

**TYPE N AND ON CARRIER REPEATERS — REPEATERED HIGH-FREQUENCY LINE
CARRIER LINE-UP — HIGH-FREQUENCY LINE MEASUREMENTS
ELECTRON TUBE REPEATER POINTS — INDIVIDUAL CARRIER OUTPUT**

Issue 4 of this section provides information for measuring the individual carriers at the output of an N or ON carrier repeater.

The section provides two procedures for measuring the carriers at a repeater output to determine the frequency characteristics of the preceding high-frequency line. The recommended procedure is to measure the individual carriers with the repeater output terminated in 135 ohms. It should be remembered, however, when a high-frequency line is terminated and the carriers are removed from the system all of the repeaters following the termination will operate at top gain.

As a result, crosstalk could develop in other carrier systems in the same cable. This is of particular importance when N carrier systems are placed in K cables. Where experience has shown that terminating a repeater output may present a noise or crosstalk problem, bridged measurements should be made to obtain an approximate slope computation.

When it is impractical to make terminated measurements, it should be kept in mind that bridged measurements are unreliable when made at locations where:

- (1) Equalizers or other networks (except span pads) are placed at the repeater output.
- (2) The central office shield cable to the carrier terminal or central office main frame is more than about 50 feet in length.

The measurements are normally *only* made at powered repeater stations where power for the test sets is available. When an undesirable deviation in the high-frequency line characteristics is encountered, the trouble can be sectionalized by making measurements at pole-mounted repeaters using a portable power supply.

Caution should be exercised, when measuring on working systems, to avoid causing hits on systems carrying SAGE or telegraph transmissions.

APPARATUS:	
1 — KS-15538, L1, L2 or L3 Carrier Frequency Voltmeter 1 — ED-92717-30 G4 Adapter, Modified (135-ohm termination for repeater) 1 — W20C Cord (used for connecting carrier frequency voltmeter to adapter and repeater switching jacks)	
MEASUREMENTS WITH REPEATER OUTPUT TERMINATED IN 135 OHMS	
STEP	PROCEDURE
1	Energize the carrier frequency voltmeter and allow 20 minutes for it to warm up. Calibrate the set according to the procedure described in the section covering the KS-15538 carrier frequency voltmeter.
2	Remove the connector from either J2 or J3 and place the modified ED-92717-30 G4 adapter in the vacant jack. See Fig. 2 for modification.
3	Remove the remaining connector from J2 or J3.
4	Connect the carrier frequency voltmeter to the adapter plug with a W20C cord.
5	Operate the selector switch to the W-E OUT or E-W OUT position as required.
6	Measure the carrier levels at the proper frequencies given in Tables I through IV and record on the proper Form E-4558.
7	Determine the repeater output slope using the method described in Section 362-400-510.
	<p>Requirements:</p> <p>(1) Each of the plotted individual channel carrier levels should be within approximately ± 3.0 db of the computed slope line ($Y_0 - Y_{12}$) plotted on Form E-4558.</p> <p>(2) The computed slope should be within approximately ± 3.0 db of the output slope for the repeater under test as specified by circuit order.</p> <p>Note: The Transmission Engineer should be notified if these requirements cannot be met on initial line-up. On routine measurements the effect of temperature on carrier slopes or other natural causes may prevent the above requirements from being met on some systems. In these cases the tests will be considered acceptable if the difference in slope variations between two successive locally powered repeater points does not exceed ± 0.5 db.</p>
8	Replace one connector in either the J2 or J3 and remove the modified ED-92717-30 G4 adapter. Replace the second connector in the vacant J jack.

BRIDGED MEASUREMENTS AT REPEATER OUTPUT

Bridged measurements may be taken for trouble investigation on a system in service. The corrections shown in Tables I through IV should be applied to the measurements before a slope computation is made.

STEP	PROCEDURE
1	Energize the carrier frequency voltmeter and allow 20 minutes for the set to stabilize. Calibrate the set according to the procedure described in the section covering the KS-15538 carrier frequency voltmeter.
2	Check that both connector plugs are in place in the J2 and J3 jacks. Remove one of the connector plugs. (When a plug-in equalizer is being used in the direction of transmission under test, remove the equalizer instead of the connector plug.)
3	Connect the carrier frequency voltmeter to the vacant J jack with a W20C cord.
4	Operate the voltmeter selector switch to the W-E OUT or E-W OUT position as required.
5	Measure the carrier levels at the proper frequencies as given in Tables I through IV and record on the proper Form E-4558.
6	<p>Determine the repeater output slope using the method described in Section 362-400-510.</p> <p>Requirements:</p> <ul style="list-style-type: none"> (1) Each of the plotted individual channel carrier levels should be within approximately ± 3.0 db of the computed slope line ($Y_0 - Y_{12}$). (2) The computed slope should be within approximately ± 3.0 db of the output slope for the repeater under test as specified by circuit order. <p>Note: The Transmission Engineer should be notified if these requirements cannot be met on initial line-up. On subsequent routine measurements the effect of temperature on carrier slopes or other natural causes may prevent the requirements from being met. In these cases the tests will be considered acceptable if the difference in slope variations between two successive locally powered repeater points does not exceed ± 0.5 db.</p>
7	Disconnect the carrier frequency voltmeter and insert a connector plug (or plug-in equalizer where required) in the vacant J jack.

TABLE I
ON1
CORRECTIONS TO BE APPLIED TO BRIDGED OUTPUT MEASUREMENTS
OF A REPEATER CONNECTED TO GROUP RECEIVING UNITS

LOW-LOW REPEATER											
CARRIER NO.	1	2	3	4	5	6	LCO	7	8	9	10
FREQUENCY — KC	132	124	112	104	92	84	76	72	64	52	44
GROUPS EQUIPPED											
1, LCO	-5.0	-4.9	—	—	—	—	-4.6	—	—	—	—
1, 2, LCO	-4.3	-4.3	-4.2	-4.0	—	—	-3.8	—	—	—	—
1, 2, 3, LCO	-3.8	-3.7	-3.6	-3.5	-3.3	-3.3	-3.2	—	—	—	—
1, 2, 3, 5, LCO	-3.7	-3.6	-3.4	-3.3	-3.1	-3.0	-2.9	—	—	-2.4	-2.2
1, 2, 3, 4, 5	-3.5	-3.4	-3.2	-3.0	-2.8	-2.7	—	-2.5	-2.4	—	—
1, 2, 3, 4, 5	-3.2	-3.1	-2.8	-2.7	-2.5	-2.3	—	-2.1	-1.9	-1.8	-1.6
HIGH-LOW REPEATER											
CARRIER NO.	1	2	3	4	5	6	LCO	7	8	9	10
FREQUENCY — KC	132	124	112	104	92	84	76	72	64	52	44
CORRECTION — DB	+0.4	+0.4	+0.4	+0.3	+0.3	+0.2	+0.1	0.0	-0.1	-0.5	-0.8

TABLE II
N AND ON2 REPEATERS

LOW-LOW REPEATER														
N CARRIER NO.	1	2	3	4	5	6	7	8		9	10	11	12	13
ON2 CARRIER NO.		1	2	3	4	5	6	7	LCO	8	9	10	11	12
FREQUENCY — KC	136	128	120	112	104	96	88	80	76	72	64	56	48	40
GROUPS EQUIPPED														
1, LCO	—	-5.0	-4.9	—	—	—	—	—	-4.6	—	—	—	—	—
1, 2, LCO	—	-4.3	-4.2	-4.2	-4.0	—	—	—	-3.8	—	—	—	—	—
1, 2, 3, LCO	—	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	—	-3.2	—	—	—	—	—
1, 2, 3, 6, LCO	—	-3.4	-3.3	-3.2	-3.0	-2.9	-2.8	—	-2.6	—	—	—	-2.2	-2.1
1, 2, 3, 5, 6, LCO	—	-3.1	-3.0	-2.8	-2.7	-2.6	-2.4	—	-2.2	—	-2.0	-1.8	-1.7	-1.5
1, 2, 3, 4, 5, 6 and N	-3.1	-3.0	-2.8	-2.7	-2.5	-2.3	-2.2	-2.0	—	-1.8	-1.6	-1.5	-1.3	-1.1
HIGH-LOW REPEATER														
N CARRIER NO.	1	2	3	4	5	6	7	8		9	10	11	12	13
ON2 CARRIER NO.		1	2	3	4	5	6	7	LCO	8	9	10	11	12
FREQUENCY — KC	136	128	120	112	104	96	88	80	76	72	64	56	48	40
CORRECTION — DB	+0.4	+0.4	+0.4	+0.4	+0.3	+0.3	+0.2	+0.2	+0.1	0.0	-0.1	-0.3	-0.6	-1.0

TABLE III
ON1
CORRECTIONS TO BE APPLIED TO BRIDGED OUTPUT MEASUREMENTS OF A
REPEATER WHERE AN ARTIFICIAL LINE OR DEVIATION EQUALIZER IS
USED AT THE OUTPUT

LOW-LOW OR HIGH-LOW REPEATER														
CARRIER NO.			1	2	3	4	5	6	LCO	7	8	9	10	
FREQUENCY — KC			132	124	112	104	92	84	76	72	64	52	44	
DEV. EQ	ART. LINE	SPAN PAD DB												
NOT USED	USED (1 Mile)	0	+0.6	+0.5	+0.4	+0.3	+0.1	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	
		2	+0.5	+0.4	+0.3	+0.2	+0.1	0.0	-0.1	-0.1	-0.2	-0.4	-0.6	
		4	+0.3	+0.3	+0.2	+0.1	+0.1	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	
		6	+0.2	+0.2	+0.2	+0.1	+0.1	+0.1	0.0	0.0	-0.1	-0.2	-0.2	
		8	+0.1	+0.1	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
		10	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
USED	USED (1 Mile)	0	+1.0	+0.9	+0.7	+0.5	+0.2	0.0	-0.2	-0.4	-0.6	-0.8	-0.8	
		2	+0.4	+0.4	+0.5	+0.4	+0.2	0.0	-0.2	-0.3	-0.4	-0.6	-0.6	
		4	+0.4	+0.4	+0.3	+0.2	+0.1	+0.1	-0.1	-0.1	-0.3	-0.4	-0.4	
		6	+0.3	+0.3	+0.2	+0.2	+0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	
		8	+0.2	+0.2	+0.1	+0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	
		10	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1		
USED OR NOT USED	USED (2 Mile or 4 Mile)	0	+3.6	+3.5	+3.2	+2.9	+2.6	+2.3	+2.0	+1.9	+1.6	+1.0	+0.7	
		2	+2.2	+2.1	+2.0	+1.9	+1.7	+1.5	+1.4	+1.3	+1.1	+0.8	+0.7	
		4	+1.5	+1.4	+1.3	+1.3	+1.1	+1.0	+0.9	+0.9	+0.8	+0.5	+0.4	
		6	+0.9	+0.9	+0.8	+0.7	+0.7	+0.6	+0.6	+0.5	+0.5	+0.4	+0.3	
		8	+0.5	+0.5	+0.5	+0.5	+0.5	+0.4	+0.4	+0.3	+0.3	+0.3	+0.2	
		10	+0.4	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.2	+0.2	+0.2	+0.1	
USED	NOT USED	ANY				NO CORRECTION								
LOW-HIGH REPEATER														
CARRIER NO.			1	2	3	4	5	6	LCO	7	8	9	10	
FREQUENCY — KC			172	180	192	200	212	220	228	232	240	252	260	
DEV. EQ	ART. LINE	SPAN PAD DB												
	USED (1 Mile)	0	+1.7	+1.8	+2.0	+2.1	+2.2	+2.4	+2.5	+2.5	+2.6	+2.7	+2.7	
		2	+1.1	+1.2	+1.3	+1.3	+1.4	+1.5	+1.5	+1.6	+1.6	+1.7	+1.7	
		4	+0.7	+0.7	+0.8	+0.8	+0.9	+0.9	+1.0	+1.0	+1.0	+1.0	+1.0	
		6	+0.5	+0.5	+0.5	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.7	+0.7
		8	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4
		10	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	
NOT USED	USED (2 Mile or 4 Mile)	0	+4.4	+4.4	+4.5	+4.6	+4.7	+4.8	+4.8	+4.8	+4.9	+5.0	+5.0	
		2	+2.6	+2.6	+2.7	+2.8	+2.8	+2.9	+3.0	+3.0	+3.0	+3.0	+3.0	
		4	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	
		6	+0.9	+0.9	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	
		8	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	
		10	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	
	NOT USED	ANY				NO CORRECTION								

+ Sign indicates that the measured value should be made more positive or less negative by the correction value.

- Sign indicates that the measured value should be made less positive or more negative by the correction value.

TABLE IV
N AND ON2
CORRECTIONS TO BE APPLIED TO BRIDGED OUTPUT MEASUREMENTS OF A
REPEATER WHERE AN ARTIFICIAL LINE OR DEVIATION EQUALIZER IS
USED AT THE OUTPUT

LOW-LOW OR HIGH-LOW REPEATER																	
N CARRIER NO.			1	2	3	4	5	6	7	8		9	10	11	12	13	
ON2 CARRIER NO.				1	2	3	4	5	6	7	LCO	8	9	10	11	12	
FREQUENCY — KC			136	128	120	112	104	96	88	80	76	72	64	56	48	40	
DEV. EQ	ART. LINE	SPAN PAD DB															
NOT USED	USED (1 Mile)	0	+0.7	+0.6	+0.5	+0.4	+0.3	+0.2	0.0	-0.1	-0.2	-0.3	-0.5	-0.6	-0.8	-0.9	
		2	+0.4	+0.4	+0.3	+0.3	+0.2	+0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.4	-0.5	-0.6	
		4	+0.3	+0.3	+0.3	+0.2	+0.1	+0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	
		6	+0.2	+0.2	+0.2	+0.2	+0.1	+0.1	+0.1	+0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	
		8	+0.1	+0.1	+0.1	+0.1	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
		10	+0.1	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
USED	USED (1 Mile)	0	+1.1	+1.0	+0.8	+0.7	+0.5	+0.3	+0.1	-0.1	-0.2	-0.4	-0.6	-0.7	-0.8	-0.8	
		2	+0.4	+0.4	+0.4	+0.5	+0.4	+0.3	+0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6	
		4	+0.4	+0.4	+0.3	+0.3	+0.2	+0.2	+0.1	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.4	
		6	+0.3	+0.3	+0.2	+0.2	+0.2	+0.1	+0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	
		8	+0.2	+0.2	+0.2	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	
		10	+0.1	+0.1	+0.1	+0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
USED OR NOT USED	USED (2 Mile or 4 Mile)	0	+3.8	+3.6	+3.4	+3.2	+2.9	+2.7	+2.4	+2.2	+2.0	+1.9	+1.6	+1.2	+0.9	+0.6	
		2	+2.3	+2.2	+2.1	+2.0	+1.9	+1.7	+1.6	+1.4	+1.4	+1.3	+1.1	+0.9	+0.7	+0.6	
		4	+1.6	+1.5	+1.4	+1.3	+1.3	+1.2	+1.1	+1.0	+0.9	+0.9	+0.8	+0.6	+0.5	+0.4	
		6	+1.0	+0.9	+0.8	+0.8	+0.7	+0.7	+0.6	+0.6	+0.6	+0.5	+0.5	+0.4	+0.3	+0.3	
		8	+0.6	+0.5	+0.5	+0.5	+0.5	+0.4	+0.4	+0.4	+0.4	+0.4	+0.3	+0.3	+0.3	+0.2	+0.2
		10	+0.4	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.2	+0.2	+0.2	+0.1	+0.1	
USED	NOT USED	ANY							NO CORRECTION								
LOW-HIGH REPEATER																	
N CARRIER NO.			1	2	3	4	5	6	7	8		9	10	11	12	13	
ON2 CARRIER NO.				1	2	3	4	5	6	7	LCO	8	9	10	11	12	
FREQUENCY — KC			136	176	184	192	200	208	216	224	228	232	240	248	256	264	
DEV. EQ	ART. LINE	SPAN PAD DB															
NOT USED	USED (1 Mile)	0	+1.5	+1.7	+1.9	+2.0	+2.1	+2.2	+2.3	+2.4	+2.5	+2.5	+2.6	+2.6	+2.7	+2.7	
		2	+1.0	+1.1	+1.2	+1.3	+1.3	+1.4	+1.5	+1.5	+1.5	+1.5	+1.6	+1.6	+1.7	+1.7	
		4	+0.6	+0.7	+0.7	+0.8	+0.8	+0.9	+0.9	+0.9	+0.9	+1.0	+1.0	+1.0	+1.0	+1.0	
		6	+0.4	+0.5	+0.5	+0.5	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.7	+0.7	+0.7
		8	+0.2	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.3	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4
			10	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2	+0.2
	USED (2 Mile or 4 Mile)	0	+4.4	+4.4	+4.4	+4.5	+4.6	+4.7	+4.7	+4.8	+4.8	+4.8	+4.9	+4.9	+5.0	+5.0	
		2	+2.6	+2.6	+2.7	+2.7	+2.8	+2.8	+2.9	+2.9	+3.0	+3.0	+3.0	+3.0	+3.0	+3.0	
		4	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	+1.6	
		6	+0.9	+0.9	+0.9	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0	+1.0
		8	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6	+0.6
			10	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4	+0.4
	NOT USED	NOT USED	ANY							NO CORRECTION							

+ Sign indicates that the measured value should be made more positive or less negative by the correction value.
 - Sign indicates that the measured value should be made less positive or more negative by the correction value.

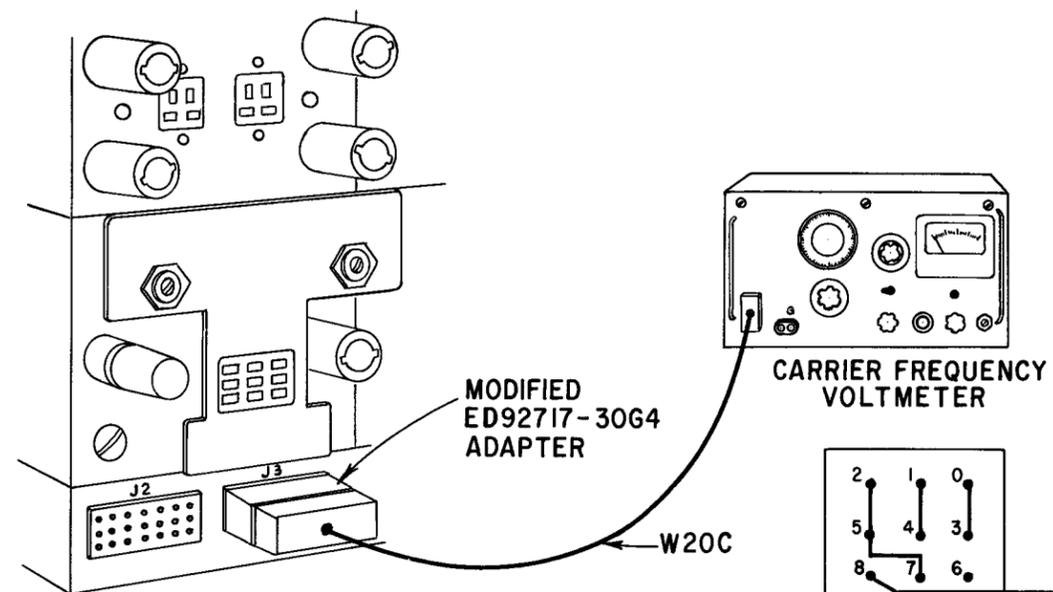


FIG. 1 TEST SETUP FOR 135 OHM TERMINATION MEASUREMENTS.

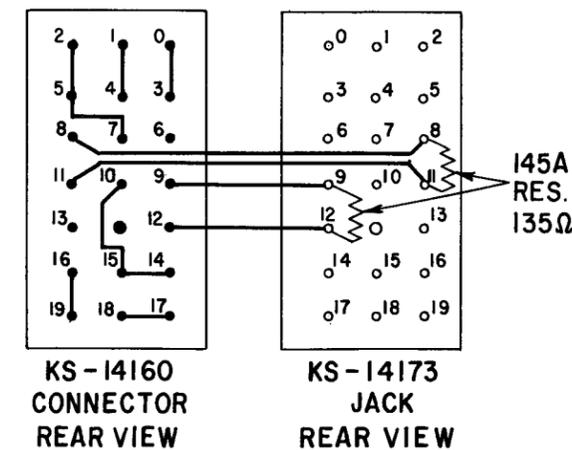


FIG. 2 MODIFIED ED92717-30G4 ADAPTER FOR TERMINATING REPEATERS.

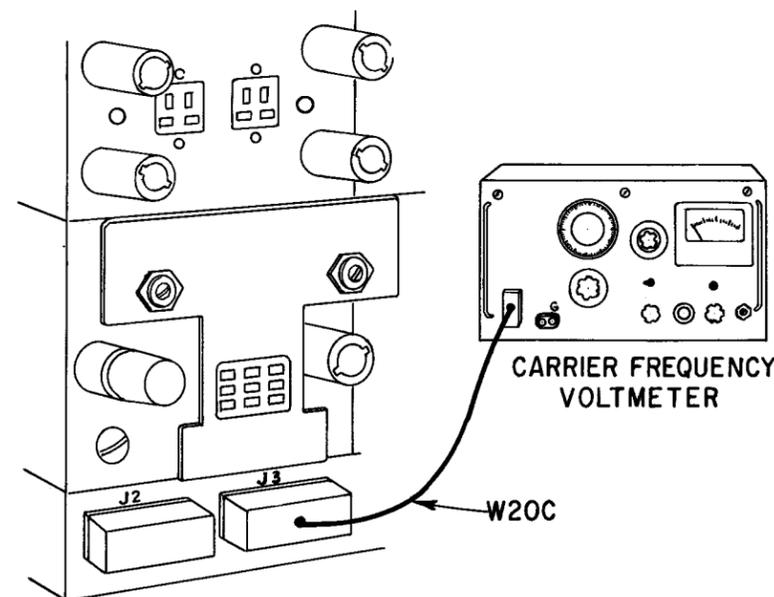


FIG. 3 TEST SETUP FOR BRIDGED MEASUREMENTS.

CHANNEL CARRIER OUTPUT
AT REPEATER POINTS