

Marconi Modulators and Demodulators for Satellite Communications

The considerable experience of the Marconi Company in the design of multi-channel communication receivers has been applied to space communication systems now in operational use. Solid state modulation, conventional and threshold extension demodulators are now being designed to meet INTELSAT requirements. The threshold extension demodulator design is easily extended in practice to cater for an increasing traffic capacity should traffic growth justify it.

FEATURES

Solid state modulator suitable for 12-120 channel telephony and 625 line colour television.

Solid state conventional demodulator for 625 line colour television.

FMFB demodulator for 24-120 channels.

FMFB demodulator for 12 channels.

Equipment

Modulator

This unit accepts the telephony or television baseband signal and converts it to highly linear wide-deviation frequency modulation. To produce the wide bandwidth required, the basic voltage controlled oscillator (v.c.o) is at u.h.f, and is mixed down to 70 MHz with the output of a second u.h.f oscillator. The output is raised in a linear amplifier and is corrected for group delay distortion. Included in the modulator is an a.f.c loop which incorporates a discriminator, the output of which is fed a pilot detector circuit, to give an alarm should the pilot fail to appear for inclusion in a rack equipped with main and standby power supply units, and is readily available for maintenance or replacement.

Conventional demodulator

This accepts the 70 MHz output of the i.f amplifier system following the down-converter, and consists of a solid state limiter, discriminator and line amplifier suitable for the wide bandwidth satellite television signal. The unit is in module form for inclusion in a rack carrying many demodulators, and is followed by a plug-in de-emphasis network and attenuator unit.

Threshold Extension Demodulator

In this type of f.m demodulator design the threshold is defined as that value of carrier to noise where the output signal to noise ratio ceases to be directly proportional to the input carrier to noise ratio. It is generally

agreed that this condition exists when the crests of noise at the input of an f.m receiver equals the peak value of the carrier.

The unit accepts a 70 MHz signal input from the down-converter (following the low noise amplifier) and passes first through a channel filter which corresponds to the uncompressed bandwidth of the signal. The signal is then up-converted by mixing with an a.f.c controlled local oscillator, and a second filter selects the desired sideband and rejects the local oscillator and unwanted sideband. This signal is then down-converted to 70 MHz by mixing with the output of a linear v.c.o.

The 70 MHz signal is amplified and passed through a single pole filter of a bandwidth suitable for the compressed deviation. This narrow-band signal is converted to baseband in a discriminator, and then fed back to the v.c.o as an error voltage via a low pass filter and a phase controlling circuit. The baseband signals are also amplified and passed through the level setting attenuator. A range in amplifier gain is provided to cater for all modulator conditions. An a.f.c circuit is included to counter any possible drift in the transmitter oscillator, the satellite or the local receiver and also because of the possibility of doppler shift caused by the low altitude of the satellite. Solid-state circuitry is used throughout.

The unit is in module form, and can be easily removed for maintenance. The adjustment for varying channel capacities in the case of the unit handling 24-120 channels is easily accomplished.

DATA SUMMARY

Modulator—Typical specification

Output frequency: 70 MHz \pm 50 KHz.

Deviation per channel: 0.2 to 0.8 MHz r.m.s.

Max. television deviation: 32 MHz peak to peak.

Highest baseband frequency: 6.5 MHz.

Power supply: -28 V.

Threshold Extension Demodulator

Input frequency: 70 MHz \pm 250 kHz.

Highest baseband frequency: 550 kHz.

Output level per channel: -15 dBm.

Gain stability: 0.5 dB per month.

Output impedance: 75 ohm.

Power supply: -28 V.

C/T values for 8400 pwp

120 channels deviation: 0.71 MHz r.m.s. -150.2 dBw/ $^{\circ}$ K.

60 channels deviation: 0.49 MHz r.m.s. -153.1 dBw/ $^{\circ}$ K.

24 channels deviation: 0.25 MHz r.m.s. -155.6 dBw/ $^{\circ}$ K.

12 channels deviation: 0.21 MHz r.m.s. -159.3 dBw/ $^{\circ}$ K.

Conventional Demodulator

Input frequency: 70 MHz.

Max. input deviation: 32 MHz peak to peak.

Output bandwidth: 30 MHz-5.5 MHz.

Output impedance: 75 ohms.

Output return loss: 26 dB.

Nominal output level: 1v peak to peak.

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