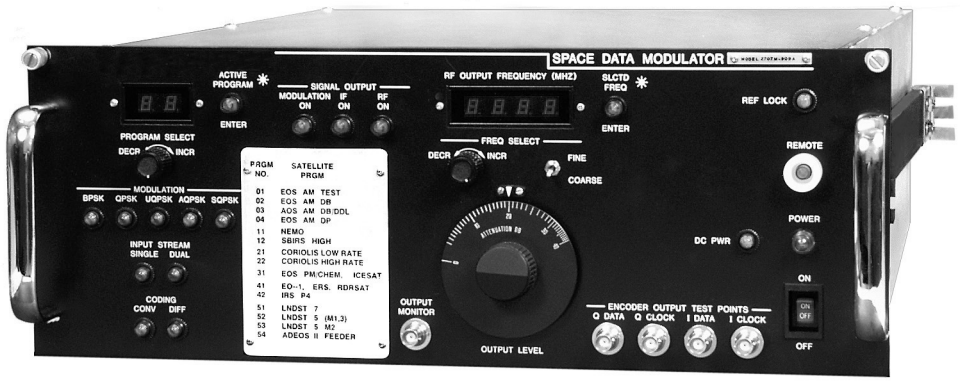
Technical Bulletin

Model 2707M-909

Space Data Test Modulator

Ground Products



FEATURES

- Provides the ability to do pre-pass and maintenance testing for multi-mission Space Data Receivers and ground stations at X-band and IF for Remote Sensing/Imaging satellites such as NASA's Terra and Aqua, Landsat 7, Radarsat, ADEOS II, Coriolis, SBIRS, NEMO, SPOT, ERS, and others.
- Accepts single and dual baseband bit streams at rates of 7.5 Mbps through 200 Mbps
- Performs NRZ-L to NRZ-M and QPSK differential coding
- Performs convolutional coding (rate ½, k=7) on I and Q with 1 to 8 branch convolutional encoders
- Groups convolutional code symbols in G1-G2 pairs or with all branch G1 symbols grouped and followed by all branch G2 symbols
- Provides for unbalanced power 4:1, Q to I or I to Q as required
- Realizes QPSK, AQPSK, SQPSK, USQPSK, BPSK modulation
- Provides a modulated 720 MHz IF and an X-band RF output (selectable at 7700 through 8500 MHz).
- Accepts external 10 MHz reference for the X-band upconversion
- Provides a 40-dB adjustable X-band output attenuation: -30dBm to +10 dBm
- Remote control via IEEE-488

DESCRIPTION

The 2707M-909 Space Data Test Modulator accepts single or dual stream baseband data input and integrates the functions of clock generation, pattern generation (optional), differential encoding, convolutional encoding and code symbol grouping, PSK Modulation, and upconversion in a single 7-inch high chassis.

The unit is pre-programmed with the coding, formatting, and modulation characteristics of a number of different remote sensing spacecraft requiring of the operator only to select and activate a program number.

L3 communications

OPERATION

The Test Modulator's wideband formatter module receives single-ended clock and data applied at the rear panel as a single data stream or dual input data streams, dependent on the satellite program selected. A single input stream can have bit rates up to 210 Mbps, if it is to be convolutionally coded, or up to 420 Mbps when there is no convolutional coding required. Dual input streams (for AQPSK operation) can have bit rates up to 105 Mbps when convolutional coding is to be applied, or up to 210 Mbps when there is no convolutional coding required.

The input data streams may be differentially encoded where I and Q are coded individually from NRZ-L to NRZ-M or NRZ-S when AQPSK or SQPSK modulation is used, or where I and Q are coded differentially in combination for channel ambiguity resolution when non-staggered QPSK is used. I and Q can also be convolutionally encoded dependent on the satellite program. When convolutional encoding is employed, the number of branch convolutional coders can range from one to two to four to eight depending on the spacecraft's wideband formatter design. (The number of branch coders is usually determined by the bit rate of the baseband data.) Convolutional coding can incorporate Alternate Symbol Inversion and code symbol grouping to match the formatting imposed by the spacecraft wideband formatter. Individual PLLs are incorporated in the I and Q paths to develop the higher frequency (X2) clocks necessary to effect convolutional coding or the one-half symbol delay timing required to establish the stagger in SQPSK.

The modulation technique used in the 2707M-909 requires that the baseband signals be normalized in DC offset (0) and peak-to-peak amplitude. This function is provided in the modulator's signal conditioning board assembly. The I and Q symbol streams are applied from the wideband formatter module and their respective outputs are routed to the IF/RF assembly.

The IF assembly contains a 720 MHz IF phase-locked source and the QPSK modulator. Block gain is provided to provide the requisite output level. Attenuators are used liberally throughout to distribute gain and to provide isolation where required. The 720 MHz IF is provided to the rear panel, and is also applied to the RF assembly where it is upconverted to X-band in the range 7700 MHz to 8500 MHz. The modulated RF is passed through a front panel attenuator so that its output level can be adjusted over a 40-dB range.

The RF Assembly contains the phase locked synthesizer necessary to upconvert the 720 MHz IF to the 7700 to 8500 MHz range. The RF center frequency is selectable in 1 MHz increments from the front panel or from remote control over the GPIB. An external 10 MHz reference is used to phase-lock the upconverter and the 720 MHz IF source.

Microprocessor-executed firmware responds to operator selections made at the front panel or through the GPIB. On the front panel a single rotary knob and a pushbutton for activation is the means used by the operator to select and activate a particular spacecraft test setup. Spacecraft are listed on the front panel and assigned a program number which the operator selects using the knob control and a program number display window. Status indicators show the type of modulation and whether a single or dual input stream is modulating the carrier. Indicators also show the type of coding applied to the bit streams. Pushbutton control is provided to turn modulation on and off, and, individually, to turn on and off the IF and RF outputs.

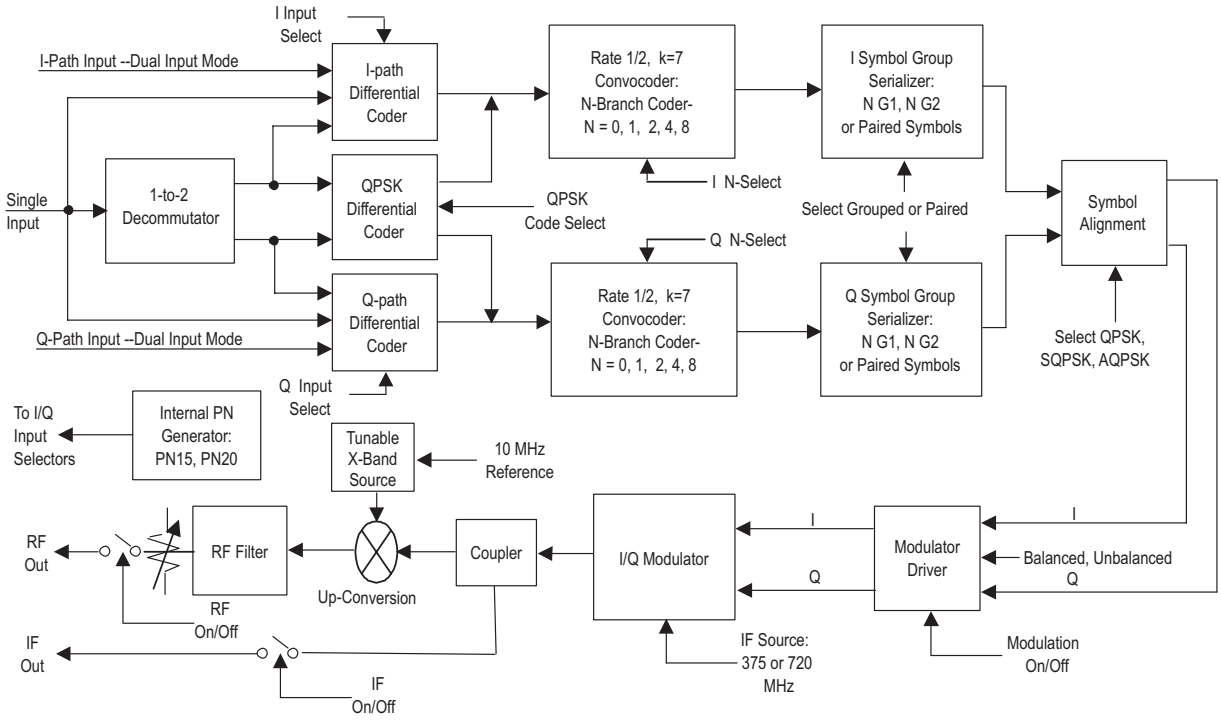
The X-band RF output frequency is adjustable in 1-MHz steps from 7700 MHz to 8500 MHz through a front panel rotary knob and four-digit display window. It can also be controlled over the GPIB. A 40-dB front panel precision attenuator is provided to set the RF output level.

Front panel status indicators are provided for Reference Lock (IF LO lock and X-band upconverter phase-locked to external 10 MHz reference) and DC power. A front panel pushbutton switch-indicator is provided to allow selection of local or remote setup control. BNC test connectors on the front panel allow monitoring of the I and Q coded data and the RF output.

The 2707M-909 is available with optional internal PN data source and with a timing reference generator for external data source timing where I and Q baseband bit streams are synchronous but unequal rate.

The 2707M-909 is preprogrammed for the following satellite missions: Terra 75/75 Test Mode, Terra DB/DDL (optional), Terra Direct Broadcast, Terra Direct Playback, NEMO, SBIRS High, Coriolis (Windsat) Low and High Rate, Aqua, Aura, Icesat, EO-1, ERS, JERS, Radarsat, SPOT, IRS P4, Landsat 5 and 7, ADEOS II Feeder Link (optional). Satellites with formatting requirements not matching any of the pre-programmed spacecraft can be accommodated by programming of the individual formatting registers via the GPIB.

Model 2707M Outline Drawing



SPECIFICATIONS

Function	*Characteristics*
IF (Output) Frequency	720 MHz
RF (Output) Frequency	7.7 GHz to 8.5 GHz adjustable in 1 MHz steps
IF and RF Frequency Stability (Over Life and Environment)	N/A (External Reference Lock)
IF Output Signal Level	-5 dBm fixed
RF Output Signal Level	+10 dBm to -30 dBm
Modulation Type	CW, SQPSK, USQPSK, AQPSK, QPSK, BPSK
IF Output	ON or OFF
RF Output	ON or OFF
Input Data (I and Q Channels)	Single and Dual: NRZ-L, ECL into 50 ohms tied to -2.0 volts.
Input Clock (I and Q Channels)	Single and Dual: 0 degree 1X clock, 50% ± 5% duty cycle, ECL into 50 ohms tied to -2.0 volts.
Input Data to Clock Skew	The I and Q Channel data shall be aligned to the rising edge of the clock within ± 10% of the clock period.
Code Converter	Provides the capability to convert the input data to NRZ-L, NRZ-M or NRZ-S. (Modulo-four Gray Code supported for differential coding in QPSK mode).
Convolutional Encoder	Constraint Length K=7; G1=171_8; G2=133_8. G2 inversion is selectable. Multiple branch encoders as required by satellite program.
Remote Control	Remote control via IEEE-488.
External Reference	Frequency -10 MHz, impedance 50 ohms, level - +10 dBm ± 3 dB, stability and accuracy <1 ppm.

ELECTRICAL AND PHYSICAL

Parameter	*Specification*
Input AC	105-125 VAC, 47-63 Hz, single phase
Power Dissipation	250 Watts nominal
Dimensions	7.0” H x 19” W x 23.5” D
Weight	Approximately 45 pounds
Mounting	Standard 19” rack mounting
Operating Temperature	0°C to 35°C
Relative Humidity	To 95%, noncondensing

Consult factory for detailed specifications and option ordering information.

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