TJ RADIO
TRANSMITTER-RECEIVER BAY
EQUIPMENT DESIGN REQUIREMENTS
TOLL SYSTEMS

1. GENERAL

SCOPE

1.001 This addendum supplements Section 804-336-151, Issue 3.

1.002 This addendum is issued to provide an isolated source of 117 volts ac for the transmitter automatic frequency control (AFC) circuit which will eliminate the impulse noise on the receiver, baseband output caused by the operation of the transmitter AFC circuit.

1.003 The above changes are in accordance with SD-59769-01, Issue 26B.

The following changes apply to Part 1 of the section.

(a) 1.05 — revised
(b) 1.19 — revised

Under 1.05

Add:

In addition to the transmitter-receiver bay common power supply, an optional source of isolated 117 volts ac is available for the transmitter AFC circuit (see 5.04).

Under 1.19

Add:

The power drain of the transmitter AFC circuit is 125 mA at 117 volts ac.

3. DRAWINGS

The following changes apply to Part 3 of the section.

Under Equipment

Add:

ED-54548-( )—Power Distribution Panel
LORAIN DC-to-AC Inverter, or Equivalent

5. GENERAL NOTES

The following changes apply to Part 5 of the section.

Under 5.03

Add:

5.04 The isolated source of 117 volts ac for the transmitter AFC circuit may be a LORAIN, or equivalent, dc-to-ac inverter. It is recommended that two such inverters be provided per station, one for the regular and one for the diversity radio bays. One ED-54548-( ) power distribution panel will provide the interconnections for up to nine regular and nine diversity radio bays. The power inverters and the power distribution panel are miscellaneously mounted.

Bell Telephone Laboratories, Incorporated

Dept 4254

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1. GENERAL

Scope

1.01 This specification, together with the supplementary information listed herein, covers the equipment design requirements for the various transmitter-receiver bay combinations for the TJ radio system.

1.02 The reasons for reissue are at the end of this specification.

Description

1.03 ***General:*** Type TJ radio is a microwave system designed to provide short-haul facilities suitable for handling television, multiplex telephony, or other broadband communication signals. The system operates in the common-carrier frequency band between 10,700 and 11,700 megacycles and can provide as many as three broadband 2-way communication channels with three additional 2-way channels as spares. This system, for which general requirements are given in Section 801-415-150 is composed of a chain of radio repeaters spaced an expected maximum of 25 miles apart consistent with transmission requirements and placed at locations and elevations suitable for microwave transmission. Each broadband radio channel is capable of transmitting one standard black and white or one National Television System Committee (NTSC) color television signal through six repeaters. For message use, each broadband radio channel is capable of handling 96 message circuits of ON-2 carrier, or 600 message circuits of L carrier through nine repeaters.

1.04 Provision is made for dropping and inserting channels at repeater stations and at terminals to make the system adaptable to a short-haul radio network with interconnections to wire facilities as required.

1.05 ***Transmitter-Receiver Bay:*** The J68371A transmitter-receiver bay covered by this specification provides the radio repeater equipment for a single one-way channel at a repeater station, or the transmitting and receiving equipment for separate channels at a repeater or at a terminal point. The equipment consists of a single frame which has two fundamental divisions:

(a) Receiver

(b) Transmitter

The equipment is so arranged that either a transmitter, receiver, or both may be furnished. A common power supply is provided on the bay, having a strapping arrangement to keep the load relatively constant regardless of the equipment arrangement. For detailed description of equipment see 1.15, Transmitter-Receiver Bay Equipment.

1.06 ***Receiver Operation:*** At an antenna the incoming microwave signal from a distant station may consist of from one to six radio channels. This complex signal is received by either a parabolic signal directed toward the next station or a combination of an elevated microwave reflector and its associated parabolic antenna. The signal is then carried through circular waveguide to a polarization separation network which separates the horizontally and vertically polarized frequencies. The separately polarized channels are transmitted through rectangular waveguide to the radio transmitter-receiver bays. In a particular bay, the received signal enters a channel separation network which selects the particular signal required for that receiving channel. The desired signal then enters the receiver through one of three different configurations. In the original design the signal enters through a waveguide spacer, a bandpass filter, a 401A tuner, and finally through a second waveguide spacer to the 1A balanced crystal modulator. In the later modified design, the signal

enters through a bandpass filter and a 9A isolator to the 1A balanced crystal modulator. In the latest version the signal enters through a bandpass filter and a 9A isolator to the modulator portion of the J99296AA, Lists 3 and 4 modulator preamplifier.

1.07 For bays equipped with the original design, the sum of the spacer lengths is held constant to provide a constant overall length of the waveguide connecting the channel separation network to the receiver modulator, the lengths of the individual spacers are determined by the received frequency. The spacer lengths are selected to minimize the overall receiver noise figure by insuring that the image frequency developed in the mixer is reflected back into the mixer in the optimum phase.

1.08 The J68372B IF preamplifier is operated on 200 volts dc and 6.3 volts ac. The Farinon power supply utilizes the 6.3 volt filament supply to provide −20 volts dc output required for the solid state IF preamplifier portion of the J99296AA modulator-preamplifier unit.

1.09 In the 1A balanced modulator, the incoming signal is combined with the output of the receiver local oscillator, a reflex klystron, and the resulting 70 MHz IF signal is amplified in a separate, low-noise IF preamplifier.

1.10 In the J99296AA modulator-preamplifier, the incoming signal is combined with the output of the receiver local oscillator and the resulting 70 MHz IF signal is amplified in the integral, transistorized IF preamplifier. For message service, the signal from the preamplifier is connected directly to the IF main amplifier by means of coaxial cable; however, for television applications a delay equalizer is required between the preamplifier and the IF main amplifier.

1.11 The IF main amplifier provides most of the gain required to raise the FM signal to the proper level for limiting. An automatic gain control (AGC) circuit in the IF main amplifier is provided to compensate for fading and for variations in transmission. The signal then enters the IF limiter-discriminator where variations in amplitude of the IF signal are removed and the video or baseband signal recovered in an FM discriminator. A receiver baseband amplifier serves to convert the baseband signal from the high impedance discriminator output to a balanced 124-ohm or unbalanced 75-ohm output impedance. This unit also contains an automatic frequency control (AFC) circuit which controls the frequency of the receiver beat oscillator and insures that the incoming IF signal will always pass through the IF amplifiers at an average frequency of 70 MHz.

1.12 ***Transmitter Operation:*** The baseband signal enters the transmitter baseband amplifier and is amplified sufficiently to deviate the transmitting klystron to a maximum of 8 MHz peak-to-peak. The transmitted signal then enters the transmitter automatic frequency control circuit which serves to keep the transmitter on frequency by means of an electromechanical servo system and an Invar cavity tuned to the operating frequency. This portion of the transmitter also contains a directional coupler for sampling a small amount of power to provide an indication of output power and to energize alarms in the event of output failure.

1.13 Next, the transmitted signal enters the isolator which transmits freely in the forward direction while absorbing reflections arising in the waveguide and antenna system which would otherwise distort the FM microwave signal. At the output of the isolator, a waveguide switch is provided to permit testing and adjusting the transmitter without inadvertently emitting an interfering signal. The transmitted signal then reaches the channel combining network, where it is combined with the other transmitted frequencies from the associated transmitter bays. The combined signals are fed into the polarization combining network which combines the horizontally and vertically polarized signals. The composite signal is transmitted by means of circular waveguide to the antenna system.

1.14 ***Frequency Allocation:*** Two frequency allocations exist for TJ radio in the 1000-MHz band between 10,700 and 11,700 MHz. The regular TJ frequencies are the same as those of the TL-1 and TL-2 plans. The staggered plan, used in TJ and TL-2, shifts all the P, formerly A, frequencies 20 MHz higher and the J, formerly B, frequencies 20 MHz lower. The regular and staggered frequency bands are each divided into 24 channels of 20 MHz bandwidth with 40 MHz separation between midchannel frequencies. At any repeater or terminal, the transmitters are grouped in one half of the band and the receivers in the other with a minimum guard band between the closest transmitter and receiver, of 90 MHz for the regular plan and of 50 MHz for the staggered plan. These channels are assigned as follows:

REGULAR PLAN					
CHANNEL NO.		FREQUENCY GHz	CHANNEL NO.		FREQUENCY GHz
OLD	NEW		OLD	NEW	
1A	1P	10.755	7A	7P	10.915
1B	1J	11.405	7B	7J	11.565
2A	2P	10.955	8A	8P	11.115
2B	2J	11.685	8B	8J	11.365
3A	3P	10.995	9A	9P	10.075
3B	3J	11.645	9B	9J	11.245
4A	4P	10.715	10A	10P	10.795
4B	4J	11.445	10B	10J	11.525
5A	5P	11.155	11A	11P	10.835
5B	5J	11.325	11B	11J	11.485
6A	6P	10.875	12A	12P	11.035
6B	6J	11.605	12B	12J	11.285
STAGGERED PLAN					
CHANNEL NO.		FREQUENCY GHz	CHANNEL NO.		FREQUENCY GHz
OLD	NEW		OLD	NEW	
1C	1E	10.775	7C	7E	10.935
1D	1D	11.385	7D	7D	11.545
2C	2E	10.975	8C	8E	11.135
2D	2D	11.665	8D	8D	11.345
3C	3E	11.015	9C	9E	11.095
3D	3D	11.625	9D	9D	11.225
4C	4E	10.735	10C	10E	10.815
4D	4D	11.425	10D	10D	11.505
5C	5E	11.175	11C	11E	10.855
5D	5D	11.305	11D	11D	11.465
6C	6E	10.895	12C	12E	11.055
6D	6D	11.585	12D	12D	11.265

Notes

1. Odd numbered channels transmit east or north.
2. Even numbered channels transmit west or south.
3. Suffix P or E denotes a channel in the lower half of the frequency band.
4. Suffix J or D denotes a channel in the upper half of the frequency band.
5. Frequency designations are being reassigned as an aid to the computerization of microwave station records in accordance with Bell System Practices Section 940-330-110, Issue 1, Radio Engineering—Microwave Radio—Interference—Microwave Station Record Program. Channel number letters, old and new, are:

OLD	NEW
A	P
B	J

Text and tables reflecting both old and new letter usage are maintained for record purposes.

1.15 ***Transmitter-Receiver Bay Equipment:*** The transmitter-receiver bay, Fig. 1, consists of a 6-1/2 foot, duct-type framework which accepts standard 19-inch panels.

The depth of the bay is approximately 11 inches and the width approximately 19-1/2 inches. To facilitate maintenance, the design is such as to permit all units to be serviced from the front of the bay. These units, starting from the top of the bay, are as follows:

Transmitter and Receiver Channel Combining and Separation Networks

Transmitter including Isolator

Transmitter Baseband Amplifier

Transmitter Automatic Frequency Control Unit.

Meter Panel

Receiver Modulator or Receiver Modulator Preamplifier

IF Limiter-Discriminator Unit

IF Preamplifier or Farinon Power Supply

IF Main Amplifier

Receiver Baseband Amplifier and AFC Unit

Power Supply

1.16 The local cable wiring between units on the bay is run in one cable form, stored in the duct at the right side of the bay, and in two lateral ducts, one directly above the meter panel and one above the power supply. The cable connections to the units are made by means of plugs and jacks to facilitate removal of the units for bench maintenance.

1.17 ***Alarm Facilities:*** Alarm connections are wired to a connector at the bottom of the bay for connection to the D1 or D2 alarm circuit in the order wire, alarm, and control bay.

1.18 ***Floor Plan Arrangement:*** This equipment is arranged for single-side maintenance with all equipment accessible and removable from the front of the frame. For information concerning the floor plan arrangement see Section 3.3, Sheet 67 of Floor Plan Data.

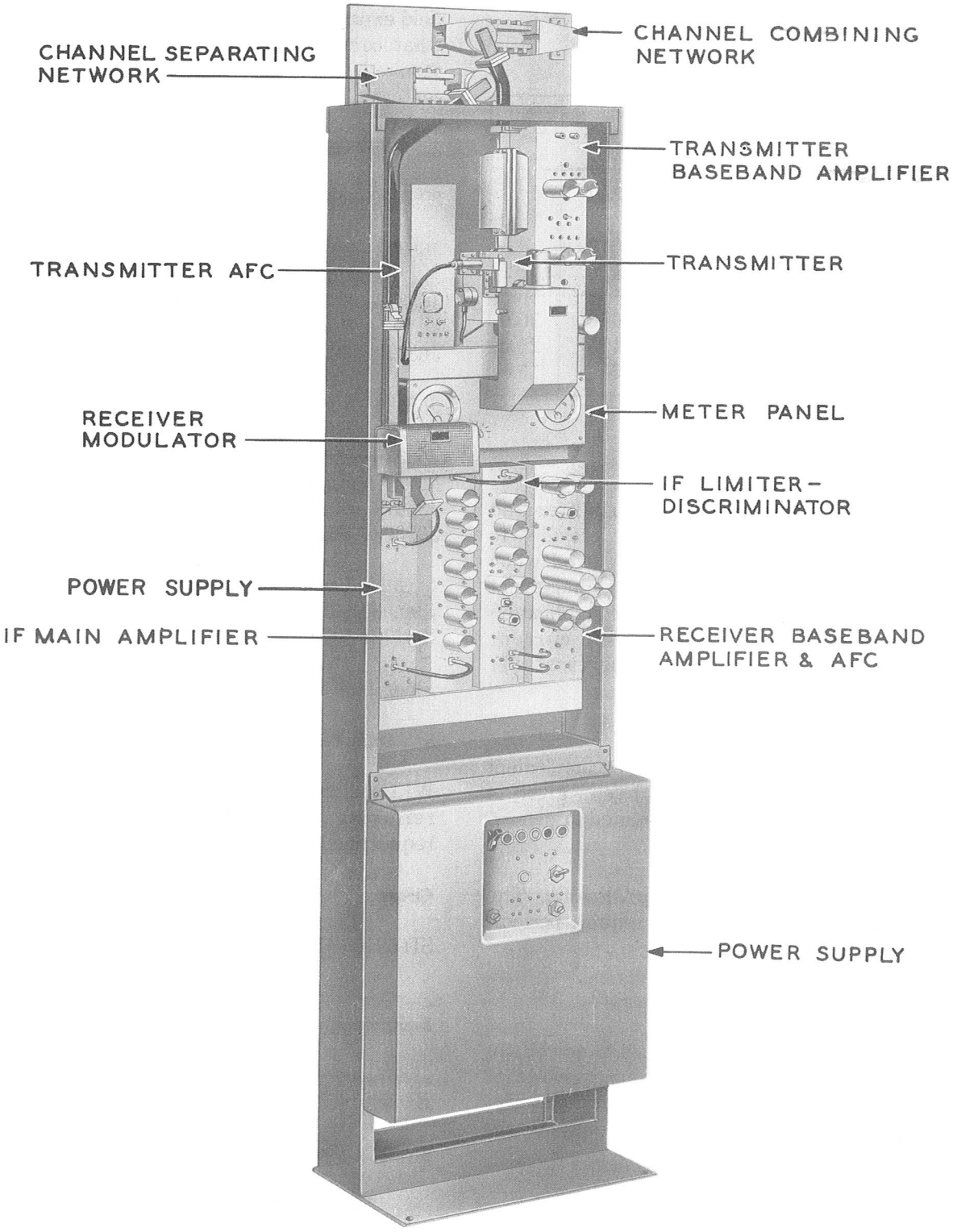

Fig. 1—Transmitter-Receiver Bay, Front View

1.19 ***Power Drain and Fusing:***

APPARATUS	VOLTS		AMPERES	WATTS
	ac	dc		
Receiver		+200	0.220	44.0
		+400	0.045	18.0
		−400	0.012	4.8
	6.3		7.5	47.2
Transmitter		+600	0.060	36.0
		+200	0.125	25.0
	6.3		2.5	15.8

Common fusing is used for the transmitter and receiver. A strapping arrangement is provided to keep the power supply load relatively fixed when a transmitter only or a receiver only arrangement is required. For further details, see application schematic, SD-59769-01. The ac line current requirement for the bay is 3.9 amperes at 117 volts (375 watts maximum).

1.20 ***Tube Complement:*** The tube complement for the transmitter-receiver bay is given in Table A. (All tubes are shipped mounted in place.)

1.21 ***Spare Equipment Complement:*** The following components may require periodic replacement:

Fuses

Electron Tubes (683A tool is required for removing electron tube heat shields, KS-13753 tube extractor for removing miniature electron tubes, and KS-5637, L1 for removing the 437A-type electron tube)

Varistors

Transmitter Klystron Fan (KS-19688)

Transmitter Servomotor (KS-15808)

Sensitrol Relays (KS-14075 and KS-16393)

Local policies of the telephone companies and their field experience with microwave systems will dictate what components and their quantities should be stocked at repeater stations and maintenance centers.

2. SUPPLEMENTARY INFORMATION

800-600-000—List of General Equipment Requirements Sections
J68372—804-336-152—TJ Radio Transmitter-Receiver Units
J68373—804-336-153—Order Wire, Alarm, and Control Bay
J68374—804-336-154—Order Wire, Alarm, and Control Units
J68375—804-132-150—D1 Alarm and Control System Units
J68376—804-336-155—TJ Radio Test Sets and Test Equipment Testing and Maintenance
J86473—802-341-161—TJ Radio Power Supply
J99303—801-415-150—Short Haul Radio Systems TJ, TL-1, TL-2, and TM-1 Application Specification, Common Systems
R90.330—TJ Radio Transmitter-Receiver Bay
X-67721—Manufacturing Testing Requirements for TJ Radio Transmitter-Receiver Bay
Floor Plan Data—Section 3.3, Sheet 67

3. DRAWINGS

WECo J drawings listed should be ordered by referring to the prefix and base number and requesting the current dash (−) number.

Circuit

SD-59769-01—TJ Radio Transmitter-Receiver Bay—Application Schematic

Equipment

J68371A-( )—TJ Radio Transmitter-Receiver Bay
ED-59514-70—Framework Details

4. EQUIPMENT

Note: Since this specification has not been kept up to date, changes to Part 4. Equipment will not be detailed at this time. Western Electric Company drawings cover all requirements and should be referred to for current information and list structures. For instance, addition of the J68372J, List 3 transmitter

TABLE A

UNIT	TUBES											VARISTORS								RELAYS			FUSES*			
	310A	396A	417A	420A	423A	427A	435A	437A	445A	5726 (RCA OR EQUIV)	NE51	KS-16410	KS-16411, L1 (MATCHED PAIR)	KS-16412	KS-16413	400A	425A	426A	400E	275B	KS-14075	KS-16393	MDL 1/4 AMP	MDL 2 AMP	MDL 2-1/2 AMP	MDX 4 AMP
RECEIVER																										
Receiver Modulator									1†				1													
IF Preamplifier			2				2																			
IF Main Amplifier							7									2										
IF Lim-Discr							5			1					6			1								
Rec Baseband Ampl AFC		1	2	1						1																
TOTAL		1	4	1			14		1	2			1		6	2		1								
TRANSMITTER																										
Transmitter									1‡			2		1												
Trans Baseband Ampl								4																		
Trans AFC Unit																		2	2	2		1				
TOTAL								4	1			2		1				2	2	2		1				
METER PANEL																					1					
POWER SUPPLY	2				1	1					1						2	135					2	1	1	1

* Fusetron Manufactured by Bussmann Mfg Co, or equivalent
† Receiver Beat Oscillator Klystron
‡ Transmitter Oscillator Klystron

AFC unit as a part of the J68371A transmitter-receiver bay is covered on the Western Electric Company drawings.

5.03 Electron tubes required for operation of the equipment are furnished, installed in their respective sockets. For detailed listing of these items, see Part 1 of this specification.

5. GENERAL NOTES

5.01 The frames shall be installed in accordance with framing information covered on J68371A-( ) and ED-59514-70.

5.02 Method of connecting the waveguide from the antennas to the transmitter-receiver bay is shown on J68371A-( ).

6. REASONS FOR REISSUE

6.01 The reasons for reissue are as follows:

(a) To provide the redesigned J68372J transmitter AFC unit as part of the transmitter-receiver bay.

(b) To reassign frequency designations as an aid to the microwave station records.

(c) To provide the TL-2 radio J99296AA modulator-preamplifier unit as a replacement for the 1A modulator and the J68372B IF preamplifier. This unit provides improved performance and eliminates a potential impedance mismatch between the old modulator and the IF preamplifier due to deterioration.

(d) To provide a Farinon electric power supply to adapt available TJ radio voltages to −20 volts required for operation of the J99296AA modulator-preamplifier.

(e) To correct frequency designation reassignments for the regular frequency plan.

(f) To add a staggered channel frequency plan.

(g) To refer to application specification J99303—801-415-150—for engineering of TJ and other short haul radio stations.

(h) To bring information covered in Parts 1 and 2 up to date and to broaden the reasons for elimination of Part 4. Equipment. Current equipment information is listed under Part 3. Drawings and covered by Western Electric Company drawings.

(i) To convert specification to 9 digit BSP number.

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Dept 4312