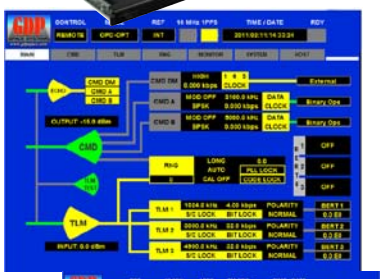
Multi-Channel Satellite Modem
Model 4405

Features

- **Software defined radio technology**
- **Multi-mode Modulator / Demodulator waveforms:**
  - **FM/*PM / BPSK / QPSK / SQPSK/OQPSK/ DPSK /***
  - ***CPFSK AM /FSK -AM/FSK-PM & others***
- **Data rates to 40 Mbps**
- **IF Frequencies: 70 MHz, tunable +/- 10 MHz**
- **Tone & PRN Ranging**
- **PCM codes: NRZ-LMS / Bi-Phase-LMS / RNRZ-15**
- **PCM Code Conversion Capability**
- **CCSDS SLE compatibility**
- **Reed Solomon and Turbo encoders and decoders**
- **Data & Network based simulators**
- **Stream Data Recording & Playback w/ 1TB Capacity**
- **FEC/ Convolutional Encoding & Decoding**
- **Data Interleave & De-interleave**
- **Test Loop Support**
- **Built in Self Test**
- **Integrated PRN BERT**
- **GPS Time & Frequency Reference**
- **Flexible design utilizing the latest in FPGA technology**
- **Advanced Digital waveform generation and processing**
- **Scalable solution allowing support of multiple communications links**
- **Field upgradeable features and performance**
- **Supports XML based command and control protocols over TCP/IP Ethernet Communications**
- **Flexible interface options**
- **Redundant power for reliable operation**

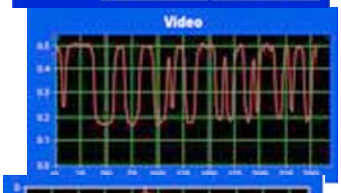
General Description

The GDP model 4405 Multi-Channel Satellite Modem system is a digital signal / data processor. This highly flexible system provides comprehensive multi-link telemetry support for satellite ground stations in a single fully integrated package.

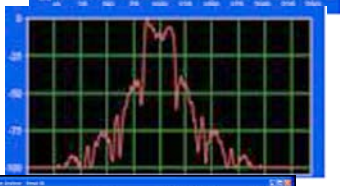


The system features FPGA based signal processing and software defined radio technology in the form of digital receivers, waveform & signal processors.

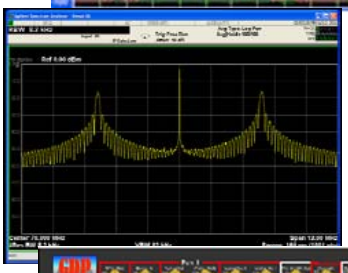
Advanced signal processing components allow signal generation and analysis for ranging and other signal processing.



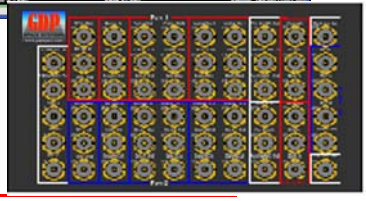
An integrated simulator with RF modulators allows local and long loop tests as well as support for system simulations. Integrated recording with 1 Tera-byte (1000 GB) capacity is included.



System level advantages include redundant power, built in test, self test and easy to use touch screen control.



In-the-field upgrade capability allows the user to install changes to enhance performance, add new features and extend capabilities.



The GDP 4405 offers an affordable high performance solution for spacecraft ground station operations.

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Multi-Channel Satellite Modem
Model 4405

SPECIFICATIONS

General
Max qty. of Receivers: 6
4 ea. Telemetry
2 ea Ranging
Max qty. of 70 MHz Modulators: 6
4 ea. Command or Telemetry Simulator
2 ea Ranging
Baseband Inputs:
4 ea Analog to 25 MHz

IF Frequency:
70 MHz, tunable +/- 10 MHz
Frequency Accuracy: +/- 0.0116 Hz
Tuning step size: 0.0233 Hz
Optional : 720 MHz +/- 70 MHz

RF / Front End
Dynamic Range: -100 to -10 dBm
VSWR: 1.2 : 1 max, 1.1 : 1 typical
Noise Figure: +4 dB max., +3 dB typical
Maximum Safe Input: +10 dBm
Locking Threshold: 2 dB Eb/N0
Nominal Impedance: 50Ω
Spurious Rejection: 70 dB
AFC Tracking: +/- 500 kHz of programmed center frequency with < 0.0233 Hz frequency resolution,
Tracking Bandwidth: Programmable between 1Hz and 2 kHz.
AGC Type: Power envelope squared detection.
AGC Control: AGC ON/OFF, Manual Gain control setting
AGC Time Constants: 0.1, 10, 100, 1000 ms. ,Controls: Automatic, Manual
IF Rejection: Input band pass SAW filter, 70 dB min, > 75 dB typical
Programmable digital IF Filters: IIR Polyphase filters selectable, 50 KHz to 30 MHz

Beamforming / Combining
Supported number of beams: 4
Pre-and Post Detect Supports Polarization, Geo-Spatial Diversity
Programmable Equalizer / Beam:
0-1.25usec
Modes: Single Source ; Best Source; Optimal Ratio; Beamforming

Waveform Processing
Type: Multi Mode providing PM / BPSK /DPSK/QPSK /SQPSK / OQPSK / AQPSK/UQPSK/ USQPSK / CPFSK AM / FSK AM/ FSKPM
CCSDS Compatible waveforms
Data Rates: to 40 Mbps (waveform dependent)
Carrier Acquisition Modes: Sweep, ML-FFT, Phase Symmetry
Loop bandwidth: 5Hz – 5 kHz
Carrier Acquisition time: 30 ms – 1 sec depending upon loop bandwidth
Carrier Acq. Time: C/NO <17dB-Hz
Waveform delay tolerance : 10 ns
PM Phase Accuracy: 0.0055 degrees
Doppler Rate: to < 15 kHz/sec
Doppler measurement available
Subcarriers Supported: 8
Subcarrier Freq. Offset: < 10 MHz
Subcarrier Data rate: < 4Mbps

Bit Synchronizer
Loop Bandwidth: Programmable bandwidth 0.1 to 3% of the programmed data rate.
Capture Range: +/- 3 X the programmed Loop Bandwidth
Tracking Range: Tracking Range +/- 5 X the programmed Loop Bandwidth
Synch Acquisition: 32 bits nominal, 100 bits max.
Data Rates: 1 bps to 25 Mbps, PCM
Code Types: NRZ L/M/S, BIφ L/M/ S , DBIφ, RZ, RNRZ,DM-M/S
Bit Error Probability: <1.5 dB theoretical for all bit rates
Viterbi (Convolutional FEC) Decoder: programmable constraint, fixed traceback ; Custom decoders available
Reed-Solomon & Turbo decoders

Modulator
Frequency: 70 MHz +/- 10 MHz
Nominal Impedance: 50Ω
Spurious Rejection: 70 dB
Signal Generation: I/Q each at 16 bit resolution
Input Source: Analog , PCM Data + Clock
Modulation Modes: Direct + up to 6 subcarriers
Mod Index Range: 0- 3.14 Radians
Output Level: -0 to -60 dBm
Frequency Deviation: to 10 MHz
Noise C/NO: 120 dB-Hz
AM Modulation Index Tolerance: 0.003%
PSK Amplitude Imbalance: 0.00013dB
NCO Phase Quant. Spurs: -90 dBc
Amplitude Quant. Spurs: -98.1 dBc
Modulator DAC Spurious Free Dynamic Range: -79dBc
3rd Order Intermod: -83 dBc
Modulator Phase Noise:
1 Hz: -78dBc/Hz
10 Hz: -105 dBc/Hz
100 Hz : -128 dBc/Hz
1 kHz: -135 dBc/Hz
10 kHz: -139dBc/Hz
100 kHz: -139 dBc/Hz

Data Processing
Minor Frame Length: up to 64 k bits
Major Frame Length: 1 to 1024 minor frames / major frame
Frame Sync Pattern: 4 to 33 bits – includes IRIG Standard Patterns
Frame Synch Strategy: Search / Check/Lock; programmable state counts
Subframe Sync: FCC or Sub Frame ID (SFID)
Synch error Tolerance: 0-16 bits; programmable
Bit Slip Window: (0 to 9999 bits)

CCSDS Data Services
Space Link Extension (SLE)
Forward CLTU
Return All Frames (RAF)
Return Channel Frames (RCF)

Frequency & Time Reference
GPS based L1 Frequency, C/A code (SPS) 12 channel continuous tracking receiver
10 MHz sine wave
Reference Phase Noise:
10 Hz –120dBc
100 Hz –135dBc
1k Hz –145dBc
10kHz –145dBc
100kHz –145dBc
1 PPS Output accuracy : to 15ns
Ext. 5/10MHZ reference - auto switching
Time support: GPS,NTP IRIG A/B/G
Time-tag accuracy: to 100 ns w/ GPS based time

Ranging
Input Channels: 2
Standards Supported: ESA, Inmarsat, ESA Custom; SGLS/USB PRN supporting Short, Med and Long codes
Doppler support:
Tracking Loop Bandwidth: 0.01 to 10 Hz
Measurement Resolution: < 1ns
Time Tag Accuracy :100 nsec w/ GPS Time
Digital Tone Generation: 1 Hz to 2 MHz
Tone Accuracy: +/- 0.0116Hz

Data Simulation
Modulator Channels: 6
Carrier & subcarrier simulation per waveform processor
Integrated Stream Data Playback
Internal or External simulation
Sources:
baseband/file /network/simulator
Integrated Frame / Generator and Simulator
CCSDS Frame simulation
Viterbi encoding
Reed Solomon and Turbo encoding
Convolutional interleaving available

Bit Error Rate Test
Integrated PRN BERT: (2 each)
Programmable Patterns: Quasi Random Signal Source (QRSS)
Optional integrated Digital Gaussian White noise source
Correlation with modulated output available

Recording & Playback
Integrated Stream Data Recording & Playback:
Capacity: 1TB
Internal or External source

System Host
CPU: 2.8 GHz Core II Duo
Memory: 4GB., DDR3 SRAM 4.0 GB
Type II HS-CFDD Boot Device
Integrated 88 key keyboard in drawer
LAN: 2 ea 10/100/1000
USB: 2 ea.
TFT LCD: 8.4"; 800 X 600 VGA Touch screen

Environmental
Operating Temperature: 0°C to +40°C
Storage Temperature: -25°C to +60°C
Relative Humidity: 10-95%
Vibration: 5 Hz to 500 Hz, 1g rms operating, 2 g rms non-operating
Shock (operating): 30g with 11 mSec duration, ½ sine wave
Acoustic Noise: Less than 52 dBA sound pressure at +5°C to +28°C (+41° F to+ 82° F)
Altitude: 0 to 3048 m (0 to 10,000 ft)

Power
Hot Swap Redundant Power Supply
100-240 VAC 50/60 Hz; 600 W

Mechanical
4U 19' rack mount
7"H x 19"W x 24" D

Safety:
UL, cUL, CE, FCC & CCC

Recognizing that no standard product can meet all the needs of all users, GDP stands ready to provide units tailored to unique applications.

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