

Radio/Communication Circuits

CA3013, CA3014

3875081 G E SOLID STATE

01E 14703

D T-77-05-07

Wide-Band Amplifier Discriminators

Features & Applications:

- Exceptionally high gain: power gain at 4.5 MHz - 75 dB typ.
- Excellent limiting characteristics - input limiting voltage (knee) = 300 μ V typ. at 4.5 MHz
- Excellent AM rejection: > 50 dB at 4.5 MHz
- High audio-voltage recovery - 220 mV typ at 4.5 MHz, 25 kHz deviation
- Wide frequency capability - 100 kHz to > 20 MHz
- Comprehensive circuit functions: if amplifier, AM and noise limiter, FM detector, audio preamplifier

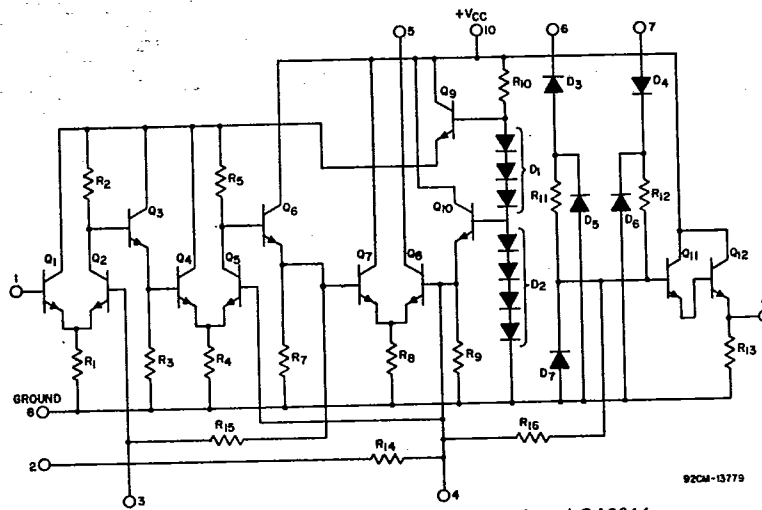


Fig. 1 — Schematic diagram for CA3013 and CA3014

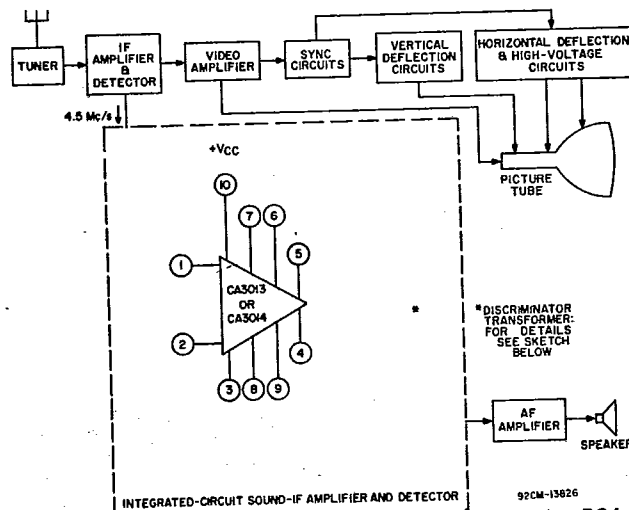


Fig. 2 — Block diagram of typical television receiver using RCA integrated-circuit sound-if amplifier and detector section

File Number 129

CA3013, CA3014

01E 14704 D

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T-77-05-07

ABSOLUTE-MAXIMUM VOLTAGE LIMITS AT TA = 25° C

Indicated voltage limits for each terminal can be applied under the specified voltage conditions for other terminals. All voltages are with respect to ground (Terminal 8).

CA3013

TERMINAL	VOLTAGE LIMITS		VOLTAGE CONDITIONS AT OTHER TERMINALS									
			1	2	3	4	5	6	7	8	9	10
1	-3	+3	-	Same as 1	Do Not Apply External Voltage	+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	AF Output	+7.5
2	-3	+3	Same as 2	-		+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	AF Output	+7.5
3	-3	+3	-3 to +3	Same as 1		+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	AF Output	+7.5
4	+2.5	+7.5	-3 to +3	Same as 1		-	+7.5	Same as 4	Same as 4	Ground	AF Output	+7.5
5	0	+10	-3 to +3	Same as 1		+2.5 to +7.5	-	Same as 4	Same as 4	Ground	AF Output	+7.5
6	+2.5	+7.5	-3 to +3	Same as 1		Same as 6	+7.5	-	Same as 4	Ground	AF Output	+7.5
7	+2.5	+7.5	-3 to +3	Same as 1		+2.5 to +7.5	+7.5	Same as 4	-	Ground	AF Output	+7.5
8	-3	+7.5	-3 to +3	Same as 1		+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	AF Output	+7.5
9	0	+7.5	-3 to +3	Same as 1		+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	-	+7.5
10	0	+10	-3 to +3	Same as 1		+2.5 to +7.5	+7.5	Same as 4	Same as 4	Ground	AF Output	-
CASE	INTERNALLY CONNECTED TO TERMINAL No.8 (GROUND TERMINAL)											

CA3014

TERMINAL	VOLTAGE LIMITS		VOLTAGE CONDITIONS AT OTHER TERMINALS									
			1	2	3	4	5	6	7	8	9	10
1	-3	+3	-	Same as 1	Do Not Apply External Voltage	+2.5 to +10	+10	Same as 4	Same as 4	Ground	AF Output	+10
2	-3	+3	Same as 2	-		+2.5 to +10	+10	Same as 4	Same as 4	Ground	AF Output	+10
3	-3	+3	-3 to +3	Same as 1		+2.5 to +10	+10	Same as 4	Same as 4	Ground	AF Output	+10
4	+2.5	+10	-3 to +3	Same as 1		-	+10	Same as 4	Same as 4	Ground	AF Output	+10
5	0	+13	-3 to +3	Same as 1		+2.5 to +10	-	Same as 4	Same as 4	Ground	AF Output	+10
6	+2.5	+10	-3 to +3	Same as 1		Same as 6	+10	-	Same as 4	Ground	AF Output	+10
7	+2.5	+10	-3 to +3	Same as 1		+2.5 to +10	+10	Same as 4	-	Ground	AF Output	+10
8	-3	+10	-3 to +3	Same as 1		+2.5 to +10	+10	Same as 4	Same as 4	Ground	AF Output	+10
9	0	+10	-3 to +3	Same as 1		+2.5 to +10	+10	Same as 4	Same as 4	Ground	-	+10
10	0	+13	-3 to +3	Same as 1		+2.5 to +10	+10	Same as 4	Same as 4	Ground	AF Output	-
CASE	INTERNALLY CONNECTED TO TERMINAL No.8 (GROUND TERMINAL)											

OPERATING-TEMPERATURE RANGE -55 to +125 °C

STORAGE-TEMPERATURE RANGE -65 to +150 °C

MAXIMUM INPUT-SIGNAL VOLTAGE:

Between Terminals 1 and 2 ±3 V

MAXIMUM DEVICE DISSIPATION 300 mW

RECOMMENDED MINIMUM DC

SUPPLY VOLTAGE (VCC) 5.5 V

Example of use of LIMITS TABLE:

For RCA-CA3013, a maximum voltage of ±3 volts may be applied to Terminal 1 under the following conditions:

- Terminal 2 is at the same dc potential as Terminal 1
- Terminal 3: do not apply external voltage
- Terminal 4 is at any dc potential between +2.5 and +7.5 volts
- Terminal 5 is at a dc potential of +7.5 volts
- Terminals 6 and 7 are at the same dc potential as Terminal 4
- Terminal 8 is at dc ground potential
- Terminal 9 is used as the af output terminal
- Terminal 10 is at a dc potential of +7.5 volts

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T-77-05-07

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01E 14705 D

ELECTRICAL CHARACTERISTICS (See Page 8 for Definitions of Terms)	SYMBOLS	TEST CONDITIONS				LIMITS						TYPICAL CHARACTERISTICS CURVES Fig.		
		SETUP & PROCEDURE Fig.	FREQUENCY f Mc/s	DC SUPPLY VOLTAGE V _{CC} volts	AMBIENT TEMPERATURE T _A °C	RCA CA3013			RCA CA3014				UNITS	
						Min.	Typ.	Max.	Min.	Typ.	Max.			
Total Device Dissipation*	P _T	3	-	6	-55	-	80	-	73	80	120	mW	4	
					+25	60	90	133	73	90	110	mW		
					+125	-	70	-	60	70	110	mW		
		3	-	7.5	-55	-	130	-	106	130	170	mW		4
					+25	87	120	187	106	120	150	mW		
					+125	-	100	-	90	100	150	mW		
		3	-	10	-55	-	-	-	165	210	250	mW		4
					+25	-	-	-	165	190	230	mW		
					+125	-	-	-	150	160	230	mW		
Voltage Gain**	A	5	1	6	-55	-	55	-	50	55	-	dB	6	
					+25	60	66	-	60	66	-	dB		
					+125	-	61	-	50	61	-	dB		
		5	1	7.5	-55	-	59	-	55	59	-	dB		6
					+25	65	70	-	65	70	-	dB		
					+125	-	65	-	55	65	-	dB		
		5	1	10	-55	-	-	-	55	61	-	dB		6
					+25	-	-	-	65	71	-	dB		
					+125	-	-	-	55	66	-	dB		
		5	4.5	7.5	+25	60	67	-	60	67	-	dB		7
					+25	55	60	-	55	60	-	dB		
		Input-Impedance Components: Parallel Input Resistance	R _{IN}	8	4.5	7.5	+25	-	3	-	-	3		-
C _{IN}	8		4.5	7.5	+25	-	7	-	-	7	-	pF	9	
Output-Impedance Components: Parallel Output Resistance	R _{OUT}	10	4.5	7.5	+25	-	31.5	-	-	31.5	-	kΩ	11	
	C _{OUT}	10	4.5	7.5	+25	-	4.2	-	-	4.2	-	pF	11	
Noise Figure	NF	12	4.5	7.5	+25	-	8.7	-	-	8.7	-	dB	13	
Input Limiting Voltage (Knee)	v _{i(lim)}	14	4.5	7.5	+25	-	300	450	-	300	400	μV	15	
Recovered AF Voltage	v _{o(af)}	14	4.5	6	+25	-	155	-	-	155	-	mV	15	
				7.5	+25	128	188	-	135	188	-	mV		
				10	+25	-	-	-	220	-	-	mV		
Amplitude-Modulation Rejection	AMR	16	4.5	7.5	+25	-	50	-	-	50	-	dB	-	
Discriminator Output Resistance	R _{0(disc)}	-	4.5	7.5	+25	-	60	-	-	60	-	Ω	-	
Total Harmonic Distortion	THD	14	4.5	7.5	+25	-	1.8	-	-	1.8	-	%	17	

* Total current drain may be determined by dividing P_T by V_{CC}.

** Recommended minimum dc supply voltage (V_{CC}) is 5.5 V. Nominal load current flowing into terminal 5 is 1.5 mA at 7.5 V.

CA3013, CA3014

T-77-05-07

TYPICAL CHARACTERISTICS AND TEST SETUPS

DISSIPATION TEST SETUP

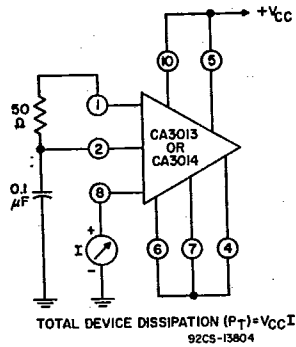


Fig.3

DISSIPATION vs. TEMPERATURE

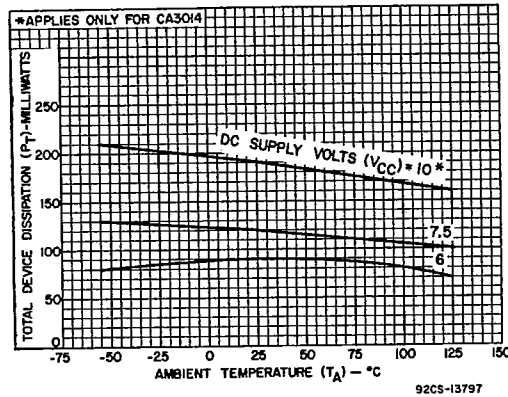


Fig.4

VOLTAGE-GAIN TEST SETUP

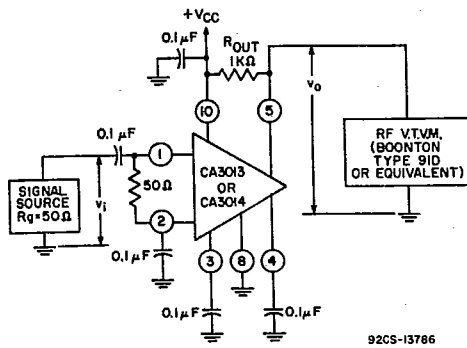


Fig.5

PROCEDURE:

- 1) Set input frequency at desired value, $v_i = 100 \mu V$ rms.
- 2) Record v_o .
- 3) Calculate Voltage Gain A from $A = 20 \log_{10} v_o/v_i$.
- 4) Repeat Steps 1, 2, and 3 for each frequency and/or temperature desired.

1-Mc/s VOLTAGE GAIN vs. TEMPERATURE

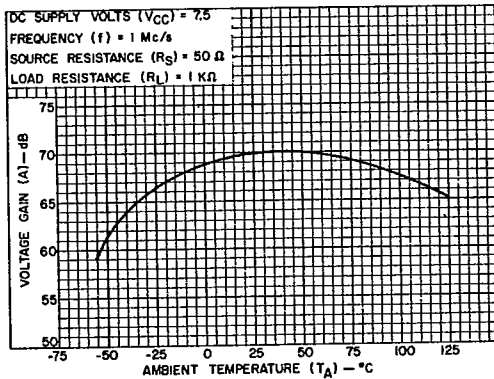


Fig.6

VOLTAGE GAIN vs. FREQUENCY

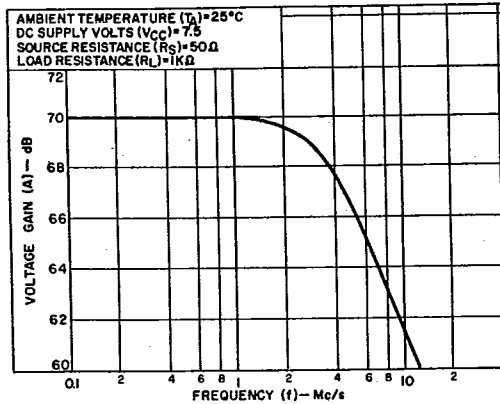


Fig.7

TYPICAL CHARACTERISTICS AND TEST SETUPS

INPUT-IMPEDANCE COMPONENTS TEST SETUP

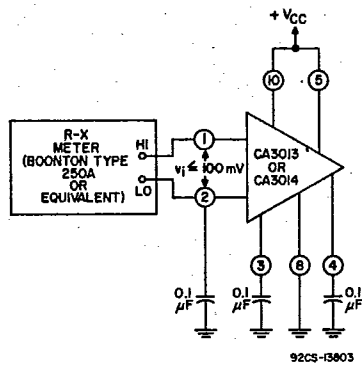


Fig. 8

INPUT-IMPEDANCE COMPONENTS vs. FREQUENCY

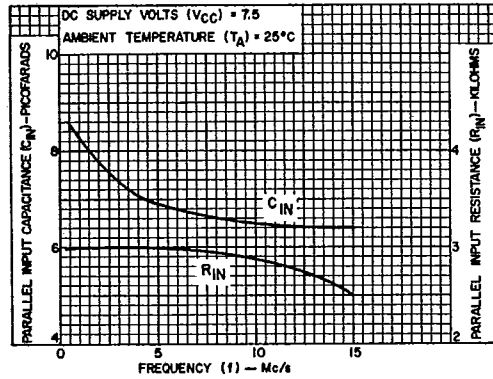


Fig. 9

OUTPUT-IMPEDANCE COMPONENTS TEST SETUP

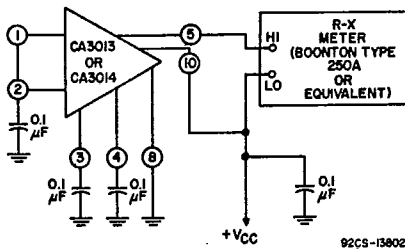


Fig. 10

OUTPUT-IMPEDANCE COMPONENTS vs. FREQUENCY

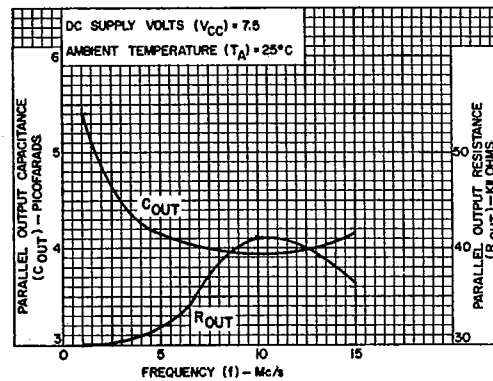


Fig. 11

NOISE FIGURE TEST SETUP

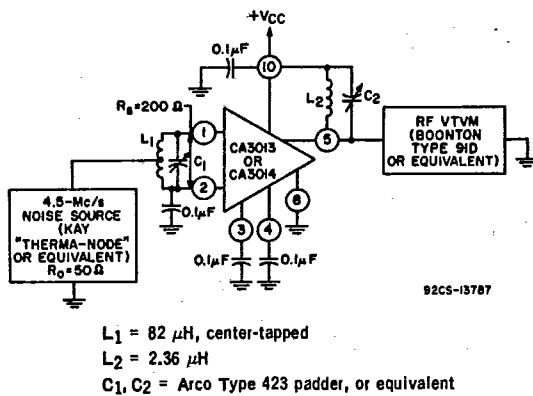


Fig. 12

NOISE FIGURE vs. DC SUPPLY VOLTAGE

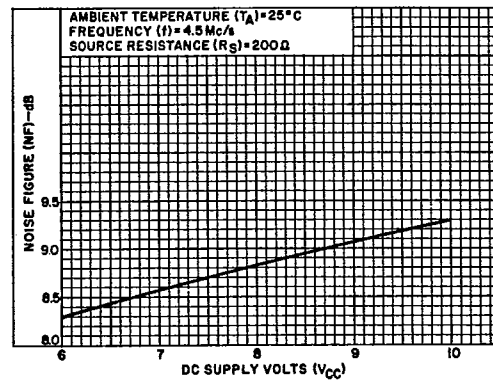
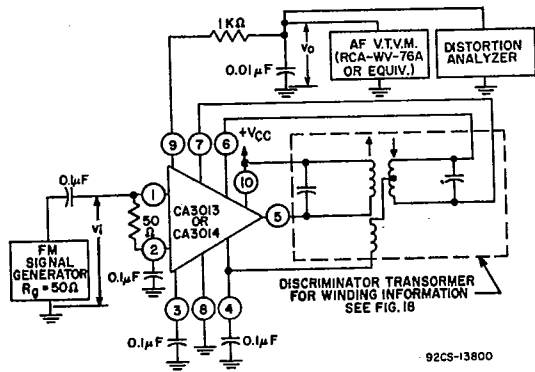


Fig. 13

CA3013, CA3014
T-77-05-07

TYPICAL CHARACTERISTICS AND TEST SETUPS

INPUT LIMITING VOLTAGE, RECOVERED AF VOLTAGE, AND TOTAL HARMONIC DISTORTION TEST SETUP



PROCEDURE:

A - Recovered-AF Voltage Output:

- 1) Set input frequency = 4.5 Mc/s, $v_i = 100$ mV rms, modulating frequency = 1 kc/s, frequency deviation = ± 25 kc/s.
- 2) Record v_o as Recovered-AF Voltage Output.

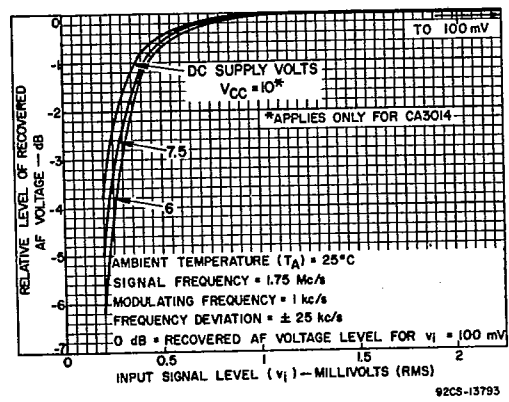
B - Input Limiting Voltage (Knee):

- 1) Repeat Steps A1 and A2, using $v_i = 100$ mV rms.
- 2) Decrease v_i to the level at which v_o is 3 dB below its value for $v_i = 100$ mV.
- 3) Record v_i as Input Limiting Voltage (Knee).

Fig. 14

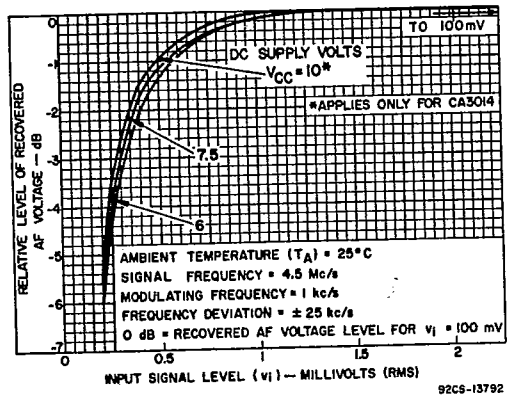
INPUT LIMITING VOLTAGE (KNEE) AND RECOVERED AF VOLTAGE

at 1.75 Mc/s



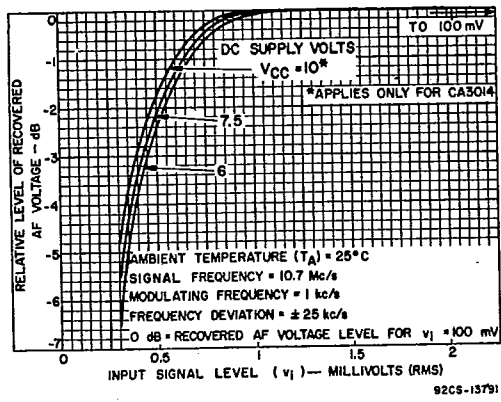
(a)

at 4.5 Mc/s



(b)

at 10.7 Mc/s



(c)

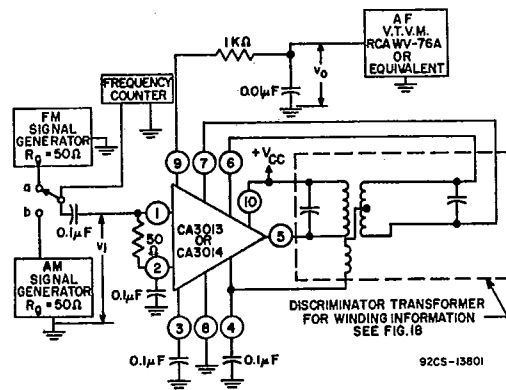
Fig. 15

T-77-05-07

CA3013, CA3014

TYPICAL CHARACTERISTICS AND TEST SETUPS

AM-REJECTION TEST SETUP



PROCEDURE:

- 1) With Switch S in position "a", set input frequency = 4.5 Mc/s, $v_i = 10$ mV rms, modulating frequency = 1 kc/s, frequency deviation = ± 25 kc/s.
- 2) Record v_o .
- 3) Place Switch S in position "b", and set input frequency = 4.5 Mc/s, $v_i = 10$ mV rms, modulating frequency = 1 kc/s, % modulation = 50.
- 4) Measure v_o , and record value in dB below value in Step 2 as AM Rejection.

Fig. 16

TOTAL HARMONIC DISTORTION vs. DC SUPPLY VOLTAGE

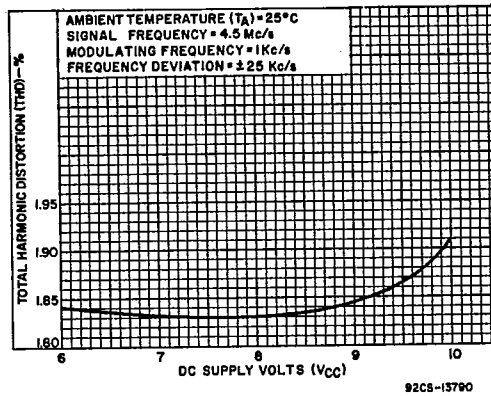
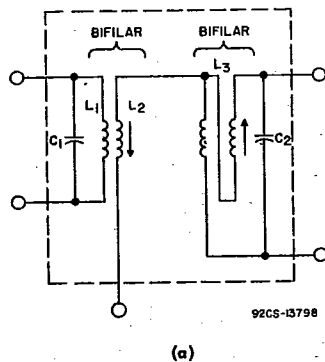


Fig. 17

DISCRIMINATOR TRANSFORMER SCHEMATIC



CONSTRUCTION DETAILS OF DISCRIMINATOR TRANSFORMERS SHOWN IN FIGS. 2, 14 AND 16

Coil-Form Outside Diameter = 7/32 inch
Slugs: Radio Industries, Inc. Type "E" Material, or equivalent
Wire Type: "GRPEZE"**, or equivalent

Operating Frequency Mc/s	Wire Size (AWG #)	Turns			C ₁ pF	C ₂ pF
		L ₁ [▲]	L ₂ [▲]	L ₃		
1.75	40	44	20	44 total (22 bifilar wound)	820	820
4.5	36	18	7	22 total (11 bifilar wound)	560	330
10.7	36	18	18	18 total (9 bifilar wound)	100	100

* Registered Trade Mark, Phelps-Dodge Copper Products.

▲ wound bifilar.

NOTE: The mutual coupling between L₁ and L₃ is adjusted for the desired degree of linearity.

Fig. 18

(b)