

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

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SHEET

OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk

TEST PROCEDURES

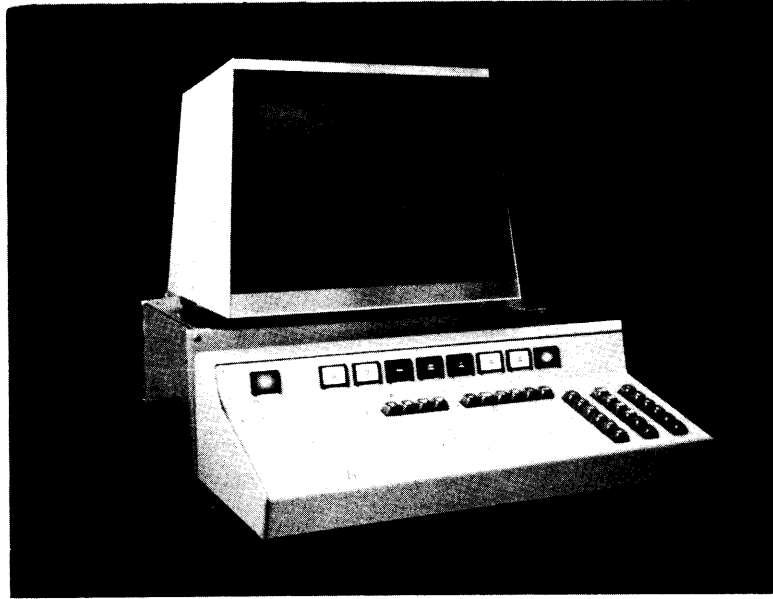
for

TRANSMITTER TERMINAL CONTROL SYSTEM

Model TCS-11

Serial

Date



THE TECHNICAL MATERIEL CORPORATION

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SHEET 1

OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk

1. INTRODUCTION
 - 1.1 Description
 - 1.2 Technical Specifications
2. TEST EQUIPMENT REQUIRED
3. PRELIMINARY TESTS
 - 3.1 Mechanical Check
 - 3.2 Electrical Check
 - 3.3 Operational Check
 - 3.4 Special Requirements
4. PERFORMANCE TEST PROCEDURES
 - 4.1 In-Process Production Tests
 - 4.2 Final Production Tests
 - 4.3 Acceptance Tests (As required)
5. SUPPLEMENTAL DATA

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 2 OF

TITLE: TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk

1.1 Description

The TCS-11 is a solid-state control system capable of providing remote control of up to 40 co-located, synthesized transmitters. Each system consists of four basic elements:

Central Processor Control Model CPC-11

Digital Keyboard Model DKY-10

Digital Display Monitor (2) Model DSP-10

Digital Processor Control Model DPC-10

Note: The DPC-10 is located at the transmitter site and the remaining equipment at the operations control site. One DPC-10 is used with each transmitter controlled.

The CPC-11 Central Processor Control Unit provides the encoding of command information and interpreting of data from the transmitter site. Its primary purpose is to act as a buffer between the remote DPC-10 and the DKY-10 keyboard/DSP-10 monitors. Equipped with a minimum of 4K of memory, the CPC-11 encodes data entered via the keyboard and creates a data word for transmission to the transmitter site. This word varies in length depending on the type of information processed. In addition, all display drive circuits are located in the CPC-11. All sequencing of instructions is controlled in the CPC-11 as is the speed at which data is transmitted to the remote site.

The DKY-10 Digital Keyboard provides the primary means for entering data into the CPC-11. The keyboard consists of a series of color-coded multi-function keys and a numeric cluster. A centrally-mounted placard is provided in the center of the keyboard in case the optional teletype or typewriter array is not selected. This placard provides operating instructions. The keys on the right-hand side are blue in color and control entry of power level, carrier suppression, and operating mode data. The keys along the top sector that are red in color control the entry of data for high tension ON/OFF, mains power ON/OFF, receiver site inhibit, transmitter site inhibit, release, alarm reset, enquiry, and enter. The yellow keys to the left control the cursor on the CRT display monitor. The left-hand sector of the array is the numeric cluster for entering data to control transmitter number, frequency, and optionally antenna number and antenna azimuth. Immediately above the keyboard array is a series of lamps color-coded to the keys. These lamps instruct the operator by indicating the next data to be entered from the keyboard. If the operator attempts to enter data not called for, an audible alarm is sounded and the keyboard is locked out.

The DSP-10 Display Monitors are used for presentation of the status of all transmitters under active control. Each monitor contains a heading line and up to twenty (20) lines of data. One monitor is provided with an additional line for editing data prior to its transmission to the transmitter site. Both displays are mounted on 19-inch chassis and are identical.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 3

OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk

The DPC-10 Digital Processor Control units co-located with each transmitter under control act as buffers in interpreting and decoding data. The command data stream from the CPC-11 at the operations site is converted in the DPC-10 to switch functions in the transmitter. As operations are completed in the transmitter, a second data stream is created in the DPC-10 that provides information on the overall status of the transmitter including any faults. This readback data is transmitted to the CPC-11 where it is interpreted and displayed on the CRT monitors with appropriate alarms if required. In case the status of any transmitter changes, information is automatically processed in the DPC-10 and transmitted to the CPC-11 for display. The DPC-10 is programmed at the factory to perform specific functions in sequence. The program it follows is burned in to integrated circuit USART's which can be changed only if specialized programming equipment is available.

All transmission of data takes place at 100 baud using a standard 8-level ASCII code. This enables the TCS-11 control components, e.g. the central processor, the monitors, and the keyboard to be replaced in an emergency situation by a standard teletype machine.

1.2 Technical Specifications

OPERATING PARAMETERS

Telecommand Capability	Forty (40) co-located synthesized transmitters.
Telecommand Functions	Frequency selection in 100Hz increments
	Operating mode selection CW/AM/USB/LSB/ISB/FSK
	FAX and 4ISB
Optional	Carrier suppression level -6/-20/-30/FULL
	Output power level 1/2/3/4
	High voltage ON/OFF
Optional	Mains power ON/OFF
Optional	Control Inhibit
Optional	Antenna matrix selection
Optional	Antenna azimuth selection
Storage Capacity	Minimum 4K
Control Time	Minimum 500mseconds/Maximum 2seconds
Transmission Rate	100 baud minimum
Optional	1200/2400/4800 and others on request
Transmission Interface	RS232
Control Interface	S-100
Transmission Format	8-level ASCII

DISPLAY PARAMETERS

CRT Screen	15-inch diagonal. Bright green phosphor
	Anti-glare, non-reflective
Format	24 lines/80 alphanumeric characters per line
	Configuration: Line 1 Column Headings
	Line 2 Space
	Line 3-22 Data
	Line 23 Space
	Line 24 Editing

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78 CHECKED: *[Signature]* APPD: *[Signature]* SHEET 4 OF

TITLE: TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Dot Matrix	60Hz system: 12 X 15 high resolution 50Hz system: 8 X 8 high resolution
Character Font	14-point upper case, CAIRO light
Content of Display	Number of transmitter Frequency Operating Mode Carrier Suppression Power Output Level Antenna Number Antenna Azimuth
Optional	Inhibit Status Status of Transmitter
Optional	Fault Isolation

KEYBOARD PARAMETERS

Array	Optional	Multi-function clusters Typewriter or TTY
Program Lamps	Optional	Eight (8) with one (1) for power ON. Engraved with Gothic lettering as follows: XMTR NBR FREQ KHZ MODE CARR LEVEL RF LEVEL ANT NBR ANT AZIM TUNE

ENVIRONMENTAL AND COOLING

Cooling	Convection with fan in CPC-11-
Acoustic Noise	Less than 70db above reference level of 10 ⁻¹⁶ watts/cm ² at 3.25 feet from cabinet when installed to TMC specification.
Operating Conditions	0 to +50°C; up to 90% relative humidity at MSL
Storage Conditions	-30 to +80°C; up to 95% R.H. at MSL
Power Supply	Totally solid-state 115 or 230 volts AC, 50 or 60Hz, single-phase
Size and Weight	CPC-11 5.25" High X 19" Wide X 18" Deep, 32 pounds DKY-10 5.25" High X 21" Wide X 5" Deep, 12 pounds DSP-10 14" High X 19" Wide X 13" Deep, 34 pounds DPC-10 3.5" High X 19" Wide X 14" Deep, 16 pounds
Shipping Data	Commercial packing for domestic air shipment Five (5) containers - Largest 20"X24"X18" Total weight/cube-9.5 cu.ft./205 pounds

TMC SPECIFICATION

NO. 620-051811-0

REV: 0 COMPILED: 1-18-78 CHECKED: *[Signature]* APPD: *[Signature]* SHEET 5 OF

TITLE: TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for completing all test procedures. In some cases, where acceptance tests are not performed, certain equipment will not be used.

<u>Description</u>	<u>Manufacturer/Model</u>	<u>Serial</u>	<u>Symbol</u>	<u>Calibration</u>
Spectrum Analyzer	Hewlett-Packard Model 141T/8552/8553	95000375	(A)	
Oscilloscope	Tektronics Model 541A	2233	(B)	
Audio Generator	Hewlett-Packard Model 200CD	10221	(C)	
Level Measuring Set	Wandel-Goltermann Model PSM-5/SG-1	5658A/B/C	(D)	
Metered Variac	General Radio Co. Model W10MT3W	Cont	(E)	
Environmental Oven	Precision Scientific Model 1264	Cont	(F)	
DC Power Supply	Hewlett-Packard Model 6202B	6A0403	(G)	

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 6 OF

TITLE: TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

3. PRELIMINARY TESTS

This section covers inspection procedures required to verify that the TCS-11 terminal system under test meets the basic requirements of the technical specification for both mechanical and electrical operation. The successful completion of preliminary tests ensures the equipment is complete and available for functional, performance testing.

3.1 Mechanical Check

3.1.1 Verify that the equipment is properly marked with model number, manufacturing number, and serial number.

3.1.2 Remove protective covers and verify that all printed circuit cards are fitted securely in their respective connector sockets.

3.1.3 Visually inspect the interior for obvious defects such as loose wires, broken terminals, improperly secured cables, mis-wiring, etc.

3.1.4 Replace protective covers and check for proper fit.

3.1.5 Inspect equipment for loose external hardware - particularly handles, knobs, pushbuttons, and cover locking screws.

3.1.6 Check the rear panel of each unit for the proper connectors. Ensure that mating connectors fit without binding.

3.1.7 Check the front panel of all units to verify that all external controls function properly and are in good mechanical condition - including all lockable controls and switches.

3.1.8 Check all exterior surfaces for correct finish and absence of marks or scratches.

3.1.9 Give the equipment a final visual check. Check external cables for strain or wear. Look for damaged or defective parts.

3.2 Electrical Check

3.2.1 Remove all AC power cords from external sources.

3.2.2 Check for obvious short circuits to ground.

3.2.3 Check for the correct value of fuses.

3.2.4 Verify that the AC source voltage and equipment power supply are rated at the same value.

3.2.5 Connect all AC power cords to the single-phase sources.

3.2.6 Set all power switches to the ON position.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *DJB*APPD: *ADP*

SHEET 7 OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

- 3.3 Operational Check
- 3.3.1 Allow approximately one (1) minute for warm-up.
- 3.3.2 Check the DSP-10 monitor displays for the following headings:
- | XMTR | FREQ-KHZ | MODE | CARR | R F | ANT | AZIMUTH | INHIBIT | STATUS |
|------|----------|------|------|-----|-----|---------|---------|--------|
|------|----------|------|------|-----|-----|---------|---------|--------|
- 3.3.3 Check line 24/position 1 for a short horizontal line (cursor)
- 3.3.4 Using the yellow keys on the keyboard, depress FWD TAB and note the movement of the cursor to the right on the CRT. Also note the indexing of cueing lamps along the top of the keyboard.
- 3.3.5 Repeat step 3.3.4 for the BACK TAB key. The cursor movement is to the left of the CRT.
- 3.3.6 Depress the CLEAR button and the cursor returns to the start position.
- 3.3.7 With the cursor in the start position (1), enter the two digits 00 using the left-hand numeric cluster of white keys. Then depress the red 'ENQ' button located at the top of the keyboard array at the far left. The screens of both DSP-10 display monitors will begin to fill at the rate of 100 baud with data on the status of each transmitter under active control (i.e. the corresponding DPC-10 is on and properly connected to the transmitter.)
- 3.3.8 With the screen filled and the cue position XMTR NBR lamp on, select a transmitter for control. This is done by depressing the appropriate two-digit number on the numeric cluster (01-40). Follow this selection by depressing the ENTER key located at the far right of the red pushbuttons. The edit line at the bottom of CRT display 'A' will fill with the data that corresponds to the transmitter data already displayed on the screen. This data accurately reflects the current status of the transmitter since update of the CRT display is automatic and continuous, requiring no verification by the CPC-11 processor control.
- 3.3.9 Change any data on the edit line by following the cue lamps and depressing the applicable keys. If the wrong key is depressed, an audible alarm will sound and no data will be displayed on the CRT screen. Depress the ENTER key for transmission of the data stream.
- Note: The ENTER key may be depressed at any time in the editing sequence. In addition, the TAB keys (yellow) may be depressed at any time in case information on the screen need not be changed. Depressing the ENTER key releases the data stream from memory and clears the edit line for the next sequence. The terminal can be used to program the next transmitter selected at random immediately after releasing the data stream. It is not necessary to wait for the readback to appear on the CRT screen.
- 3.3.10 Depending on the characteristics of the transmitter under control, the revised data will appear opposite the transmitter number when either the tuning sequence is completed or a fault occurs. Status is also displayed.
- 3.3.11 The terminal is now ready for performance testing.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 7-1 OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk

3.4 Special Requirements (Page Communications Contract SC-C-98363)

3.4.1 Materials and equipment shall be of new or recent manufacture and of best quality and shall be installed in accordance with the recommendations of the manufacturer. Materials, workmanship and equipment design shall conform to the National Electric Code for Electrical Wiring and Apparatus NFPA no. 70. Cable shall conform to REA PE-50.

3.4.2 Safety Protection for Personnel

Projecting setscrews, keys and rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded. The equipment shall also conform to National Electrical Safety Code NBS Handbook H30-1948.

Control panel shall be "Dead front" and shall have suitable barriers or screens, wherever necessary, to protect personnel from contacting live electrical parts with dangerous voltage during routine use. Removable panels, that when removed will expose live electrical parts, shall have warning decals attached thereto.

3.4.3 Hardware

All ferrous bolts, nuts, screws, washers, etc. when used, shall receive a zinc plating and chromate dip or cadmium plating before assembly.

3.4.4 Painting and Finishing

Metal surfaces shall be thoroughly cleaned, primed, and finish-coated before assembly with two coats of rust resistant primer. The final outside finish coats of all equipment shall be a light gray color per MIL-E-15090B.

3.4.5 Nameplates.

Each major device or equipment shall have the original manufacturer's name, address, and style, type or catalog number, together with its rating, on a plate securely attached to the item. In addition, the complete unit or system shall have a nameplate conforming to the referenced standards. Nameplates shall not be attached with adhesives.

3.4.6 Fungus Proofing

Materials which are not nutrients for fungus shall be used wherever possible. If it is necessary to use nutrient materials, these materials shall be treated by a method which will render the resulting exposed surface fungus resistant.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 8

OF

TITLE:

TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

4. PERFORMANCE TEST PROCEDURES

4.1 In-Process Production Tests

Test results are not required for acceptance test procedures.

4.2 Final Production Tests

Test results are not required for acceptance test procedures.

4.3 Acceptance Tests

TMC Contract 525362
Page Communications Engineers Contract SC-C-98363
Northrup-Page Technology Park
Vienna, Virginia 22180

- 4.3.1 Design
- 4.3.2 Telecommand Capability
- 4.3.3 Telecommand Functions
- 4.3.4 Display Readback
- 4.3.5 Continuous Monitoring
- 4.3.6 Alternate Remote Control
- 4.3.7 Simultaneous Control
- 4.3.8 Remote Control Inhibition
- 4.3.9 Control Time
- 4.3.10 CRT Display Screen
- 4.3.11 Display Format
- 4.3.12 Programming Facilities
- 4.3.13 Dot Matrix
- 4.3.14 Keyboard Array
- 4.3.15 Keyboard Controls
- 4.3.16 Storage Capacity
- 4.3.17 Modem Interface
- 4.3.18 Modem Impedance
- 4.3.19 Modem Audio Interface
- 4.3.20 Modem Audio Frequencies
- 4.3.21 Audio Output Level
- 4.3.22 Audio Spurious Outputs
- 4.3.23 Frequency Stability
- 4.3.24 Modem Audio Rate
- 4.3.25 Demodulator Input Level
- 4.3.26 I/O Correction
- 4.3.27 Power Supply
- 4.3.28 Environmental Conditions
- 4.3.29 MTBF
- 4.3.30 MTRR
- 4.3.31 Electromagnetic Compatability

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *[Signature]*

SHEET 8-1 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

- 4.3.1 Design
The TCS-11 shall use solid-state devices for all the circuits.

SET-UP:

Not Required

PROCEDURE:

1. This procedure consists of a visual inspection of the terminal units to determine the presence of components not classified as solid-state.
2. Remove covers from CRT display unit and drop front panel of processor control unit to expose all internal wiring, components and circuit cards.
3. Carefully inspect each circuit card in turn by removing each from their respective multi-pin sockets. All circuit cards are removed horizontally from the rear/front of the units.
4. Inspect internal components either attached to the chassis or mounted on circuit cards affixed to the chassis.
5. Only solid-state components should be used excepting the CRT.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-2 OF

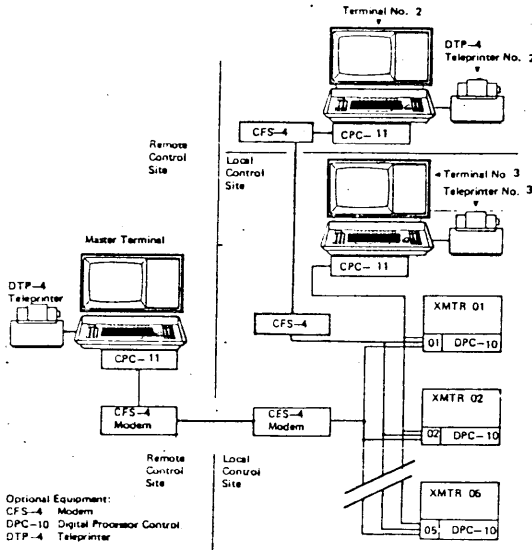
TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

SPECIFICATION:

4.3.2 Telecommand capability
 The TCS-11 shall have a telecommand capability of 40 transmitters.

SET-UP:



PROCEDURE:

1. Select one transmitter for control. Set the exciter address in the DPC-10 interface to the numeric digit '01'.
2. Program the exciter from the DKY-10 keyboard following normal operating procedures and note the location of the readback on the display screen.
3. Repeat steps 1 and 2 for any exciter address from 01 to 40. For each address selected, the readback will be displayed on a different line on the display screen

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-3 OF

TITLE: ACCEPTANCE TESTS/TCS-11

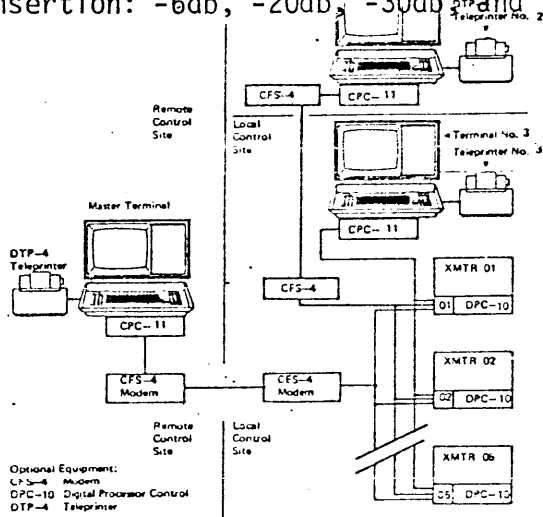
Page Communications SC-C-98363/TMC 525362

SPECIFICATION:

4.3.3 Functions to be telcommanded for each transmitter
 For each transmitter, the TCS-11 shall telecommand the following functions:

- on/off
- stand by/operate
- frequency selection in 100Hz steps from 2MHz to 29.9999MHz
- mode selection: USB, LSB, 2ISB, 4ISB
- carrier reinsertion: -6db, -20db, -30db and full

SET-UP:



PROCEDURE:

1. Select a transmitter with the STATUS display indicating MAINS OFF. Call this transmitter to the edit line and then depress the MAINS ON key. The edit line will clear and the STATUS display will change to read MAINS ON after the operation is complete at the transmitter (approximately 2 minutes). Following a period of 3 minutes, the MAINS ON display will automatically change to read STANDBY which corresponds to the switching on of the filaments at the transmitter. This time delay is standard to Continental and TMC transmitters.
2. With the transmitter in a STANDBY condition, call to the edit line and depress the red H/T ON line. The edit line will clear and the readback display will indicate OPERATE once the operation is completed at the transmitter.
3. With the transmitter in a HV ON condition, call to the edit line and program a different frequency, mode and carrier level than that indicated on the display. Depress the ENTER key and wait approximately 2 to 10 seconds for the readback.
4. Repeat Step 3 for other frequencies, modes and carrier levels.
5. Repeat Step 2 for H/T OFF which places the transmitter in STANDBY.

NOTE: The TCS-11 provides control of CW, AM, USB, LSB, ISB and FSK. There is no distinction in the selection of ISB since TMC exciters are provided with squelch circuits that control 2ISB, 3ISB and 4ISB operation.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-4 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

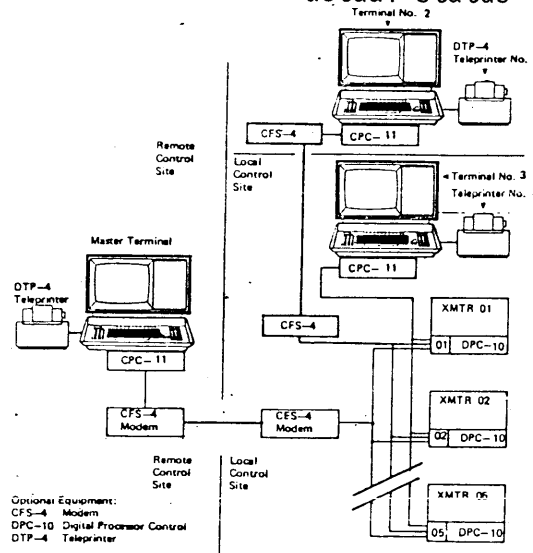
SPECIFICATION:

4.3.4 Display readback

Automatic interrogation and readback of each transmitter. The control of sequencing shall be by terminal microprocessor with a scanning time of 500 ms/max 2 s. The display readback shall be:

- preassigned number of transmitter
- actual carrier reinsertion
- working frequency
- actual type of emission
- working mode
- actual status

SET-UP:



PROCEDURE:

1. To demonstrate the automatic feature of the TCS-11 system, select one transmitter for control. Without programming the transmitter, change one function at the exciter such as frequency, mode, carrier suppression level, or on/standby. Note the corresponding change in the readback display caused by the change in status of the transmitter. An alarm will sound if the change causes a fault to occur. Note that the time required for readback is one second.
2. The DSP-10 display screen contains a heading line as follows:

XMTR FREQ-KHZ MODE CARR R F ANT AZIMUTH INHIBIT STATUS

Select a transmitter with all information displayed on the CRT screen. Compare the settings on the exciter and transmitter to the data displayed on the screen. Verify that both settings and data correspond to each other. The data displayed includes a) number assigned to transmitter; b) operating frequency; c) operating mode; d) carrier level; and e) transmitter status. Type of emission is working mode in all cases except AME (A3H). This mode is obtained by selecting USB or LSB and suppressing the carrier -6db.

PCE

TMC

NOTES

TMC SPECIFICATION

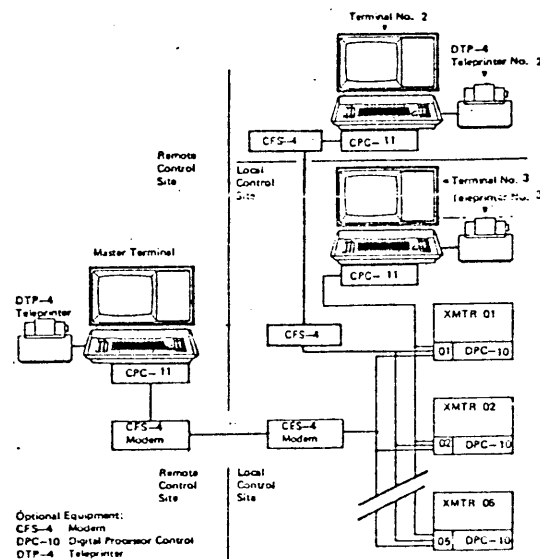
NO. 620-051811-0

REV: 0
 COMPILED: 2-12-78 CHECKED: *JFM* APPD: *MP* SHEET 8-5 OF
 TITLE: ACCEPTANCE TESTS/TCS-11 Page Communications SC-C-98363/TMC 525362

SPECIFICATION:

- 4.3.5 Continuous monitoring
 If a fault occurs, the appropriate status line will blink and display the word FAULT. An audible alarm will sound until the RESET key is depressed.

SET-UP:



PROCEDURE:

1. Select as transmitter for control and without programming it from the keyboard, change one function at the exciter such as frequency, operating mode or carrier level. Change the transmitter simulator to fault. Note the readback display at the CRT screen. The audible alarm will sound and an asterick directly in front of the STATUS line appears to indicate the transmitter at fault.
2. Depress the red ALARM RESET key on the keyboard to remove the asterick and squelch the alarm. To eliminate the FAULT indication, return the transmitter fault switch to normal and re-program the transmitter from the keyboard.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-6 OF

TITLE: ACCEPTANCE TESTS/TCS-11

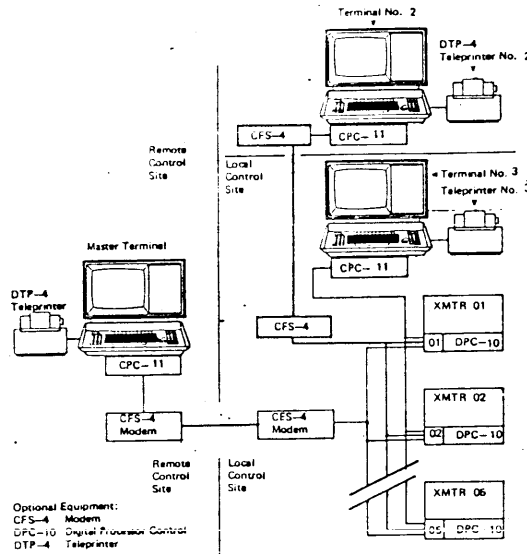
Page Communications SC-C-98363/TMC 525362

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SPECIFICATION:

4.3.6 Possibility for alternate remote control
 The remote control system shall have the possibility for alternate control of the above mentioned transmitters and functions either from the Control center or from the Receiver center.

SET-UP:



PROCEDURE:

1. Select a transmitter for control.
2. Program the transmitter from Terminal #1.
3. Repeat Step 2 from Terminal #2.
4. Repeat Step 2 from Terminal #3.
5. Note that the readback display resulting from programming the transmitter by each terminal indicates that alternate remote control is provided.
6. Repeat as required for additional transmitters.

NOTE: If the Receiver or Transmitter site terminals are inhibited by the Control site terminal from control of transmitters, no display will appear on the Receiver or Transmitter site monitors. Under this condition, alternate remote control is not possible unless the terminal is released.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*

APPD: *MDP*

SHEET 8-7 OF

TITLE: ACCEPTANCE TESTS/TCS-11

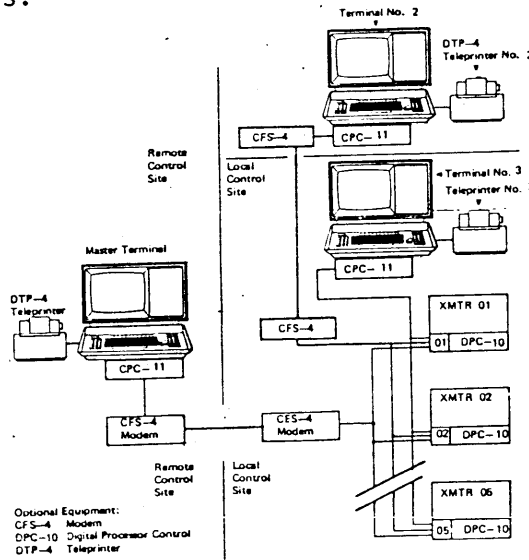
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.7 Possibility of simultaneous control
 The remote control system will telecommand directly from the Receiver center up to ten transmitters out of the possible forty preselected preferably by the Control center or by the Transmitter center. Telecommand from Control and Receiver centers should be possible simultaneously when controlling different transmitters.

SET-UP:



PROCEDURE:

1. Select two transmitters for control. Program one transmitter from Control terminal and the second transmitter from the Receiver or Transmitter site terminal. DO NOT DEPRESS THE ENTER KEY OF EITHER TERMINAL.
2. Verify the data on the edit line and SIMULTANEOUSLY depress both terminal ENTER keys. Observe the operation of the exciter units. Both will function at the same time. Upon completion of the cycle, the respective readback displays will appear on all CRT monitors.

NOTE: Any programming completed at the Receiver or Transmitter site terminals are displayed on ALL DSP-10 monitors, including the Control site terminal. Data will not be displayed on the Receiver or Transmitter monitors if the Control site has inhibited control of transmitters from those sites.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

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SHEET 8-8 OF

TITLE: ACCEPTANCE TESTS/TCS-11

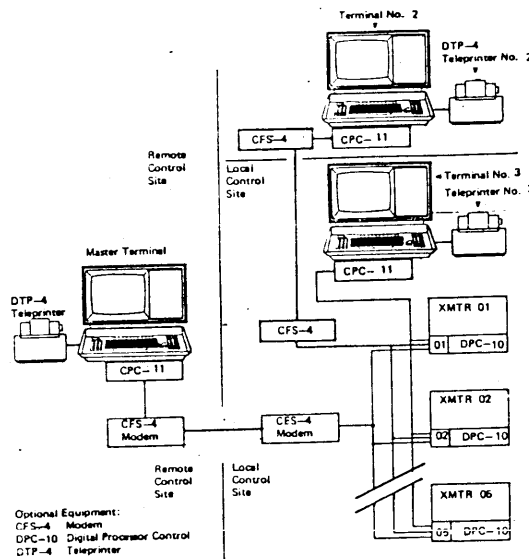
Page Communications SC-C-98363/TMC 525362

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SPECIFICATION:

4.3.8 Remote control inhibition
 Inhibit circuits shall have to "lock out" selected terminals remotely from the Control center site or locally by manual switching on the exciter. This feature shall restrict control of any one transmitter to one, or all TCS-11 terminals.

SET-UP:



PROCEDURE:

1. Select one transmitter for control. Call this transmitter to the edit line of the Control site terminal.
2. Depress the red RCVR SITE key to inhibit the Receiver site terminal from controlling that transmitter. Note the Control site monitor under the INHIBIT column displays a numeric '1' to indicate Receiver site inhibit. The data line corresponding to the transmitter selected will disappear from the Receiver site monitor.
3. Repeat for Transmitter site by depressing the XMTR SITE key on the Control site terminal.
4. Call the transmitter under control to the edit line and depress the red RLS key to release inhibit from both the Transmitter and Receiver site terminals. All programming is completed at the Control terminal.
5. Switch the front panel pushbutton on the DPC-10 unit at the transmitter site to locally remove the inhibit. Manual switching is not provided to allow the Transmitter site to inhibit control by the Receiver site terminal.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*

APPD: *MDP*

SHEET 8-9 OF

TITLE: ACCEPTANCE TESTS/TCS-11

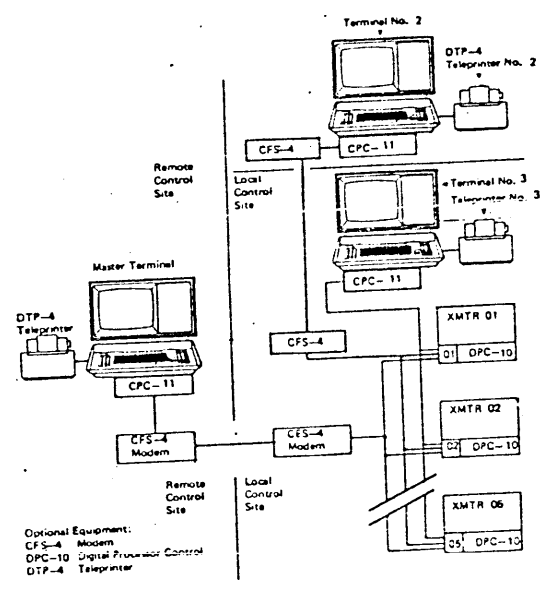
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.9 Control time
The control time shall be lower than 1 to 4.5 sec.

SET-UP:



PROCEDURE:

1. Select one transmitter for control.
2. Program this transmitter for any combination of functions. Verify the data presented on the edit line and depress the ENTER key.
3. The response time from releasing the data to start of the switching at the exciter is nominally one second.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SFM*APPD: *ndp*

SHEET 8-10 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

- 4.3.10 CTR display screen
Each CTR display shall be:
- 15" diagonal
 - bright green phosphor
 - anti-glare non reflective

SET-UP:

Not required

PROCEDURE:

The CRT display screens are supplied as 15-inch diagonal monitors with an anti-glare, non-reflective viewing surface. Lettering is a bright green activated by an electron stream on phosphor coating internal to the CRT tube.

Examine the screens provided while under operation to determine the size and characteristics of each monitor.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SFM*

APPD: *ADP*

SHEET 8-11 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.11 Display format

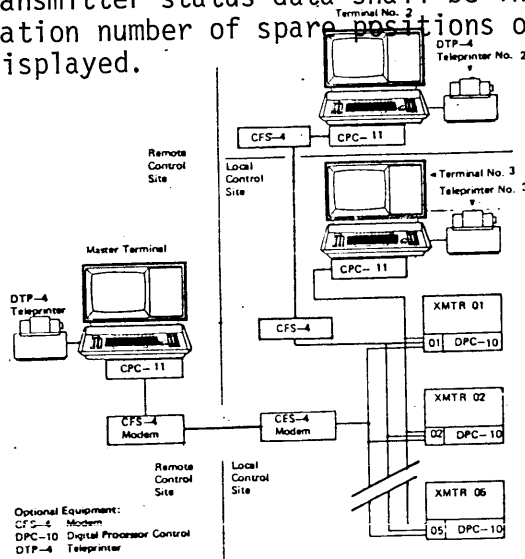
The display format shall be:

-80 characters per line

-24 lines configured as follows: 1 line column heading, 20 lines transmitter status, 1 line test editing, and 2 lines spacing

The display of the transmitter status data shall be in the conventional numerical order. Identification number of spare positions or disconnected transmitter shall not be displayed.

SET-UP:



PROCEDURE:

1. Enter the numeric digit '00' and depress the ENQ key on the Control terminal. This results in the display of all status data for those transmitters under control. Note that the transmitters are displayed in numerical sequence beginning with 01 on monitor #1 and with 21 on monitor #2. For those transmitters that are not active or are missing, a blank appears in the corresponding position. No assigned numbers appear if transmitters are inactive or missing.

2. Exam the display on the DSP-10 monitors. There is spacing for a total of 80 alphameric characters per line. There are 24 vertical spaces for display of data and editing as follows:

- | | |
|-----------|-----------------|
| Line 1 | Column heading |
| Line 2 | Space |
| Line 3-22 | Data (20 lines) |
| Line 23 | Space |
| Line 24 | Edit |
- Note: Line 24 blank on monitor #2.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *[Signature]*

SHEET 8-12 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

- 4.3.12 Programming facilities
Remote control TCS-11 shall have the possibility of being reprogrammed by the user. Systems will be pre-programmed to control established functions of (40) transmitters.

SET-UP:

None required.

PROCEDURE:

The TCS-11 is programmed at the factory using specialized, digital equipment. If this specialized equipment is available to the user, the TCS-11 can be re-programmed in the field. However, it is recommended that only experienced computer programmers with a minimum of two years formal training in computer science be authorized to program under field conditions.

The TCS-11 is pre-programmed to control established functions of 40 co-located, synthesized transmitters.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-13 OF

TITLE: ACCEPTANCE TESTS/TCS-11

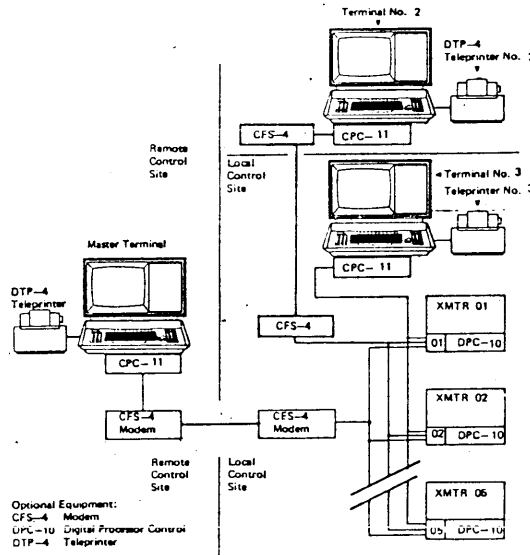
Page Communications SC-C-98363/TMC 525362

CHK

SPECIFICATION:

4.3.13 Dot matrix
12 x 15 high resolution

SET-UP:



PROCEDURE:

1. Examine the display screen characters with the system in operation.
2. Note that the minimum matrix for a 50Hz system is 8X8 high resolution. For a 60Hz system, this resolution expands to 12X15 depending on the storage capacity of the system.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*

APPD: *ndp*

SHEET 8-14 OF

TITLE: ACCEPTANCE TESTS/TCS-11

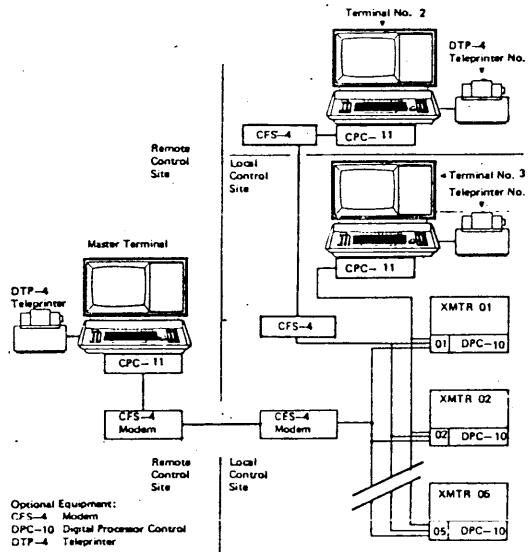
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.14 Keyboard array
Multi-function cluster

SET-UP:



PROCEDURE:

Exam the DKY-10 keyboard for the following:

- | | |
|-------------|--|
| White keys | Numeric cluster for control of transmitter assigned number, assigned frequency, antenna number, and antenna azimuth. |
| Yellow keys | Function cluster for control of cursor position. |
| Red keys | Function cluster for control of mains on/off, H/T on/off, enquiry, inhibit/release, alarm reset, and enter. |
| Blue keys | Function cluster for control of operating mode, carrier level and RF level. |

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SPM*

APPD: *ndp*

SHEET 8-15 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

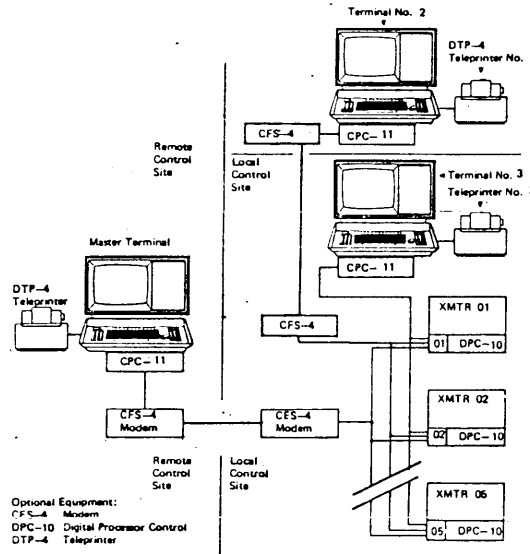
Chk

SPECIFICATION:

4.3.15 Keyboards controls

- numeric 0 to 9
- enter/skip
- stand by/operate
- reset
- power on/off

SET-UP:



PROCEDURE:

Examine the DKY-10 keyboard for the following:

- | | |
|-------------|--|
| White keys | Numeric cluster: 0 to 9 with decimal point '.' |
| Yellow keys | Function cluster: Forward/Back tab and Clear |
| Red keys | Function cluster: Mains On/Mains Off
H/T On and H/T Off
Enquiry
Xmtr/Rcvr Inhibit and Release
Alarm Reset
Enter |

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-16 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

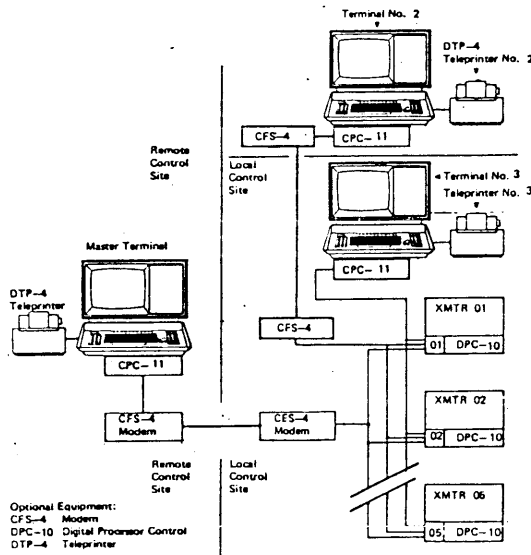
Chk

SPECIFICATION:

4.3.16 Storage capacity

The microprocessor terminal shall have a minimum storage capacity of 6K.

SET-UP:



PROCEDURE:

1. Remove the front cover of the CPC-11 central processor control unit.
2. Examine the memory devices and by reference to design data, determine the size of the storage capacity.
3. Remove the top cover of the DPC-10 digital processor control unit.
4. Examine the memory devices and by reference to design data, determine the size of the storage capacity.
5. The storage of the TCS-11 terminal exceeds 6K in capacity.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*

APPD: *[Signature]*

SHEET 8-17 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

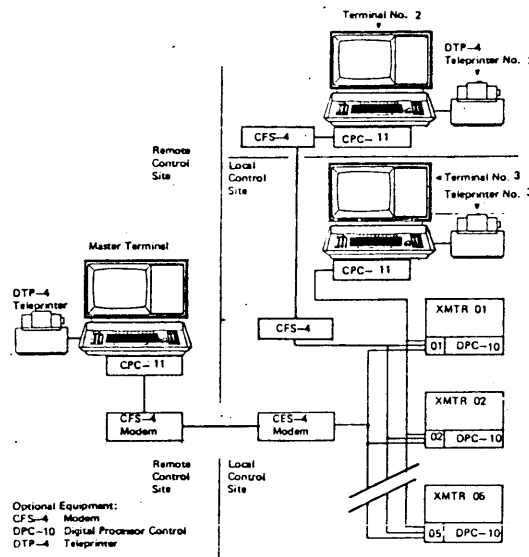
CHK

SPECIFICATION:

4.3.17 Modem d.c. input/output interface

The modem d.c. input/output interface shall be the appropriate for direct interconnection to microprocessor terminal, and to B/D buffer decoder unit.

SET-UP:



PROCEDURE:

1. Examine the rear panel of the CFS-4 modem.
2. Note that the terminal strips are standard RS-232 types and are totally compatible with both the CPC-11 and DPC-10 interface units. Using an optional converter circuit supplied by TMC, the CPC-11 can be removed and a standard teletype machine with a RS-232 interface connected directly to the modem.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *ndp*

SHEET 8-18 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.18 Modem audio input/output impedance

The modem audio input/output impedance shall be 600 ohms balanced with a minimum return loss of at least 26 dB. The electrical balance shall be sufficient to suppress longitudinal currents at least 40 dB below prevailing metallic currents.

SET-UP:

See following pages, Specifications 4.3.18.1 to 4.3.18.4.

PROCEDURE:

See following pages.

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*

APPD: *[Signature]*

SHEET 8-19 OF

TITLE: ACCEPTANCE TESTS/TCS-11

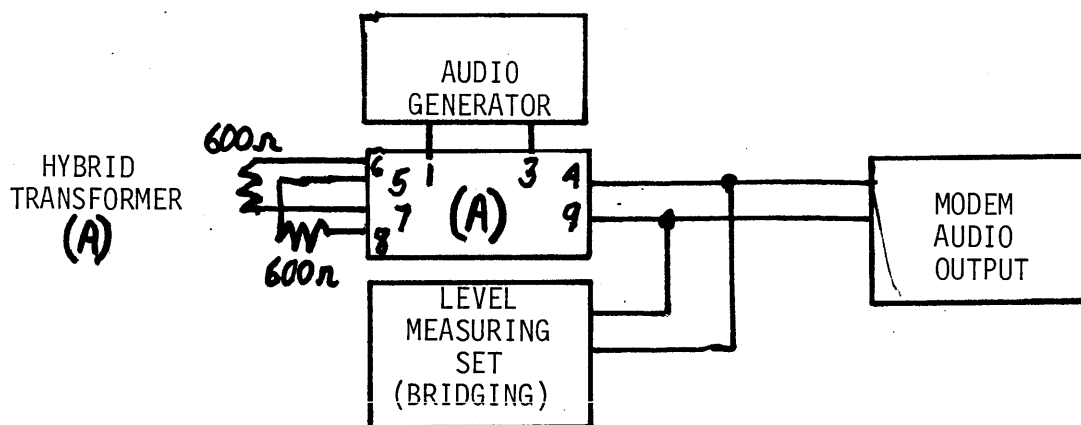
Page Communications SC-C-98363/TMC 525362

SPECIFICATION:

4.3.18.1 Nominal audio output impedance
600 ohms balanced to ground. If any connector would be used for audio output, the appropriate mating connector shall be furnished with each modem.

NOTE: Procedure is applicable to both nominal audio impedance and return loss.

SET-UP:



PROCEDURE:

1. Connect the equipment to the hybrid as shown. The audio generator should be connected in a balanced condition to the primary winding (1-3).
2. Turn off the CFS-4 modem control tone oscillator.
3. Connect the level measuring set across the modem 600-ohm balanced input terminals and adjust the audio generator so that a 1000Hz, 0dbm signal level is obtained at the modem terminals.
4. Remove the level measuring set and short circuit 4-9; open 6-7.
5. Connect the level measuring set across 5-8. Obtain the signal level on the scale of the level measuring set and record in db.
6. Remove the short and re-connect the modem and balance resistor terminals.
7. Measure and record the new signal level across terminals 5-8.
8. The return loss of the system impedance at the point of measurement against the 600-ohm resistance is given by the difference between the signal levels recorded in steps 5 and 7. The return loss should not be less than 26db.
9. Repeat steps 1-9 for audio generator frequencies of 300 and 3020Hz.

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SFM*

APPD: *ADP*

SHEET 8-20 OF

TITLE: ACCEPTANCE TESTS/TCS-11

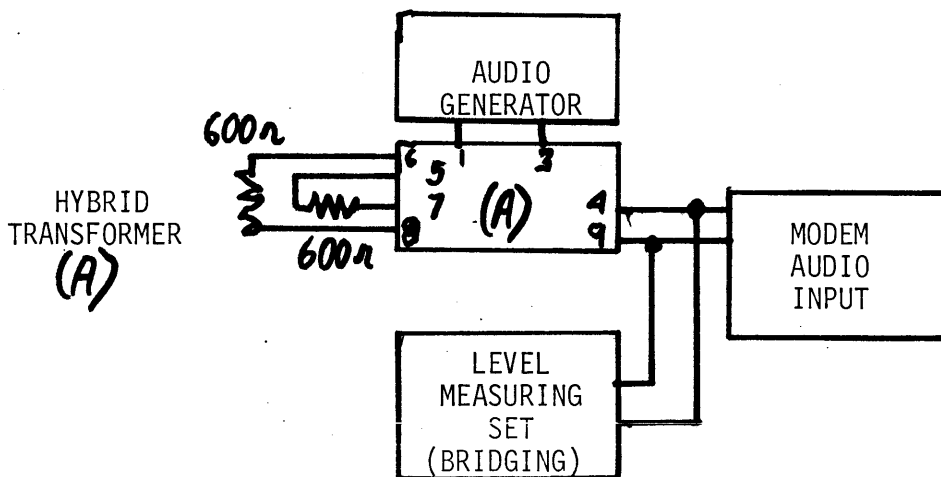
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.18.2 Nominal audio input impedance
600 ohms balanced to ground. If any connector would be used for audio input, the appropriate mating connector shall be furnished with each modem.
NOTE: Procedure is applicable to nominal audio impedance and return loss.

SET-UP:



PROCEDURE:

1. Connect the equipment to the hybrid transformer as shown. The audio generator should be connected in a balanced condition to the primary winding 1-3.
2. Connect the level measuring set across the modem balanced input terminals and adjust the audio generator so that a 1000Hz, 0dbm signal level is obtained at the modem terminals.
3. Remove the level measuring set and short circuit 4-9; open 6-7.
4. Connect the level measuring set across 5-8. Obtain the signal level on the scale of the level measuring set and record in db.
5. Remove the short circuit and re-connect the modem and balanced resistor terminals.
6. Measure and record the new signal level across transformer terminals as obtained on the level measuring set.
7. The return loss of the system impedance at the point of measurement against the 600-ohm resistance is given by the difference between the signal levels recorded in steps 4 and 6. The return loss is less than 26db.
8. Repeat the above steps for audio generator frequencies of 300 and 3020Hz.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JPM*APPD: *WDP*

SHEET 8-21 OF

TITLE: ACCEPTANCE TESTS/TCS-11

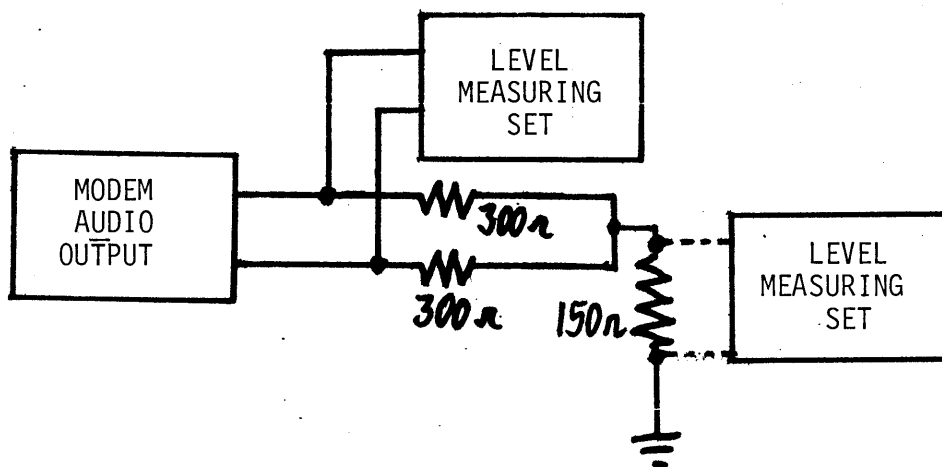
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.18.3 Longitudinal balance to ground of the modem audio output. Sufficient to eliminate longitudinal currents at least 40db below reference level at the output frequency of the modem.

SET-UP:



PROCEDURE:

1. Connect the equipment as shown. The level measuring set is connected across the audio output terminals of the modem.
2. Adjust the output of the modem to obtain a 0dbm indication on the level measuring set.
3. Connect the level measuring set across the 150-ohm resistor and record the longitudinal power level in dbm.
4. The longitudinal power level is less than -40dbm.

PCE

TMC

NOTES

TMC SPECIFICATION

No. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JPM*APPD: *WLP*

SHEET 8-22 OF

TITLE: ACCEPTANCE TESTS/TCS-11

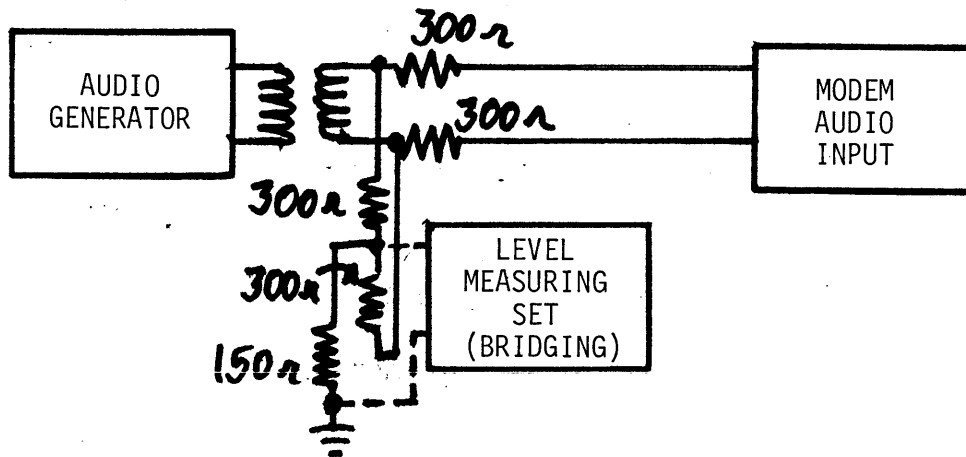
Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.18.4 Longitudinal balance to ground of the modem audio input
Within the 300 to 3020Hz range. Sufficient to eliminate longitudinal
currents at least 40db below reference signal level.

SET-UP:



PROCEDURE:

1. Connect the equipment as shown. The 300-ohm resistors are connected to the input of one of the audio channels. The 150-ohm resistor is connected between the common point of the 300-ohm resistor and the system ground.
2. Adjust the audio generator to obtain 1000Hz.
3. Connect the level measuring set across the modem audio input terminals.
4. Adjust the output of the audio generator to produce a signal at the audio input of 0dbm.
5. Connect the level measuring set across the 150-ohm resistor and record the longitudinal power level in dbm.
6. The longitudinal power level is a minimum of -40dbm.

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *ADP*SHEET **8-23** OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.19 Modem audio input/output interface

Modems will allow transmission of command and signalling information between the remote and local control units through a 4 wire CCITT telephone circuit.

SET-UP:

None required.

PROCEDURE:

Examine the modem module outputs and inputs. The connectors are compatible with 4-wire CCITT telephone circuits.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *Red P*

SHEET 8-24 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

- 4.3.20 Modem audio input/output frequencies
The modem audio input/output frequencies shall be as per CCITT and allocated in the 300 Hz to 3400 Hz center band.

SET-UP:

None required.

PROCEDURE:

The CFS-4 modems are factory adjusted to a center-band frequency of 1275KHz. The frequency shift of the audio tone is 42.5Hz. Determination of the frequency was based on the recommendation that lower frequencies are used for modems operating at 100 baud rates.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 8-25 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

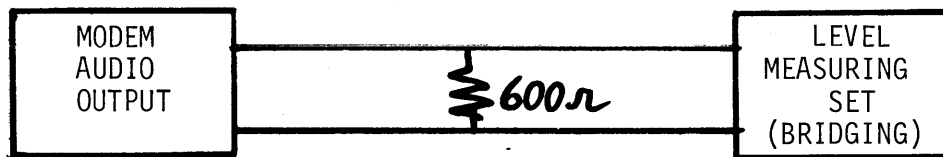
Chk

SPECIFICATION:

4.3.21 Audio output level

The modulator audio output level shall be adjustable from -25 dBm to +4 dBm with less than 5 dB variations between mark and space frequencies.

SET-UP:



PROCEDURE:

1. Set the modem to "steady mark" and adjust the output level until the level measuring set indicates +4dbm.
2. Change the modem to "steady space" and record the output level. The change in output level should not be greater than 5db.
3. Set the modem to "steady mark" and reduce the output level to -25dbm.
4. Repeat step 2.

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 8-26 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

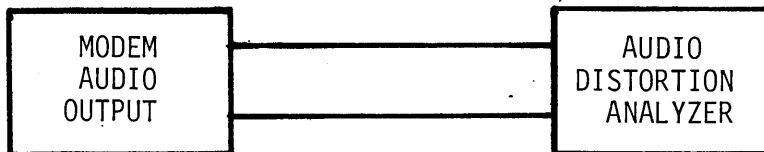
Chk

SPECIFICATION:

4.3.22 Audio spurious outputs

The maximum level of spurious outputs shall be -60 dBm.

SET-UP:



PROCEDURE:

1. Connect the equipment as shown.
2. Set the modem to "steady mark" and adjust the output level to 0dbm as indicated on the audio distortion analyzer.
3. Measure and record the amplitude of the second harmonic of the "mark tone".
4. Set modem to "steady space" and adjust the output level to 0dbm as indicated on the audio distortion analyzer.
5. Measure and record the amplitude of the second harmonic of the "space tone".
6. The second harmonic is less than -60dbm.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *ADP*

SHEET 8-27 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.23 Frequency stability

± 5 Hz over voltage and temperature ranges.

SET-UP:

None required.

PROCEDURE:

The stability of the ovenized crystal oscillators meet MIL-STD-188C, Paragraph 7.3.8.2 which specifies a maximum deviation of +/-4Hz. The frequency stability is applicable over both voltage and temperature ranges.

Since the standard oscillators are calibrated at the supplier's factory and re-checked by TMC on a statistically significant basis, TMC does not propose to conduct this test but verify compliance by reference to prior test results.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 8-28 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.24 Modem audio input/output rate
100 baud FSK

SET-UP:

None required.

PROCEDURE:

Since the baud rate is determined electronically by circuit design, TMC does not propose to conduct this test but verify compliance by analysis of the circuits in the CPC-11 and DPC-10 units.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *[Signature]*APPD: *[Signature]*

SHEET 8-29 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

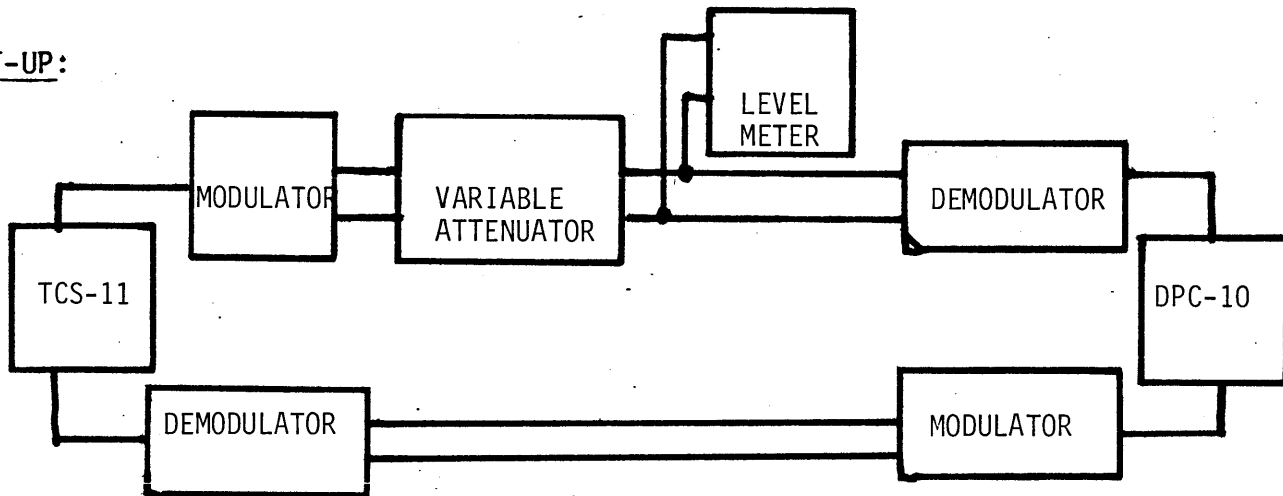
Chk

SPECIFICATION:

4.3.25 Demodulator input level

The demodulator shall detect signals from +4dbm to -40dbm without adjustments as a minimum.

SET-UP:



PROCEDURE:

1. Connect the equipment as shown.
2. Set the variable attenuator for 0 loss and adjust the output level of the modulator until the level meter indicates +4dbm.
3. Verify proper operation of the demodulator by instituting various tuning commands at the TCS-11 terminal and observing the exciter and transmitter (simulator) to determine that all commands are executed without error.
4. Adjust the variable attenuator until the level meter indicates -40dbm and repeat step 3.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *SJM*APPD: *MDP*

SHEET 8-30 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

- 4.3.26 Input and output connection
If the remote control system inputs/outputs were effected through connectors,
TMC shall deliver with the equipment the suitable mating connectors.

SET-UP:

None required.

PROCEDURE:

Examine loose items package for mating connectors.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 8-31 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.27 Power supply

The TCS-11 shall operate from single phase $220 \pm 10\%$ VAC $50 \pm 10\%$ Hz.

If connectors will be used for power feeding, the appropriate mating connector shall be furnished with each equipment.

SET-UP:

None required.

PROCEDURE:

The preliminary electrical check determined the proper power supply rating. All subsequent tests are performed at this rating or at ratings within the tolerances specified.

PCE

TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 8-32 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.28 Environmental conditions

The equipment shall be capable of continuous operation maintaining all its characteristics at:

- ambient temperature range: 0°C to +50°C
- relative humidity: 5% to 90%
- altitude: up to 3000 m over sea level

SET-UP:

None required.

PROCEDURE:

Tests performed in this acceptance procedure are designed for any combination of the environmental conditions specified.

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TMC

NOTES

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *[Signature]*

SHEET 6-33 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.29 MTFB
4000 hours

SET-UP:

None required

PROCEDURE:

Reliability data is based on both field operations and calculations using MIL-HDBK-217. The procedure and results are contained in the following pages.

PCE

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NOTES

RELIABILITY

Equipment and Circuit Design

Designed into all TMC products is quality. From the time a circuit is first sketched on a drafting table, meticulous attention is given to minimizing the number and density of components while maximizing the functions performed. Whenever possible, solid-state components including large scale integrated (LSI) circuits are used. All of the modern TMC equipment is solid state except for the final tube circuits in the higher power linear amplifiers (1KW and above). This includes such sub-systems as the exciter, driver amplifiers, power supplies, and control circuits as well as such accessory equipment as frequency shift keyers and test generators. Maximizing the use of solid state components increases overall reliability by reducing the number of components needed to perform a given function and reducing the power requirement (stress) on the system. This improvement in reliability is reflected in a higher MTBF value (see below). Costs also decrease as the overall reliability improves since downtime, maintenance and the requirement for spare parts are all reduced. With each proven advance in modern technology, TMC modifies its designs to reduce cost and improve reliability while maintaining compatibility with older systems. Consequently, the reliability of TMC equipment, already well-known, improves with age as modern technologies are incorporated in designs. This attention to designing reliability into its transmitter systems is one reason why TMC equipment is selected more often to perform the most demanding jobs.

The reliability of electronic equipment is defined as the probability the equipment will perform properly for a desired length of time under the conditions (operational and environmental) for which it is designed. There are basic assumptions which underlie the construction of a mathematical model to be used to predict the reliability of equipment:

- (1) Part failure rates are constant;
- (2) Probability of part survival or part reliability follows a Poisson or exponential distribution;
- (3) Parts within a particular equipment or the equipment within a particular system have a series relationship. That is, each part or each equipment must operate properly so that the function for which they are used can be performed.

Mathematically, the reliability of an item of equipment or a complete system is a function of the sum of the failure rates of the parts constituting the equipment or the equipment constituting the system. Normally, failure rates can be predicted for specific parts. However, for equipment in systems, failure rates are less precise since the time interval for which the equipment reliability is being

determined is usually not well defined. Mean-Time-Between-Failure (MTBF) is used in this latter case and is equal to the reciprocal of the failure rate for the equipment.

The following steps were taken to calculate the reliability and the MTBF of the transmitter system:

- (A) A list of all parts used in the design of the transmitter was compiled from material lists stored on magnetic disks on an IBM computer system.
- (B) The failure rate of each part was determined using MIL-HDBK-217 Reliability Stress and Failure Rate Data for Electronic Equipment. In the case of equipment for which adequate test time was not available, a list of components with typically average failure rates was used. This list appears at the end of this Section.
- (C) The predicted failure rate of each part was recorded on a magnetic disk. The summation of these failure rates yielded the failure rate for the entire equipment.
- (D) The MTBF was then calculated by taking the reciprocal of the summation of the failure rates. Since the transmitter system has been operating well over 10,000 hours in the field, failure rates were calculated by computer and then modified to reflect actual performance.

Experience with actual systems operating in the field over a period of 1,000 to 10,000 after fire-up, indicate the system average failure rate for all components in terms of percent per 100,000 hours of operation is 0.18. This calculates out as 5,555 hours for the MTBF. Somewhat lower values are obtained using stress analysis per MIL-HDBK-217 since components in actual operating conditions are rarely stressed to maximum.

Two important factors further affect MTBF values: (1) the age of the equipment, and (2) the degree of preventive maintenance. TMC has found through experience that new equipment (less than one year operating) and old equipment (greater than seven years operating) have more failures than normal for a given period of time. The "burning in" of new parts and the normal wear of old parts are the primary factors which contribute to this condition. Once corrected, the system gives extremely reliable service particularly if the basic preventive maintenance procedures are conscientiously followed throughout the 20-year life of the equipment.

TYPICAL AVERAGE FAILURE RATES*

<u>Components</u>	<u>Estimated Failure Rates % per 100,000 Hours of Operation</u>
Capacitors (general purpose).....	0.01 - 0.6
Capacitors (electrolytic).....	0.02 - 2.0
Crystal diodes.....	0.05
RF inductors.....	0.05
Integrated circuits.....	0.1
Meters.....	0.2
Motor/generators.....	0.04
Potentiometers.....	0.3
Relays.....	0.001 - 0.5
Resistors, fixed.....	0.01 - 0.3
Switches.....	0.01 - 0.1
Transformers.....	0.05 - 2.0
Transistors.....	0.2
Tubes (receiver types).....	1.0 - 2.0
Tubes (high power, transmitting).....	1.0 - 20.0
Soldered joints (dipped).....	0.0001
Wrapped joints.....	less than 0.0001

*Based on actual performance from TMC
field engineering and maintenance records

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JFM*APPD: *ADP*

SHEET 8-34 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

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SPECIFICATION:

4.3.30 MTR
20 min.

SET-UP:

None required.

PROCEDURE:

Maintainability data was taken under operating conditions in the engineering laboratory. Procedures and results are contained on the following pages.

PCE

TMC

NOTES

MAINTAINABILITY

Technical Manual

TMC technical manuals perform an important function in successfully maintaining transmitter control systems. As a minimum, each manual consists of seven sections:

- 1) General Information
- 2) Installation
- 3) Operating Procedures
- 4) Principles of Operation
- 5) Maintenance and Troubleshooting
- 6) Replacement Parts
- 7) Drawings and Schematics

This breakdown simplifies the maintenance function by providing a ready reference for both operator and technician. Each manual is based on the actual equipment supplied and is updated by addenda sheets as changes in design occur. The manual can also be used as a training guide and as a reference for the ordering of spare parts.

Preventive Maintenance

A key factor in the successful operation of this transmitter system is the degree to which preventive maintenance is performed. Dust, dirt or other destructive elements can cause the equipment to fail if conditions are allowed to continue over an extended period of time.

At periodic intervals, the equipment should be pulled out on its slides for internal cleaning and inspection. The wiring and all components should be visually inspected for accumulations of dirt, dust, corrosion, grease and other harmful substances. Removal of these elements by dusting or treating with a solvent is essential to extending the useful life of the equipment.

Troubleshooting and Repair (MTTR)

An important feature of the TMC transmitter system is the number of front panel indicators visible to the operator. Virtually all critical circuits are monitored by meters or lamps. The use of these indicators simplifies the troubleshooting process by directing attention to a specific area. Corrective action can then be taken immediately with a minimum of down time.

The technical manual also assists in troubleshooting by devoting attention to fault indications, to probable causes, and to suggested remedies.

All low power circuits are mounted on removeable circuit cards mounted on slide-retainers. The higher power circuits up through the final amplifier section are composed of a series of interlocking assemblies that can easily be removed from the main frame. The final tube can be removed with ease from its socket. Test points are located in full view of the technician at specific locations throughout the system. These test points are clearly shown on technical manual schematics.

The Mean-Time-To-Repair (MTTR) is nominally fifteen (15) minutes for the entire TCS control system and is based on actual test times taken in the engineering laboratory under operating conditions. This MTTR figure will vary depending on the degree of the failure and the availability of spare parts. Interchangeable assemblies can be used to reduce MTTR further.

TMC SPECIFICATION

NO. 620-051811-0

REV: 0

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SHEET 8-35 OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

Chk

SPECIFICATION:

4.3.31 Electromagnetic compatability
No degradation when immersed in $.01 \text{ w/cm}^2$ of RF field.

SET-UP:

None required

PROCEDURE:

The components of the TCS-11 control system are totally encased in electro-static shielded cabinets to withstand the presence of high RF electric fields.

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TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 2-12-78

CHECKED: *JPM*APPD: *[Signature]*

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OF

TITLE: ACCEPTANCE TESTS/TCS-11

Page Communications SC-C-98363/TMC 525362

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SPECIFICATION:SET-UP:PROCEDURE:

PCE

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TMC SPECIFICATION

NO. 620-051811-0

REV: 0

COMPILED: 1-18-78

CHECKED: *JJB*

APPD: *WSP*

SHEET OF

TITLE: TEST PROCEDURES - Model TCS-11 Transmitter Terminal Control System

Chk