TJ/TM-1 MICROWAVE RADIO
SYSTEM TESTS — TELEPHONE WITH DIVERSITY
SIGNALING AND PILOT TONE LEVELS

TJ/TM-1 radio diversity system carrying message uses the lower 4 kilocycles of the baseband for order wire, signaling, and pilot tone circuits. To minimize interference and still provide noise free performance, the levels of audio, 2600-cycle signaling tone and 3700-cycle pilot tone, must be maintained at specific values. This section outlines the correct levels and the method of making measurements as applied to the radio system. The order wire and alarm path is common to the multiplex path through the radio system. In the diversity switch unit, provision is made for separating and combining 3700-cycle pilot tone, 2600-cycle signaling tone, and order wire with the multiplex path. On a system comprising more than one diversity pair, the order wire, 2600-cycle signaling tone, and 3700-cycle pilot tone will be carried on the first diversity pair. The other diversity pairs in the system will carry only the 3700-cycle pilot tone. The 3700-cycle pilot tone is always transmitted, thus the pilot levels can be checked without the use of a signal generator. At each radio station, a 3700-cycle oscillator installed in the diversity switch unit generates tone for one direction of radio transmission. Test jacks are provided for making bridging measurements without interrupting service.

Measurements of 2600 cps signaling tone must be made ***initially at all stations*** at the diversity, switch bridge jacks and also in all D2 order wire and alarm units.

The 2600-cycle signaling tone and 3700-cycle pilot tone tests are listed separately for clarity only, but may be done concurrently.

Tests and adjustments are to be performed at indicated stations as follows:

(1) 2600-cycle Signaling Tone Level — Systems or Branches Without Spurs — (Steps 1 to 7)

(2) 2600-cycle Signaling Tone Levels — Systems or Branches With Spurs — (Steps 8 to 13)

(3) 3700-cycle Pilot Tone Levels — (Steps 14 to 20)

(4) D2 Order Wire, Alarm, and Control Unit 2600-cycle Signaling Levels — (Steps 21 to 28)

APPARATUS:

1 — KS-15538, L4 Frequency Selective Voltmeter

1 — ED-59517-10, Group 8 Test Cord — Supplied with J68376C impedance matching test set

4 — 258C Dummy Plugs

1 — P2AW Test Cord — Supplied with J68376C impedance matching test set

1 — 368A, 75-ohm Termination

1 — P3N Cord — Supplied with J68376C impedance matching test set

1 — P-49R874 Test Cord (310 Plug to General Radio 274MB)

1 — Pomona Electronics 2BA-PT063-48(WE) Test Cord

1 — Banana Plug with 600-ohm 1% — 1/2 watt Resistor

2 — 262B Terminations (4-262B Terminations are required at Spurs)

1 — ED-59517-10 G10 Test Cord

1 — ED-59517-10 G25 Test Cord

STEP	PROCEDURE
	2600-CYCLE SIGNALING TONE LEVEL — SYSTEMS OR BRANCHES WITHOUT SPURS
1	At the near-end terminal, make test connections as shown in Fig. 1. Calibrate the frequency selective voltmeter in accordance with the instructions furnished by the manufacturer.
2	Connect the test cord to the BDG 2 jack on the diversity switch and transmission unit, and measure the level of the 2600-cycle pilot tone. Decibels may be read directly with input set to 600 ohms bridged at 250 cycles. ***Requirement:*** −35.5 ±1 db If this requirement is not met, check the levels of the D-type alarm, control, and order-wire unit.
3	Remove the test cord from the BDG 2 jack and connect it to the BDG 1 jack. This is the signaling tone return path. Measure the level as indicated on the frequency selective voltmeter. ***Requirement:*** −36 ±2 db If the requirement is not met, trouble is indicated at some station in the system. This could be at the near-end terminal, at a repeater, or at the far-end terminal, in either the transmitting or receiving path of the signaling tone. To determine if radio trouble exists, proceed as in Steps 4 through 6.
4	Determine the receiver in operation, and measure the level at the BDG 1 jack.
5	Operate MAN AUTO switch S1 to the alternate receiver and measure the level at the BDG 1 jack. From this measurement and the measurement of Step 4, it can be determined if the trouble is common to both receivers in the diversity pair. If the system is equipped to remotely operate each diversity switch, monitor the received 2600-cycle level at BDG 1 of the near-end terminal diversity switch unit while the alarm attendant operates each diversity switch unit. If a radio link should be in trouble, a change in level will occur when the switch is operated to that link. See Fig. 2 for a simplified diagram of the equipment and levels involved. Should the switching sequence locate the trouble, perform Step 6; otherwise perform Step 7 at each station until the trouble is located.
6	At the link in trouble, perform tests as outlined in Section 409-241-503 and, if necessary, 409-241-505.
7	At succeeding stations of the route in question, measure the BDG 1 and BDG 2 levels using the test setup of Fig. 1. ***Requirement 1:*** BDG 1 −36.0 ±1 db ***Requirement 2:*** BDG 2 −35.5 ±1 db At a station where a correct BDG 1 level exists but the BDG 2 requirement is not met, check the alarm equipment using procedures in Part 4 of this section.
	2600-CYCLE SIGNALING TONE LEVEL — SYSTEMS OR BRANCHES WITH SPURS
8	At the near-end terminal, perform Steps 1 through 3 and if required, Steps 4 through 7 to establish correct levels on the main route.

STEP	PROCEDURE
9	At each junction station, notify the alarm center that 2600-cycle tone will be momentarily interrupted.
10	In the D2 substation, block the OP relay in the operated position. This removes 2600-cycle tone on the return route.
11	In the D2 spur unit, block the C1 relay in the operated position. This allows 2600-cycle tone to be returned to the main station from the spur route.
12	At the primary system diversity switch unit transmitting toward the main station, set up the test circuit of Fig. 1 with the test cord connected to BDG 2. ***Requirement:*** −35.5 ±1 db If the requirement is met, make the relay normal. If this requirement is not met, measure the 2600-cycle level at BDG 1 and BDG 2 on the diversity switch unit or units transmitting toward and receiving from the spur. The spur levels at BDG 1 and BDG 2 should be −36.0 ±1 db and −35.5 ±1 db, respectively. (See Fig. 2 for a typical arrangement.) If the spur BDG 2 requirement is NOT met or if both spur requirements ARE met, trouble is indicated in the D2 equipment. (See Section 951-420-100.) If the spur BDG 2 requirement IS met, but BDG 1 requirement is NOT met, all or part of Steps 4 through 7 may be applied to the spur route until the trouble is found.
13	If two spurs are furnished at the junction station, repeat Steps 8 through 12 except operate relay C2 instead of relay C1.
14	At each diversity switch unit make the test connections as shown in Fig. 3.
15	Measure the 3700-cycle output level. ***Requirement:*** −34.5 db If this requirement is not met, readjust the output control of the oscillator.
16	Connect the test circuit of Fig. 4(A) with the KS-15538 frequency selective voltmeter set to accept 135-ohm bridged input at 250-cycle bandwidth.
17	Measure the 3700-cycle level at TRS MON. ***Requirement:*** −49 ±0.5 db
18	Set up the circuit of Fig. 4(B) with the KS-15538 frequency selective voltmeter set to accept 135-ohm bridged input.
19	Measure the 3700-cycle level at REC MON. ***Requirement:*** −33 ±0.5 db
20	At each succeeding station, repeat Steps 14 through 20.
	D2 ORDER WIRE, ALARM, AND CONTROL UNIT 2600-CYCLE SIGNALING LEVELS
21	Notify the D2 main station that momentary opens in the 2600 cps signaling tone will result from the following measurements at the D2 order wire and alarm substation and, if furnished, spur units (Step 23). It will be necessary to perform this test with assistance from the main station operator to silence the audible alarms.

STEP	PROCEDURE
22	Connect the test circuit of Fig. 5.
23	Measure the following 2600 levels in the D2 order wire and alarm system.

	OUTGOING ROUTE	RETURN ROUTE	LEVEL
At the Substation:	LINE OUT 1		−36 ±0.5 dbm
	E PAD OUT		−35.5±0.5
		LINE OUT 2	−36 ±0.5
		M NET OUT	−36 ±0.5
		D PAD OUT	−35.5±0.5
At the First Spur (If Equipped)	EQT OUT		−38.5±1.0
	G PAD OUT		−35.5±1.0
		L OUT 3	−36 ±0.5
		M NET A*	−36 ±0.5
		J PAD OUT	−19 ±0.5
At the Second Spur (If Equipped)	K PAD OUT		−35.5±0.5
		L OUT 4	−36 ±0.5
		M NET B†	−36 ±0.5
		M PAD OUT	−19 ±0.5

* Operate C1 relay in first spur station unit.
† Operate C2 relay in second spur station unit.

	OUTGOING ROUTE	RETURN ROUTE	LEVELS (NORMAL)	LEVELS (HIGH)**
At the Main Station	LINE TRS		−36	−36
	B PAD OUT		−36	−10
		LINE OUT 1	−35.5	−10 − {LINE LOSS}
		A AMPL OUT	−19	−19

** A high level may be furnished when the first radio location is substantially distant from the main station.

	OUTGOING ROUTE	RETURN ROUTE	LEVELS (NORMAL)	LEVELS (HIGH)**
At the Local Radio Alarm Panel	LINE 1 OUT		−36 ±0.5	−10 − {LINE LOSS
	HYB OUT		−35.5±0.5	−32±0.5
		LINE OUT 2	−36 ±0.5	−36±0.5
		C AMPL OUT	−35.5±0.5	−10±0.5

** A high level may be furnished when the first radio location is substantially distant from the main station.

If the requirements are met, remove test equipment and restore to normal conditions.

If the requirements are not met, perform the following tests.

STEP	PROCEDURE
	Resetting Substation 2600 cps Signaling Levels
24	Notify the main station operator that the substation is to be removed from service and order-wire communication to the stations will be interrupted. *Note:* Order wire and 2600 cps signaling tone will be normal through a repeater station under test by inserting 258C dummy plugs in LP FLT OUT and LP FLT IN. This allows tone to be transmitted to the next station 0.5 db low. Setting terminal station levels will interrupt service.
25	Insert 258C dummy plugs LP FLT OUT and LP FLT IN of the primary route diversity switch and transmission unit of the station to be tested (one diversity switch at the far-end terminal or two diversity switches at a repeater). Do not use dummy plugs at the near-end terminal.
26	Set up the test circuit of Fig. 6, option A, with the KS-15538 frequency selective voltmeter set to read 135 ohms bridged.
27	Adjust the 2600-oscillator to −36 dbm.
28	Make connections per Fig. 6, option B. Measure and adjust, if necessary, 2600 cps levels using the following table.

TONE INSERTED	MEASURED AT	REQUIREMENT	REMARKS
*A AMPL IN (Substation)	A PAD OUT	−32 ±0.5 dbm	
−36 dbm	E PAD OUT	−35.5	Set A AMPL

* At the near-end terminal, a high level 2600 cps tone option may be furnished. In this case it will be necessary to insert sufficient level at A AMPL IN to provide −32 dbm at A PAD OUT.

TONE INSERTED	MEASURED AT	REQUIREMENT	REMARKS
	A HYB OUT	−38.5±0.5	
	B PAD OUT	−19	Set B AMPL
	D PAD OUT	−35.5±1	600Ω Term in F PAD IN and E PAD OUT — Manually operate CL RELAY. (May be necessary to manually operate STA REL to clear alarms)
If 1st Spur Furnished:			
A AMPL IN (of Substation)	EQ OUT	−38.5±0.5	
	E AMPL OUT	−29.5±0.5	Set E AMPL
−36 dbm	G PAD OUT	−35.5	
If 2nd Spur Furnished:			
A AMPL IN (of Substation)	K PAD OUT	−35.5±0.5	
−36 dbm			
F PAD IN (of Substation)	M NET OUT	−36 ±0.5	
	TEL BRDG OUT	−39.5±0.5	
−36 dbm	D PAD OUT	−35.5	Set C AMPL
If One Spur is Furnished:			
F PAD IN (of Substation)	M NET (Spur Unit)	−36 ±0.5	
−36 dbm	BRDG OUT 1	−45.5±0.5	
	TEL BRDG OUT	−39.5	Set G AMPL
	D PAD OUT	−35.5	Set C AMPL
F AMPL IN (of Spur)	J PAD OUT	−19 ±0.5	
−36 dbm	M NET A	−36	Set F AMPL
			Manually operate C1 relay on spur unit

TONE INSERTED	MEASURED AT	REQUIREMENT	REMARKS
If the Second Spur is Furnished:			
H AMPL IN (of Spur)	M PAD OUT	−19 ±0.5	
−36 dbm	M NET B	−36	Set H AMPL Manually operate C2 relay on spur unit
If Local Alarm Circuit is Furnished:			
HYB IN	H PAD OUT	−36	Set A AMPL
−36* dbm	A HYB OUT	−35.5	
F PAD IN	TEL BRDG OUT	−39.5	
−36 dbm	C AMPL OUT	−35.5*	Set C AMPL

* If a high level is provided, adjust this level accordingly.

Note: The following pads should be installed in the D2 order wire, alarm, and control unit (and spur unit if installed) for TJ/TM-1 systems.

LOCATION	PAD	VALUE
Substation	A**	0
	B	8.5
	C	11.0
	D	0
	E	0
	F	0

** At the near-end terminal, an option may be furnished to provide a high level 2600 cps tone. In this case it will be necessary to select the A pad to provide the proper level at A PAD OUT, and adjust the C AMPL accordingly.

LOCATION	PAD	VALUE
1st Spur	G	0
	H	25
	J	8
2nd Spur	K	0
	L	25
	M	8
Local Alarm Ckt.	F	0

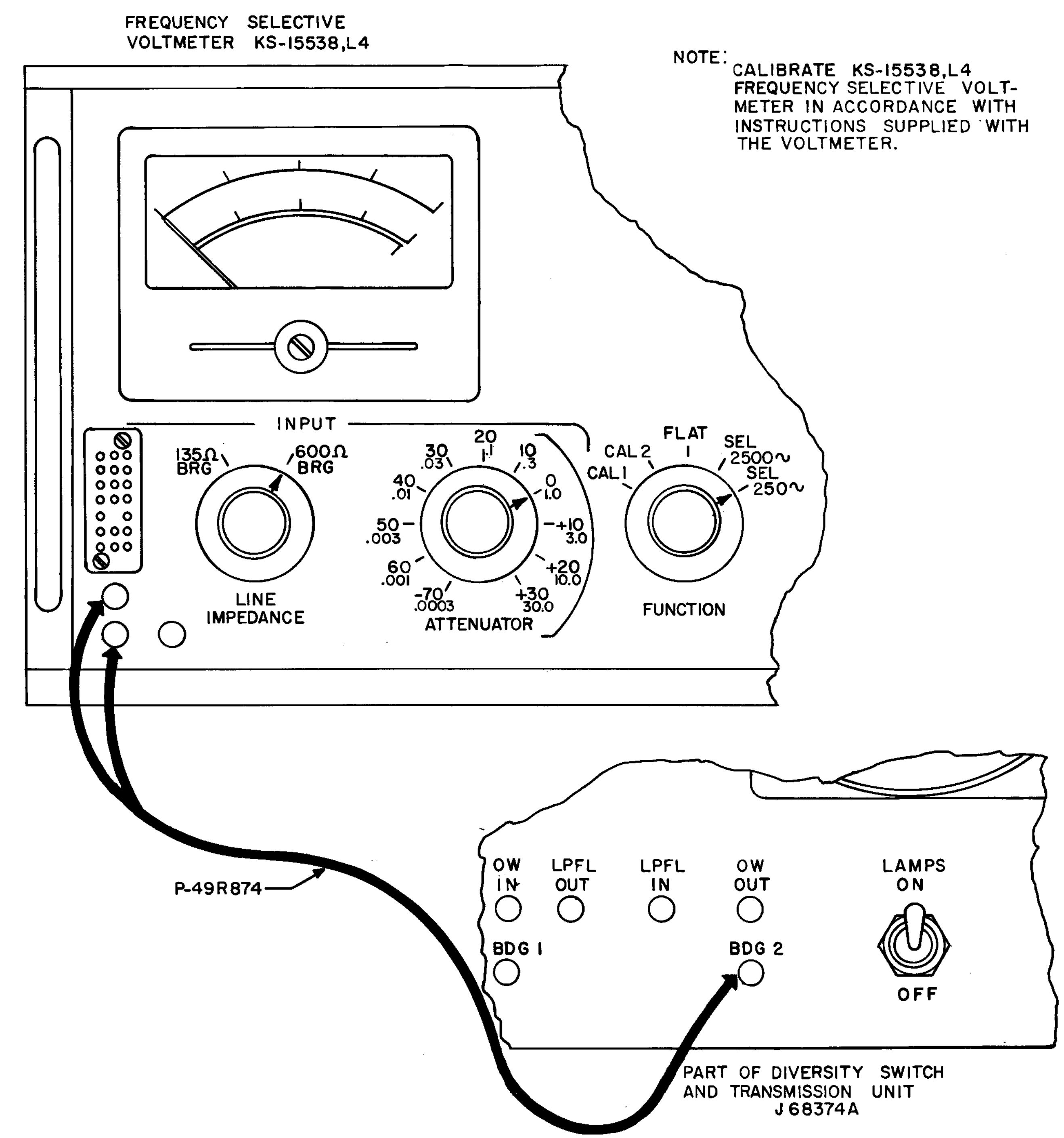

Fig. 1 – Test Connection for Signaling Tone Measurements

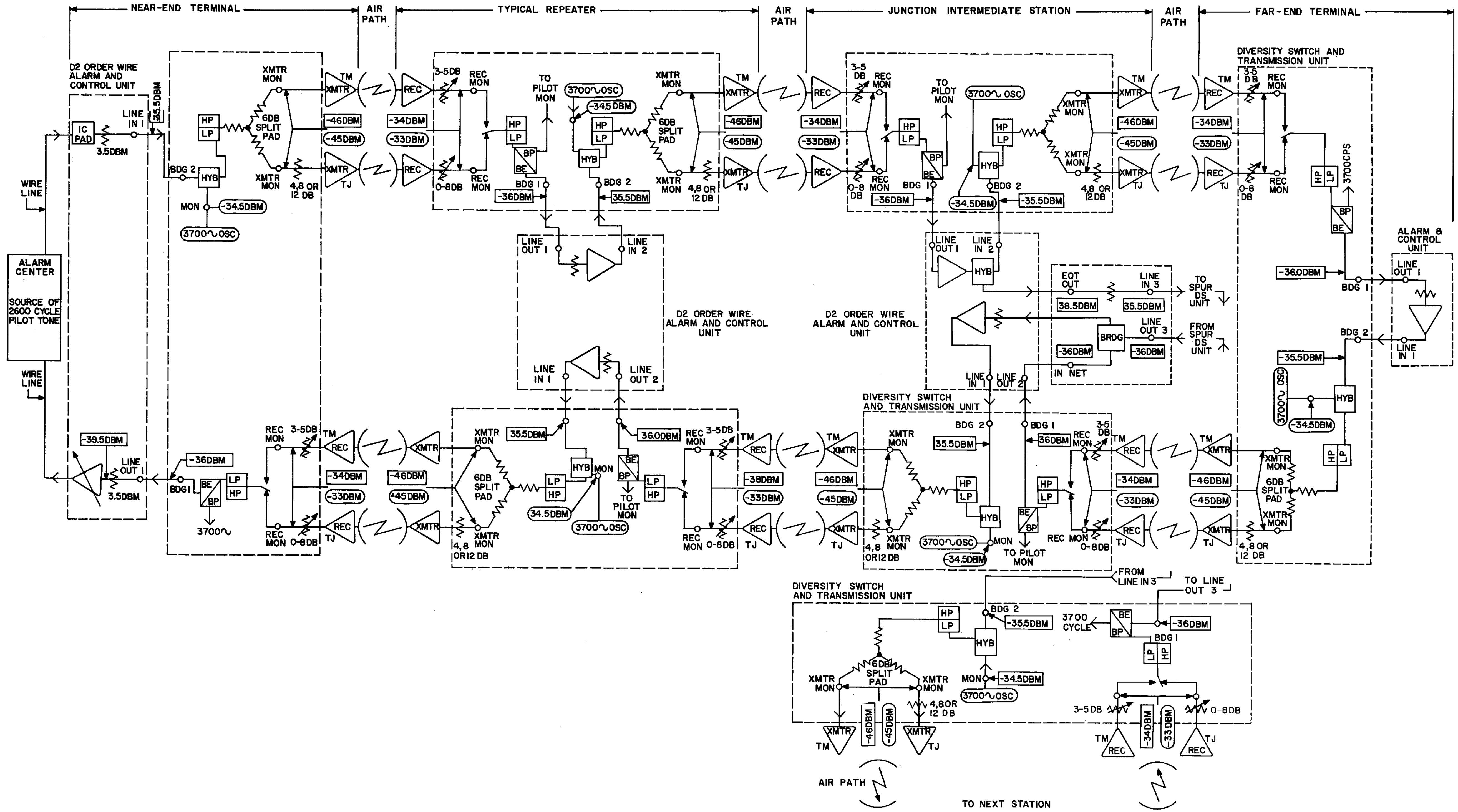

Fig. 2 – Typical TJ/TM-1 Radio D2 Order Wire and Alarm System

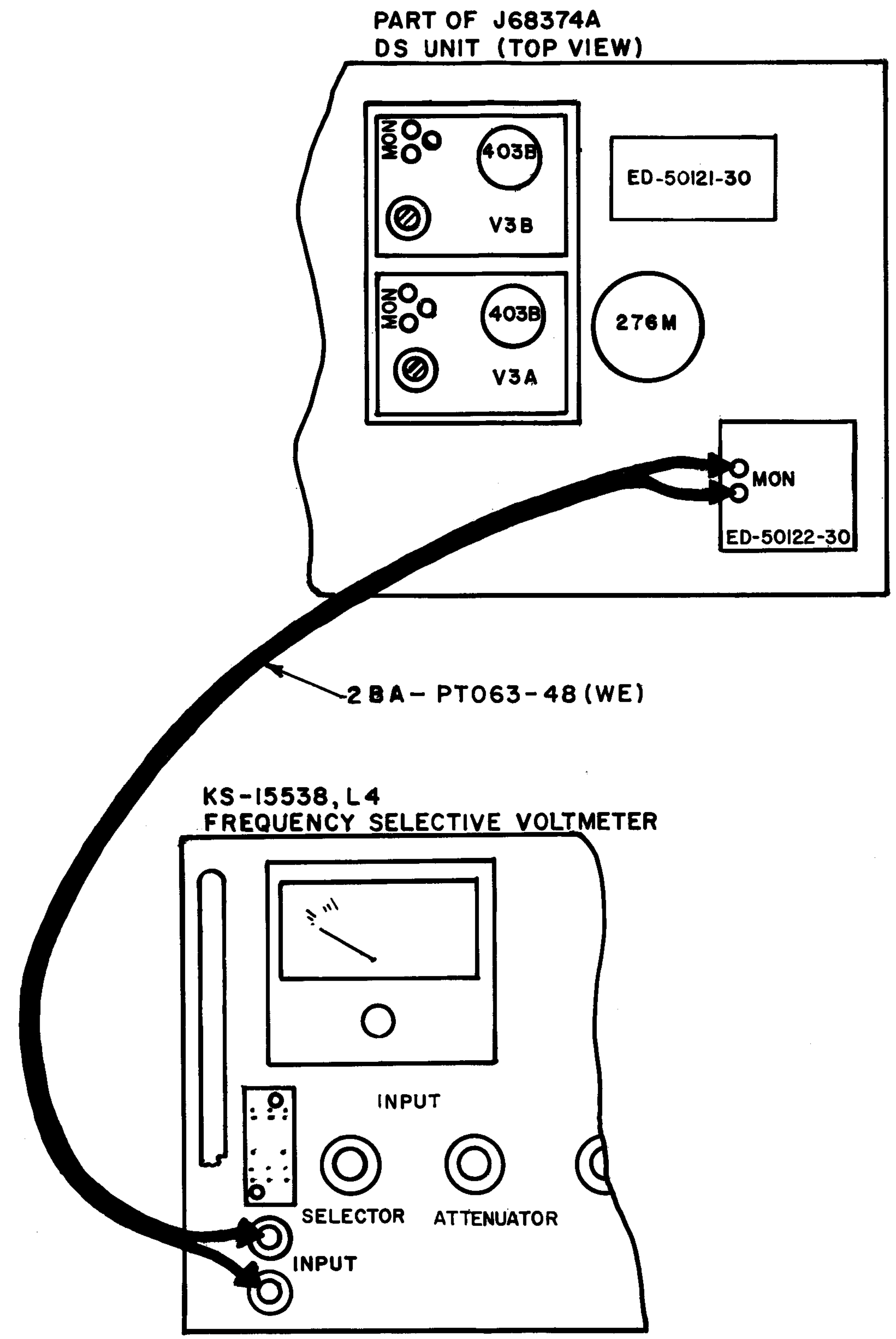

Fig. 3 – Test Connections for 3700-Cycle Pilot Tone Measurements

FIG. A
MEASUREMENT OF TRANSMITTED 3700-CPS
RADIO PILOT

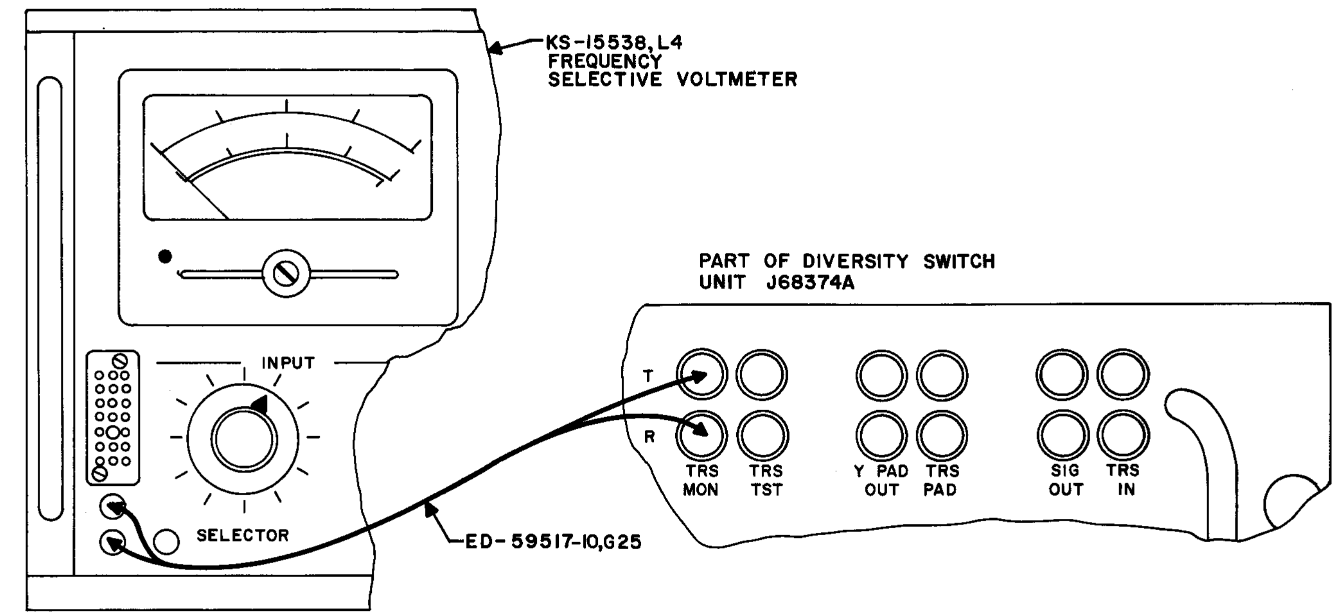

FIG. B
MEASUREMENT OF RECEIVED 3700-CPS
RADIO PILOT

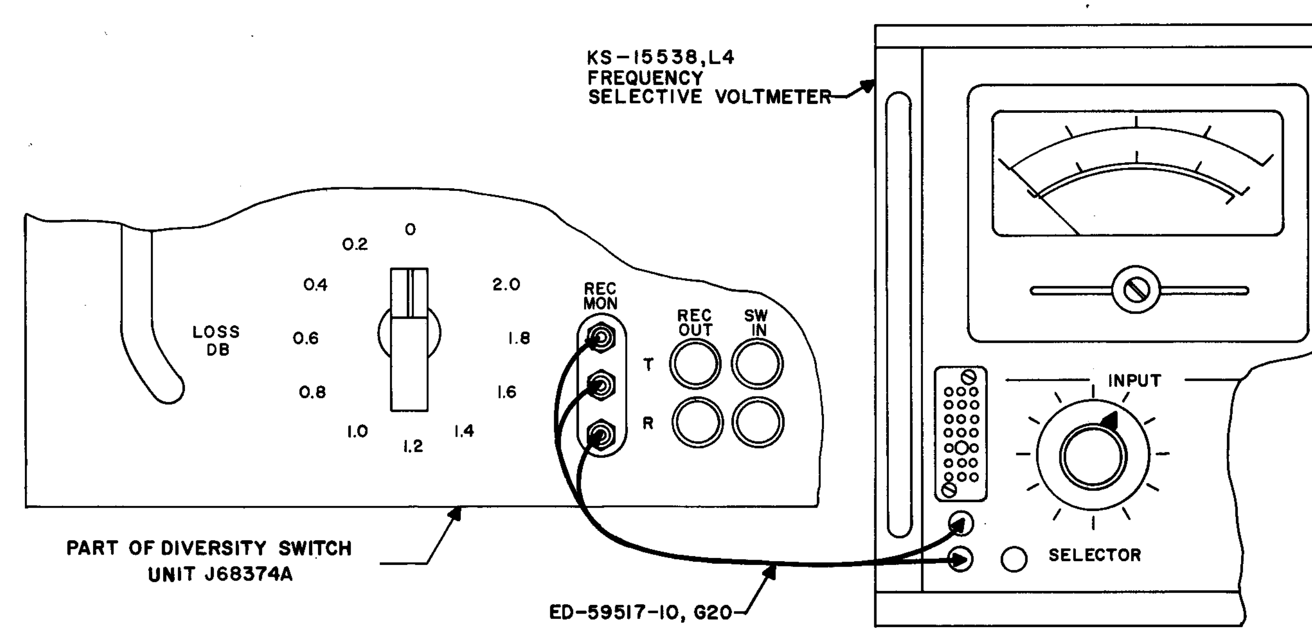

Fig. 4 — Test Connection for Measurement 3700 CPS Radio Pilot

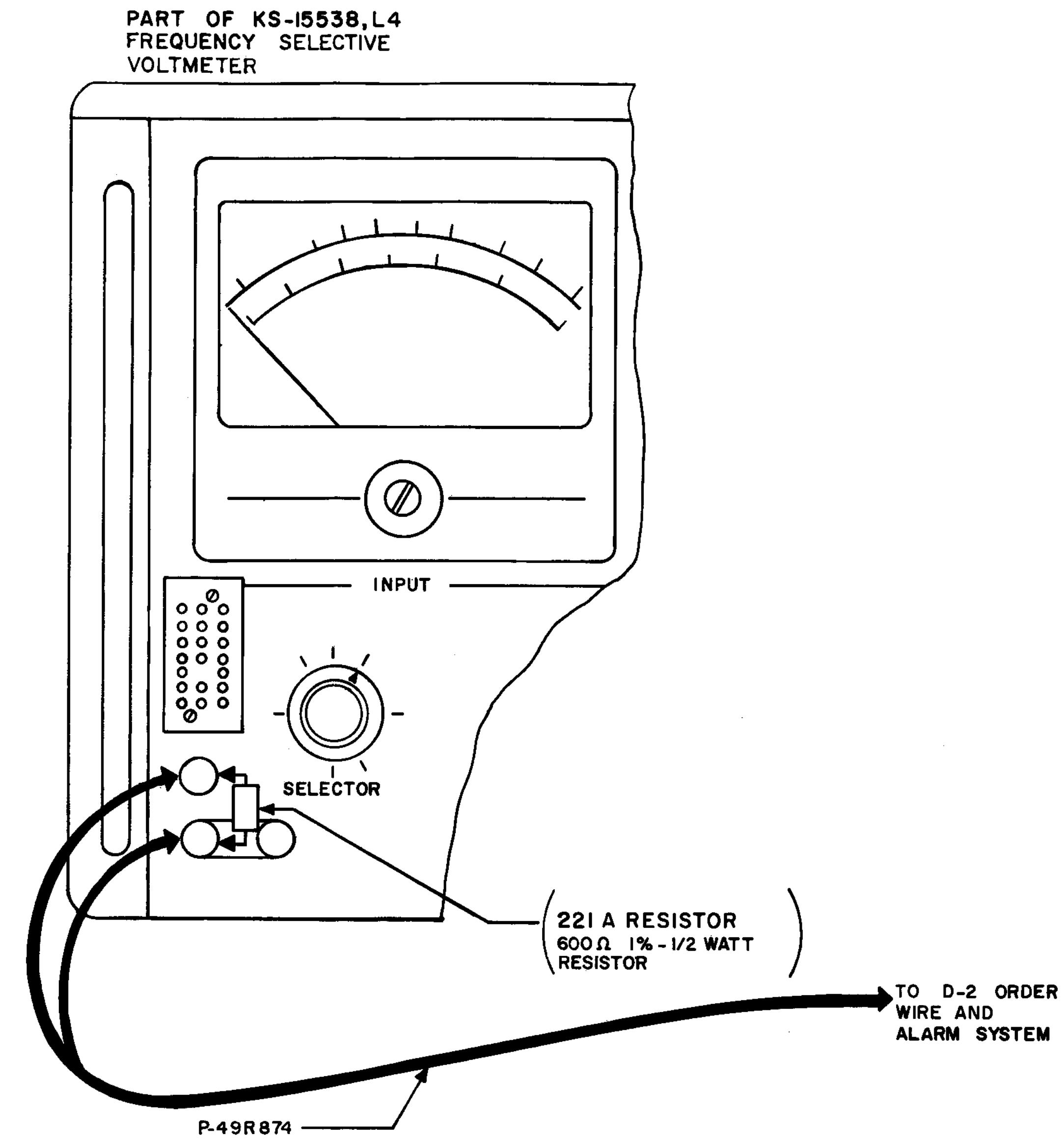

Fig. 5 – Test Connections for Measurement of 2600 CPS Signaling Tone

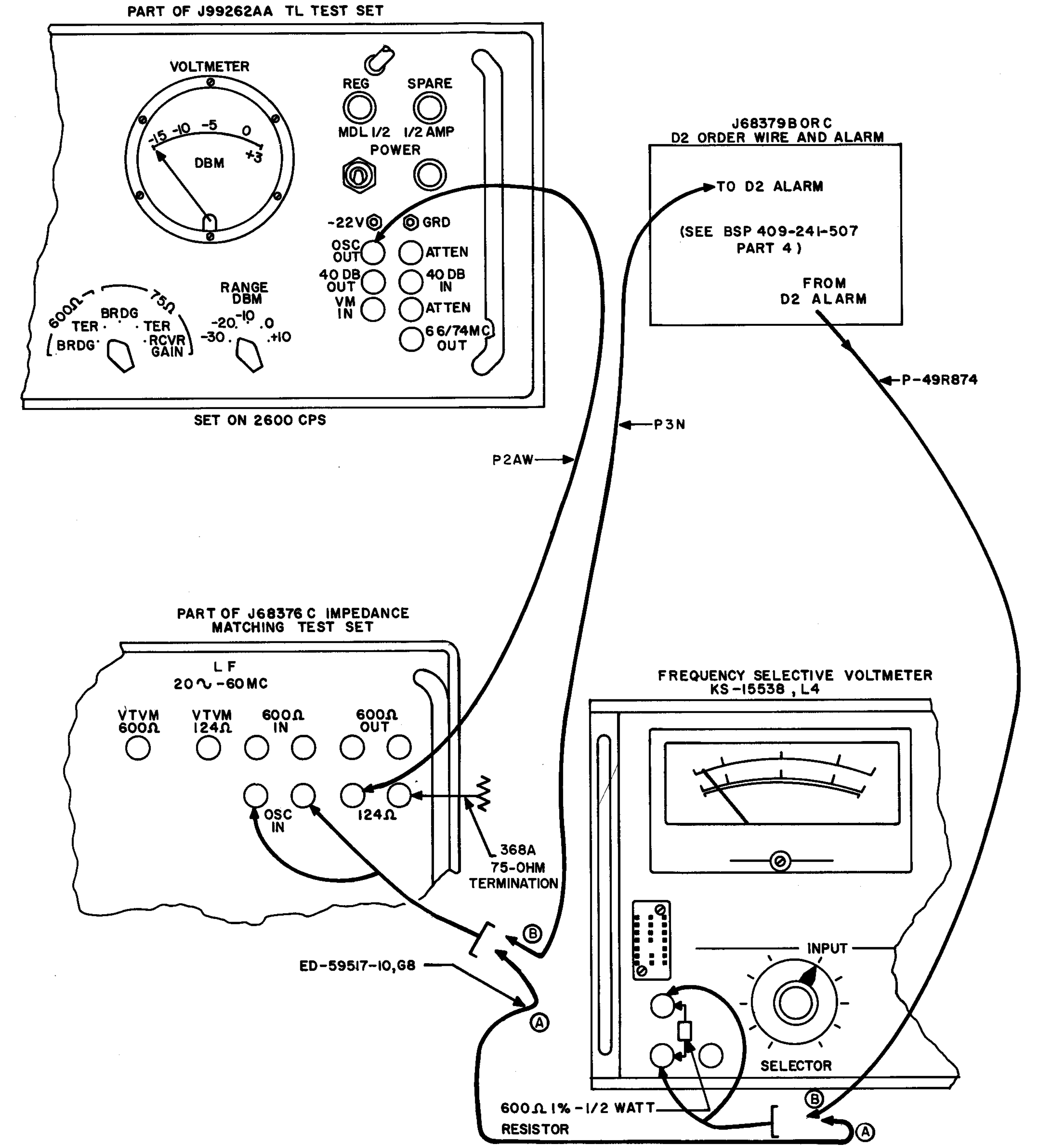

Fig. 6 – Test Connections for Setting 2600 CPS Signaling Tone Levels