From ATR-100 manual, vol 2

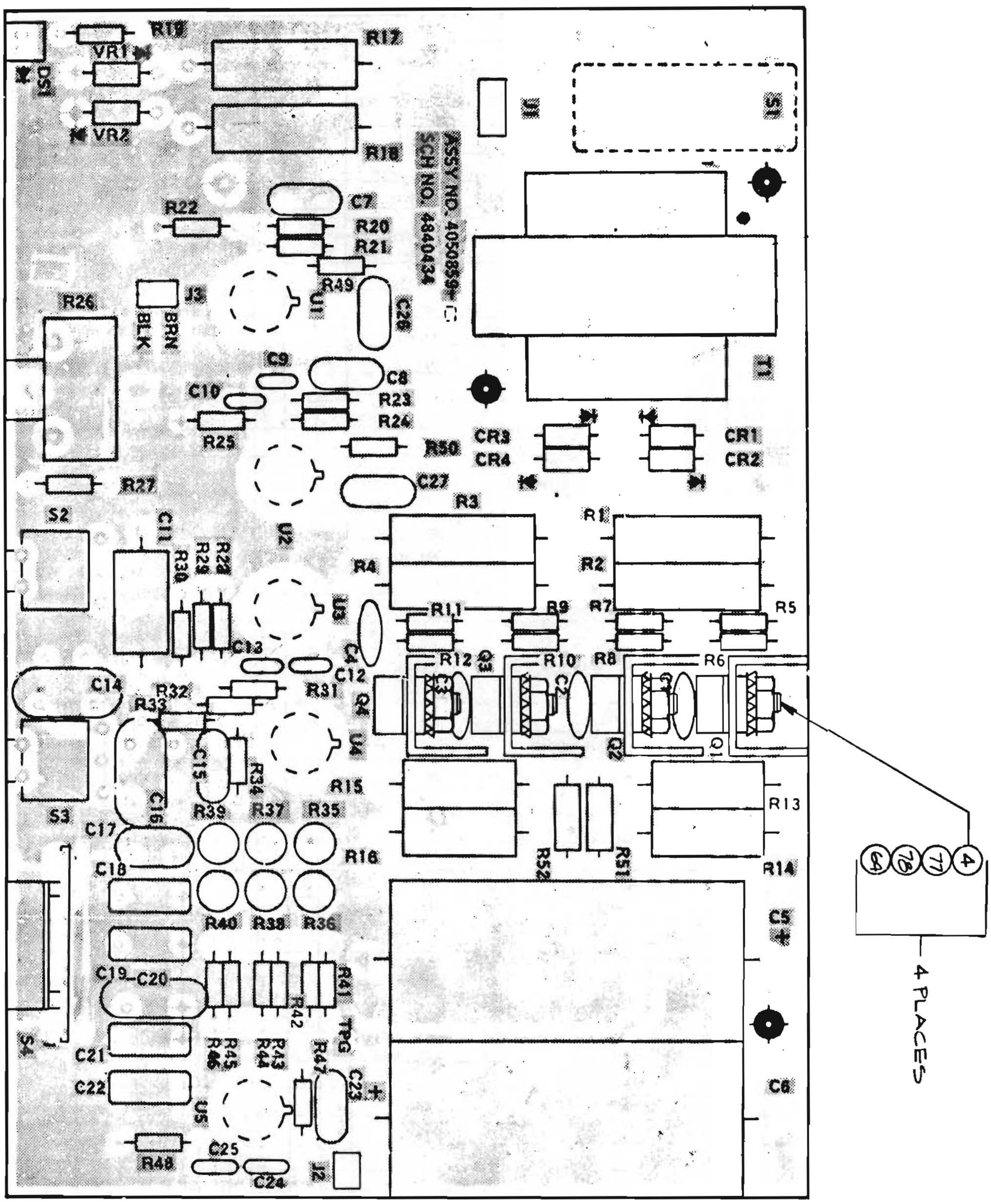
4020424-01 FLUX LOOP EQUALIZING AMPLIFIER ASSEMBLY REV. B
NEXT HIGHER ASSEMBLY 4010294,4010295,
4010296,4010297

ITEM NO	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER -01
1				
2				
3				
4				
5	4030416-01	CHASSIS ASSY		1
6	4110147-23	NAME PLATE		1
7	4290962-01	COVER		1
8	6000006-10	KNOB, SKIRTED 5/8" MED. DK. GY		2
9				
10				
11				
12				
13	070-996	FUSE, SLOW BLOW 0.1A, 125V	F1	1
14	084-032	CORD, POWER, 6 FT		1
15	085-001	HOLDER, FUSE		1
16	120-746	SWITCH, DPDT	S5	1
17	167-369	CONNECTOR PART, CONTACT, (6 REQUIRED)		AR
18	167-404	CONNECTOR PART, BODY, 2 POSITION	P2,3	2
19	167-442	CONNECTOR PART, BODY, 3 POSITION	P1	1
20				
21	172-009	SOLDER LUG, #10		4
22	172-004	SOLDER LUG, #4		1
23	187-003	POST, BINDING, BLACK		1
24	187-004	POST, BINDING, RED		3
25	250-192	FOOT, .300 H.X .812 W.		4
26	265-075	BUSHING, STRAIN RELIEF		1
27				
28	302-335	TIE-STRAP, 4"		2
29	473-324	SCREW, SEM, 4-40 X .250		4
30	476-998	SCREW, HEX HD, SELF TAPPING, #6 X .250		4
31				
32	492-457	NUT, 3/8-32		1
33	501-008	WASHER, FLAT #4		2
34				
35		WIRE, PVC, 22 AWG		AR
36		SLEEVING, SHRINK, BLK	REF:S5,F1	AR

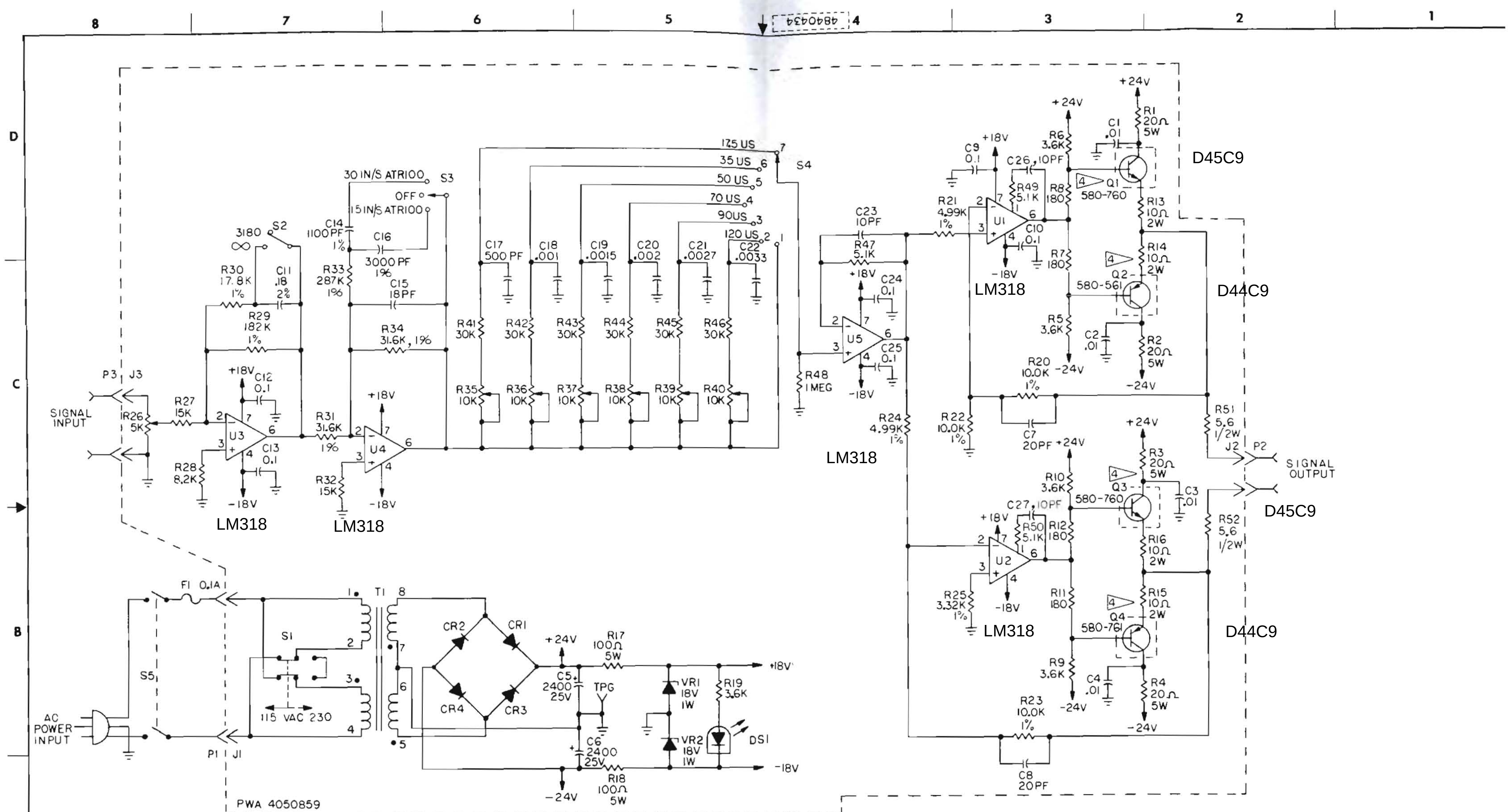
ITEM NO.	PART NUMBER	D	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER -01									
1														
2	4840434	SCHEMATIC			(—)									
3														
4	4290857-01	HEAT SINK			4									
5	103307-01	STAND-OFF		R1-4,13-18	20									
6														
7	013-630	RECTIFIER, 1A 200V		(1N4003) CR1-4	4									
8	581-292	DIODE,ZENER, 18V. 5% 1W		(1N4746A) VR1.2	2									
9														
10	580-760	TRANSISTOR,PWR,NPN	(D44C9)	Q1,3	2									
11	580-761	TRANSISTOR,PWR.NPN	(D45C9)	Q2,4	2									
12	587-478	I.C. OP AMP	(LM318H)	U1-5	5									
13														
14														
15	064-062	CAPACITOR, CER MONO, .1uF, 100V		C9,10,12,13,24,25	6									
16	064-116	CAPACITOR, CER, .01uF, 50V		C1-4	4									
17														
18	034-215	CAPACITOR, MICA, 10pF, 5%, 500V		C23,26,27	3									
19	034-206	CAPACITOR, MICA, 18pF, 5%. 500V		C15	1									
20	034-944	CAPACITOR, MICA, 20pF, 5%, 500V		C7,8	2									
21	056-292	CAPACITOR, MICA, 500pF, 5%, 500V		C17	1									
22	055-863	CAPACITOR, MYLAR, .001uF, 5%, 50V		C18	1									
23	069-134	CAPACITOR, MYLAR .0015uF, 5%, 50V		C19	1									
24	034-161	CAPACITOR, MICA, 2000pF, 5%, 500V		C20	1									
25	069-133	CAPACITOR, MYLAR, .0027uF, 5%, 50V		C21	1									
26	055-865	CAPACITOR, MYLAR, .0033uF, 5%, 50V		C22	1									
27														
28	069-132	CAPACITOR,POLYCARBONATE.18uF, 2%, 50V		C11	1									
29	056-020	CAPACITOR, MICA, 1100pF, 1%, 500V		C14	1									
30	034-243	CAPACITOR, MICA, 3000pF, 1%, 500V		C16	1									
31														
32	031-870	CAPACITOR,ALUM. 2400uF-10+75% 25V		C5,6	2									
33														
34														
35														
36														
37														

AMPEX	Ampex Corporation, Redwood City, California	CODE IDENT NO 92739	LIST OF MATERIALS	LM-4050859 SHEET 2	REV A

ITEM NO.	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER -01
38	041-691	RESISTOR CF 5.6 OHM, 5%, 1/2W	R51,52	2
39	041-667	RESISTOR, CC, 10Ω, 5%, 2W	R13-16	4
40	043-325	W.W.20Ω, 5%, 5W	R1-4	4
41	043-273	W.W,100Ω,5%, 5W	R17,18	2
42				
43				
44	076-004	C.F,180Ω,5%, 1/4W	R7,8,11,12	4
45	066-863	3.6K	R5,6,9,10,19	5
46	066-842	5.1K	R47,49,50	3
47	066-669	8.2K	R28	1
48	066-856	15K	R27,32	2
49	066-846	30K	R41-46	6
50	066-673	C.F. 1M 5%, 1/4W	R48	1
51				
52				
53	062-955	M.F. 3.32K, 1%, 1/4W	R25	1
54	062-968	4.99K	R21,24	2
55	062-983	10.0K	R20,22,23	3
56	066-451	17.8K	R30	1
57	062-797	31.6K	R31,34	2
58	065-803	182K	R29	1
59	076-176	RESISTOR, M.F. 287K 1% 1/4W	R33	1
60				
61	058-611	POTENTIOMETER, 10K, 20%, 1/2W	R35-40	6
62				
63	075-126	POTENTIOMETER, 5K, 1/2 W	R26	1
64	087-388	HEAT SINK COMPOUND (DC 340)		AR
65	4620089-01	SWITCH,ROTARY, PC MOUNT	S4	1
66				
67	560-462	TRANSFORMER,	T1	1
68				
69	122-423	SWITCH SPDT (ON-NONE-ON)	S2	1
70	119-476	SWITCH,DPDT, SLIDE	S1	1
71	119-469	SWITCH,SPDT (ON-OFF-ON)	S3	1
72				
73	581-522	LED,RIGHT ANGLE PC MOUNT	DS1	1
74				
75	187-254	TERMINALS, STRIP, POST	REF J1-3 (6 REQ'D)	A/R
76				
77	470-017	SCREW, SOCKET HEAD, 6-32 X 5/16		4
78	496-002	NUT, WITH ASSEMBLED WASHER, #6-32		4



Assembly No. 4050859. Flux Loop Equalizing Amplifier PWA



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS ARE IN OHMS, 5%, 1/4W.
2. ALL CAPACITORS ARE IN MICROFARADS, 50V MIN.
3. ALL DIODES ARE 013-630.
4 HEATSINKS REQ. ON THESE TRANSISTORS.

INTEGRATED CIRCUIT LIST	
REFERENCE DESIGNATIONS	U1-5
AMPEX PART NO.	587-478
VENDOR PART NO.	LM318H

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C27	
CR4	
DS1	
J3	
Q4	
R52	
S5	
T1	
U5	
VR2	

FIELD SERVICE COMPONENT SUBSTITUTION LIST	
AMPEX PART NO.	NEAREST COML EQUIVALENT
580-760	D44C9
580-761	D45C9
013-630	IN4003
581-292	IN4746A

Schematic No. 4840434—.
Flux Loop Equalizing Amplifier PWA

AMPEX 4890407-02

completely on the takeup reel and then place the recorder/reproducer in the rewind spool mode to wind the tape back on its original reel. Note that after extensive use, high frequency tones on the alignment tape may drop as much as 2 dB, particularly at the slower tape speeds.

Operating level and reproduce frequency response can be checked with a standard alignment tape (Table 5-1). When using a standard alignment tape that is recorded the full width of the tape to check a system with heads less than full width, the response readings below approximately 10.0 kHz become progressively invalid as the frequency decreases. This is caused by the low-frequency fringing effect of the reproduce head. The reproduce head picks up additional flux beyond the track width of the head as the frequency decreases. This error, being wavelength dependent, becomes worse as the wavelength increases.

Therefore, if the equalization is correctly adjusted, the reproduce response when using a full-track alignment tape on either a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system should conform to the relative curves shown in Figure 5-11 within the tolerances given in Table 5-3. The curves given in Figure 5-11 display the *relative* fringing frequency response and *do not* include the fixed error due to the wider reproduce core width (as compared to the record head width).

Table 5-4 provides the amplitude correction factors to be used when setting operating level using a full-track alignment tape on a 2-track, 1/4-inch tape system or a 4-track, 1/2-inch tape system.

The correction factors in Table 5-4 are the amounts by which the actual measured reproduce output from a full width alignment tape will exceed the reproduce output of the correct track width recorded to the same fluxivity. The table includes the fixed error due to the wider reproduce core width and the relative fringing error (shown in Figure 5-11) for frequencies of 500 Hz, 700 Hz, and 1.0 kHz. For example, when reproducing the 700-Hz, 185 nWb/m tone on an Ampex 15 in/s full-width alignment tape on a 2-track, 1/4-inch tape system, the output (as read on an ac voltmeter) will be +1.14 dB higher (Table 5-4) as compared to reproducing and alignment tape that has the same track format as the recorder/reproducer.

The amplitude correction factor of 1.14 dB was obtained by adding the following figures:

0.56 dB - compensation for wide reproduce core width (see asterisk, Table 5-4).

0.58 dB — relative fringing frequency response due to fringing error effect at 700 Hz and 15 in/s (Figure 5-11).

1.14dB — amplitude correction factor.

Note that if the alignment tape used matches the head track format, the correction factors given in Table 5-4 are not used. Also no corrections are required when using a full-width alignment tape to align a full-track head assembly system.

Another source of error is the reproduce head pole contour effect. This effect is prevelent when using the low-frequency sections of the alignment tape. If the alignment tape track format matches the reproduce head format, the error is not severe. This type of error can be minimized by adjustment of the low frequency reproduce equalizers while performing the overall record/reproduce alignment procedure.

5-37. Using a Flux Loop — General Discussion. An accurate method of setting equalization involves the use of a flux loop driven by an audio oscillator in order to induce an electromagnetic field into the reproduce head. The field produced by the flux loop may be equalized to simulate the short circuit flux/frequency response from an ideally recorded alignment tape. The response of a correctly equalized reproduce system to a correctly equalized flux loop will be an almost constant output with frequency over the audio range of interest. However, the use of the flux loop will not disclose the following errors:

- Reproduce head low frequency pole contour and secondary gap effect.
- Reproduce head high frequency gap loss.

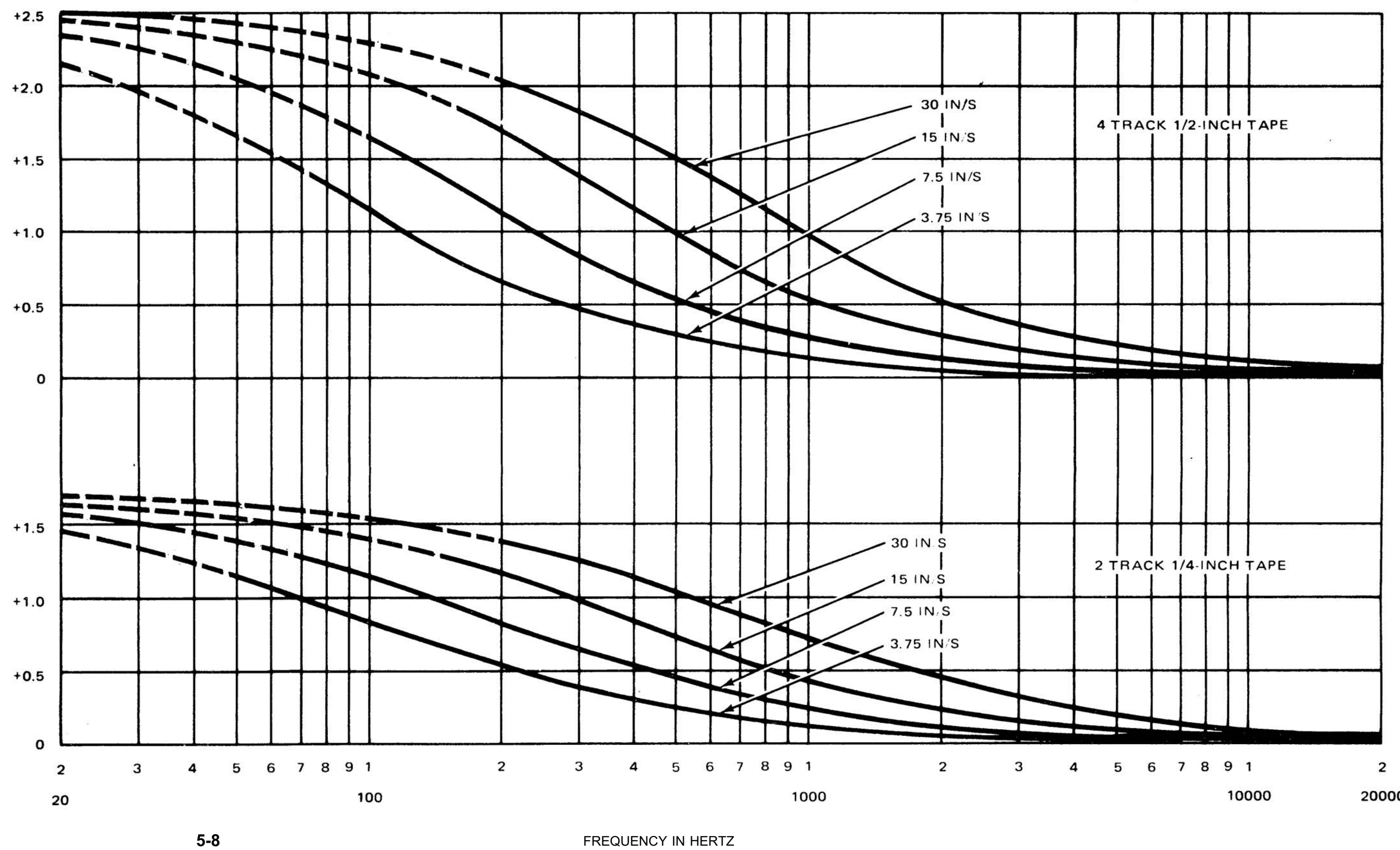


Figure 5-11. Relative Fringing Frequency Response Due to Fringing Effect

Table 5-3. Reproduce Frequency Response Tolerances

SPEED	TOLERANCE ±0.5 dB	TOLERANCE ±1.5 dB	SEL SYNC ±2.0 dB
30 in/s	250 Hz - 20 kHz	35 Hz - 250 Hz 20 kHz-28 kHz	50 Hz - 15 kHz
15 in/s	125 Hz - 15 kHz	20 Hz - 125 Hz 15 kHz - 20 kHz	40 Hz - 12 kHz
7.5 in/s	125 Hz - 10 kHz	30 Hz - 125 Hz 10 kHz- 15 kHz	-
3.75 in/s	125 Hz-5 kHz	30 Hz - 125 Hz 5 kHz - 10 kHz	-

NOTE: To the above tolerances, add manufacturing tolerances Of the alignment tape and relative fringing frequency response due to fringing effect (Figure 5-8).

Table 5-4. Amplitude Correction Factors for Setting Operating Level when using Full-Track Alignment Tapes on 2-Track or 4-Track Systems

SPEED	REFERENCE FREQUENCY	CORRECTION FACTOR*	
		2 TRACK	4 TRACK
30 in/s	500 Hz	+ 1.61 dB	+2.10 dB
	700 Hz	+1.46dB	+1.85 dB
	1.0 kHz	+ 1.29dB	+1.58 dB
15 in/s	500 Hz	+1.29 dB	+1.58 dB
	700 Hz	+1.14 dB	+1.34 dB
	1.0 kHz	+1.01 dB	+1.13 dB
7.5 in/s	500 Hz	+1.01 dB	+1.13dB
	700 Hz	+0.90 dB	+0.99 dB
	1.0 kHz	+0.81 dB	+0.87 dB
3.75 in/s	500 Hz	+0.81 dB	+0.87 dB
	700 Hz	+0.74 dB	+0.79 dB
	1.0 kHz	+0.69 dB	+0.74 dB

*The amplitude correction factors shown in the table are the sum of the values shown in Figures 5-11 for the frequencies shown in the table, and the fixed errors due to wider reproduce core width as follows:

2 track — 0.56 dB due to 80-mil reproduce core on 75-mil track
4 track — 0.6 dB due to 75-mil reproduce core on 70-mil track

- Effects due to head-to-tape contact or azimuth errors.

The ATR-100 incorporates automatically selected preset equalization to correct for secondary gap rise at 15 and 30 in/s. Therefore, at 15 and 30 in/s, with the reproduce low-frequency and high frequency equalizer controls correctly set, the actual flux-looped low-frequency response will depart from a flat response by a specific amount depending on frequency. Figure 5-12 shows the correct response that should be obtained at 15 and 30 in/s with the reproduce equalizers adjusted to match the equalization standard set on the equalized flux loop. The output frequency response using a correctly equalized flux loop should be flat for 3.75 and 7.5 in/s.

A recommended flux loop for use with the ATR-100 is the Ampex flux loop (Ampex Part No. 4020423) used with an Ampex flux loop equalizing amplifier (Ampex Part No. 4040424). This equalizing amplifier contains inverse compensation for the secondary gap rise for the setting of equalization at 15 and 30 in/s. Therefore, Figure 5-12 does not apply when using the Ampex equalizing amplifier.

When an equalizing amplifier is not used, the flux loop may be passively equalized by use of a capacitor connected across the oscillator terminals, to provide the high-frequency transition. Table 5-5 provides capacitor values for specified equalization standards when using an audio oscillator with 600 ohms output and an Ampex flux loop that has a de resistance of 100 ohms. If a flux loop or audio oscillator with other characteristics is used, a nominal capacitor value may be calculated by the following formula:

$$C = \frac{T(R_0 + Ri)}{R_o \cdot Ri}$$

Where:

T = equalization transition time constant (seconds) (Table 5-5)

RQ = oscillator output resistance (ohms)

R-] = flux loop de resistance (ohms)

C = capacity in μF

Figure 5-13 shows the desired system response from an unequalized flux loop, with constant current drive, for the most common equalization standards.

5-38. Head Azimuth and Phase — General Discussion. The only head adjustment required is for record and reproduce head stack azimuth. Precision mounting of the record and reproduce head stack has eliminated the need for adjusting tape wrap, height, and zenith. The azimuth adjustment is made by turning a hex socket screw accessible through the top of the head shield (Figure 5-14)

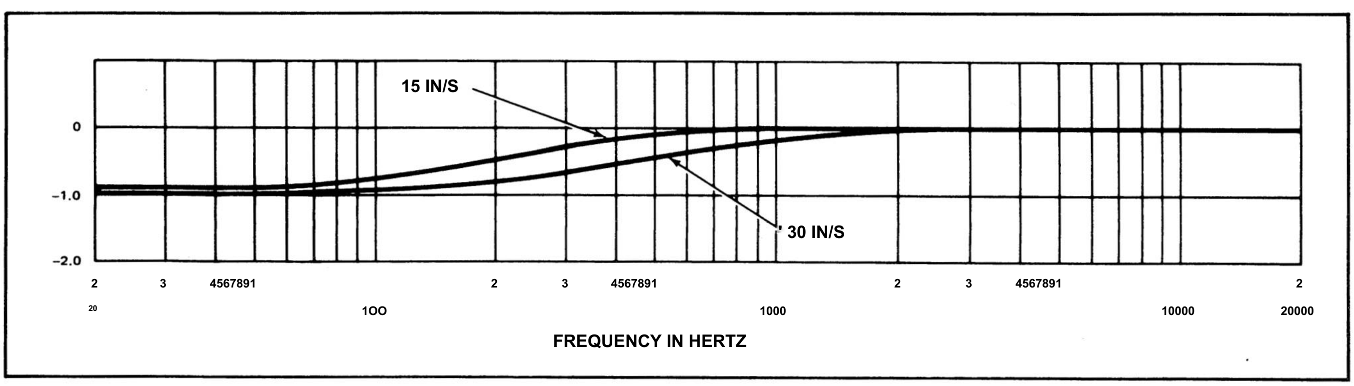


Figure 5-12. Equalized Flux Loop Response for 15 in/s and 30 in/s

Table 5-5. Capacitor Values for Passive Equalization of High Frequency Turnover

TAPE SPEED AND EQUALIZATION STANDARD	HIGH FREQUENCY TRANSITION TIME CONSTANT	-3dBFREQUENCY	CAPACITOR VALUE*
30 in/s AES	17.5 MS	9,095 Hz	0.204 MF
15 in/s IEC/CCIR	35 jus	4,547 Hz	0.408 MF
7.5/15 in/s NAB	50 MS	3,183 Hz	0.583 MF
7.5 in/s IEC/CCIR	70 MS	2,274 Hz	0.817 MF
3.75 in/s	90 MS	1,768 Hz	1.05 MF

*Capacitor value when using audio oscillator with 600-ohm output impedance and Ampex flux loop, part number 4020423-01 <Rloop = 100 ohms).

which causes a tapered gear to rotate underneath the head-stack precision plate. The azimuth adjustment is adjustable over a range of ±15 minutes of arc.

The adjustment of head phase can be considered a fine adjustment of head azimuth and is adjusted to eliminate phase error between tracks of a 2-track or 4-track head assembly. Prior to the adjustment of head phase, the following criteria should be met:

1. Reproduce head — Reproduce equalization is correct.

2. Record head — Reproduce equalization and reproduce head azimuth have been adjusted. Record equalization and bias have been set for overall system high-frequency response and azimuth adjusted for maximum short-wave output.

Failure to observe the above criteria can result in incorrect mechanical azimuth being set in order to compensate for inter-track phasing errors. These errors are electrical in origin (differences between tracks in reproduce equalization, record equalization and/or record bias).

5-39. Operating Level — General Discussion. The operating level used is a matter of individual preference by the user of the recorder/reproducer. However, the use of Ampex 456 tape (or direct equivalent) with an operating level of 370 nWb/m is recommended. This level will provide the lowest distortion and adequate headroom prior to tape saturation. Use of Ampex 456 tape with a lower operating level will degrade signal-to-noise ratio but will lower distortion and increase headroom.

With other types of tape, other operating levels may be preferable. For example, when using Ampex 406/407 tape, an operating level of not more than 260 nWb/m is recommended.

Operating level is set while reproducing a standard alignment tape of known short circuit fluxivity, and adjusting the recorder/reproducer reproduce gain appropriately. In the case of the Ampex alignment tape, reference levels of 700 Hz (500 Hz at 3.75 in/s) at 185 nWb/m are used. (Other manufacturers of alignment tape have standard reference levels at 200 nWb/m or 250 nWb/m at 1.0 kHz, or 320 nWB/m at 1.0 kHz.) Table 5-6 shows the relative differences in level between Ampex reference level (185 nWb/m) and other reference levels in domestic and international use.

If a full width alignment tape is used to set reproduce gain on a 2 or 4-track system, errors in absolute reproduce sensitivity to recorded fluxivity will result due to the fringing effect. This error becomes more pronounced at the higher tape speeds. Table 5-4 lists the correction factors to be applied when using a full-width alignment tape for setting reference level when using a 2-track or 4-track reproduce head assembly.

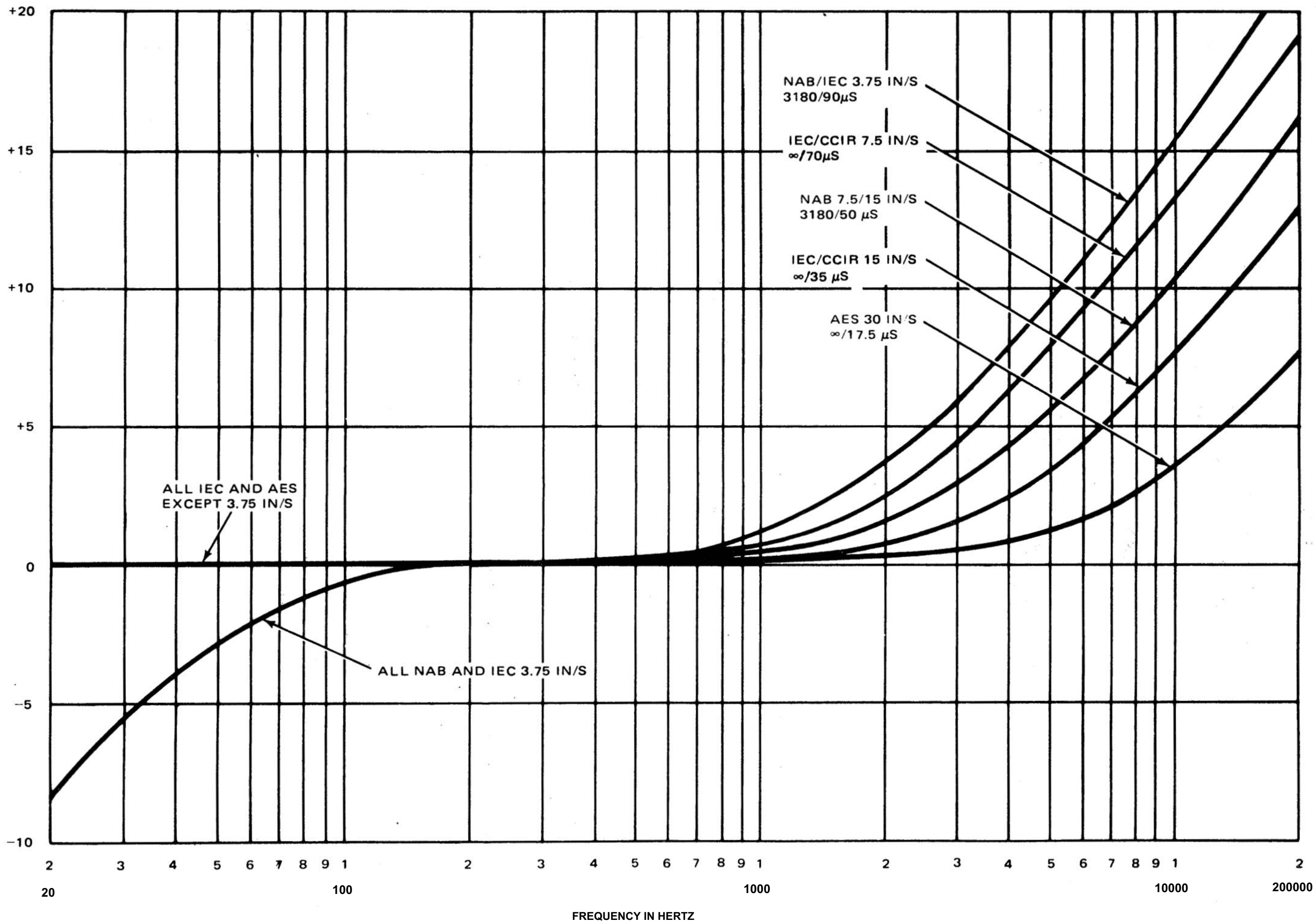


Figure 5-13. Reproduce Response from Unequalized Flux Loop

5-26 Using a Flux Loop

An accurate method of setting equalization involves the use of a flux loop driven by an audio oscillator in order to induce magnetic field in the reproduce head. The field produced by the flux loop may be equalized to simulate the short circuit flux/frequency response from an ideally recorded alignment tape. The response of a correctly equalized reproduce system to a correctly equalized flux loop is an almost constant output with frequency over the audio range of interest. However, the use of a flux loop does not disclose the following errors:

- Reproduce head low-frequency pole contour and secondary gap effect.
- Reproduce head high-frequency gap loss.
- Effect due to head-to-tape contact, azimuth, or head racking errors.

The ATR-116/124 incorporates automatically selected preset equalization to correct for secondary gap rise at 7.5, 15, and 30 in/s. Therefore, at 7.5, 15, and 30 in/s, with the reproduce low-frequency and high-frequency equalizer controls correctly set, the actual flux-looped low-frequency response departs from a flat response by a specific amount depending on frequency. Figure 5-16 shows the correct response that should be obtained at 7.5, 15 and 30 in/s with the reproduce equalizers adjusted to match the equalization standard set on the equalized flux loop.

A recommended flux loop for use with the ATR-116/124 is the Ampex flux loop (Ampex Part No. 4020484) used with an Ampex flux-loop equalizing amplifier (Ampex Part No. 4040424). When an equalizing amplifier is not used, the flux loop may be passively equalized by use of a capacitor connected across the oscillator terminals to provide the high-frequency transition. The nominal capacitor value may be calculated by the following formula:

$$C = \frac{T(R_0 + R_1)}{R_0 \cdot R_1}$$

Where:

T =equalization transition time constant (seconds) (Table 5-3)
R_0 =oscillator output resistance (ohms)
R_1 =flux loop dc resistance (ohms)
C =capacitance (microfarads)

Figure 5-17 shows the desired system response from an unequalized flux loop for the most common equalization standards. This assumes constant current through the flux loop when driven from a constant voltage source with an output resistance equal to or greater than zero ohms.

5-27 Head Azimuth Phase

Head adjustment is required for record and reproduce head stack azimuth. Precision mounting of the record and reproduce head stack has eliminated the need for adjusting height and zenith. The azimuth adjustment is made by turning a hex screw (Figure 5-18) which causes a tapered gear to rotate underneath the head-stack precision plate. The azimuth adjustment is adjustable over a range of ± 10 minutes of arc.

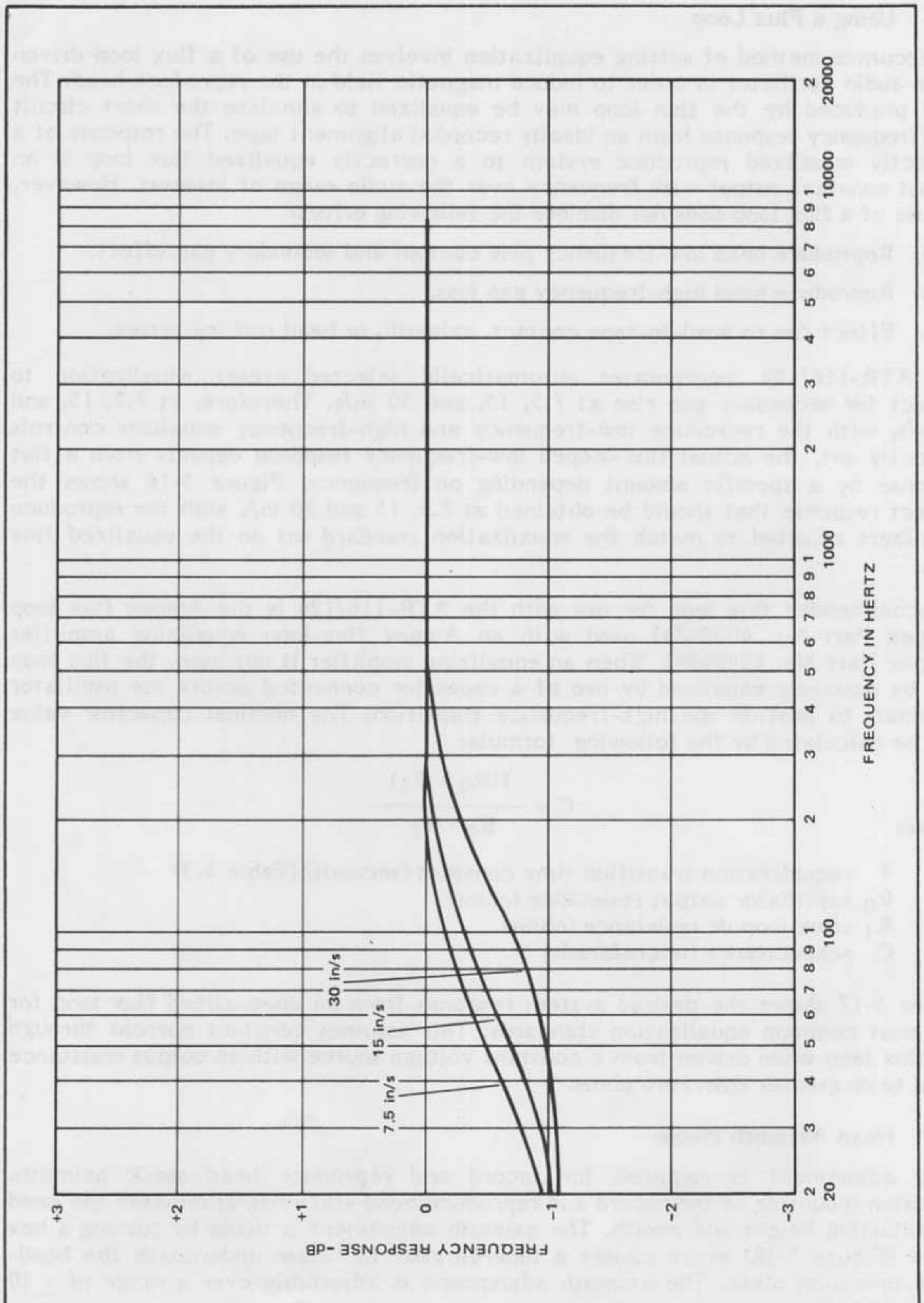


Figure 5-16. Equalized Flux Loop Response

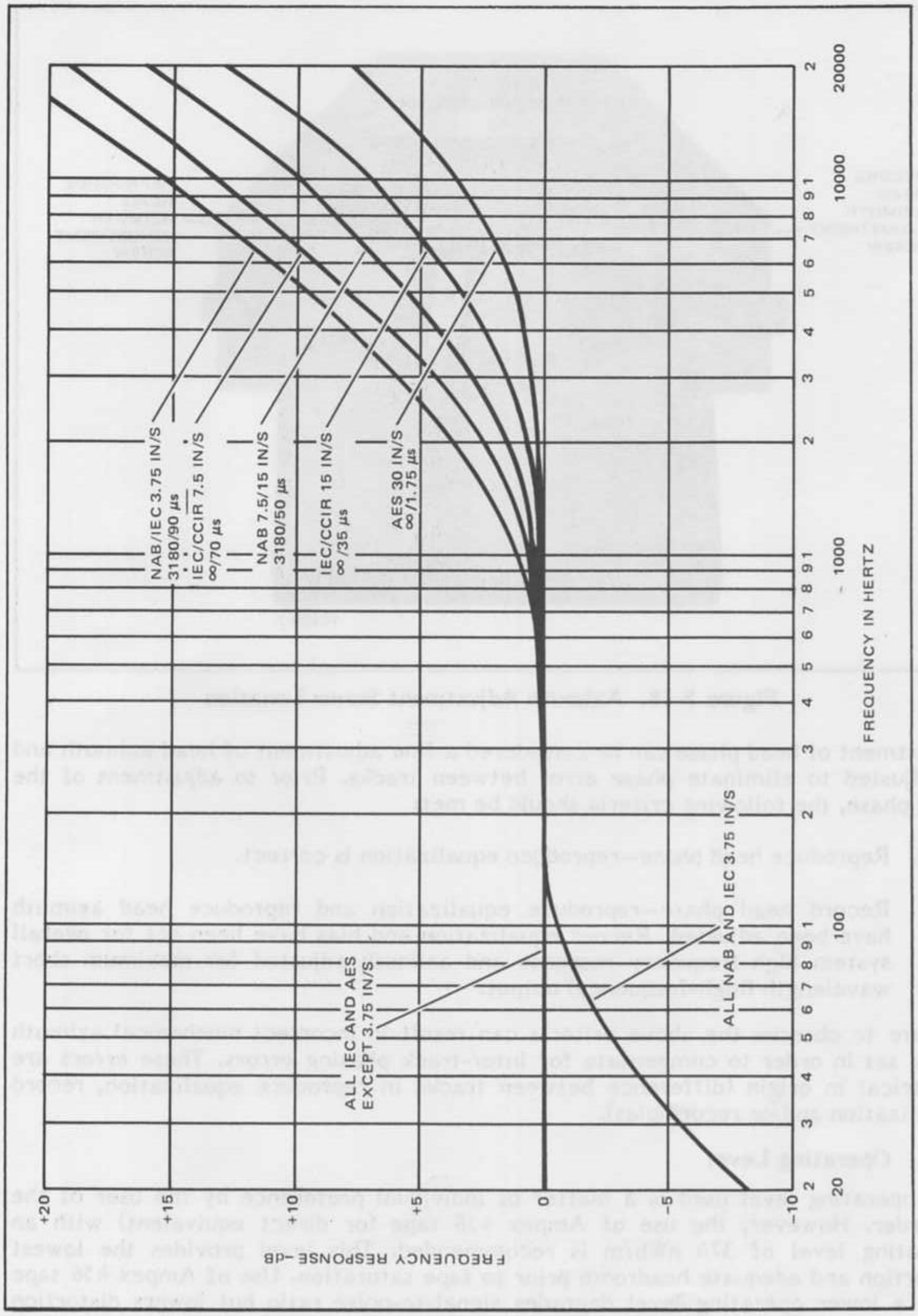


Figure 5-17. Reproduce Response From Unequalized Flux Loop

Goran Finnberg mastering@telia.com <mastering@telia.com>

>I couldn't find any explanation of how to set the trimpots on the
>equalizing amp schematic, at least not in the manuals that I looked
>in.

$$R35 = \frac{\mu S}{C} = \frac{17.5e-6}{500e-12} = 35 \text{ kohm} = 35k - 30k = 5 \text{ kohm.}$$

R35 = 5 kohm
R36 = 5 kohm
R37 = 3.3333 kohm
R38 = 5 kohm
R39 = 3.3333 kohm
R40 = 6.3636 kohm

As the Cs are all rated at 5% tolerance then all the above trimpot values can only be
seen as nominal values since they have all been computed with all the Cs being spot on.

So all the trimpots MUST be adjusted using an accurate frequency counter + a very accurate output
level oscillator, flat +- 0.05 dB up to 20 kHz, as follows:

$$R35 = 17.5\ \mu S = \frac{1}{2p17.5e-6} = 9.09457 \text{ kHz / -3 dB down}$$

R35 = 17.5µS adjusted for - 3 dB down at 9.09457 kHz at the output of any of the RED output binding posts = P2 on the schematic.
R36 = 35 µS   - 3 dB down at 4.54728 kHz
R37 = 50 µS   -3 dB down at 3.18310 kHz
R38 = 70 µS   -3 dB down at 2.27364 kHz
R39 = 90 µS   -3 dB down at 1.76839 kHz
R40 =120 µS   -3 dB down at 1.32629 kHz

Best regards,

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Sweden

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Learn from the mistakes of others, you can never live long enough to make them all yourself.   -   John Luther