx	TCXO based frequency reference with optical 1PPS input and either coaxial or fibre-optic reference outputs
RS-MRGGT10-GPS-xx	Combination of TCXO based frequency reference and GPS receiver and either coaxial or fibre-optic reference outputs
RS-CGGO10-PPF-xx	OCXO based frequency reference with optical 1PPS input and either coaxial or fibre-optic reference outputs
RS-CGGO10-GPS-xx	Combination of OCXO based frequency reference and GPS receiver and either coaxial or fibre-optic reference outputs
RS-FOC10-10-xx-yy	Fibre-optic reference receiver with clean-up oscillator
RS-FOT50-xx	Single output electrical reference to fibre-optic converter
RS-FOD50-xx	8 channel electrical reference to fibre-optic converter
RS-PPSOT	Electrical 1PPS to fibre-optic converter for existing installations (GPS receivers)
RS-PPSFR	Single channel fibre-optic to electrical receiver to feed existing frequency references with electrical 1PPS input
RS-PPSD	Fibre-optic 1PPS receiver with 8 electrical outputs

For the latest product information, data-sheets and application information please visit our website at http://www.rf-suisse.ch

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Except as noted otherwise all RF-SUISSE product is RoHS 5 compliant meeting the requirements as per the date of shipping.

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