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Satellite Communication - INMARSAT Terminal

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The age of satellite communication for ships at sea officially began on 1st Feb 1982, when the International Maritime Satellite Organisation (INMARSAT) began its work (Main Office 40, Melton Street, London). INMARSAT operates a global marine communication service by means of 3 satellites used today (1984) having a total capacity of approximately 339 channels (25 KHz channel separation). The ship earth station is used in the Indian Antarctic Research Station (Land-based).

The INMARSAT system consists of groundstation-linked satellites in geostationary orbit 22,300 miles (35,700 km) above the equator over the Atlantic Pacific and Indian oceans at longitudes of W 026, E 179 and E 063 respectively.

The system operates on the following frequency bands
Transmit 1636 5 to 1645 0 MHz
Receive 1535 0 to 1543 5 MHz

The communication modes are
I Teletype 50 baud, full duplex per CCITT requirement
II Voice Full duplex conforms to CCITT requirement for telephone service

The full technical specifications are given in table 1

The satellite communication terminal DEBEG 3211 consists of only four items - a telephone, teleprinter electronics unit and antenna.

The PABX interface is inserted as an additional module in the electronics unit to enable Slow Scan TV transmission/reception. The SS TV system consists of a slow scan TV converter (DSC-2000), TV- Camera (CC-111) and TV Monitor (CTM-2000). The detailed specifications are given in table 2.

The first SATCOM terminal HIND (1640105) was installed at the base camp in a BSA tent on 13-1-1984, and its commissioning tests successfully completed on 19-1-1984 (at 18 12 GMT) for telex and telephone. On 20-1-1984 a slow scan TV picture was transmitted to SATCOM 1640102 MVTT at Goa (for storage in an audio casette).

The variation in satellite ELEVATION (ELN) and AZIMUTH (AZM) values obtained in this location are

ELN	04 to 06 deg
AZM	313 deg
GYR	010 deg (GYRO reading from FORE of Antenna)
LVL	155 to 161 (Signal level strength)

The unit was futher shifted to its present location (Portacabin) on 27-1-1984. The system was extensively used for official and private traffic for Expedition members.

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The second SATCOM 1640106 INDI X was installed in the radio (Communication) room in the Indian Antarctic Research Station on 14-2-1984, and commissioned on 15-2-84 at 15 14 GMT through Goonhilly (Code 02) Coast Earth Station.

The Antenna (ANT) variation values during the period 15-2-1984 to 28-2-1984 are

ELN	05 to 07
LVL	171 to 173
AZM	280
GYR	280

The extension of the system for Telefax Transmission was tried unsuccessfully due to the lack of technical information regarding the interfacing of NEFAX 4500 to DEBEG 3211. Hence the system is further modified to incorporate Slow Scan TV transmission as an additional option.

The following precautions were taken into consideration

1 Power supply fluctuations (in voltage and frequency).

2 Power supply voltage transient suppression.

3 Exposure of CC TV Camera to strong light (to prevent permanent damage to the vidicon tube).

4 The supply voltage for SS TV(Camera Converter and Monitor) is 220 Vac and for the SATCOM equipments 110 Vac, obtained using a power line conditioner.

5 Antenna Flywheel Circuit Breaker. *NEVER* to Switch—ON.

6 Not to use the service lock pin in the Antenna *(NEVER).*

Observations

1 The telex machine ink-flow was not smooth due to out-side low temperature. To overcome this, it was necessary either to keep the printer ON for some time, or use in-house tests like SELF-TEST, ANT AIM, POS, TME etc, to enable free flow of ink.

2 When it was not possible to go through UK (Code 02) Coast Earth Station, use of US (Code 01) was made (where STORE AND FORWARD facility for telex exist).

3 The present lat 70°S and long 12°E is ideally suited for using Atlantic Ocean (WO 26) as well as Indian Ocean (EO 63) satellites.

4 We could hence make use of the following C E S
Atlantic. UK (02) USA (01), France (11) and Kuwait (06)
Indian. Japan (03) and Norway (04).

5 ERROR 103 SHIPS GYRO ERR should be ignored as the ship terminal is used as Land-based terminal in Antarctica.

Recommendations

1 Stabilized power supply source should be used.

2 Telexes should be stored in memory before transmitting (to save time, cost and human errors).

3 Minimum three sets of spares should be available at the Base Camp (to keep both units functional), in view of

I Boards being not field-repairable.

II Being a remote location no replacements could be sent in emergency. List of spares is given in table 3.

4 Power down of the system is not normally required for any reason. Life of the unit will be extended if power downs are minimised.

5 The spares should be tested occasionally for satisfactory performance. List of items handed over at Base Camp is given in table 4.

Team

The wintering team participants who were familiarised with the system's performance, operation, servicing, maintenance and diagnostics are Capt Paramjit Singh and Capt R R Sinha.

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TABLE 1

Equipment Characteristics

Characteristic	*Requirement*
Environmental	
Antenna Group	
Temperature	— 40°C to + 65°C
Wind	Operate up to 100 knots and survive 120 knots
Humidity	Marine conditions externally and up to 95% internally
Below Decks Group	
Temperature	0°C to + 50°C
Humidity	Up to 95%
Pitch	± 10°
Roll	± 30°
Azimuth	± 270° (540° total including yaw compensation)
Elevation	0° to 90°

Characteristic	*Requirement*
Physical	
Antenna Unit	
Height	78 5 in (199 cm)
Diameter	79 0 in (200 cm)
Weight	650 lb (295 kg)
Electronic Unit	Fits 18 in rack or wall mount
Height O A	26 5 (67 3 cm)
Width O A	19 0 (48 3 cm)
Depth O A	13 4 (34 cm)
Weight	85 lbs (38 6 kg)
Power	
Voltage	115 Vac ± 10% (220 volt adapter available)
Frequency	50 or 60 Hz ± 5%
Loading	
Nominal	550 W
Startup	1100 W
Communications Modes	
Teletype	Full duplex 50 baud maximum (60 words per minute)
Voice	Full duplex, 12 kHz FM maximum (300-3000 Hz nominal bandwidth)
Data	Full duplex, voice limits
Channelization Capabilities	
Request	2 channel
Teletype	339 channel pairs
Voice	339 shore selectable channel pairs
Tracking	1 of 2 frequencies
Automatic Operation	Fully automatic antenna tracking of satellite, transmission and reception of messages
Antenna	
Polarization	Right hand circular
Beamwidth (e dB)	11°
G/T	-1 6 dBK typical, — 4 dBK worst case
Transmitted Power	37 dBW ± dB (saturated)
Receiver Sensitivity	
Tracking	-167 dBW/m^2-142 dBW/m^2 nominal
Time Division Multiplexed	-155 dBW/m^2—143 dBW/m^2 nominal
Voice	-152 dBW/m^2—139 dBW/m^2 nominal
Antenna Tracking	± 10° pitch, ± 30° roll, ± 270° azimuth + yaw compensation, 0° to 90° elevation
Frequency Range	
Receive	1535 0 to 1543 5 MHz (25 kHz steps)
Transmit	1636 5 to 1645 0 MHz (25 kHz steps)

TABLE 2

Slow Scan TV converter type DSC 2000

Principle of Operation

Conversion of TV-CCIR-Standard signals to Slow Scan TV signals and vice versa. Transmission and Reception of Slow Scan TV signals via audio channels.

Modes of Operation

a Receive Reception of incoming signals.

b Prepare Display of own picture on monitor and storage in memory.

c Transmit Memory Transmission of pictures from one of the memories.

d Transmit Tape Transmission of pictures stored on a casette or tape of an external recorder.

The pictures which are to be transmitted are stored within 20 m sec.

The pictures can be stored manually or automatically after transmission of the previous picture.

Technical Data

Picture	256 elements per line 256 lines 64 grey levels 120 msec line rate
Subcarrier Frequencies	
Sync pulse	1200 Hz
Black	1500 Hz
White	2300 Hz
Grey	between 1500 Hz and 2300 Hz
Storage of Pictures	2 built in memories or via external cassette recorder
Operating Temperature	—15 + 45°C
Power Supply	220V/50 Hz 30 W
Dimensions	305 x 105 x 260 mm
Weight	3 kg

TV Camera Type CC 111

Technical Data

Tube	Vidicon 2/3 Type 20 PE 20 (S4097)
Output	BAS synch negativ IV CCIR standard
Output impedance	75 Ohms
Resolution	Greater than 500 lines horizontal
Sensitivity	10 LUX min
Automatic Light	10000 1

Amplification	
Operating Temperature	: - 5 ° .. + 50°C
Power Supply	220V/50 Hz 10 W
Objective	: C Mount
Objective	: Zoom 12 5 75 mm 1 1 8
Weight	: 1 5 kg
Dimensions	: 60 x 80 x 176 mm

TV Monitor 12 Type CTM 2000

Technical Data

Screen	: 12 , white
Bandwidth	: 18 MHz
Scanning Distortion	: 1%
Scan Linearity	- Max 10%
Input	: 75 Ohms
Power Supply	: 220V/50 Hz 35 W
Front Controls	
Contrast	
Brightness	
Mains Indicator	
ON/OFF Push Button	
Operating Temperature	0 55°C
Dimensions	290 x 306 x 325 mm
Weight	9 kg

TABLE 3

Recommended Spares List for Antarctic Station

	Description	*Part No*	*Quantity*
A	SATCOM		
1	Integ LO Amplifier	..	2
2	Servo Electronics Assembly	.	3
3	EL Motor	.	3
4	AZ Motor	..	3
5	EL Pot	..	3
6	AZ Pot	..	3
7	Power Supply	5 A1A1	2
8	IF/LO (PCB 1)	910805-801	3
9	TX/FM Synthesizer (PCB 2A)	910820-801	5
10	Modulator (PCB 3)	918051-801	3
11	TEL INTFC (PCB 4)	918084-801	3
12	TDM Channel Rx (OCB 5)	910857-801	3
13	FM Channel Rx (PCB 6)	911961-801	3
14	RT INTFC Bd (PCB 11)	..	3
15	Control INTFC (PCB 12)	910859-801	3
16	CPU/MEM Ckt(PCB 13)	..	3
17	PABX INTFC	..	2
18	QWINT Teleprinter	MSR-742	1
19	Printhead Carrier Mechanism	..	3
20	Teleprinter Paper	..	30 Rolls

B. SS TV CONVERTER DSC-2000

No.	*Item*	*Sl No*	*Quantity*
1	Power supply Bd	2000-81	2
2	Main Bd	2000-72	2
3	Memory Bd	2000-68	2
4	Timer Bd	2000-67	2
5	Switch Bd	2000-73	2
6	Synchr Gen Bd	2000-71	2

TABLE 4

Third Indian Scientific Expedition to Antarctica Sub Satellite Communication Terminals at Indian Base (inventory of items)

No.	*Item*	*Sl. No.*	*Quantity*
1	RADOM Antenna for DEBEG 3211	260	1
2	Electronic Unit	219	1
3	Electric Typewriting Machine	10207	1
4	Telephone/Control Unit	348	1
5	Installation Material	..	used
6	Accessories	-	1 set
7	Technical Manual	..	1
8	Operation Manual	..	1
9	Option Control Unit	175	1
10	PABX/DATA/FAX/I/F Card with Ribbon Cable	135	1
11	Junction Cable Assembly	..	1
12	Set of Antenna Cable	..	30 Mtrs
13	TV Camera Type CC 11	09201	1
14	Monitor Type CTM 2000 12	4871	1
15	Slow Scan TV Converter Type DSC 2000	09201	1
16	Manual for Slow Scan TV Equipment	.	1
17	DEBEG 7911 Weather Chart Fax Recorder	3001245	1
18	Instruction Manual	..	1
19	wallmountings for DEBEG 7911	..	1
20	Set of Spares for DEBEG 7911	..	1 set
21	DEBEG W 7911 Power supply 110/220 VAC	4050586	1
22	Metal Recording Paper for DEBEG 7911	..	10
	(LOCATION OF THE ABOVE ITEMS PORTACABIN) SATCOM IDENTIFICATION NUMBER 1640105 HIND X		
23	RADOM Antenna for DEBEG 3211	218	1
24	Electronic Unit	283	1
25	Electric Typewriting Machine	10177	1
26	Telephone/Control Unit	299	1
27	Set of Installation Material	..	1
28	Set of Accessories	..	1
29	Technical Manual	.	1
30	Operation Manual	..	1
31	Set of Antenna Cable	..	30 Mtrs

No.	Item	Sl. No	Quantity
32	T V Camera Type CC 111	09191	1
33	Monitor Type CTM 2000 12	4853	1
34	Slow Scan TV Converter Type DSC 2000	09191	1
35	Manual for Slow Scan TV Equipment	..	1
36	DEBEG 7911 Weather Chart Fax Rec	300234	1
37	DEBEG 7911 Weather Chart Fax Rec	3001235	1
38	Instruction Manual for DEBEG 7911	..	1
39	Wallmountings for DEBEG 7911	..	2
40	Set of Spares for DEBEG 7911	..	2
41	DEBEG W 7911 Power supply 110/220 VAC	4050593	1
42	DEBEG W 7911 Power supply 110/220 VAC	4050596	1
43	Metal Recording Paper	.	20
44	Set (12 pc) of Printing nails for DEBEG 7911	.	4
45	Option Control Unit	146	1
46	PABX/DATA FAX I/F Card with Ribbon Cable	146	1
47	Junction Cable Assembly	..	1
48	**SPARE PARTS FOR SS TV AND WEATHER FAX RECORDER**		
	a PCB A1, A2, A3, A4, A5 (One each)		
	b Grounding brush	..	10
	c Set of screws	..	2
	d Contact springs	.	10
	e Running spare kit type F 239	..	2
	(Note (a) to (e) spares for Weather Fax)		
	f Power Supply baord	2000-81	1
	g Main Board	2000-72	1
	h Memory Board	2000-68	1
	i Timer Board	2000-67	1
	j Switch Board	2000-73	1
	k Synchr. gen bd.	2000-71	1
	(Note Items (f) to (k) are spares for SS TV Converter)		
49	**SPARES FOR SATCOM ELECTRONICS UNIT**		
	PCBs 1, 2, 3, 4, 5, 6, 11,12 and 13 (PCB No 12 has been used already in the set 1640105 HIND Unit on 14-2-1984, since the original PCB 12 failed). PCB 12 (original) colud be used in case ONLY Phone calls to be made, and No Telex possible. Hence, Bd left behind Quantity ONE each.		
50	MX-1 Power Line Conditioners	..	One with each SATCOM
5	Paper Rolls for Telex machine	..	12
52	TELEFAX Machine (NEFAX)	..	1

(LOCATION OF THE ITEMS Nos 23 TO 52 RESEARCH STATION)
TOTAL FIFTY TWO ITEMS ONLY