SECTION II
TEST PROCEDURES AND DATA

2.1 Modulation Characteristics [2.987(a)]

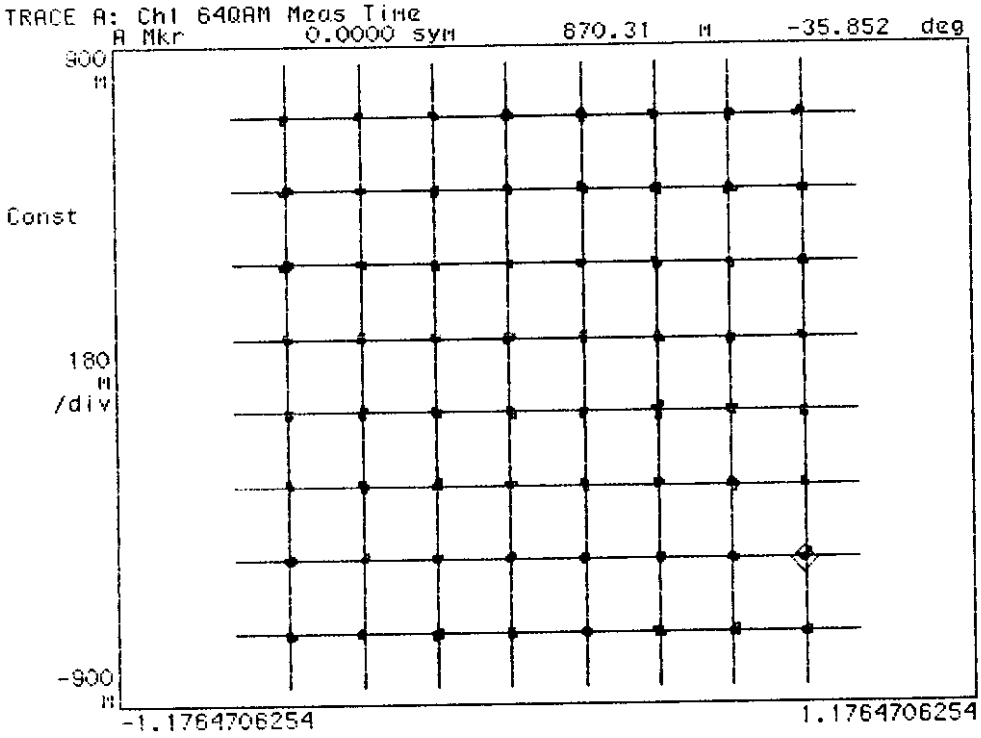
Test Equipment Setup — Figure 2–1A

Digital Output Power — 100 watts average

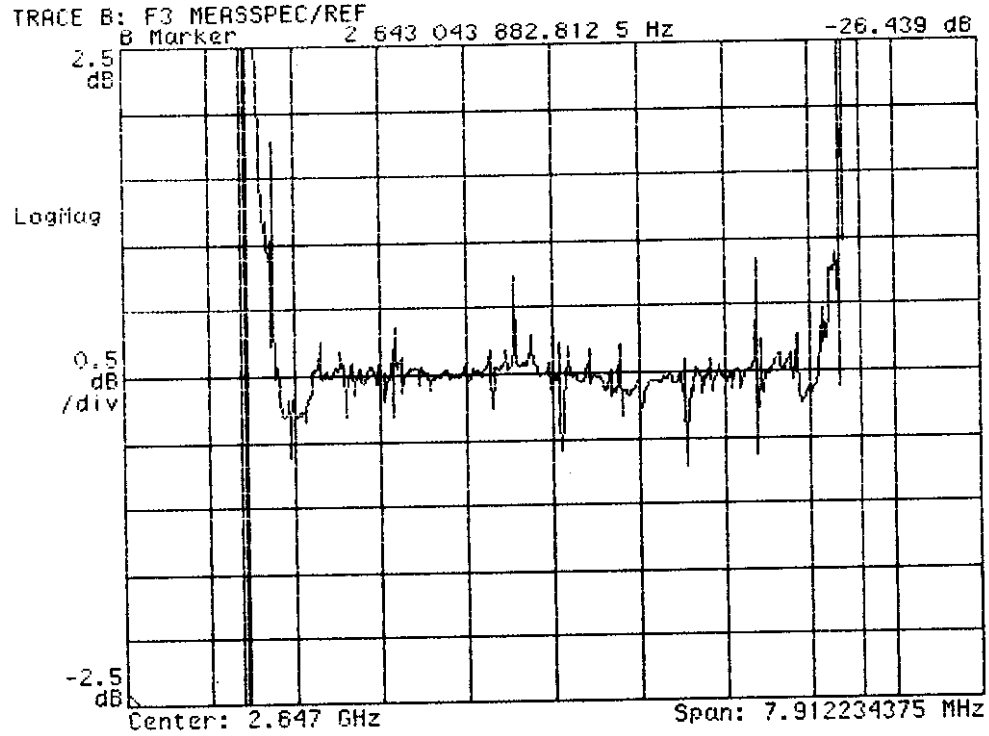
Type Modulation — Quadrature Amplitude Modulation (QAM) and Vestigial Sideband Modulation (VSB) are currently the two most popular digital formats to be employed by broadcast, wireless and cable television operators for distribution of high definition TV (HDTV) and video/ audio program compression (SDTV). Both of these formats share common time and frequency domain characteristics offering high bandwidth efficiency particularly when used for signal compression.

In a QAM or VSB modulator a serial bit stream, containing digitized program material organized into fixed length packets, is split into parallel streams which are randomized according to a pseudo-random binary sequence (PRBS). This process, which is active even when the bit stream to the modulator is absent, insures that the output signal spectrum is flat across the transmitted channel. Forward error correction (FEC) is then applied to the randomized packets in the form of Reed-Solomon parity bytes before data interleaving is employed to protect the signal against burst noise interference. The parallel data are then mapped to corresponding multilevel symbols in the in-phase and quadrature plane. These vectors are the baseband in-phase (I) and quadrature (Q) components of the digital modulation with the number of levels depending on the desired QAM (32/64/256) or VSB (4/8/16) mode. The symbols are then converted to analog form, passed through shaping filters to control the spectrum of the modulated signal and modulated on two separate IF carriers, each of the same frequency (44MHz) but 90° apart in phase. Each carrier is phase and amplitude modulated by the separate I and Q components with the resulting signals transmitted as a single waveform. The signal spectrum of the digital signal is flat, wide and noise like in appearance with widely varying random peak power (more than 6dB above average) but with a very stable average power component.

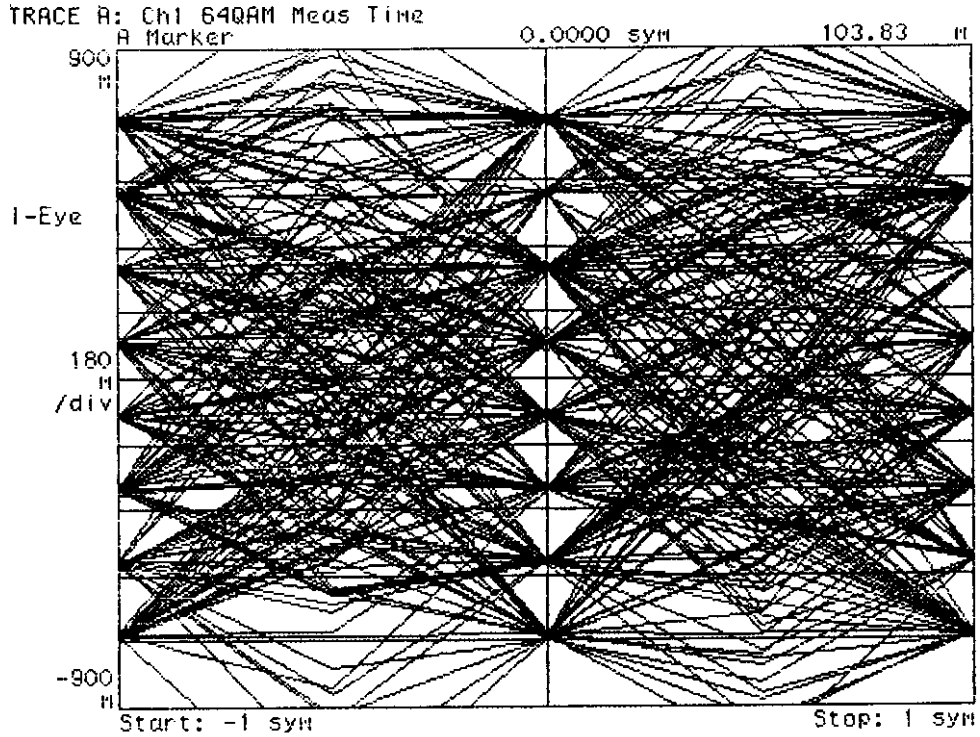
The following figures show the typical demodulated performance of a 64 QAM signal from the transmitter under test as presented by a Vector Signal Analyzer.



CONSTELLATION DIAGRAM



FREQUENCY RESPONSE

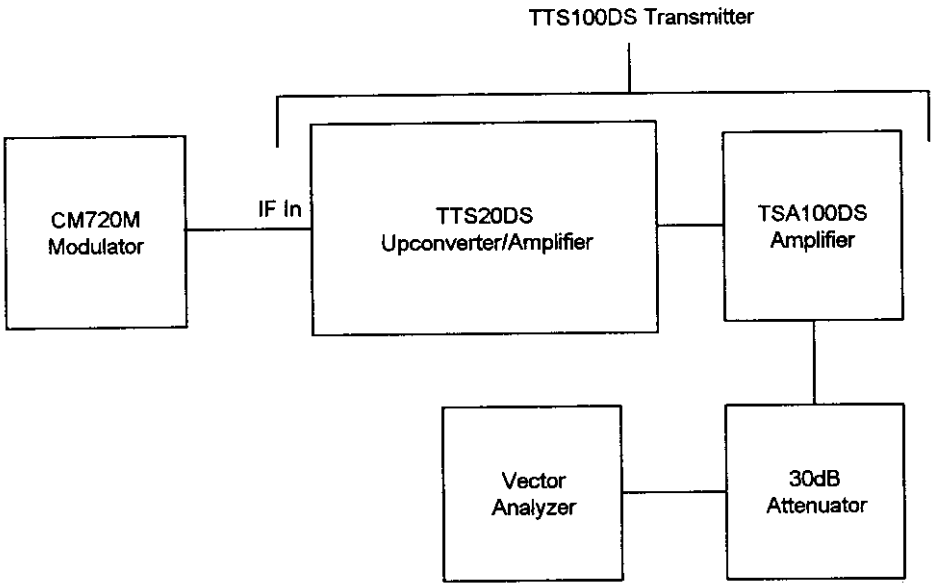


EYE DIAGRAM

EVM	= 747.09	m%rms	1.6181	% pk at sym	395	
Mag Err	= 473.76	m%rms	-1.4654	% pk at sym	395	
Phase Err	= 817.45	mdeg	-5.1014	deg pk at sym	261	
Freq Err	= 1.2541	kHz				
IQ Offset	= -62.549	dB	SNR	= 38.927	dB	

0	00000000	00100001	01100111	10000110	11100101	11011001
48	11111101	10011100	00110011	10111101	01100101	11110001
96	00111100	11001010	11111100	10101100	00000010	10101101
144	01100111	01101000	00000001	01100010	10100010	01101001
192	00010110	01011010	10001010	10100100	10011010	10111010
240	11000110	10110000	11000101	10001011	01001011	10100010
288	01011100	00001010	01001000	00000011	00101000	11111001
336	11000001	11010001	10111100	11111000	00100000	11110101
384	01010100	00100110	10100011	11100011	01000001	00001000
432	00001110	10001011	10101011	00111000	10000111	00100010
480	11011100	01100011	10111100	01101111	10001001	10010010
528	11101111	01011111	10000110	11011110	00110101	01110111
576	11110011	11101001	00011011	11111010	11000000	00100001
624	00111111	00110010	10001111	11100101	00101001	01101000
672	00001010	00010010	00100010	11100001	10010001	00000011
720	10000110	11100101	10000100	01001110	01110101	01001000
768	01001011	11011000	01100110	00011100	10110000	10000100
816	11001110	11101011	10110100	00110111	00111100	00100010
864	11001000	10110011	01111010	01001001	01010100	01010111
912	11110010	11101011	10011011	01001001	00001011	11001000
960	10011101	01111000	01101001	01101011	00110010	01001101
1008	01001101	11011010	10001011	10100011	01010100	11111010
1056	11010001	11010011	10111001	10110100	10101001	00100001
1104	10010110	00001000	01111100	01010000	10001101	01101110
1152	11011101	00000101	11000101	01111001	11000000	00010011

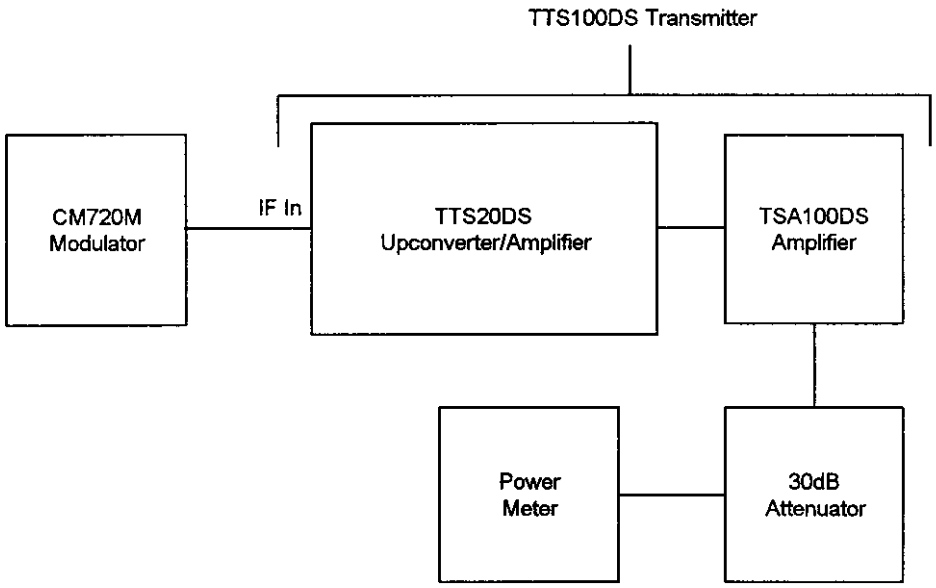
SYSTEM ERRORS



MODULATION CHARACTERISTICS MEASUREMENT SETUP
Figure 2-1A

2.2 RF Power Output [2.985(a)]

Test Equipment Setup	Figure 2–2A
Digital Output Power	100 watts average
Type Modulation	QAM
Method of Measurement	The transmitter was operated into a 50 ohm load and the CONTROL display was accessed on the transmitter's front panel liquid crystal display (LCD). Through the Control Menu, the PWR ADJ (Power Adjust) function was accessed and the FWD (Forward Power) bar graph indication on the LCD was set at 100% using the 100% soft key. Power calibration potentiometer R6 of the IF Upconverter, accessible through the top of the module, was then adjusted for a 100W average indication on the external power meter. Using a voltmeter, the voltage at TP1 of the TSA100DS Metering Detector was measured via the access hole on the Detector's top cover. Potentiometer R12 of the Detector was adjusted for a 4Vdc reading on the voltmeter, providing for a 100% FWD power indication on the transmitter's front panel Main Menu display. The tests recorded in the following sections of this report were conducted at this power level.



RF POWER OUTPUT MEASUREMENT SETUP
Figure 2-2A

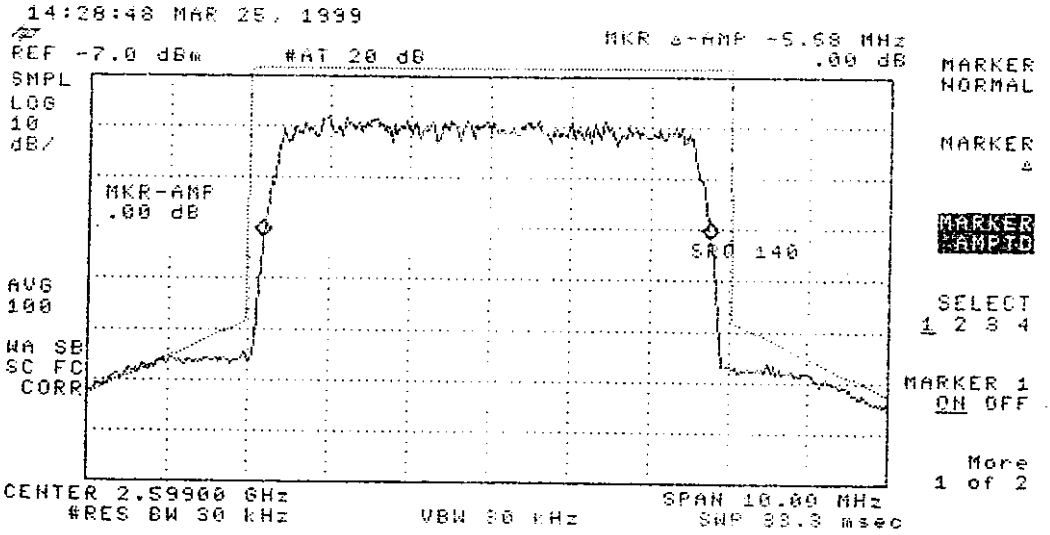
2.3 Occupied Bandwidth [2.989(h)]

Test Equipment Setup	Figure 2–3A
Digital Output Power	100 watts average
Type Modulation	QAM
Method of Measurement	The transmitter was operated at its rated power and maximum symbol rate. The spectrum analyzer settings were as follows:

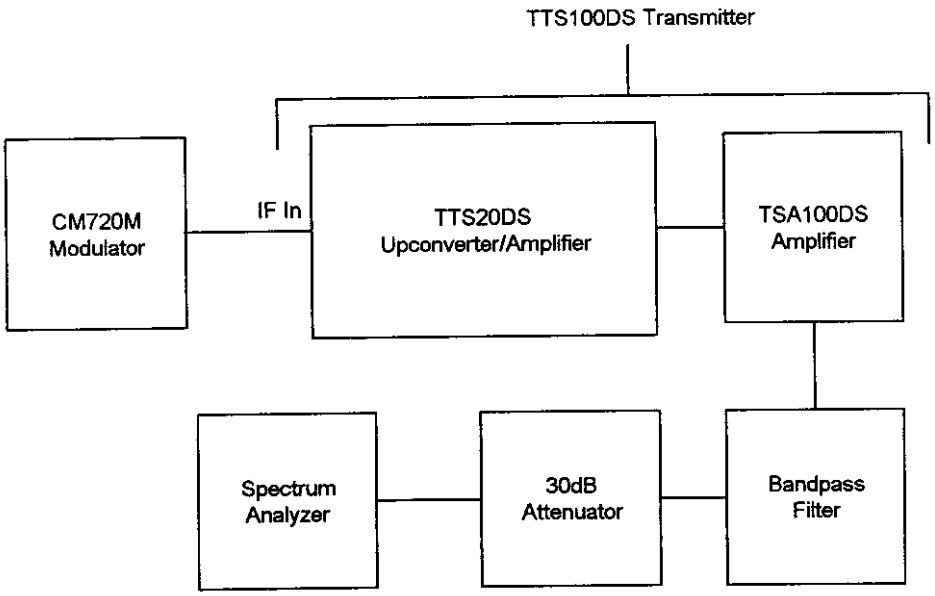
Frequency Span/Division	–	1MHz
Resolution Bandwidth	–	30kHz
Sweep Time	–	33msec
Input Attenuation	–	20dB
Reference Level	–	-7dBm
Video Bandwidth	–	30kHz

The occupied bandwidth was read at 0.5% (-23dB) of mean power. A printout of the spectrum analyzer display is shown below.

Measured Bandwidth 5.8MHz



OCCUPIED BANDWIDTH



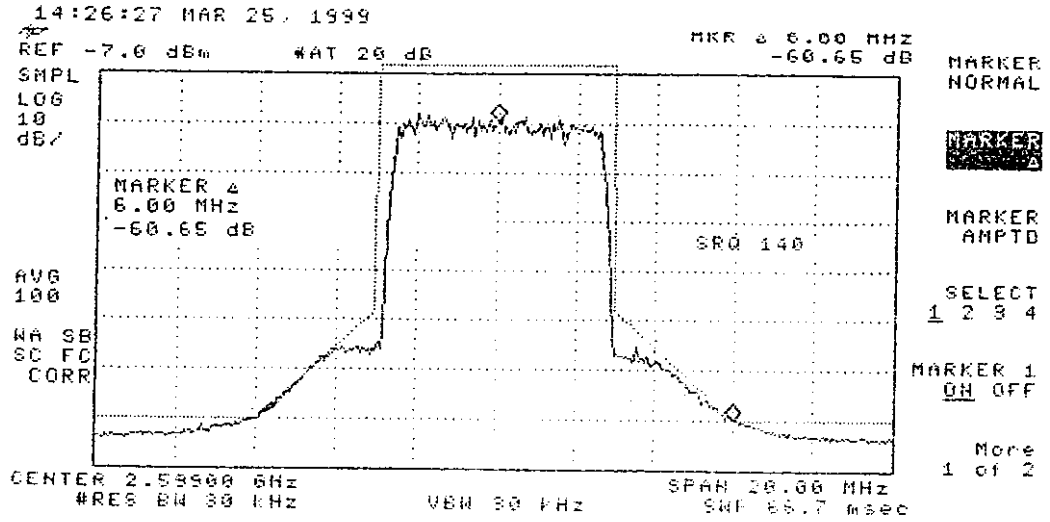
OCCUPIED BANDWIDTH MEASUREMENT SETUP
Figure 2-3A

2.4 Spurious Emissions at Antenna Terminal [2.991, 2.997, DA95-1854 para. 21 & 25]

Test Equipment Setup	Figure 2–4A
Digital Output Power	100 watts average
Type Modulation	QAM
Method of Measurement	Operating the transmitter at its rated output, the spectrum analyzer display was adjusted for a zero reference level at the center of the signal using the following settings:

Frequency Span/Division	–	2MHz
Resolution Bandwidth	–	30kHz
Sweep Time	–	67msec
Input Attenuation	–	20dB
Reference Level	–	-7dBm
Video Bandwidth	–	30kHz

All emissions were checked relative to the zero reference from 10MHz to 21GHz (spectrum analyzer limit). All emissions below the -70dB noise floor of the spectrum analyzer were not noted.

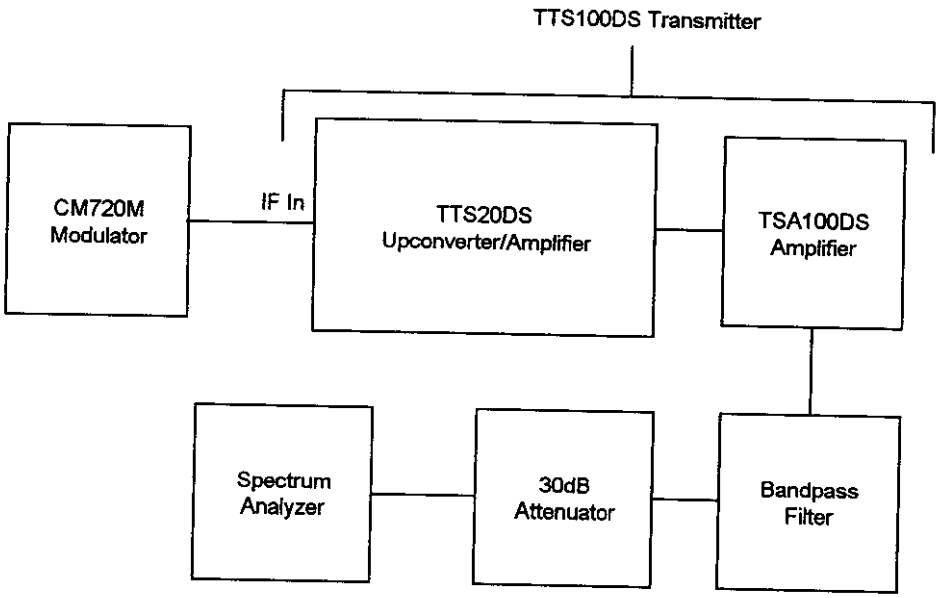


SPECTRAL MASK PER DECLARATORY RULING DA95-1854

SPURIOUS EMISSIONS DATA

FREQUENCY (MHz)	LEVEL (dB relative to zero reference)	
2599	0dB	Channel Center/Reference
44	----	Modulator IF
2596	-45.0dB	Lower Channel Edge
2602	-46.0dB	Upper Channel Edge
2593	-60.0dB	Lower Channel Edge -3MHz
2605	-60.6dB	Upper Channel Edge +3MHz
2643	----	Local Oscillator
5198	----	2nd Harmonic
7797	----	3rd Harmonic
10396	----	4th Harmonic
12995	----	5th Harmonic
15594	----	6th Harmonic
18193	----	7th Harmonic
20792	----	8th Harmonic

---- Not Visible



SPURIOUS EMISSION MEASUREMENT SETUP
Figure 2-4A

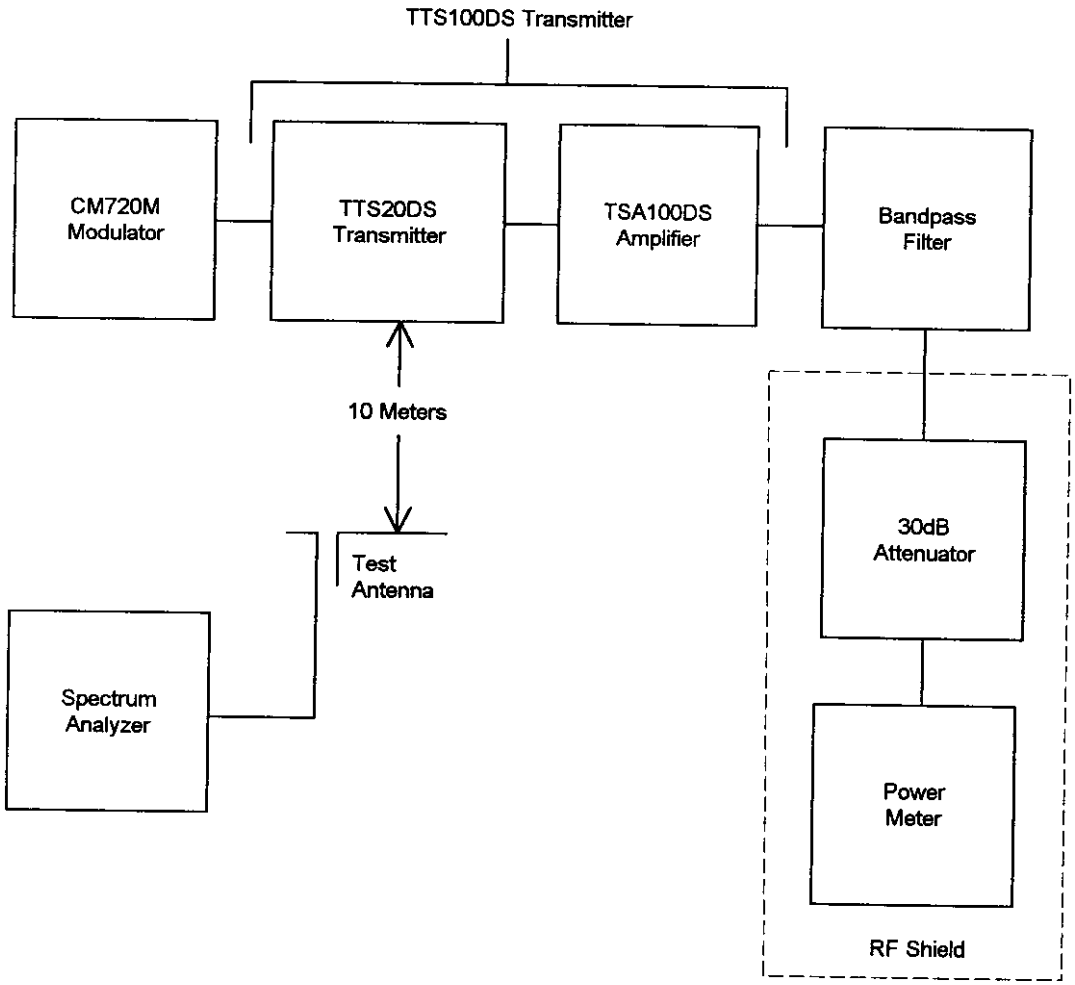
2.5 Spurious Radiation Field Strength [2.993]

Test Equipment Setup	Figure 2–5A
Digital Output Power	100 watts average
Type Modulation	QAM
Method of Measurement	The broadband receive antennas were moved horizontally and vertically around the unit to maximize receive level. Absolute power level of each spurious radiation was measured on a calibrated spectrum analyzer and converted to an equivalent field strength by finding the power density (absolute power divided by the antenna area). The relative field strength of the spurious radiation was then calculated with respect to the unit's rated output power. The field strength of the rated output was found using $\sqrt{49.2P}/R$ (P = rated output, R = distance). All emissions were assumed to be radiated from half-wave dipoles. Frequencies scanned extended from 20MHz to 21.0GHz (spectrum analyzer limit).

SPURIOUS RADIATION FIELD STRENGTH DATA

E Output = $\sqrt{49.2P}/R = \sqrt{(49.2)(100)}/10 = 7.01$ Volts/Meter

FREQUENCY (MHz)		POWER MEASURED	EQUIVALENT FIELD STRENGTH (VOLTS/METER)	RELATIVE FIELD STRENGTH (dB)
Channel	2599	-55dB	1.92×10^{-2}	-51.2dB
IF	44	Not Visible	-----	-----
LO	2243	Not Visible	-----	-----
2nd Harmonic	5198	Not Visible	-----	-----
3rd to 8th Harmonics		Not Visible	-----	-----



SPURIOUS CABINET RADIATION MEASUREMENT SETUP
Figure 2-5A

2.6 Frequency Stability [2.995, 21.101, 74.961]

Test Equipment Setup — Figure 2–6A

Method of Measurement — The EMCEE S-Band Synthesizer and dual conversion IF Upconverter, containing a 400MHz (1st LO) PLL oscillator, were removed from the transmitter and placed in an environmental chamber with their B+ lines intact. The modulator was set in the CW mode (44MHz unmodulated carrier out) and the synthesizer and converter stability were first tested with ±15% variations in the AC line voltage. The chamber's internal temperature was then changed and the transmitter's output frequency was noted at every 10°C increment. The results of both tests are shown in the following tables.

LINE VOLTAGE	TTS20DS OUTPUT FREQUENCY (MHz)	CHANNEL E1 ERROR (Hz)
95	2599.000060	+60
115	2599.000063	+63
135	2599.000058	+58

TEMP C°	TTS20DS OUTPUT FREQUENCY (MHz)	CHANNEL E1 ERROR (Hz)
+50	2599.000201	+201
+40	2599.000156	+156
+30	2599.000117	+117
+20	2599.000055	+55
+10	2599.000009	+9
0	2598.999960	-40
-10	2598.999876	-124
-20	2598.999790	-210
-30	2598.999655	-345

Test Equipment Setup — Figure 2–6B

Method of Measurement — The CM720M Modulator was placed in an environmental chamber and the frequency stability of the 44MHz IF carrier was monitored during variations in line voltage and ambient temperature. The results of both tests are recorded in the tables below.

LINE VOLTAGE	IF CARRIER (MHz)	CHANNEL E1 ERROR (Hz)
95	44.000073	+73
115	44.000073	+73
135	44.000072	+72

TEMP C°	IF CARRIER (MHz)	CHANNEL E1 ERROR (Hz)
+50	44.000197	+197
+40	44.000185	+185
+30	44.000116	+116
+20	44.000070	+70
+10	43.999959	-41
0	43.999880	-120
-10	43.999796	-204
-20	43.999844	-156
-30	43.999906	-94

Adding the worst instances of frequency variation for the modulator and dual conversion Upconverter, the TTS100DS output frequency is well within the ±1kHz specification for ITFS and MMDS/MDS television transmitters.

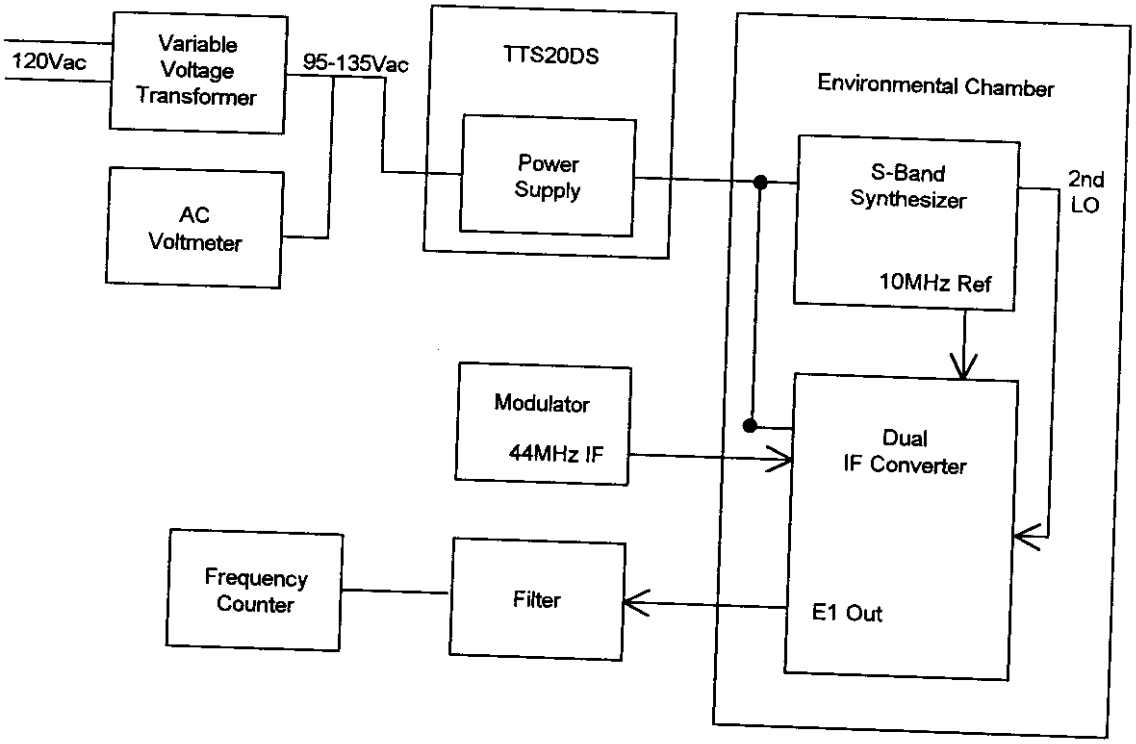


Figure 2-6A

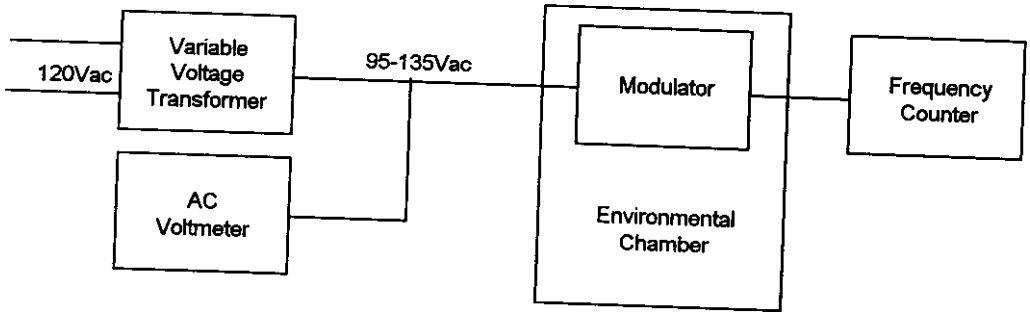


Figure 2-6B

FREQUENCY STABILITY TEST SETUP

2.8 Photographs [2.983 (g)]

The following photographs will be used as part of the TSA100DS Amplifier Instruction Manual. Mechanical layouts of the circuits internal to each transmitter module are included as part of the separate package for which we are requesting confidentiality.