


**PRASAR BHARATI
(BROADCASTING CORPORATION OF INDIA)
DIRECTORATE GENERAL: DOORDARSHAN**

Spec: No: SATD/Maintenance Workshop _June/2010

**SPECIFICATIONS
FOR
Maintenance Workshop at Todapur, Delhi**


01/07/18
प्रसार भारती
दूरदर्शन (सि.स.)



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Specifications for Maintenance Workshop at Todapur

This document lays down performance specifications for Maintenance Workshop facility at Todapur Delhi for satellite Earth station related equipment. The scope for this workshop is detailed in the specifications as given below:

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1 INTRODUCTION

The scope of this project includes Supply, Installation, and Testing & Commissioning (SITC) of the Maintenance Workshop for Earth Station equipment. These specifications envisage providing the test benches for compression equipment (like Encoder, Multiplexer, Modulator, and IRDs etc.), RF equipment (like, TWTA HPA, Upconverter etc.) and Base-band equipment (like optical transmitter & receivers A/D converters etc.).

All the equipment to be supplied should have necessary control interfaces through RS 232 / RS 422/ RS 485/ RJ45 so that they can be interfaced with a PC for remote monitoring and control with suitable GUI. The associated software for logging, archiving, monitoring and controlling along with the accessories should also be made available.

Power supply for Maintenance Workshop has to be arranged (by the integrator) from the existing 40 KVA UPS system (available for carrier monitoring earth station). PDP & Power supply cable of approximately 20 KVA load is to be provided by integrator.

The offer including supply, installation and commissioning of the setup should be complete in all respects. A representative block schematic is provided to give a general idea about the intended configuration. **A complete schematic of proposed implementation should be supplied along with the quote.**

1.1 General Requirements

1. A detailed block diagram showing the equipment layout in the racks and wiring must be given along with the offer for approval.
2. Assorted items like RF cables with connectors (N type, Male & Female), Bullets N type, wave guides Rigid & semi-rigid, RF attenuator (10 dB, 20 dB and 30 dB) etc of reputed make are also to be offered.
3. One full set of measuring equipment consisting of video measuring equipment (test pattern Generator, transport stream analyzer), digital audio measuring equipment (audio generator cum analyzer), RF Power Meter, RF Frequency counter, spectrum analyzer, digital waveform monitor and 6½ DMM should be offered.
4. Remote control setups are required for remote operations at RF test bench and Compression & Base-band test bench. All the system components to be supplied should have necessary software and hardware interfaces so that these could be interfaced and controlled from respective remote control computer. The set-up should be able to select any individual equipment like encoder, modulator, multiplexer, router, TWTA etc. for operation and monitoring.
5. One rack mount industrial PC based on industry standard, open system hardware & software as RF remote control computer is to be provided in the RF test bench for remote control and operations of DUT as well as RF related equipment to be used in the RF test bench.
6. One rack mount industrial PC (other than RF control PC) based on industry standard, open system hardware & software as RF remote control computer is to be provided in the Compression & Base-band test bench for remote control and operations of DUTs as well as Compression & base band related equipment to be used in the compression & Base-band test benches.
7. Software upgrades within three year of installation should be supplied free of cost.
8. As an SITC contract, all supplied equipments are to be installed, tested and commissioned at site by the tenderer. The cost of any other interconnecting material and labour including that for laying of cables, earthing, earth pits etc. should be indicated and included.

9. Cost of any other work, consultancy required to complete the installation & commissioning of the earth station should be taken into account and clearly mentioned while submitting the tender.

1.2 System Requirements

1.2.1 Design Standards

The maintenance workshop shall be designed to diagnosis of the faulty equipment of international standards for digital satellite broadcasting known as the DVB-S/S2 standards.

1.2.2 Basic Configuration

The basic requirement is for a collection of test benches for compression equipment (like Encoder, Multiplexer, Modulator, and IRDs etc.), RF equipment (like, TWTA HPA, Upconverter etc.) and Base-band equipment (like optical transmitter & receivers, A/D converters etc.). The system should be complete and fully wired for testing of all satellite earth station related equipment fitted in 19" standard rack.

1.2.3 Remote Control computer setups

Control computer systems (one for RF test bench and one for Compression & Base-band Test bench) with suitable software should be able to control the respective equipment to be supplied along-with equipment under test like Encoder, Multiplexer, Modulator, Upconverter, HPAs (TWTA), optical Transmitter & receivers etc. These computers should be supplied with complete hardware and software to interface respective equipment in the chain for their proper control and operation.

1.2.4 Trouble shooting tree software

Troubleshooting tree software with search facility for various makes of different equipment such as CPI, MCL, Xicom make TWTA for HPA in RF test bench control computer, Tandberg, Scopus, Nextream (Thomson) make Encoders, Multiplexers, Modulator for Compression equipment in Compression & Base-band test bench are to be provided.

These softwares should have facility for drop down list for make, model, serial number, ratings etc. there should be provision for specified fault as pull down menu and provision for entering additional fault if any. Manuals of existing equipment in hard copy will be provided by DD from which database for fault finding is to be created by the integrator in trouble shooting software in respect of existing equipment types and models.

Firm will have to give source code along-with documentation related to Trouble Shooting Software for future upgrade requirements.



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2. Specifications for RF Equipment Test-Bench

RF equipment test bench is intended to be used for testing and calibration of RF frequency related equipment like HPA (TWTA etc.), Up-converters etc. RF test bench will consist of a Rack (including RF trolley for test & measurement equipment) which is to be fully wired for testing of HPA, frequency converters and should be equipped with measuring and monitoring equipment like Network Analyser, Spectrum Analyser, Directional coupler, Dummy load RF remote control computer system etc. following gives the details of testing methodology & chain for various RF equipment:

2.1 HPA Test bench

HPA test bench will comprise of vector network analyser, spectrum analyser, directional coupler and Dummy load along with accessories like waveguide, waveguide adapter etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of TWTAs of CPI, MCL and Xicom makes available in Doordarshan network. A tentative schematic of testing chain is given at Figures 1 & 2.

The test setup shown in the figures-1 & 2 are general ones. However HPA test bench is to be provided for both C-band HPAs & Ku-band HPAs. Vector network analyser shown in figure 1 will be same for both C & Ku band HPAs only Directional coupler and Dummy load along-with waveguides and adapters will be of respective frequency bands. Similarly Signal Generator shown in figure-2 will be same for both C & Ku-band and other equipment will be of respective frequency bands.

Following measurements and tests are necessarily to be conducted in the HPA test bench:

- a) Using Vector network analyser as per figure 1: Gain, 1 dB compression point, transmission parameters (S parameters), Stability factor (or spurious), Group delay, AM to PM conversion loss etc.
- b) Using Signal Generator and Spectrum Analyser as per figure 2: Harmonics, Intermodulation products, spectrum overview (frequency response) etc.

Troubleshooting tree software with search facility along-with remote monitoring software for these HPAs is to be provided in the RF test bench remote control computer. Representative specifications for various measuring and monitoring equipment are detailed below:

2.1.1 RF Spectrum Analyzer

ESSENTIAL FEATURES

- i) The instrument should be rack Mountable, AC operated and supplied complete with all accessories like input probes, Adapters and power cords, printer etc.
- ii) The instrument should have full set of marker functions including delta Marker, peak search marker, centre marker and multi marker (minimum 4) etc.
- iii) The instrument should have time and Data storage functions with internal memory to store minimum of 500 traces and 500 measurement setups.
- iv) The instrument should be programmable for automatic measurements.
- v) The instrument should have auto-calibration function.
- vi) The Spectrum analyzer should be capable of making measurement for
 - a) Noise power (in dBm / Hz, dBm/ Ch.)


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- b) C/N (in dBc / Hz, dBc/ Ch.)
- c) Occupied Band Width and Adjacent channel power
- d) Average power of bust signal

- vii) Spectrum analyzer should have TFT color display.
- viii) It should have measurement for AM/FM/SSB demodulation.
- ix) The equipment should have suitable software for transfer of screen shot measurement data to PC or Laptop.
- x) The offered spectrum analyzer should have over all accuracy of 3.0 dB
- xi) The offered spectrum analyzer should have DC block facility.

Sr. No.	Features	Specifications
1.	Frequency Range	100KHz to 18 GHz
(a)	Aging Rate	$\leq 1 \times 10^{-6}$ / year
(b)	Temp. stability (0 to 50deg.C)	$\leq 1 \times 10^{-6}$
(c)	Frequency span	0 Hz (Zero span) , 100Hz to 18.0GHz
2.	Spectral Purity	
(a)	SSB Phase Noise @ 10KHz offset	< -100 dBc/Hz for full frequency range.
(b)	Harmonics @ -30 dBm level at mixer input	< -60 dBc/Hz for full frequency range.
3.	Sweep time:	
(a)	Span = 0 Hz	50 μ sec to 2000 sec
(b)	Span > 100 Hz	200 msec to 2000sec.
(c)	Sweep Mode	Continuous and single
4.	Bandwidths	
(a)	Resolution Bandwidth (3dB)	10 Hz to 8 MHz
(b)	Video Bandwidths	1 Hz to 3 MHz , in 1-3 Sequence
5.	Amplitude	
(a)	Max. Input level (Continuous)	+30 dBm. Suitable external Attenuator can be provided to meet this requirement, if required.
(b)	Level Measurement Range	+30 dBm ; ± 50 Vdc
(c)	Level measurement uncertainty	± 1.3 dB for full frequency range.
(d)	Displayed average noise level at 0dB attenuation (RBW 1 KHz and 10 Hz VBW)	-110dBm minimum at 18 GHz
(e)	RF input attenuation range	0 dB to 65 dB (manual or automatic) in 1, 5 dB step.
(f)	Input impedance	50 ohms and 75 ohms (selectable)
6.	Sweep Trigger	Free run, single, Video, External,
7.	Display	
a)	Modes	Normal, Save Subtracts Averaging, Cumulative and Over write

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|---|---|
| <ul style="list-style-type: none"> b) Scales 8. Interface 9. Accessories | <p>Log & Linear, Scales with 1dB/div to 10dB/ Div. in suitable steps
RS232 /RJ45/USB</p> <p>Standard accessories list shall be provided in the offer. Optional accessories shall be offered to complete all the measurement applications.</p> |
|---|---|

2.1.2 Network Analyser

The existing Vector network analyser at Kendra (i.e. Todapur) ZVM 1127 of Rhode & Schwarz make is to be used in the RF test benches. Integrator has to integrate this VNA with supplied equipment. This VNA is to be integrated with the RF test bench control computer for remote control and operation of VNA.

2.1.3 Directional Coupler

The directional coupler to be used in the RF test bench should have 40 dB down signal level at monitoring port. Two Directional couplers of C-band & Ku-band frequencies are to be supplied for respective measurements in C& Ku bands.

2.1.4 Dummy load

The Dummy load to be used in the RF test bench should be of 1 KW capacity. Two dummy loads of C-band & Ku-band frequencies are to be supplied for respective measurements setups in C& Ku bands. The Dummy load should have feed through output port.

2.1.5 Signal Generator

Frequency		
1	Frequency Range	10MHz to 20GHz
2	Frequency Resolution	1KHz
3	Ageing Rate	$<1 \times 10^{-6}$ /year
	Spectral Purity	
4	SSB Phase Noise(at 10KHz @ 10GHz)	< -83 dBc/Hz
5	Harmonics	< -40 dBc
6	Non harmonics (>50KHz offset)	Better than -50 dBc
	Output Level	
7	Level Range	+5 to -120 dBm
8	Resolution	0.01 dB
9	Total error	$< +/-1$ dB at $f \leq 20$ Ghz
	Sweep	Digital and Analogue both , Ramp Sweep
10	RF Digital Sweep	Automatic, Single, manual or external triggered
10.a	Sweep range and width(lin.)	Freely selectable
10.b	Step time	10 ms to 1s with resolution of 0.1ms




	RF Analogue sweep	Automatic, Single, manual or external triggered
11	Sweep range	Freely selectable
12	Resolution	1KHz
13	Sweep time	10ms to 100s
14	Sweep rate	600MHz/ms

2.2 Frequency Converters (Up/ Down) test bench

Frequency test bench will comprise of vector network analyser, spectrum analyser, along with accessories like calibrated cables etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of Frequency converters (Up-converters / Down-converters) of various makes (like Comtech EF Data, Radyne Comstream, L-3 com., Advent etc) available in Doordarshan network. A tentative schematic of testing chain is given at Figure-3.

The test setup shown in the figure-3 is general one. However this test bench is to be used for both C-band HPAs & Ku-band converters.

Following measurements and tests are necessarily to be conducted in the test bench:

- c) Using Vector network analyser & Spectrum analyser as per figure 3: Conversion loss, Transmission parameters (S parameters), Group delay, Harmonics, Intermodulation products, spectrum overview (frequency response) etc.

Troubleshooting tree software with search facility along-with remote monitoring software for these Frequency converters are to be provided in the RF test bench remote control computer. Representetative specifications for various measuring and monitoring equipment have already been provided in the HPA test bench specification section.

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3 Specifications for Compression Equipment Test-Bench

Compression equipment test bench is intended to be used for testing and calibration of Compression and IF frequency related equipment like Encoder, Multiplexer, Modulator, IRD etc. This test bench will consist of a set of Racks which is to be fully wired for testing of Encoder, Multiplexer, Modulator and should be equipped with measuring and monitoring equipment like Test Pattern Generator, Transport Stream Analyser, Video Measurement set, Remote control computer etc. following gives the details of testing methodology & chain for various compression equipment:

3.1 Encoder/ Multiplexer Test bench

Encoder/ Multiplexer test bench will comprise of Test pattern generator, Device-Under-Test DUT, Transport stream analyser, IRD (with ASI input), Video Monitor along with accessories like waveform monitor etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of Encoders or Multiplexers of Tandberg, Scopus and Nextream (Thomson) makes available in Doordarshan network. A tentative schematic of testing chain is given at Figure-4.

Troubleshooting tree software with search facility along-with remote monitoring software for this equipment is to be provided in the Compression & base-band Remote control computer. Representetative specifications for various measuring and monitoring equipment are detailed in the following sections:

3.2 Modulator Test bench

Modulator test bench will comprise of Test stream analyser, Device-Under Test (DUT), 70 MHz to L-band U/C, IRD (with QPSK input), Video Monitor along with accessories like waveform monitor etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of Modulators of Tandberg, Scopus and Nextream (Thomson) makes available in Doordarshan network. A tentative schematic of testing chain is given at Figure-5.

Troubleshooting tree software with search facility along-with remote monitoring software for this equipment is to be provided in the Compression & base-band Remote control computer.

3.3 IRD Test bench

IRD test bench will comprise of Test stream analyser, Device-Under-Test (DUT), QPSK Modulator, Video Measurement Test (Existing to be provided by DD), Video Monitor along with accessories like waveform monitor etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of IRDs of Tandberg, Scopus makes available in Doordarshan network. A tentative schematic of testing chain is given at Figure-6.

Troubleshooting tree software with search facility along-with remote monitoring software for this equipment is to be provided in the Compression & base-band Remote control computer. Representative specifications for various measuring and monitoring equipment are detailed in the following sections:

3.4 Specification Compression Test & Measurement Equipment

Representative specifications for various measuring and monitoring equipment for compression Test Bench are detailed below:

3.4.1 Multi format Video Generator (Test Pattern Generator)

The multi format digital signal generator is to be used for test signal generator for broadcast facilities and to test the equipment performance the essential features are:

1. The equipment should have multi format digital (SD-SDI and HD-SDI) test signal generation facility.
2. It should have channel configuration and performance to support reference generator needs.
3. It should have unique, robust channel of mode to provide stable synchronization signal for digital broadcast facility.
4. It should provide 8 channels (4 AES/EBU pairs of audio signal generation).
5. It should have various Analog colour bar test signal in PAL format.

Sl No.	Parameters	Requirement
1.	Audio signal	
a)	Output Standard	ANSI S4.40 (AES3)
b)	Amplitude	1V \pm 0.2V
2.	Digital test signal (SD-SDI)	
a)	Output Standard	ITU-R BT 601
b)	Bit rate	270 Mbps
c)	Amplitude	800 mV p-p \pm 10%
3.	Digital test signal (HD-SDI)	
a)	Output Standard	ITU-R BT 709
b)	Bit rate	1.485 Gbps
c)	Amplitude	800 mV p-p \pm 10%
4.	Analog Test Signal (PAL format)	
a)	Output Standard	CCVS (Colour bars) PAL 50Hz
b)	Amplitude	1 V p-p \pm 10%

3.4.2 Transport Stream Analyzer

Transport Stream Analyzer is to be used for measurement and analysis of ASI stream available at the output of encoders, multiplexers and IRD. The salient features are as follows:

1. The T. S. Analyzer should be able to capture and analyze both real time (Live stream) and deferred time transport streams.
2. It should be able to generate record and analyze streams at the highest ASI data rate.
3. It should be able to diagnose and solve most subtle, complex and intermittent Digital TV problems in the minimum time.
4. It should include comprehensive analysis tool to analyze – Transport Stream compliance, Buffer, PES, Compressed Video and audio elementary Streams together with TS editor, multiplexer and data broadcast applications for stream creation, analysis and error injection.
5. It should have the facility to analyze the compression standard like MPEG-2, H.264.
6. Ability to monitor network which carry multi programme stream (MPTS) or single programme stream(SPTS)
7. It should have PCR, PTS and PIT graphing and measurement Display, SI/PSI/PSIP display, Real-time and deferred-time EPG display, Section and Packet view.
8. It should carry Proper PCR measurement as per TR 101 290 measurement guide line.
9. It should have facility to take L-band input for DVB-S and DVB-S2 modulated signal.
10. It should be possible to do analysis in CBR and VBR modes as per DVB and MPEG standards (one at a time) and log the results along-with measurement mode.

11. Platform Characteristics

- a) Operating System
- b) Display

Window based
LCD, 10.4 inch nominal

12. ASI Input Parameters

- a) Connector
- b) Input signal level
- c) Input Return loss
- d) Bit Rate

BNC 75Ω
800mV ± 10 %
Better than 17 dB (5 MHz to 270 MHz)
250 kbps to 214 Mbps
Input and output aggregate bit rate (simplex or duplex operation)

13. L-band Input Parameters

- a) Input frequency range
- b) Input signal range
- c) Modulation Type

950 MHz to 2150 MHz step size of 1 MHz
- 60dBm to -30 dBm for CBER < 1e-6
QPSK (as per ETSI EN 300421) & 8PSK
QPSK, 8PSK, 16APSK and 32 APSK in accordance with DVB-S2 (ETSI EN 302307) Including Constant and Variable Coding and Modulation (CCM & VCM)
F type

- d) Connector

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14. L-band signal measurement Parameters

a) Modulation Error Ratio	
i) Display range	10 to 30 dB
ii) Resolution	1 dB
iii) Accuracy	± 2 dB
b) Signal or Carrier to Noise Ratio	
i) Display range	10 dB to 30 dB
ii) Accuracy	± 2 dB
c) Constellation display	RF constellation should be displayed on screen.
d) Error Vector Magnitude (EVM)	
i) Display range	$\leq 4.0\%$ to $\geq 30.0\%$ rms
ii) Resolution	0.1 %

3.4.3 MPEG 2/MPEG 4/DVB Prof. IRD Specifications

The IRD should have a front panel display and one should be able to enter or edit all the parameters for a perfect reception of the signals. **There should be provision for observing the BER of the signal and signal level on the front panel. IRD should be able to descramble BISS mode 1 and BISS-E signals. Also the IRD should be able to store at least 20 channels in memory.**

The IRD should have capability for configuration of parameters through remote PC using IP control port.

3.4.3.1 RF Parameter Specifications

Parameter	Specification
(a) Input Frequency Range	950 - 1750 MHz
(b) No. of Inputs	1 nos.
(c) Tuning Step Size	125 kHz, maximum
(d) Satellite Frequency Band	C- & KU-Band, selectable
(e) Input Impedance	75 Ohms
(f) Input Connector	F-Type female
(g) Input Power Range	-30 to -65 dBm per carrier
(h) Image Rejection	>30 dB
(i) Input Return Loss	7 dB, minimum
(j) Noise Figure	20 dB, maximum
(k) AFC Tuning Range	± 5 MHz
(l) De-Modulation Method	DVB-S QPSK, DVB-S2 8PSK demodulation
(m) Variable Symbol Rates	1.0 to 44.5 M symbol/Sec for (DVB-S) 1.5 to 30 Msymb/sec, (minimum) for (DVB-S2)
(n) Convolutional Inner FEC Rates selectable	R= 1/2, 2/3, 3/4, 5/6, 7/8 (DVB-S option QPSK) R= 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 (DVB-S- 2, QPSK), R= 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 (For DVBS2, 8PSK)
(o) IF Filter Bandwidth	Automatic Selection (dependent on Symbol Rate).


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3.4.3.2 Audio and Video Decompression Parameters

Parameter	Specification
(a) Video Resolution (all resolutions shall be capable of I, P & B frame decoding) (other standard resolution should be selectable)	For HD 1080x1920/1440/ i 25 , 720x1280/ p 50 and for SD 720 x 576, 704 x 576, 544 x 576, 480 x 576, 352 x 576,
(b) Video Decompression Type	HP@L4, MP@ L3, 422P @ ML & MP@ML (H.264 Part 10)
(c) Television Standard	PAL-B (EN50083-9)
(d) Audio Decompression Type	MPEG-1 Layer-II audio (Stereo/ Musicam, i.e. Single Mono, Dual Mono, Stereo, and Joint Stereo) Digital AAC (HE, LE Mode) AC-3 passes through

3.4.3.3 Transport Stream O/P

MPEG-2 DVB-ASI on BNC

3.4.3.4 Video Output Specifications

- a) The IRD shall have one composite video output, one SD-SDI, one HD-SDI, and one ASI output.

(If IRD's ports are configurable then there should be minimum 3 output ports, so that at any given point of time at least one Analog, one SDI (HD or SD) and one DVB ASI output will be available by configuration.)

- b) There should be a Genlock input. (Firm has to demonstrate during the demo, as and when asked as part of technical evaluation of Tender.)

3.4.3.4.1 Analog Video Output Specifications

Parameter	Specification
(a) Connector Type	BNC (75 Ohms)
(b) Quantity	1 Nos. of analog composite PAL-B CCIR Standard
(c) Level	1.0 V p-p +/- 5%

3.4.3.4.1.2 Digital Video Output Specifications (SD-SDI)

Parameter	Specification
(a) Serial Interface	SMPTE 259M ,270 Mb/s & SMPTE 272-1994 (10 bit), Note: ASI to SDI conversion should take place directly, i.e. not through Analog to Digital converter.
(b) Connector Type	BNC (75 Ohms)
(c) Quantity	1 Nos. of DIGITAL output compliant to ITU-R BT.656 Standard
(d) Level	800mV p-p for SDI As per ITU-R BT.601 (part A)

Note: ASI to SDI decompression should take place directly, i.e. not through Analog to Digital converter.

3.4.3.4.1.3 Digital Video Output Specifications (HD-SDI)

Parameter	Specification
(a) Serial Interface	SMPTE 292M, 1.485 Gbit/s (10bit),
(b) Connector Type	BNC (75 Ohms)
(c) Quantity	1 Nos. of DIGITAL output compliant to 1080i and 720p
(d) Level	800mV p-p for SDI As per ITU-R

3.4.3.4.2 Video Performance Specifications

Parameter	Specification
(a) Frequency Response	within 2 dB at 5 MHz
(c) Chroma-Luma Delay	±30 ns, maximum
(d) Field Time Distortion	< 2%
(e) Line Time Distortion	< 1%
(f) Short Time distortion	< 2%
(g) Differential Gain	< 4%
(h) Differential Phase	< 2°
(i) Signal to Noise Ratio	>55 dB (luminance weighted)

3.4.3.4.3 VBI Signal Reinsertion Specifications

Parameter	Specification
(a) VBI Formats Supported	WST VITC
(b) Range of VBI Lines	Field 1 lines 7 to 22 (PAL) and corresponding lines of Field 2
© Synchronization with video	Within ± 1 frame
(d) Preservation of line numbering	VBI data shall be reinserted on the Original line number

3.4.3.5 Audio Output

3.4.3.5.1 Analog Audio

Each analog audio output shall be presented as a stereo pair. In the event of “Mono” Input, the same input channel will be output to both left and right connectors. In other modes (“Stereo”, “Joint Stereo” and “Dual Mono”), the two audio input channels will be output as left and right. Means shall be provided to combine the left and right channels on the IRD output to produce a mono output from stereo input to accommodate testing of equipment not equipped for stereo outputs.

3.4.3.5.1.1 Analog Audio Output Specifications

Parameter	Specification
(a) Output Impedance	600Ω (balanced)
(b) Number of Outputs	4, configurable as Stereo, Joint Stereo, Single mono, Dual mono.
(c) Connector Type	XLR Male Socket or with suitable XLR Adapter



3.4.3.5.2 Digital Audio Output Specifications

Parameter	Specification
(a) Output Level	2 to 7 volts
(b) Output Format	AES/EBU
(c) Load Impedance	110 Ohms
(d) Connector Type	XLR male Socket or with suitable XLR adapter (i.e. no terminal block)
(b) Number of Outputs	2, Stereo Channels

3.4.3.5.2.1 Audio Performance Specifications

Parameter	Specification
(a) Peak Output Level	+ 18 dBm into 600Ω balanced
(b) Clipping Level	S/W Selectable to be provided (demo has to be given)
(c) Sampling Rates	32, 44.1 and 48 KHz
(d) Frequency Response	40 Hz to 20 kHz ± 2 dB
(e) THD	<0.3 % at 1 kHz
(f) Dynamic range	80 dB (ITU-R/Arm weighting)
(g) Cross talk at 1 kHz	60 dB, full scale (20 Hz to 20 kHz)
(i) Signal to noise ratio	55 dB (min) at 0 dBm

3.4.3.6 LNB Power Supply & Control

(a) LNB Voltage	+ 13 V (Vertical)/ 18 V (Horz) polarizations switching or 19 V fixed.
(b) Power Consumption	400 mA. (Max.)
(c) Over Current protection	Fold back current limiting.
(d) LNB Power Supply & Control	Receive Polarization Control by electrical Command Via LNB-IF feeder (High & Low band switching Pulse for KU-Band operation).

3.4.3.7 Size Mount

19" Rack Mount

3.4.4 Specification for 20" nominal LCD (TFT) HD & SD Colour monitor

ESSENTIAL FEATURES:

1. The offered 20" nominal LCD Colour monitor should accept High Definition and Standard Definition, SDI input as well as analog composite video input.
(Firm may offer higher size of monitor i.e. 20" or higher to meet full HD resolution. Firm may offer higher size of monitor i.e. 20" or higher to meet DD specification.)
2. The product should be a broadcast quality monitor with front panel controls. The monitor should be light weight, robust, and compact.
3. The offered product should have a high brightness, high-resolution and high contrast active LCD panel.
4. The offered monitor should support 4:3 & 16:9 aspect ratio format of the video signal.

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5. The offered product should have the facility to control the display parameter like brightness, contrast, Colour saturation, sharpness etc.
6. The offered equipment should have a wide viewing angle both in horizontal and vertical direction with no reduction in brightness, picture contrast and Colour saturation.
7. The LCD monitor offered should have a minimum response time for facilitating viewing of fast moving picture like sports events without any delay.
8. The offered monitor should function with standard AC 230 V, 50 Hz power supply.
9. The offered product has to be mounted on control console table. A suitable mounting hardware should be supplied and integrated.
10. Aesthetically designed matching professional grade speakers along-with professional grade audio driving amplifiers should be supplied with Monitor for audio monitoring.
11. The offered product which is of internationally reputed make, meeting the specification and proven in the broadcasting media only will be acceptable. The firm should enclose the user list of the broadcasters to whom this product has been supplied.

Technical Specifications

Display Size	:	20" nominal diagonally
1. Resolution	:	1920 x 1080 pixels
2. Colour reproduction	:	16 millions or better
3. Contrast ratio	:	1000: 1 or better
4. Viewing Angle	;	150 degree (min.) in Horizontal 150 degree (min.) in Vertical
5. Brightness	:	300 cd / sq. m or better
6. Aspect ratio	:	16:9 & 4:3
7. Video Input	:	HD SDI S-Video x 1 • Component x 2 • Composite x 2 • HDMI x 1 • Audio (RCA) x 4 • RF x 1 • 1 x D- Sub (RGB PC), SD-SDI Digital Audio input
9. Video Format	:	For HD 1080x1920/1440/ i 25 , 720x1280/ p 50 and For SD 720 x 576, 704 x 576, 544 x 576, 480 x 576, 352 x 576,
11. Power consumption	:	125 Watts (max.)




3.4.5 70 MHz to L-band Up-converter Specifications

70 MHz to L-band Upconverter is to be used to check the monitoring output of modulators. The specifications are detailed below:

1. Input Frequency	:	70 MHz \pm 18 MHz
2. Output Frequency range	:	950 MHz to 1450 MHz
3. Frequency Steps Size	:	Synthesized 125 KHz
4. Input return loss	:	14 db minimum
5. Out put return loss	:	14 db minimum
6. Gain	:	15 dB
7. Phase Noise	:	IESS308/309 compliant
8. Spurious	:	-55 dBc modulated (carrier related) -65 dBm unmodulated (Non carrier)

3.4.6 DVB-S & DVB-S2 Modulator Specifications

The modulator shall be compact reliable and have state of art technology. It should provide IF output as per DVB-S and DVB-S2 standard's modulation schemes based on the user requirement.

3.4.6.1 ASI Inputs

Parameter	Specification
(a) Compliance	DVB Document A010 rev. 1, May 1997: Section 4.4
(b) Byte stuffing modes	Byte & Signals Packet Burst modes.
(c) Connector	BNC

3.4.6.2 Forward Error Correction and Modulation Scheme as per DVB-S standard

Parameter	Specification
(a) Multiplex Adaptation and Energy Dispersal	As per ETS 300 421 (1994)
(b) Outer Coding	Reed-Solomon (204,188, T=8)
(c) Interleaving Depth	12
(d) Inner Coding	Convolution, R=1/2, 2/3, 3/4, 5/6 or 7/8 (QPSK)
(e) Spectrum Roll off factor	25% and 35% selectable
(f) Modulation Format	QPSK
(g) Transmission Rates	Variable, 1.0 to 44.5 MSPS

3.4.6.3 Forward Error Correction and Modulation Scheme as per DVB-S2 standard

Parameter	Specification
(b) Multiplex Adaptation and Energy Dispersal	As per ETS 300 307 (2009) Should be capable of emitting signals on following modes: 1. Backward compatible mode. 2. Constant Coding and Modulation (CCM)
(b) Outer Coding	BCH
(c) Inner Coding	LDPC

	R= 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 (For DVB-S- 2, QPSK), R= 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 (For DVBS2, 8PSK) 20%, 25% and 35% selectable
(d) Spectrum Roll off factor	
(e) Modulation Format	QPSK & 8PSK
(f) Transmission Rates	Variable, 1.0 to 35 MSPS

3.4.6.4 IF Output Interface Specifications

Parameter	Specification
(a) Output Frequency Range	70±18MHz
(b) Synthesizer Step Size	1 kHz, step
(c) Frequency Stability	< ± 1 KHz
(d) Output Impedance	75 ohms unbalanced
(e) Connector	BNC, female
(f) Output Return Loss	15 dB (min.)
(g) Output Level Range	-20 to +5 dBm
(h) Level Step Size	0.2 dB max.
(i) Spurious Outputs	Better than 50 dBc/4 kHz
(j) Synthesizer Phase Noise	Meets requirements of IESS-308
(k) CW mode	Selectable
(l) Noise floor (No / C)	< -120 dBc/Hz




4 Specifications for Base-band Equipment Test-Bench

Base-band equipment test bench is intended to be used for testing and calibration of base-band equipment like optical fibre link etc. This test bench will consist of a set of Racks (if required or it can be a part of compression test bench racks) which is to be fully wired for testing of Optical transmitter, Optical receiver, etc. and should have provision for measuring and monitoring using equipment like Test Pattern Generator, Video Measurement set, waveform monitor, etc. following gives the details of testing methodology & chain for various compression equipment:

4.1 Optical Transmitter Test bench

Optical transmitter test bench will comprise of Test pattern generator, Mainframe IQH3A-S-P of Snell & Wilcox make (which includes Module-Under-Test, IQMUX 3352-2A card and IQORX3056-1A), OFC cable, video measurement set, and Video Monitor along with accessories like waveform monitor etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of Optical Transmitter of S&W makes available in Doordarshan network. A tentative schematic of testing chain is given at Figure-7.

Troubleshooting tree software with search facility along-with remote monitoring software for this equipment is to be provided in the Compression & Base-band control computer. Proprietary Fault Diagnostic software from OEM if any required for testing of these modules should be quoted as an optional item.

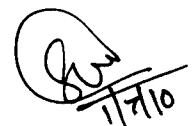
4.2 Optical Receiver Test bench

Optical Receiver test bench will comprise of Test pattern generator, Mainframe IQH3A-S-P of Snell & Wilcox make (which includes Module-Under-Test, IQDEC3352-2A card and IQOTX3133-1A), OFC cable, video measurement set, and Video Monitor along with accessories like waveform monitor etc. This test bench is intended for testing (fault diagnostics up to card level not up to component basis) & calibration of Optical Receiver module of S&W makes available in Doordarshan network. A tentative schematic of testing chain is given at Figure-8.

Troubleshooting tree software with search facility along-with remote monitoring software for this equipment is to be provided in the Compression & Base-band control computer. Proprietary Fault Diagnostic software from OEM if any required for testing of these modules should be quoted as an optional item.

4.3 Video Measurement Set

The existing Video Measurement set at Kendra (i.e. Todapur) VM 700T of Tektronix make is to be used in the Base-band & compression test benches. Integrator has to integrate this VM 700 with supplied equipment. This Video measurement set is to be integrated with the Compression & Base-band test bench remote control computer system for remote control and operation of VM 700.

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 (सहायक निदेशक)

4.3 Waveform Monitor (with Video & Audio measurement facility)

Waveform monitor is to be used for performance monitoring of Base Band signals i.e. audio and Video in digital mode for PAL format. Also this is to be used for SDI signal measurements. The essential features are:

1. The equipment should be able to monitor PAL analog video, SD digital video SD-SDI and HD SDI) along with Analog audio and digital audio (embedded or AES/EBU).
2. The equipment should be able to provide total solution for SD-SDI & HD-SDI signal monitoring.
3. The equipment should have dual input support.
4. The equipment should have capabilities of carrying Waveform monitor & Vectroscope, Picture display, eye pattern diagram, SDI format analyzer, SDI jitter application, inter channel timing, etc .
5. The equipment should have capabilities to display Parade and Overlay displays with interpolated waveforms.
6. The equipment should have capabilities to numerical & Graphical display of A/V delay.
7. The measuring equipment should be able take both vertical Interval and full field measurements.
8. The equipment should have dual limit verification system employed to generate a caution or alarm system when either limit is violated.
9. It should have Graphic display of Amplitude and timing measurement, linear and nonlinear distortion measurements.
10. The equipment should have USB printer ports, fully documented remote control operation, hardcopy for analysis and documentation.
11. The equipment should have real time format analyzer with event logging and frame capture.
12. Fully remote control option.



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5 PHYSICAL, ENVIRONMENTAL & MECHANICAL SPECIFICATIONS

5.1 Power Supply

Equipment shall operate from a wide range of power supply voltages without interruption or damage.

Parameter	Specification
(a) Voltage Range	220 VAC (+10% -15%)
(b) Frequency	48-52 Hz

5.2 Environmental Specifications

Parameter	Specification
(a) Operating Temperature (Indoor)	0°C to 45°C
(b) Operating Temperature (Outdoor)	-10°C to 50°C
(c) Storage Temperature	-20°C to 60°C
(d) Humidity (Indoor)	0 to 85% non-condensing
(e) Humidity (Outdoor)	0 to 100%
(f) Altitude	0 to 3000 m

5.3 Mechanical Specifications

Equipment shall be rack mounted and required number of racks should be supplied pre-wired to house all the supplied equipment.

Parameter	Specification
(a) Construction	Modular approach, EIA RS-310C, 19" rack-mount
(b) Cooling	internal circulation fans




6. POWER SUPPLY

The power supply system for Maintenance Workshop is to be arranged from existing (available at Carrier Monitoring earth Station at Todapur) 2x40 KVA UPS operating in 1+1 redundant parallel load sharing mode with 15 minutes battery back up for each UPS along with AVR and PDP. The Integrator has to arrange for extending the power supply from the existing setup.



7. GENERAL

7.1 COMPLIANCE

- (a) A point-by-point compliance statement from the principal manufacturer in respect of all the points, sub-points and paras laid down in this specification from page 1 onwards is to be enclosed along with the offer. Mere signature on a copy of Doordarshan specifications shall not be accepted as a compliance statement. Page no. of location of data sheet should be given in page no. column. One copy of compliance statement and Bill of material should also be given on CD-ROM in the same format as DD specifications.
- (b) Compliance statement in the format as indicated below only shall be accepted.

Sr. No. of DD specs.	DD specs.	Compliance (Yes/No)	Performance fig. of equipment offered.	Deviations, in case of non-compliance	Optional items if any required to make the system Compliant to DD specs.	Features in the system offered Which exceed DD specs.	Page No.	Remarks
1	Scope							
2	General							
3	Essential features (a)----- (b)-----							

- (c) The manufacturer should also record the performance figures of the equipment offered in the quote for which the compliance statement is enclosed.
- (d) The compliance statement should be supported by highlighted record of these in the technical literature/data sheets enclosed with the tender **and a clear reference to the attached supporting document should be given in the remarks column against each & every specs.** Any offer without proper supporting document of each & every specs and containing only a commercial hand out/pamphlet will be rejected.
- (e) The data sheets should be included as desired in para 7.1 (b) of this specification.
- (f) Any deviation from the specification detailed in the compliance statement is to be highlighted separately.
- (g) Offers without proper & duly completed compliance statement are likely to be rejected with the sole responsibility of tenderer and no further claim/correspondence will be entertained.

7.2 Ordering Information

One soft copy of ordering information/Bill of material (in MS Excel format) should be provided along with the quote in the same format as DD BOM.

7.3 Documentation

Offer should include the supply of four complete sets of original documents (about operation and maintenance of equipments) for all equipment. They have to supply two sets for each unit of the equipment i.e. one set for Directorate and one for respective Zonal offices. All the information as asked above should also be supplied in CDRom with each set of document. The CDRoms supplied should have full features of find & search of Microsoft. One set of the above manuals for each equipment should be enclosed along with the tender for technical evaluation. Offers without the manuals for evaluation are liable to be rejected.

7.4 Guarantee

- i) The equipment shall be guaranteed against any manufacturing defects for a period of two year from the date commissioning.
- ii) Any parts failing during the guarantee period shall be repaired/replaced free of charge by the supplier at site i.e. no transportation charges would be paid by DD for transporting the defective / repaired items if required to be removed from site during the guarantee period.
- iii) Guarantee period is to be extended corresponding to the outage period if the failure rectification takes more than 15 days time.

7.5 Spares

1. Necessary spares required for the maintenance of the equipment offered should be quoted separately. This shall not be taken into consideration for deciding the lowest bidder.
2. A complete recommended spare list with quote should be offered, along with the bid.
3. Supplier should give a certificate for providing spares and maintenance support for this system for the next five years.

7.6 Accessories

1. All essential accessories like cables, connectors and power cord etc. should be included in the offer. Optional accessories should be quoted separately.

7.7 Inspection

1. All the equipment to be supplied against the supply order for this tender shall be subjected to inspection at New Delhi/manufactures facility by Doordarshan.
2. ATP is to be provided by the Tenderer for approval by Doordarshan before inspection.

7.8 Necessary Requirement

1. The offer should indicate the time frame for completing the activities up to the commissioning of the set-up on a bar chart.
2. All the essential items, which the manufacturer feels are necessary to complete the equipment/chain for the full exploitation of all the features of the equipment offered, may also be quoted.

3. Equipment from renowned and well-known firms of the industry with proven track record only will be accepted. The tenderer should enclose a list of organizations to which same equipment as in this tender has been supplied.
4. System/equipment (motor controllers etc.) should be offered along with its frame/housing and other accessories which are necessary to meet the specifications/requirement and for the full exploitation of the equipment.
5. The system/equipment preferably should be mountable into industry standard 19" rack.
6. Cost of all the equipment which are necessary to complete the configuration to meet the specifications/requirement should be very clearly specified and will be included for commercial evaluation.
7. The system offered should be complete in all respects even if missed in the specification.
8. The offer incomplete in any respect is liable to be rejected.
9. If required, one sample of system/sub system complete in all respects alongwith operators & technical manuals may be required for technical evaluation.
- 10 The firm should have supplied and installed Earth stations for TV uplink in India or abroad and should have been in the broadcasting field for at least three years.

8. EQUIPMENT LIST

Bill of Material					
Sl. No.	Equipment	Quantity		Make	Model
I	R.F. TEST BENCH				
1	Directional Coupler	1	set		
a	Ku-Band	1	no.		
b	C-Band	1	no.		
2	Dummy Load with feed thorough output port	1	set		
a	Ku-Band	1	no.		
b	C-Band	1	no.		
3	R.F. Signal Generator	1	no.		
4	R.F. Spectrum Analyzer along with all accessories (including memory card etc.)	1	no.		
5	Flexible Waveguides	1	set		
a	Flexible waveguide Ku-Band	2	Mtr		
b	Flexible waveguide C-Band	2	Mtr		
6	R F Test Bench equipment control system	1	set		
a	Remote Control computer -I system (industrial rack mount) including Hardware & software	1	set		
b	Trouble shooting tree Software for TWT HPA of CPI, MCL, Xicom makes	1	set		
7	RF Power meter up to 18 GHz	1	no.		
8	RF attenuators with 30 dB, 20 dB, 10 dB attenuation (2 nos. each)	1	set		
9	RF step attenuator (30 dB in 1 dB steps)				
10	Required no. of 19" rack frames (including RF trolley for test and measurement equipment) for RF Test Bench (with redundant power supply, other interface cards for complete monitoring & control through remote control computer).	1	set		
11	Essential item (if any) to complete the installation of R.F. Test Bench Measurement system.	1	set		
II	Compression Equipments Test Bench				
1	Multi-format Digital Video & Audio Test pattern generator	1	no.		
2	Transport Stream Analyzer	1	no.		
3	Professional IRDs	1	Set		
a	Prof. IRDs (with ASI inputs and with DVB-ASI, SDI, AES/EBU, SDI embedded audio and PAL video & Analog Audio outputs) along with 4:2:0 and 4:2:2 decoding and Common Interface slot hardware	2	nos.		
b	Prof. IRDs (with L-band QPSK input and with DVB-ASI, SDI, AES/EBU, SDI embedded audio and PAL Video & Analog Audio outputs) along with 4:2:0 and 4:2:2 decoding and Common Interface slot hardware	2	nos.		
4	70 MHz to L-Band Up Converter	1	no.		
5	Modulator	1	no.		

6	Video Monitor	1	Set		
a	Colour monitor 20"nominal LCD (TFT).	2	nos.		
b	Professional grade speakers along with Professional grade audio driving amplifier.	2	sets		
8	Compression Equipments Test Bench equipment control system	1	set		
a	Remote Control computer -II system (industrial rack mount) including Hardware & software	1	set		
b	Trouble shooting tree Software for Encoders and Modulator or Multiplexers of Tandberg, Scopus and Nextream (Thomson) makes	1	set		
9	Required no. of 19" rack frames for Compression Equipments Test Bench with redundant power supply, other interface cards for complete monitoring & control through remote control computer.	1	set		
10	Essential item (if any) to complete the installation of Compression Equipments Test Bench Measurement system.	1	set		
III	Base-Band Equipments Test Bench				
1	Mainframe Unit consisting of	1	set		
a	Mainframe Unit with chassis power supply & gateway card IQH3A-S-P of S&W	1	no.		
b	Extended card IQHEXT of S&W	2	nos.		
2	Analog to Digital converter with Audio Embedder -IQMUX 3352-1A of S&W	1	no.		
3	Optical Transmitter unit consisting of	1	set		
a	Optical Transmitter board IQOTX 3133-1A of S&W	2	nos.		
4	Optical Receiver unit consisting of	1	set		
a	Optical receiver board IQORX 3056-1A of S&W	2	nos.		
5	Distribution Amplifier for HD/ SD SDI with rellocking facility - IQSDA 1001-1A of S&W	1	no.		
6	Waveform Monitor (With Video & Audio Measurement facility)	1	no.		
7	Optical fiber cable (OFC) 2 core of 5 meter length with suitable connector at both ends	2	sets		
8	Base-Band Test Bench equipment control system (to be loaded on Remote control Computer -II)	1	Set		
a	Roll call software of S&W				
9	Essential item (if any) to complete the installation of Base-Band Equipments Test Bench Measurement system.	1	set		
IV	Miscellaneous Items				
1	Colour Printer Laser type	1	no.		
2	Digital multi meter (6.5 digits)	1	no.		
3	Set of Tools for maintenance including soldering, jigs etc. (Detailed list to be given).	1	no.		
4	Audio (43216 of Belden make or equivalent), Video (1694A of Belden make or equivalent), IF, etc. Cables with assorted connectors for proper measuring & monitoring.	1	set		
5	Installation material for laying of cables protection pipes, support, earthing strips, earth pits etc.	1	set		

6	RF, IF, Base band patch panels, dividers, waveguide Switches, terminations. if required (This should be clearly illustrated with detailed block diagram)	1	set		
7	PDP and Power supply cables of Approximately 20 KVA load.	1	set		
8	Antistatic table top & floor mat including accessories like wrist band, connecting coiled cable, insulated gloves.	1	set		
9	Wooden work bench of standard size	2	Nos.		
10	Essential item (if any) required for completing the installation and commissioning work of the system as per specification, should be included and quoted. No extra cost will be paid for any extra item declared at a later date for completion of the project installation.	1	set		
V Documentation					
a	Operation and maintenance manuals (whenever applicable) for all the equipment supplied (hard copy)	4	sets		
b	All software backups are to be supplied on CDs.	4	sets		
c	Operation and maintenance manuals (Softcopy) for all the equipment supplied on CD's (with Search facility etc). (2 set for the station, 1 set for DG DD and 1 set for CE(NZ))	4	sets		
VI Training					
1	Training (including Theoretical & Practical, hands on experience) for RF Test Bench set up (minimum Two weeks) (for procedure to be adopted for RF equipment testing & maintenance).	1	set		
2	Training (including Theoretical & Practical, hands on experience) for Compression Test Bench set up (minimum two weeks) (for procedure to be adopted for Compression equipment testing & maintenance).	1	set		
3	Training (including Theoretical & Practical, hands on experience) for Base-Band Test Bench set up (minimum one week) (for procedure to be adopted for Base-Band equipment testing & maintenance).	1	set		

Note:

1. All the Tenderer are advised to attend Pre-tender conference on the date and time specified in the NIT. All the technical queries (if any) should be raised during this conference only. No technical queries will be entertained after this conference. Doordarshan will have the right to revise the technical specifications of the system after Pre-tender conference if required.
2. One soft copy of Bill of Material having Make & Model of offered equipment, in the same sequence and keeping same serial numbers, should be provided along-with the quote (in the form of MS Excel work sheet).
3. There should be a separate technical offer (separate BOM) for each combination of offered subsystems.



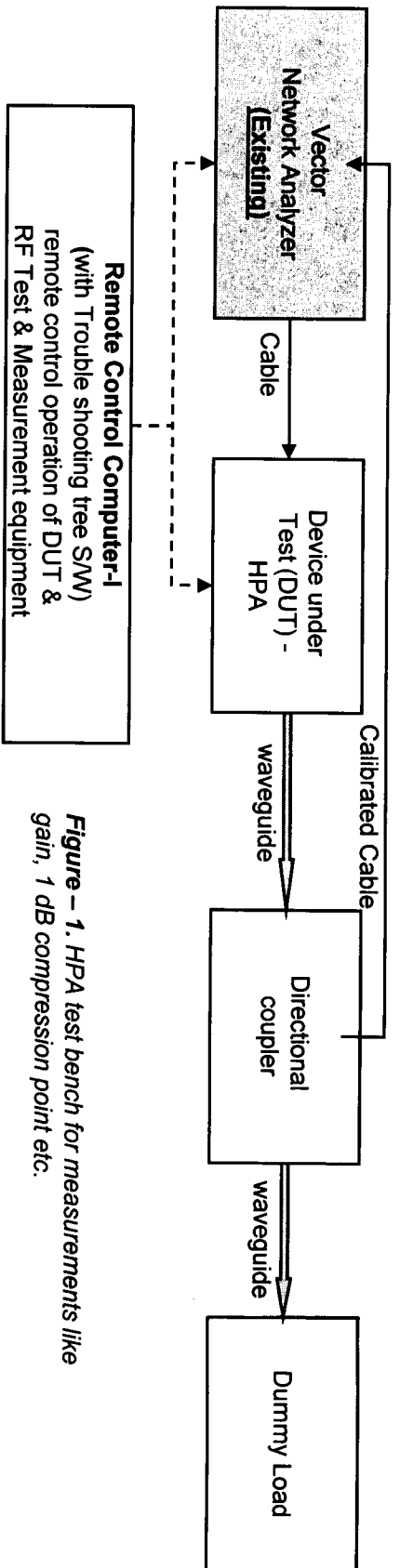



Figure - 1. HPA test bench for measurements like gain, 1 dB compression point etc.

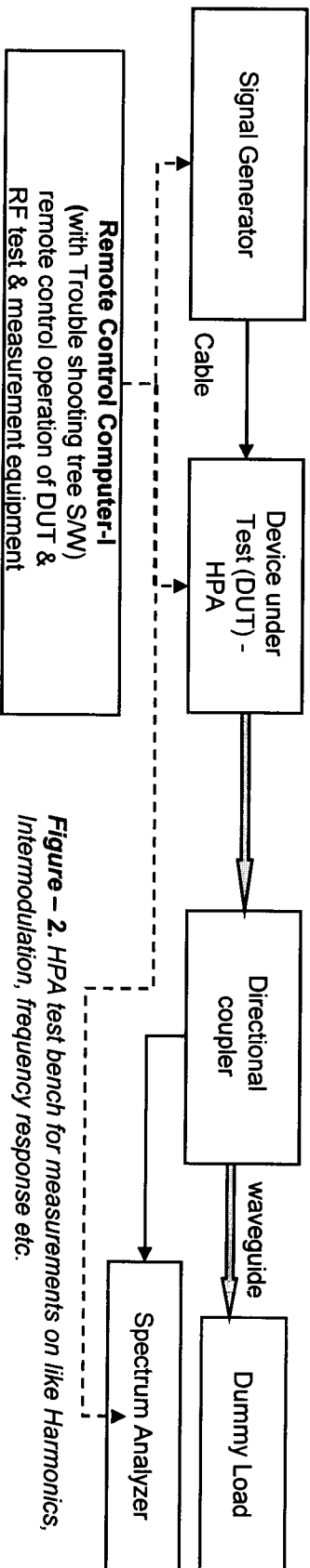


Figure - 2. HPA test bench for measurements on like Harmonics, Intermodulation, frequency response etc.

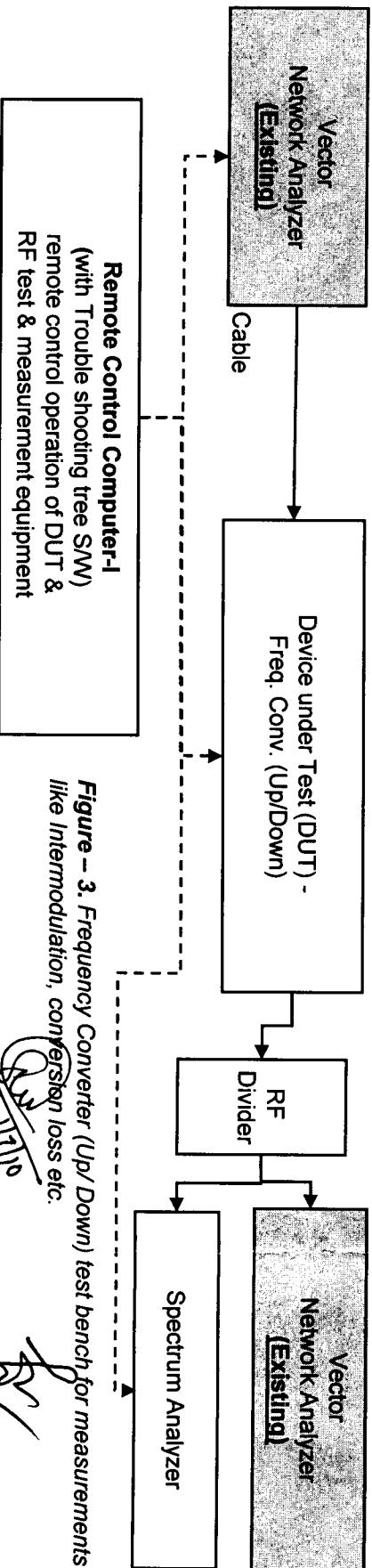


Figure - 3. Frequency Converter (Up/ Down) test bench for measurements like Intermodulation, conversion loss etc.

Block diagram for Maintenance Work Shop at Todapur

SATD/BD/2010

Compression Equipment Test Bench

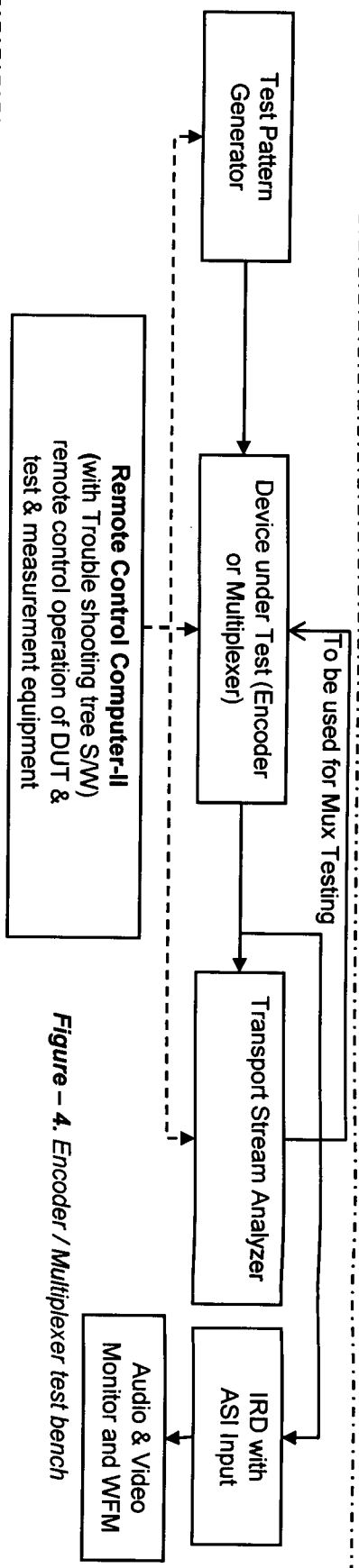


Figure - 4. Encoder / Multiplexer test bench

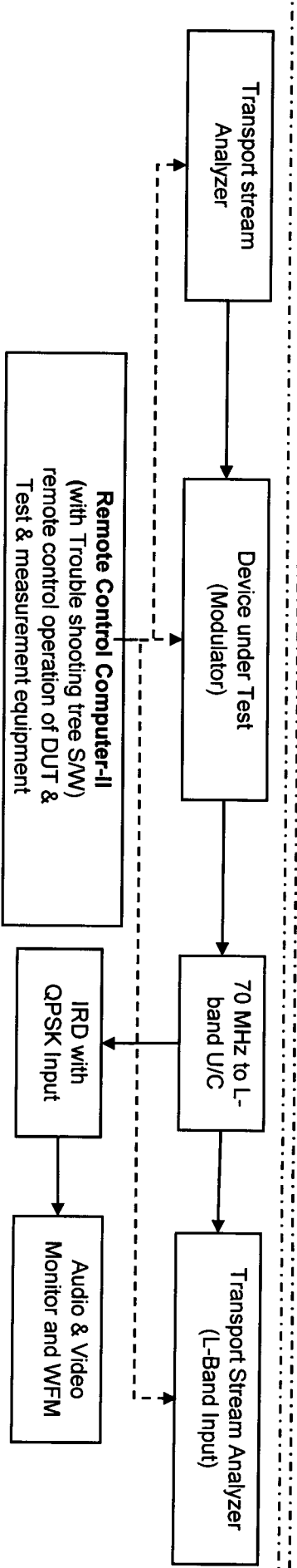


Figure - 5. Modulator test bench

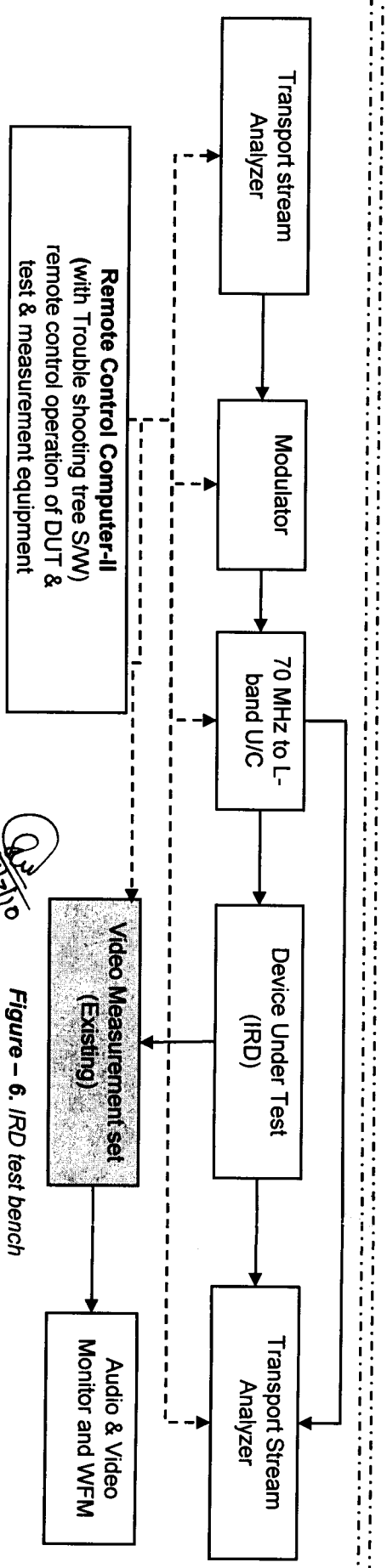


Figure - 6. IRD test bench

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Block diagram for Maintenance Work Shop at Todapur Base-Band Equipment Test Bench

SATD/BD/2010

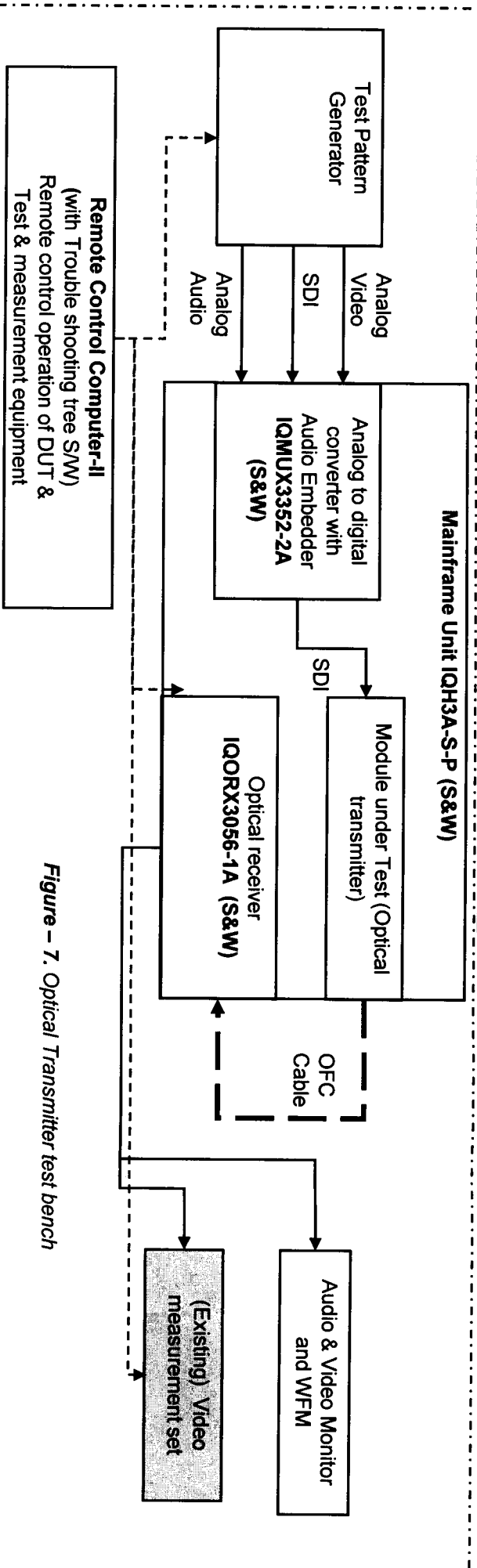


Figure - 7. Optical Transmitter test bench

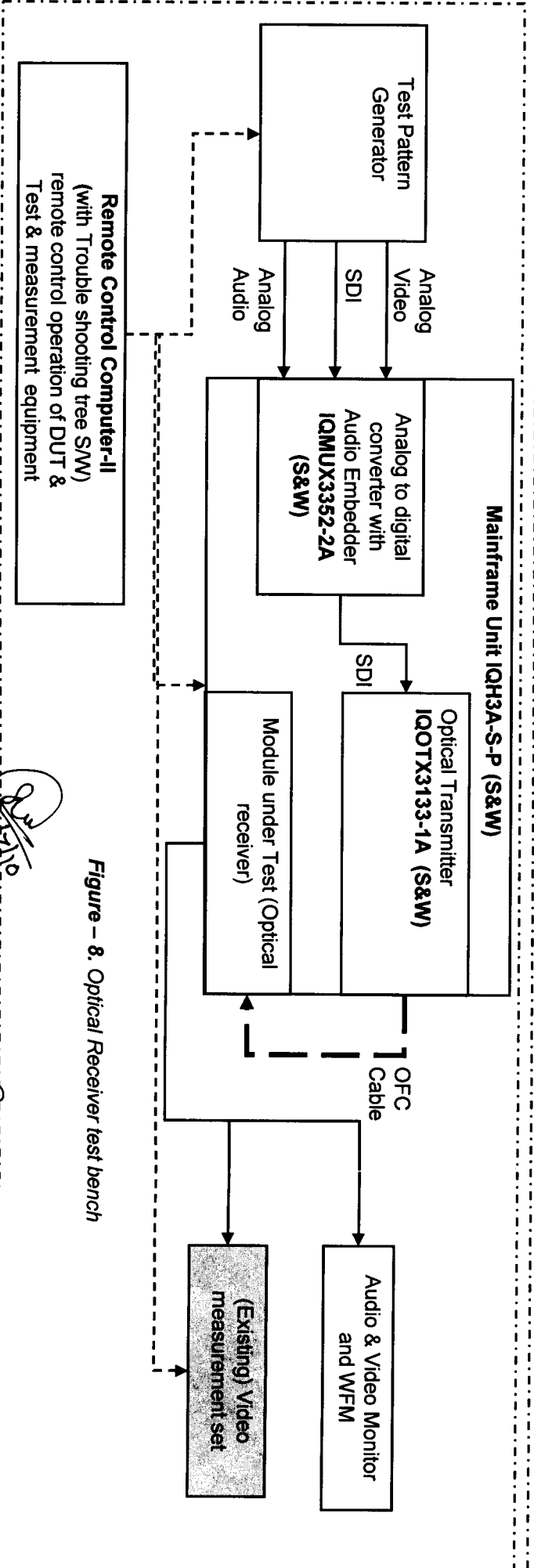


Figure - 8. Optical Receiver test bench

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 30/11/10
 30/11/10 (after)

Handwritten initials: *R*