1.0 IDENTIFICATION OF APPLICANT AND EQUIPMENT

1.1 Applicant:

Information Transmission Systems Corp.
375 Valley Brook Road
McMurray, PA 15317

The above name and address is printed on a label attached to the rear panel of the equipment.

1.2 Equipment and Model Number: ITS-5722

This information is provided on the front panel of the equipment.

1.3 ITS Corporation shall manufacture this product in quantities necessary to satisfy market demand.

2.0 TECHNICAL DESCRIPTION - MODEL ITS-5722

2.1 Introduction

The ITS-5722 is a complete digital transmitter capable of operating as television transmitter at an output power of 5 watts (average). Functionally, the ITS-5722 is comprised of a modulator (SAT Division Telecommunications PQM2100) and upconverter/amplifier tray. The modulator receives a 28 Mbit/sec serial bit stream, consisting of multiplexed MPEG-2 transport streams, translates the signal to a Quadrature Amplitude Modulated (QAM) format, converts the digital information to analog, and modulates the signal to IF (44 MHz). The modulator tray's IF output is routed to the upconverter/amplifier tray for IF signal processing, upconversion to the MDS/MMDS/ITFS frequency, and final amplification. The upconverter/amplifier tray utilizes ALC circuitry for automatic level control of the output signal to maintain a constant power level. Both modulator and upconverter/amplifier trays are 19-inch rack mount assemblies and can be supplied with or without a cabinet. Both trays are supplied complete with cables and cabinet slides.

Parameters and specifications for operation of this unit as a digital transmitter are provided on the following pages, and a complete circuit description and alignment procedure is also included in this report. Refer to the overall system block diagram and the particular referenced schematics in the attached circuit description section of this report.

2.0 TECHNICAL DESCRIPTION

2.2 Technical Specifications

Type of Emissions..... 6M00D7W
Frequency Range .....2150 to 2162 and 2500 to 2686 MHz (any 6 MHz channel)
Output Power Rating ..... 5 watts average
DC voltage and total current of final amplifier stage ..... 10 volts DC at 16.8 amps
(Class A - Not RF power dependent)

2.3 Performance Specifications

Operating Frequency Range.....2150 to 2162 and 2500 to 2686 MHz
RF output - Nominal:
Power.....5 watts average
Impedance .....50 ohms
Connector..... Type N

Input (Modulator) .....QAM, MPEG-2 Transport Stream
Impedance:.....75Ω (BNC)

Out-of-Band Power.....-38 dB max (at channel edge)
-60 dB max (3.0 MHz above channel edge and 3.0 MHz below channel edge)

Electrical Requirements

Power Line Voltage
Modulator.....90 to 132 VAC, 47 to 63 Hz
Upconverter/Amplifier.....117 VAC ±10%, 60 Hz or
220 VAC ±10%, 50 Hz
Power Consumption
Modulator.....55 watts
Upconverter/Amplifier.....380 watts

Environmental

Maximum Altitude
Modulator..... 10,000 feet (3,050m)
Upconverter/Amplifier..... 12,000 feet (3,660m)

Ambient Temperature
Modulator..... +5° to +45°C
Upconverter/Amplifier.....0° to +50°C

Mechanical

Dimensions: (WxDxH)
Modulator..... 16.9" x 17.7"x 1.73" (43.0cm x 45.0cm x 4.4cm)
Upconverter/Amplifier..... 19" x 21" x 8.75" (48.3cm x 53.3cm x 22.24cm)

Weight:
Modulator..... 11 lbs. (5.0 kgs)
Upconverter/Amplifier..... 47 lbs. (21.3 kgs)

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description

The ITS-5722 ITFS/MDS/MMDS Transmitter can be subdivided further as follows:

Modulator	-Reception Digital Interface Card -QAM Modulator Card -Supervision and Management Card -Power supply Unit
Upconverter/Amplifier	- IF Processing Module - Power Amplifier Module - Power Supply Module - Control Monitoring Module - L.O./Upconverter Module - Backplane Board - Front Panel LCD Display - Keyboard Entry Board - LCD Display

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description

Modulator Tray

The PQM2100 modulator tray generates a 64 QAM digital IF output which is used to drive the upconverter/amplifier tray. The PQM 2100 also provides processing of the MPEG2 bit stream received from program encoding and multiplexing equipment.

The PQM2100 consist of a Reception Digital Interface Card, DVB-QAM Encoder Card, QAM Modulator Card, Supervision and Management Card, and Power Supply Unit.

The Reception Digital Interface Card provides connection provides connection of the PQM 2100 unit to encoding equipment through a proprietary RS422 (M2P) parallel interface or to multiplexing equipment through a DIVICOM Rx Int interface.

The DVB Encoder Card provides channel encoding of the bit streams and associated clock signals transmitted by the Reception Digital Interface Card. Bit streams are encoded in compliance with DVB recommendations for transmission to the QAM modulator function. The DVB QAM Encoder functions include: energy dispersal (scrambling), Reed/Solomon forward error detection, interleaving, differential inner encoding, QAM symbol mapping.

The QAM Modulator Card provides square-root Nyquist filtering in compliance with DVB recommendations, and amplitude modulation of two carriers in phase quadrature (QAM).

The Supervision and Management Card supervises the PQM2100 unit through processing of fault indications supplied by the various cards of the unit. The corresponding major and minor alarms are transmitted through relay contacts.

Local configuration access to the PQM2100 cards is available via the front panel keypad/display or using a PC connected to the RS-232 interface. Remote configuration access is provided through a Ethernet (LAN) interface. Test functions activated via the operating software options allow Unit and link supervision.

The front panel of the PQM2100 modulator contains a Keypad/LCD display, two LED fault indicators, and two LED status indicators (Test and On). Also included on the front panel are IF, clock (Clk), base-band I signal, and base-band Q signal output test ports (refer to Chapter 4: Operation of the Installation and Operation Manual, included in Exhibit III of this report, for a complete description of front panel operation).

The PQM2100 power supply produces tertiary voltages used to operate the various cards of the unit from a standard 115VAC and 47 to 63 Hz supply.

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Upconverter/Amplifier Tray

IF Processing Module

The input to the Upconverter/Amplifier tray is the IF output from the CM720M modulator tray. The 64 QAM IF output signal from the modulator is applied to the IF input jack (J1) on the rear of the tray. This IF input signal is then fed to the IF Processing Card (1585-3108).

The IF signal enters the card at J1 and is transformer coupled for impedance matching of the IF signal (75Ω to 50Ω). The signal is then applied to an adjustable resistor pad network, which allows for three IF input level ranges of 10 dB each. The signal is amplified and applied to a 6 dB transformer directional coupler which provides a sample to a peak detector in the ALC portion of the circuit. The main output of the coupler is fed to frequency response correction circuitry, which consists of four adjustable notch filters. The frequency response correction circuit may be removed using on board jumpers. The output of the frequency response corrector is amplified and applied to a PIN diode attenuator. The ALC circuitry takes a peak-detected sample of the IF signal and generates an ALC voltage, which biases the PIN diode attenuator. The ALC circuit senses any change in the IF level and automatically adjust the loss through the PIN attenuator to compensate, thereby maintaining a constant IF output regardless of minor changes in the input signal. The ALC circuit uses a DC level generated externally to control the output power level. There are two possible bias voltage inputs. The first, Inner Loop, is generated form a peak- detected sample of the output amplifier. The second, Outer Loop, is used only if an external final amplifier tray is connected to the system. If both Inner Loop and Outer Loop inputs are used, the signal that is the largest in level controls the ALC circuit.

The ALC circuit may be bypassed by placing switch SW2 in the manual position. When the ALC circuit is disabled, the loss through the PIN attenuator is adjusted by a manual gain potentiometer, which then directly controls the output in a manual fashion.

The ALC circuit also contains a average detector which detects the average level of the IF signal. This average level is compared to the output of the peak detector and if the average level approaches the peak level, indicating a loss of modulation on the IF signal, a mute signal will be generated muting the IF. This prevents against overpower conditions in situations where the modulating signal is interrupted. The ALC circuit provides several front panel LED indicators including: Peak Vs. Average Fault, I/P Fault, Mute, and ALC Fault.

The output of the PIN diode attenuator is amplified an applied to three sections of group delay equalization which compensate for group delay created by external filters. Each section of group delay may be removed from the circuit using on board jumpers. For non-adjacent analog applications, Delay Equalizer 1 is removed from the circuit. For adjacent analog applications, all three sections are used. For adjacent and non-adjacent digital applications, Delay Equalizer 3 is removed from the circuit. The output of the delay equalizer circuit is fed to a 6 MHz lumped element band-pass filter. The band-pass filter may be removed from the circuit using on board jumpers. The band-pass filter may also be bypassed through a SAW filter when tight filtering of the IF is required.

The output of the band-pass filter is applied to a linearity correction circuit, which compensates for compression in later stages of the system. The output of the linearity correction circuit is fed to a 6 dB transformer directional coupler which provides a front panel sample of the IF signal. The main output of the coupler is connected to the output of the IF Processing Card (J1B).

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Frequency Generator/Upconversion/PLL Module

The Frequency Generator/Upconversion/PLL Module consists of a L.O./Upconverter Board (1585-3117), Inter-digital Filter (2140-1006), and a Single stage Amplifier Board (1585-3101).

The L.O./Upconverter Board generates a UHF L.O. frequency using a voltage-controlled oscillator (VCO) IC (V804ME01). The VCO is locked to an external precise 10 MHz reference using a frequency synthesizer PLL IC (LMX2325TM) in a phase lock loop configuration. The LMX2325TM is a high performance frequency synthesizer with integrated pre-scalers and uses a proprietary digital phase lock loop technique to produce a very stable low noise signal that is used to control the VCO frequency. The desired L.O. frequency is selected using the front panel LCD display/keypad. The Control Monitoring Assembly detects the keyboard input and routs the serial data to the serial data input of the PLL IC.

Under normal operating conditions, the external 10 MHz precise reference input will be routed to the oscillator input of the PLL IC through a magnetic latching relay (K1). IF the external precise reference is removed the relay will open and an internal 10 MHz reference oscillator IC will be routed to the oscillator input of the PLL IC.

The L.O. signal from the VCO is buffered to an internal micro-strip coupler, which provides an L.O. sample that is routed to a rear panel jack. The L.O. signal is then amplified by an IC amplifier (U8) to a sufficient level to drive the L.O. input of an IC mixer(U10). An IF input to the mixer is provided via the IF Processing Assembly. The output of the mixer is amplified by an IC amplifier (U12) and fed to the RF output jack of the board (J8).

The RF signal is then fed to a 6 MHz band-pass inter-digital filter (2140-1006) which selects the desired conversion frequency (L.O. - IF) and attenuates any undesired signals generated during the mixing process.

The RF output of the filter is then fed to the Single Stage Amplifier Board (1585-3101), which consist of a single IC amplifier (VNA-25) with a gain of 14 dB. An RF sample is obtained using a micro-strip coupler (J2). The main RF output is connected to the output jack of the module (J8).

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Power Amplifier Module

The Power Amplifier Module consist of an 40W PEP Amplifier Module (1585-3196), 3 Section Bias Board (1585-3250), and Dual Power Detector Board (1585-3125).

The 40 W PEP Amplifier module is subdivided into two functional sections: preamplifier section, and power amplifier section.

The RF input signal from the Frequency Generator/Upconversion/PLL Module enters the module at J1 and is fed to the preamplifier section. The preamplifier consists of four cascaded GaAs FET amplifiers (FLL 101ME driving a FLL 351ME driving a FLL351ME driving a FLL 120MK) with an overall gain of approximately 45 dB. The output of the final FET is applied to a 3.0 dB micro-strip hybrid coupler, which splits the signal into two equal signals. The split signal is then fed to the power amplifier section of the module.

The power amplifier consist of two parallel GaAS FET amplifiers (both S45V2527-51's) with an overall gain of approximately 12 dB. The output signals of the parallel amplifiers are applied to a micro-strip hybrid coupler, which combines the two signals. The output of the coupler is applied to a circulator, which provides an RF sample, then to the output of the module (J8). A 20 dB forward power sample is obtained using an internal micro-strip coupler.

The DC biasing of the FET amplifiers in each section of the module is controlled and filtered by corresponding daughter boards (daughter boards D1, D2 and D3 for the preamplifier, daughter boards D4, D5, and D6 for the power amplifier), which are soldered directly to the main board. The DC bias drain to source currents are set by adjusting the negative gate to source voltages which are adjusted by potentiometers on the daughter boards.

The 3 Section Bias Protection Board distributes the -5V bias voltages and +10V drain voltages to the Amplifier Module as well as providing protection from an over current condition with board mounted fuses.

The -5V bias voltage is generated on board using a voltage regulator (LM377T). This bias voltage is also used as an interlock, which is fed to the Transmitter Control and Monitoring Module. IF the bias voltage is lost, the control circuitry will immediately shut down the switching supply, thereby removing the drain voltages from the amplifier modules and protecting the GaAS FET devices.

Differential amplifier OP Amp circuits are used to monitor the drain currents of the FET devices. The OP Amp outputs drive LED indicators as well as an opto-isolated O/P amplifier status line.

The Dual Power Detector Board inputs forward and reflective power signals from the Amplifier Module and detects the levels using peak detector circuits. These circuits provide voltage levels proportional to the power level of the sampled signal, which is used for metering and ALC purposes. Metering adjustment is provided with on board potentiometers.

The Dual Power Detector Board also contains a gating pulse timing circuit that serves to maintain the proper power level when sync suppression scrambling systems are used.

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Transmitter Control Monitoring and Module

The Transmitter Control and Monitoring Module (1585-1129) consists of an 8-bit microcontroller (MC68HC705B`6) and associated control circuitry and provides the capability to control and monitor the operating status o the transmitter. The interconnection between the Transmitter Control and Monitoring Module, IF Processing Module, and Local Oscillator/Upconverter Module is accomplished through the Backplane Board. The interconnection between the Transmitter Control and Monitoring Module, Power Supply Module, and Power Amplifier Module is accomplished through interconnect cables. A detailed listing of all the interfaces between the Transmitter Control and Monitoring Module and the various modules, which make up the ITS-5722 transmitter is given below.

Power Amplifier Module

Signal Name	Signal Type/Description
Amplifier Interlock	Discrete contact closure input - indicates Power Amplifier Module is installed.
Reflective Pwr Metering	Analog input (0 - 1.25V) - indicates reflective power from Power Amplifier Module.
Over-temp Fault	Discrete contact closure input - indicates over-temp condition exist in Power Amplifier Module.
O/P Amplifier Status	Discrete open collector input - indicates operating status of output amplifier.
-5V Bias Sense	Analog input (0 - 6V) - indicates the voltage level of the - 5V bias supply.

Local Oscillator/Upconverter Module

Signal Name	Signal Type/Description
External Reference Indicator	Discrete open collector input - indicates the presence of external 10 MHz reference.
Logic Enable	Discrete CMOS output - provides a load enable signal the frequency synthesizer chip.
Data	Discrete CMOS output - provides serial data to the frequency synthesizer chip.
Clock	Discrete CMOS output - provides the serial clock the frequency synthesizer chip.
AFC	Analog input (1 - 10V) - indicates the level of the AFC voltage.

Signal Name	Signal Type/Description
L.O./Upconverter Interlock	Discrete contact closure input - indicates L.O./Upconverter Module is installed.
Unlock Indicator	Discrete open collector input - indicates the L.O./Upconverter Module is locked to the external or internal 10 MHz reference.

IF Processing Module

Signal Name	Signal Type/Description
Open Loop Monitor	Analog input (1 - 1.25V) - indicates output power of an external amplifier.
Forward Power Metering	Analog input (0 - 1.25 V) - indicates output power tray's power amplifier.
IF Processor Interlock	Discrete Contact Closure Input - indicates that IF Processing module is installed.
ALC Voltage	Analog input (0 - 10V) - indicates voltage applied to pin attenuator in ALC circuit.
Mute to IF Processor	Discrete open collector output - controls mute feature in the IF processor.
Mute from IF Processor	Discrete open collector input - indicates IF processor is in mute.
Input Fault	Discrete open collector input - indicates that IF is not present.
ALC Conditioning	Analog Input (-1 - +1V) - Provides adjustment voltage to the ALC circuitry to correct for frequency dependence of peak detector.

Power Supply Module

Signal Name	Signal Type/Description
P.S Good	Discrete open collector input - indicates switching power supply is operating properly.
P.S Enable	Discrete open collector output - enable signal to switching power supply.

Front Panel Assembly

Signal Name	Signal Type/Description
Fault Anode	Fault LED drive voltage (+5V) - supply to anode of Fault LED.
Fault Cathode	Discrete open collector output - provides pull down to turn on Fault LED.
Operate Anode	Fault LED drive voltage (+5V) - supply to anode of Operate LED.
Operate Cathode	Discrete open collector output - provides pull down to turn on Operate LED.
S1-S5	Discrete contact closure inputs - input lines from front panel keyboard switches.
VSS (GND)	Ground - Provides return to front panel board.
VCC	+5VDC - provides +5V to front panel display logic.
VEE	Control voltage output (0 - 5V) - controls contrast of LCD display.
RS	Discrete TTL/HCMOS output - indicates to display whether instruction or data command is being sent.
E	Discrete TTL/HCMOS output - initiates the transfer of data to the display.
DB0-DB7	Discrete TTL/HCMOS bidirectional data lines - data lines which pass data between the display and transmitter control and monitoring module.
Anode Backlight	Control voltage output (3.8 - 4.6 V) - provides drive voltage to LCD backlight of display.
Cathode Backlight	Control voltage return - return for control voltage of LCD display.

SCADA Communications Interface

Signal Name	Signal Type/Description
+ Serial Line	+RS-485 communications line - provides the +differential line for the +bidirectional line of the bidirectional RS-485 communications..
- Serial Line	-RS-485 communications line - provides the -differential line for the +bidirectional line of the bidirectional RS-485 communications..

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Transmitter Control and Monitoring Module - continued

Control and Remote Interface

Signal Name	Signal Type/Description
Standby Command (FA)	Discrete open collector input - indicates frequency agile is requesting transmitter be placed into standby mode.
Operate Command (FA)	Discrete open collector input - indicates frequency agile is requesting transmitter be placed into operate mode.
Aural/Visual Mute (FA)	discrete open collector input - indicates that frequency agile is presently in aural/visual mute.
ABS Standby CMD	Discrete open collector input - indicates that Automatic Back-up System is requesting transmitter be placed into standby.
EXT Operate CMD	Discrete open collector output - enables external amplifier when transmitter enters operate mode.
XMTR Interlock Iso Return	Ground - configurable ground return which can be either jumpered directly to ground or be the “source” pin of an FET so that transmitter interlock can be daisy chained with other transmitters.
XMTR Interlock	Discrete open collector output - enables transmitter interlock or complete interlock daisy chain.
EXT O/P Amp Mod Status	Discrete open collector input - indicates external amplifier has a fault.
EXT P.S. Status (amp)	Discrete open collector input - indicates power supply in external amplifier is functional.
Operate Indication	Discrete open collector output - indicates transmitter is in operate mode.
EXT Over=temp (amp)	Discrete open collector input - indicates external amplifier has Over-temp condition.
EXT Refl Pwr (amp)	Analog input (0 - 1.25V) - indicates reflected power of external amplifier.
Standby CMD (RCVR)	Discrete open collector input - indicates external receiver is requesting transmitter be placed into standby.
Operate Commend	Discrete open collector input - indicates external receiver is requesting transmitter be placed into operate.

Control and Remote Interface

Signal Name	Signal Type/Description
RMT Operate Indicator	Discrete open collector output - indicates transmitter is in operate mode.
O/P Amp Module Status	Discrete open collector output - indicates no faults present in amplifier modules of transmitter.
RMT FWD Power O/P	Analog output (0 - 1.25V) - power amplifier module forward power loop through.
RMT REFL Power	Analog output (0 - 1.25V) - power amplifier module reflective power loop through.
RMT XMTR Fault Ind	Discrete open collector output - indicates fault exist in transmitter.
IF Present Status O/P	Discrete open collector output - indicates IF is not present.
RMT PLL Locked Ind	Discrete open collector output - indicates frequency generator/upconverter is unlocked.
RMT XMTR Over-temp Ind	Discrete open collector output - indicates transmitter amplifier module is in over-temp.
P.S. Fault Ind	Discrete open collector output - indicates that power supply of transmitter has failed.
EXT PLL Ref Present	Discrete open collector output - indicates external 10 MHz reference is not present.
RMT XMTR Stby Command	Discrete open collector input - indicates remote interface is requesting transmitter be placed in standby.
RMT XMTR Oper Command	Discrete open collector input - indicates remote interface is requesting transmitter be placed in operate.

2.0 TECHNICAL DESCRIPTION

2.4 Circuit Description - continued

Power Supply Module

The transmitter may be powered by either a 115 VAC/60 Hz or 230 VAC/50 Hz source. The AC source enters the tray at jack J1and passes through the Power Entry Module. The Power Entry Module contains a switch, for selecting 115V or 230 V input, a line filter and fuse protection. The output of the Power Entry Module is distributed to a terminal block (TB1). Varistors, VR1, VR2, VR3 and VR4 provide transient and over voltage protection to the transmitter. The rear panel circuit breaker applies AC voltage to the input of the 530 W Switching Power Supply (MP6-2K-4ll-00-415-CE) located on the Power Supply Module.

The Switching Supply provides three outputs. The first output is a +11 VDC/31A line used to power the GaAs FET amplifiers with power The remaining outputs are +12 VDC lines used to supply the modules within the transmitter. The +12 VDC line is also used to power the 12 VDC cooling fan via the Backplane Board.