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ALTEC LANSING TECHNICAL LETTER NUMBER 5

APPLICATION OF THE A-322-C LIMITER AMPLIFIER

The limiter amplifier has been considered a valuable tool for many years. It is especially needed in connection with the large high quality Public Address systems.

Essentially the limiter amplifier operates such that its gain is fixed up to a predetermined output. Beyond this point an increase of level at the input does not produce a corresponding increase in output. Actually an increase of 10 db input increases the output by only 1 db. This limiting effect is accomplished without distortion of the signal wave form. As much as 20 db limiting can be obtained. A limiter is different than a compressor in that the limiter does not go into operation until a certain output level is obtained.

Another form of automatic gain control is the compressor type amplifier. It begins to compress 20 db below the wanted maximum and squeezes 20 db range into 10 db or it has a 2-1 ratio over this range. The compressor is a more difficult circuit to balance for thumps since it is changing the gain a large share of the time. The limiter with its 10-1 ratio is preferred because it acts only as a safety valve when the need arises. In broadcasting stations and recording studios it prevents overmodulation and allows a higher average level of recording without danger of distortion. It compensates for variations in volume resulting from changes in the

speakers position with respect to the microphones and for different voices using the same microphone. In high powered public address systems its use will prevent sudden or accidental peak power which can cause annoying loud sounds and loudspeakers failure. A few of the many applications of this amplifier are as follows:

Many large Public Address systems such as the Briggs Stadium in Detroit and the University of Kentucky Field House use Altec limiter amplifiers to protect the speaker driver units and at the same time insure that the Public Address System will not be overdriven by an excited announcer and blast the audience. A Miami dog track installed an A-322-C limiter for the express purpose of maintaining the top level of the system at a point where the surrounding neighborhood would not complain.

Ottis Jett, communication supervisor for the Union Pacific Railroad with headquarters at Omaha uses Altec Lansing equipment throughout the many passenger and freight terminal yards in the Union Pacific system. He reports distinct advantages of keeping the top level of train calling and paging at the point where passengers in sleeping cars will not be awakened while the train is in a terminal during the night. They also hold the level constant from the control tower in the freight yards when talking to train men on the tracks. The use of the limiters has reduced neighborhood complaints.

The Voice of America has recently installed forty 322-C limiters for all of their outgoing facilities. The Glenn Olegg Recording Studios have 35 in use on their T V channels. All America Cables & Radio, Inc. use A-322-C amplifiers on their radio channels in the Caribbean area where static is very intense and

according to their supervisor, Kenneth Barbier, the percentage of reliable transmission has materially improved.

The U. S. Navy Air Missile Center at Point Mugu, California uses 40 Altec limiters in their various communication and telemetering circuits which are concerned with missile firing. Mr. Brown of their organization reports that the efficiency of his circuits has been maintained at an exceptionally high level after the amplifiers were placed in service and because of the conservative design their problem with vacuum tube and component failures have been greatly reduced. Before using these limiters they had considerable difficulty in maintaining a good signal to noise ratio and in many cases missile launching was performed without obtaining proper data.

The limiter amplifier is installed at the point nearest the final power amplifier. It has an input impedance of 500 ohms or bridging tap. Its output impedance is 500 ohms and is capable of supplying 1 watt. The gain is 65 db maximum so that it can serve as a line amplifier having broadcast specifications in terms of noise and distortion.

For high quality performance it has been considered necessary to have push pull circuits in all stages of the amplifier and good balance is a requirement. The input stage uses type 1612 variable  $\mu$  tubes to accomplish the limiting. The second stage is resistance coupled 6J7 pentode tubes and the output stage uses the 6V6 beam power tubes. The screen and plate grid on the 1612 type tubes varies over wide limits with limiting and a static balance is accomplished by means of adjustment V1 and V2. Ordinarily it is sufficient to balance these

tubes on DC. On some tubes the mutual conductance slope is not constant over the entire range of limiting and added tests are required as follows:

Talk into a microphone and use words which have the letter P or B, such as Pop, pump, boom, busy, etc. Make sure that the sound is clean without thump with no limiting. Then adjust for 5-10 db of limiting. Adjust the balance  $V_1 - V_2$  until the thumps are not audible.  $V_1$  and  $V_2$  may not be balanced on DC but disregard this if adjustments will remove the thumps.

This method has been very successful in obtaining good balance. It takes up 50 hours of use to age a new pair of 1612 tubes and for this reason it is recommended that when a limiter amplifier is installed or a change in 1612 tubes is required that the limiter amplifier be left on for 50 hours and during this period it may be necessary to rebalance a few times. After this aging process the balance will remain constant for a long period of time. The last two stages are not as critical for precise balance and a DC balance is adequate.

In summary the A-322-C limiter amplifier is of radio broadcast quality and uses the highest grade components to insure long life and reliable service. The large number of limiters purchased over a period of time by each user is a testimonial to their performance.

It is a key item to any successful sound system; radio station, recording and Public Address installation.

When the amplifier is included in bidding specifications it is a strong point in swinging the final award to Altec equipment.

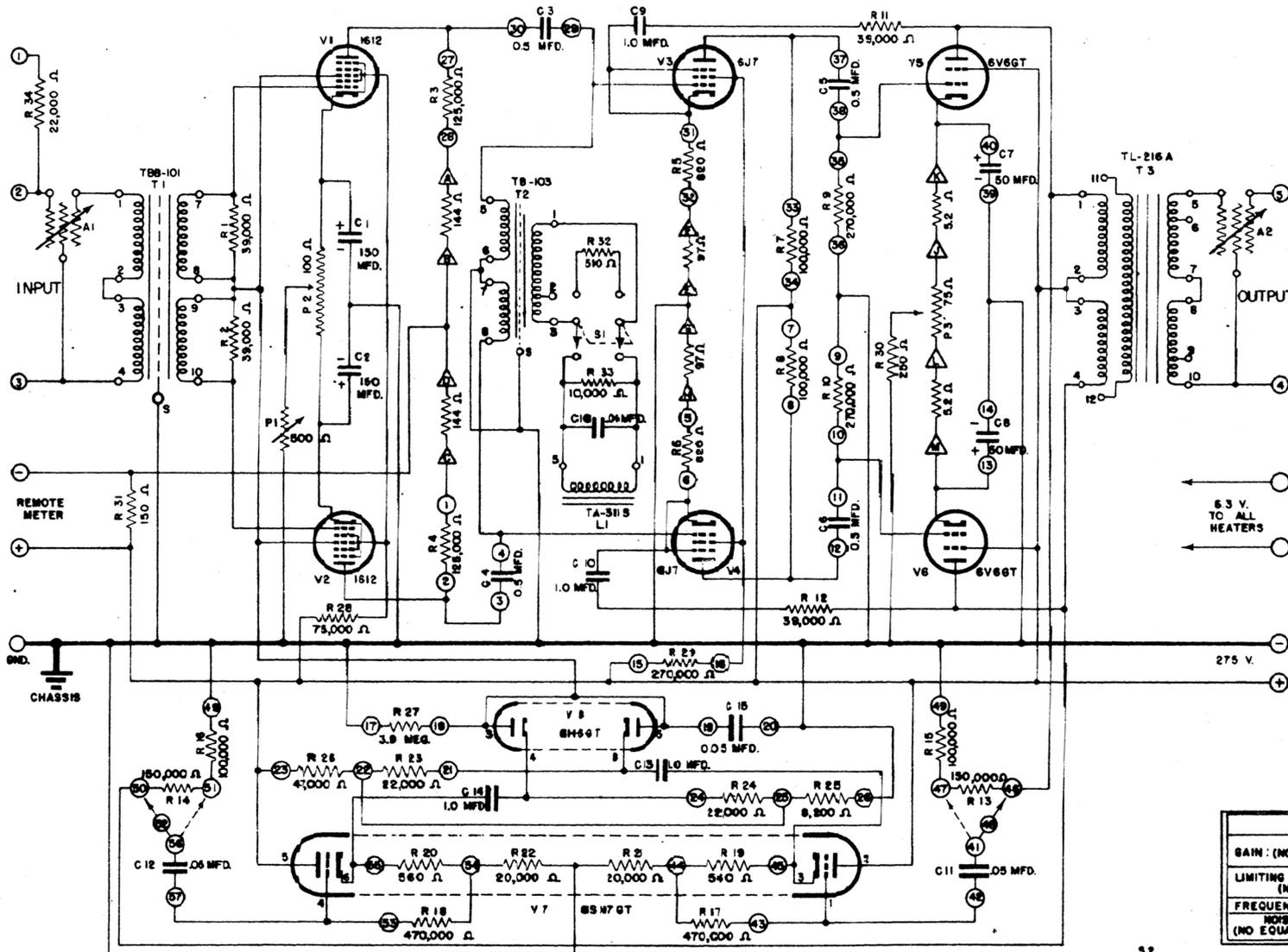
### A-322-C LIMITING AMPLIFIER

#### Terminal board voltage readings to ground

No.	Reading								
1	260	12	115	23	265	34	265	45	135
2	115-120	13	16.5	24	40	35	0	46	260
3	115-120	14	0	25	40	36	0	47	110
4	0	15	265	26	0	37	115	48	260
5	0	16	68	27	115-120	38	0	49	0
6	1-7	17	0	28	260	39	0	50	265
7	265	18	0	29	0	40	16.5	51	110
8	115	19	0	30	115-120	41	260	52	265
9	0	20	0	31	1-7	42	90	53	90
10	0	21	40	32	0	43	90	54	130
11	0	22	40	33	115	44	130	55	130
								56	265
								57	90

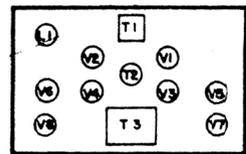
#### Tube socket voltage reading to ground.

<u>V1 &amp; V2</u>	<u>V3 &amp; V4</u>	<u>V5 &amp; V6</u>	<u>V7</u>	<u>V8</u>
Pins Volts	Pins Volts	Pins Volts	Pins Volts	Pins Volts
3 115-120	3 110-115	3 250	1 90	3 0
4 45	4 65	4 260	2 260	4 40
5 0	5 1.7	5 0	3 130	5 0
8 1-6		8 16.5	4 90	8 40
			5 260	
			6 130	



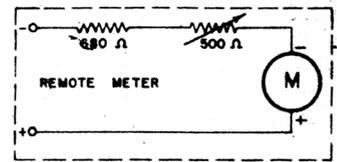
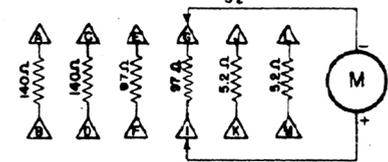
PARTS LIST	
R1, R2	39,000 Ω, 1/2W, ±5% MATCHED, 3%
R3, R4	125,000 Ω, 1W, WIRE WOUND, ±1%
R5, R6	820 Ω, 1W, ±5% MATCHED, 3%
R7, R8	100,000 Ω, 1W, ±5% MATCHED, 3%
R9, R10	870,000 Ω, 1W, ±5% MATCHED, 3%
R11, R12	39,000 Ω, 1/2W, ±5% MATCHED, 3%
R13, R14	150,000 Ω, 1/2W, ±5%
R15, R16	100,000 Ω, 1/2W, ±5%
R17, R18	470,000 Ω, 1/2W, ±10%
R19, R20	560 Ω, 1W, ±5%
R21, R22	20,000 Ω, 1/2W, ±5%
R23, R24	22,000 Ω, 1/2W, ±10%
R25	8,200 Ω, 1W, ±10%
R26	47,000 Ω, 1W, ±10%
R27	3.9 MEG, 1W, ±10%
R28	75,000 Ω, 20W, ±10%
R29	270,000 Ω, 2W, ±10%
R30	280 Ω, 20W, ±10%
R31	150 Ω, 1/2W, WIRE WOUND, ±10%
R32	510 Ω, 1/2W, ±5%
R33	10,000 Ω, 1/2W, ±10%
R34	22,000 Ω, 1/2W, ±10%
C1, C2	150 MFD, 50V D.C.
C3, C4	0.5 MFD, 400V D.C.
C5, C6	0.5 MFD, 400V D.C.
C7, C8	50 MFD, 50V D.C.
C9, C10, C14	1.0 MFD, 500V D.C.
C11, C12, C15	0.05 MFD, 500V D.C.
C13	0.01 MFD, 400 V.D.C.
T1	ALTEC LANSING TRANS. T88-101
T2	ALTEC LANSING TRANS. T8-103
T3	ALTEC LANSING TRANS. TL-216A
L1	ALTEC LANSING TRANS. TA-311B
A1	DAVEN ATTENUATOR T-334-S
A2	DAVEN ATTENUATOR PT-324-S
P1	500 Ω WIRE WOUND IRC W-500
P2	100 Ω WIRE WOUND IRC W-100
P3	75 Ω WIRE WOUND IRC W-75
S1	CENTRALAB NO. 1482
S2	CENTRALAB NO. 1411

OPERATING DATA	
GAIN: (NO EQUALIZATION)	68 DB. 75 DBM
LIMITING THRESHOLD: (NORMAL)	+72 DB. (.008 W. REF. LEVEL) +25.2 DBM. (.001 W. REF. LEVEL)
FREQUENCY RESPONSE: (NO EQUALIZATION)	±1 DB. 20 - 20,000 Hz NOISE LEVEL: -45 DB. (.008 W. REF. LEVEL) -37 DBM. (.001 W. REF. LEVEL)



TERMINALS  
 INPUT 1-3  
 OUTPUT 4-5  
 IMPEDANCE 600 OHMS  
 600 OHMS

ALTEC LANSING  
 A-522 C AMPLIFIER



(10474 ASSEMBLY)