Generation 1 Laser Locker

Simple Commissioning Instructions

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FQMT

The frequency multiplier expects 0dBm input, nominally at 476 MHz. The 3808 output will be nominally 0 dBm as well. The other outputs are typically +/- 2 dBm, but their harmonic content is non-optimal, and should not generally be used in installations. Best phase noise performance will be with the other inputs/outputs terminated into 50 Ohm.

RECV

The front end down converter generates LO internally from the 10 MHz reference provided to the SIM900. Therefore, the crate should have a high-quality RF reference provided to it, typically via the SRS Rb frequency standard installed in the crate, with an output connecting that module's outputs to the input on the crate. The DIP switches need to also be set appropriately to distribute the reference to the slots.

The input levels are something like -40 dBm to the reference input and -50 dBm to the laser (diode) input. This is with the gain of the opamp stages set to minimum (set via trim pots accessed through two holes in the front panel of the module). The scale of the diode input is determined by the nominal operating point of the ET-4000 photodiode with the Vitara oscillator. It is best to set and maintain this level via diode alignment, once proper external attenuation is added to set the appropriate inputs to the RECV. Do not use the op amp gain except in cases where the diode alignment is optimized and you need to adjust the signal levels finer than the 1dB afforded by external fixed attenuators.

Note, when setting these levels, it will feel like you're putting a ton of attenuation in line, but don't worry too much about it.

To verify the levels are correct, you can look at three signals. First, look at the monitor outputs on the RECV, or the actual outputs. The monitor outputs can be put directly on a scope, whereas the main outputs will need to be terminated in either a 50 Ohm pass-through or scope impedance. These signals will be a sine wave that is a few dB below saturation (which will be clear on a scope trace by the sinewave clipping). When set correctly and connected to the inputs on the DITM module (see following), the readback levels of the DITM should indicate something between 3.2 and 3.6 Volts.

DITM

The DITM module has six inputs, and four outputs. See figure for a visual description of the various connections.

The Enable/Disable and feedback input gain scaling connections are accessed via the back panel db9 connector. In general the gain scaling should be connected to ground (the firmware is designed for the vitara oscillator and piezodrive amplifier response). The enable/disable is 0V:enable, 5V:disable.

The front panel inputs will be crossed in two places, a result of how the designs and board layouts were done. I point this out here, because if it doesn't look weird, you probably haven't set it up correctly.

The phase control, incorporating the IQPC module (described below) takes step and direction inputs to rotate through the internal phase parameter space. Output C from the IQPC should go to DIn1, and D should go to DIn0.

The downconverted diode signal from the RECV should be connected to Ain0, and the downconverted reference RF should be connected to Ain1. The output signals in order from AOut0 and increasing, are the piezo amplifier control signal, the diode average rms, rf reference average rms, and phase error. These last three, along with the piezo amplifier monitor output, should be connected to the control system via ADCs.

To summarize:

Front panel connections (DITM)

AIN0 <- From Diode

AIN1 <- From RF Reference

AOUT0 -> Piezo Amplifier

AOUT1 -> Diode Power RB

AOUT2 -> RF Pwr RB

AOUT3 -> Phase Error RB

DIN0 -> Direction

DIN1 -> Step Front panel connections (IQPC)

C -> Step (connect to DITM DIN1)

D -> Direction (connect to DITM DIN0)

IQPC

The IQPC incorporates a modified version of the IMS Smart Motor, to provide a simple motor controller interface to the control system, allowing the phase control to easily benefit from speed ramp controls without having to implement them ourselves. The module is communicated with via the RS-422 connection on the front panel. This will require connection to a serial port server with the proper cabling. More information can be found in the extended documentation for the timing system.

LSIT

The laser interface module combines a number of functions in one module. For current generations, though, there are must two primary inputs, the second of two resync triggers from the TGRS module, described below, and the output of the regenerative amplifier photodiode (typically another ET-4000). The resync trigger resets the fast flip-flop triggered by the very fast regen diode signal, such that the Laser Interface module has a clean square wave of rise time comparable to the laser pulse, and dwell time long enough for the time interval counter set up time.

The regen diode signal can be difficult to set up correctly. The observed peak voltage will depend on the reactance of the input impedance on a scope looking at the diode signal. On a typical 500 Mhz bandwidth scope, you'll be looking for a peak voltage of around 10 mV. At 2 GHz, likely around 70-80 mV.

To confirm the diode level is appropriate, look at the output of the LSIT via the complementary output. If the level is too high, you'll see the flip-flop retriggering close to the original pulse, zoom in, otherwise you might think that it isn't doing anything. And on the other side, if the signal is too low, the comparators won't fire so there will be no output from the flip-flop. Once the optical alignment is set, adjust the signal level via an ND filter wheel installed in front of the regen diode.

The output of the LSIT should be a pulse with a -400 mV baseline, to 0 V. This should be connected to the A input of the Time Interval Counter.

TGRS

The Trigger resync expects a typical EVR input, and an RF reference at nominally 0 dBm from the RFFO module. The + input should look like a positive going trigger pulse with a -400 mV offset. The complementary output should be 0 V to -400 mV.

The -400 to 0 output should be connected to channel B of the Time Interval Counter.

TIC

The time interval counter should always have trigger levels set to -200 mV. In the case of goose trigger operation, the gate input should be configured appropriately for this mode of operation. More information on this can be found on Confluence.