Beacon Tracking Receiver Technical Notes

Novella SatComs tracking receivers have been designed to track and measure pilots or beacons of all known commercial and military satellites. They are particularly suited to track satellite beacons (frequency and power stable signals generated on board satellites, used for telemetry and control) in earth stations using large antennae requiring good boresight alignment and stable uplink power.

These receivers are synthesized, in 10kHz steps, allowing accurate targeting of the pilot (generated on the ground and re-transmitted on board) on the on-board beacon.

Novella's most common tracking receiver has an input at L-band, 940 to 1,750MHz, optionally 940 to 2,150MHz. The L-band signals are downconverted to around 70MHz and then processed by a coherent tracking and detection module.

The tracking module uses a 2kHz PLL, optionally 300Hz, for signal acquisition and level measurement by coherent detection. A search device tunes a VCO (usually by ±200kHz, optionally wider or narrower customer defined values) close to acquisition. Phase lock is at that point achieved by PLL pull-in. An anti-sideband (ASB) device prevents lock to telemetry sidebands. This is designed to avoid sidebands between 2kHz and 50kHz from carrier.

The VCO sweep/search and the PLL tracking enable these receivers to find and re-acquire a beacon in all loss of lock circumstances and make them ideal to track beacons of highly inclined orbit satellites where Döppler shift may be larger than the AFC range of simpler tracking receivers.

300Hz PLL receivers have a re-acquisition threshold of 35dBHz and require around 90 seconds to lock (for a VCO sweep of ±200kHz). They are recommended for antenna or propagation measurements where dynamic and measuring range is important.

2kHz PLL receivers have a re-acquisition threshold of 43dBHz and require less than 1 second to lock (for a VCO sweep of ±200kHz). They combine fast acquisition with the advantages of a coherent system, and are recommended for tracking applications. They are ideal for tracking the BPSK modulated beacons of the military satellites and the ASTRA 1A, ASTRA 1B and G-Star satellite type beacons, with analogue phase modulation (±0.5rad or ±1rad peak phase deviation) of the beacon main carrier by a 1,024b/s telemetry digital stream. In this case an incoherent (peak) detector is used to accurately measure the beacon's aggregate power spread over a finite band while a PLL is still used for locking and tracking.

Novella's receivers are extensively used to track NATO/Skynet/DSCS BPSK modulated beacons. Their low threshold, fast acquisition and high linearity make them the preferred choice for small antenna field deployable X-band stations and other small terminals requiring fast automatic satellite acquisition.

These receivers are fully linear up to the detector output, providing a simple way of measuring the relative power of the input signal. If this is required to be in dB the following formula could be used:

Pin = 20 x log (Vout/Vref)

where:

Pin - Input power expressed in dB

Vout - Detector output voltage; detector is an ideal voltage source
with internal impedance of 0 ohms

Vref - Scaling output voltage reference.

A log amplifier is used to provide an output voltage representing the input power in logarithmic scale, making the input power to output voltage log-conformal. A 2dB/V slope is commonly used. Other slopes are available if specified at time of order.

Tracking receivers with interface at C, X or Ku-band combine one or more C, X or Ku to L-band Block Downconverter modules with a standard L-band receiver. Alternatively, an L-band receiver may be supplied ready to drive an external LNB or BDC. DC may be supplied via the L-band interface cable, with a back-panel switch provided to disable this facility. LNB polarization and/or band selection may be made via DC level change or 22kHz tone insertion. The frequency display will read frequencies at SHF, as in the equivalent SHF receivers.

Some receivers may cover more than one SHF downlink segment. Novella manufactures receivers covering all of the Ku-band receive segment, extended C-band plus Ku-band, and C, X plus Ku-band.

S-band receivers, covering a spectrum around 2.0 to 2.4GHz, are simple adaptations of the L-band module.

Polarization and/or channel switching may also be supplied: two or four inputs selected via coaxial switches.

All tracking receivers are fitted as standard with an RS485/422 and RS232 remote interface, selectable from front panel menus.

Novella's tracking receivers may be used for Automatic Frequency Compensation (AFC), in conjunction with Novella's frequency up and downconverters, in earth stations of satellite systems such as INMARSAT. In this case the phase-locking loop is closed via an L-band downconverter and the measured frequency drift in the received pilot is used to pre-compensate transmitted traffic at C-band.

Novella's tracking receivers are also used in conjunction with the uplink power controller, UPC300, for simple uplink power control applications.

Novella's tracking receivers are commonly packaged in 1U 19" standard rack mounted chassis, but they may be also packaged in compact ruggedized aluminum IP67 boxes for field deployable earth stations or splash proof enclosures for outdoor protected environments. These packages use a newer more integrated and compact design which significantly reduces the size of the required electronics.

A key consideration is reliability. Novella's production techniques and high level of circuit integration is reflected in a standard warranty period of 36 months which may be extended to 5 years for a nominal fee. All products are stressed for a minimum of 24 hours at 500C and 12 hours at -250C and must be fully functional at the end of each cycle.

Specialist Applications

Novella manufactures a wide range of COTS and bespoke tracking receivers for S, X and Ka-bands, based around a standard L-band tracking module with a S, X or Ka to L-band block downconverter. Please consult our Sales Department quoting your requirements for a solution and a quotation.