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Microwave Journal

Loop Test Translators for Satcom Systems

The loop test translator (LTT) is an extremely valuable tool for evaluating the performance of satellite earth stations. It allows the user to carry out analysis, alignment and testing without incurring satellite airtime costs and the risk of interfering with other satellite users. Thus, it has applications during equipment development, qualification, trouble-shooting and in-service routine monitoring.

A basic loop test translator comprises a mixer and local oscillator to translate the ground-to-space transmit frequency to the ground-from-space receive frequency in just the same way that the satellite does. In practice other features are provided to enhance usefulness and flexibility.

A BROAD RANGE

The ALT range of loop test translators from AtlanTecRF covers the satellite communication bands S, C, X, Ku, DBS and Ka. They are block converters, which means they convert the whole transmit band with a single frequency LO to the required receive band or directly to the first IF band (which is typically in L-band). ***Table 1*** shows the breadth that the standard ALT product range covers; non-standard bands and non-standard LO frequencies can also be provided.

The local oscillators leverage the company's expertise in low noise phase-locked oscillators. Standard products have internal 25, 50 or 100 MHz reference oscillators, according to model, but a range of options, including 10 MHz internal and/or external reference frequencies can be supplied for compatibility with station reference signals. Enhanced stability of internal references is available using OCXO and TCXO solutions. A reference frequency output is supplied together with a loss of phase lock alarm.

Double balanced mixers are used and the input path features a 30 dB variable attenuator, adjustable via a 10-turn control with dial. Optionally, a 69 dB range step attenuator can be provided. The purpose of the input attenuator is to set the input to the mixer so that it is operating at the correct level. The overall con-

AtlanTecRF
Braintree, UK

TABLE I

THE ALT RANGE OF STANDARD LOOP TEST TRANSLATORS OFFERED BY AtlanTecRF

Model No.	Translation Bands	Input Freq. Range (MHz)	Output Freq. Range (MHz)	LO Frequency (MHz)
ALT-0175-S	S-S	2025-2125	2200-2300	175
ALT-1075-S	S-L	2025-2125	950-1050	1075
ALT-2225-C	C-C	5845-6425	3620-4200	2225
ALT-4975-C	C-L	5925-6425	950-1450	4975
ALT-7375-CI	C-L(inv)	5925-6425	1450-950	7375
ALT-0650-X	X-X	7900-8400	7250-7750	650
ALT-6950-X	X-L	7900-8400	950-1450	6950
ALT-1800-Ku	Ku-Ku	12750-13250	10950-11450	1800
ALT-2050-Ku	Ku-Ku	12750-13250	10700-11200	2050
ALT-11800-Ku	Ku-L	12750-13250	950-1450	11800
ALT-1750-KuE	KuE-Ku	13750-14500	12000-12750	1750
ALT-2300-KuE	KuE-Ku	13750-14500	11450-12200	2300
ALT-2800-KuE	KuE-Ku	13750-14500	10950-11700	2800
ALT-3050-KuE	KuE-Ku	13750-14500	10700-11450	3050
ALT-12800-KuE	KuE-L	13750-14500	950-1700	12800
ALT-1750-Ku	Ku-Ku	14000-14500	12250-12750	1750
ALT-2300-Ku	Ku-Ku	14000-14500	11700-12200	2300
ALT-2550-Ku	Ku-Ku	14000-14500	11450-11950	2550
ALT-3050-Ku	Ku-Ku	14000-14500	10950-11450	3050
ALT-13050-Ku	Ku-L	14000-14500	950-1450	13050
ALT-5100-DBS	DBS-DBS	17300-17800	12200-12700	5100
ALT-5178-DBS	DBS-DBS	17300-17800	12122-12622	5178
ALT-5600-DBS-A	DBS-DBS	17300-17800	11700-12200	5600
ALT-5600-DBS-B	DBS-DBS	17300-18100	11700-12500	5600
ALT-5600-DBS-C	DBS-DBS	17800-18100	12200-12500	5600
ALT-7400-DBS	DBS-DBS	18100-18400	10700-11000	7400
ALT-16350-DBS-A	DBS-L	17300-17800	950-1450	16350
ALT-16350-DBS-B	DBS-L	17300-18100	950-1750	16350
ALT-16350-DBS-F	DBS-L	17300-18400	950-2050	16350
ALT-16850-DBS	DBS-L	17800-18100	950-1250	16850
ALT-17150-DBS	DBS-L	18100-18400	950-1250	17150
ALT-9800-Ka	Ka-Ka	27500-31000	17700-21200	9800
ALT-10300-Ka	Ka-Ka	28000-31500	17700-21200	10300

version loss is 20 dB nominal, or 35 dB for Ka-band.

These LTTs are normally 'wide open', i.e. they contain no filtering and no additional gain. This provides the optimum conditions for the investigation of spurious signals. However, both filtering and additional gain to compensate for conversion loss can be provided if required.

The situation arises in Ku-band where a common transmit frequency range is associated with three differing receive bands. This can be addressed by a three-band model in which three local oscillators can be switched via a front panel control to allow a single unit to be used for all three receive bands. This is useful for testing mobile or fly-away systems, which may have to be field-configurable to suit the region in which they are deployed.

Fig. 1 Three-band switched unit with custom-designed test translator.

Figure 1 illustrates a three-band switched unit together with a custom-designed test translator. The same principle of combining several LOs in one product can be applied to provide a cost-effective combined C- and Ku-band unit. Custom translation frequencies can also be supplied.

The standard mechanical configuration is 19-inch rack mounting with a height of only 1U to minimize space in a crowded earth station rack, although other mechanical arrangements can be provided, including weatherproof enclosures designed for external mounting. Similarly, connector configurations can be changed to suit the application and waveguide interfaces can also be provided if necessary.

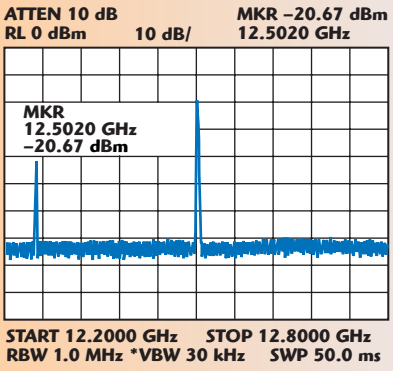

Fig. 2 ALT1750-KuE with 0 dBm input at 14.25 GHz.

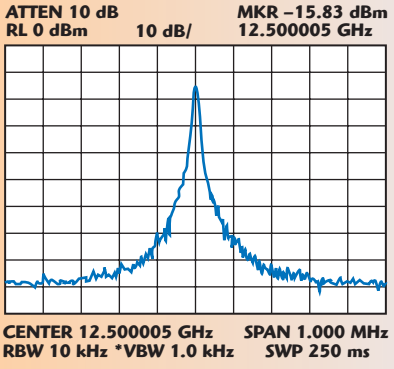

Fig. 3 Expanded centre portion of Fig. 2.

EXAMPLES

The ALT-1750-KuE LTT is an Extended Ku-band (13,750 to 14,500 MHz) unit translating to 12,000 to 12,750 MHz via a 1,750 MHz LO with internal reference. It has a nominal conversion loss of 20 dB. ***Figure 2*** shows a typical plot of the output with a transmitter input of 0 dBm at 14.25 GHz. This unit has an LO of 1,750 MHz and its seventh harmonic can be observed at 12,250 MHz.

Figure 3 is an expansion of the centre portion of the display. The local oscillator in this unit has a typical phase noise of -105 dBc/Hz at 1 kHz, extending to -140 dBc/Hz at 1 MHz offset. Frequency stability with a standard internal reference is ±5 ppm maximum over 0° to 50°C, with a typical stability of ±2 ppm over +10° to +40°C and ±2 ppm maximum per day.

The ALT-9800-Ka and ALT10300-Ka models cater for the increasingly popular Ka-bands. They cover transmit frequency bands of 27.5 to 31.0 GHz and 28.0 to 31.5 GHz, respectively, both models downconverting to 17.7 to 21.2 GHz.

APPLICATIONS

Most operational earth stations do not have the luxury of a continuously-available spectrum analyzer capable of observing waveforms at signal frequency, so the LTT provides a convenient and cost-effective way of downconverting the uplink signal to enable it to be seen in the receiver or with an IF spectrum analyzer. Typically this enables checks to be made on the modulation, power levels, spurious and noise. Used in conjunction with a baseband BER test set, BER can be measured. If group delay measurements are required, the LO in the LTT can be locked to the station reference to improve accuracy.

In the event of a hardware failure within a VSAT network it is common for the transceiver to be replaced in the field and returned to the service-provider's central workshop. The LTT is the ideal tool for verifying the perceived fault under controlled conditions before embarking on a costly repair process or returning the transceiver to the supplier. The availability of multiple translation frequencies in a single unit adds to flexibility at minimum cost.

CONCLUSION

This ALT range of loop test translators is suitable for off-air testing and monitoring of satellite earth station equipment, including the analysis of spurious, modulation and alignment of transmitter chains. Models are available for the satellite bands S to Ka and a wide range of options can be specified.

AtlanTecRF, Braintree, UK,
Tel: +44 1376 550220,
www.AtlanTecRF.com.

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