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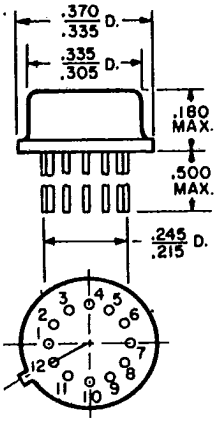
ECG786

SPECIAL-FUNCTION SUB-SYSTEM

HIGH-GAIN IF AMPLIFIER, LIMITER, FM DETECTOR, AND AF PREAMPLIFIER/DRIVER

For FM IF Amplifier Applications in Communications Receivers and High-Fidelity FM Receivers up to 20 MHz



Features:

- High sensitivity - input limiting voltage (knee) 50 μV typ. at 10.7 MHz
- Excellent AM rejection - 58 dB typ. at 10.7 MHz
- Inherent high stability - internally shielded
- Internal Zener-diode regulated voltage supply
- Low harmonic radiation
- Wide frequency capability - <100 kHz to >20 MHz
- Low harmonic distortion

ECG786 provides in a single monolithic silicon chip, a major sub-system for the IF sections of Communications and high-fidelity FM receivers. As shown in the Schematic Diagram (Figure 2) and the FM Receiver Block Diagram (Figure 1), the ECG786 contains a multistage IF-amplifier/limiter section, an FM-detector stage, a Zener-diode regulated power-supply section, and an AF-amplifier section. In FM receivers, ECG786 can be used to provide IF amplification and limiting, FM detection, and AF preamplification. The ECG786 provides exceptional versatility of circuit design because the IF-amplifier/limiter section, FM detector section, and AF-preamplifier/driver section can be used independently of each other.

The four stage emitter-follower-coupled IF amplifier section provides 80-dB voltage gain at 10.7 MHz, features an output stage with exceptionally good limiting characteristics because of its transistor constant-current sink.

The FM detector section is distinguished by circuitry which provides forward bias to the detector diodes, D2 and D3, and also provides a reference voltage for AFC.

The audio amplifier provides a low-impedance drive for subsequent audio amplifiers.

The power supply section provides zener-regulated, decoupled voltages for the IF amplifier, detector, and audio amplifier sections.

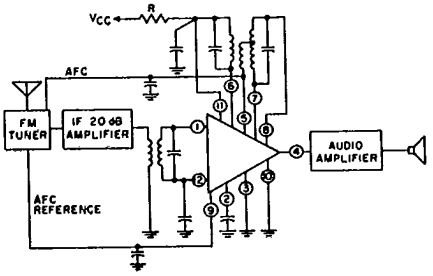


Fig.1 - Typical application of the ECG786 as a high-gain limiter, amplifier-detector in an FM receiver.

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ABSOLUTE-MAXIMUM RATINGS at T_A = 25°C

DISSIPATION:

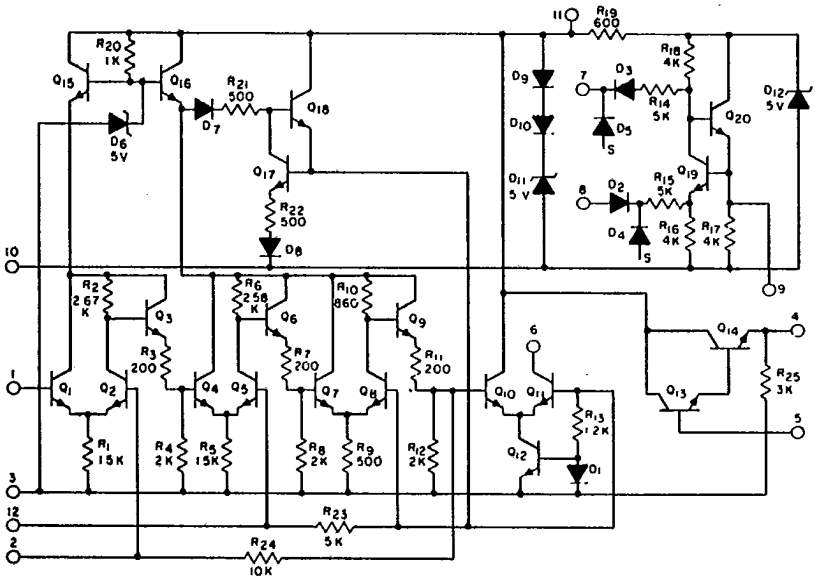
At T_A = 25°C to T_A = 85°C . . . . . .450 mW

Above T_A = 85°C . . . . Derate linearly 5 mW/°C

TEMPERATURE RANGE:

Operating . . . . . -55°C to + 125°C

Storage . . . . . -65°C to + 150°C



Notes:

S = Substrate

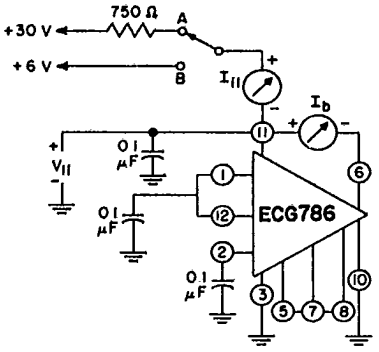
Terminal No.3 wire-connected to the case.

Terminal No.10 connected to the case through the substrate.

Terminals No.3 and 10 which are connected to the substrate should be connected to the most negative point in the circuit.

Diodes D_4 and D_5, act as capacitors and are used to balance the detector substrate capacitances.

Fig.2 - Schematic diagram.



Switch in Position A for:

Regulator-Voltage, Quiescent-Operating-Current, and Device Dissipation Test

Switch in Position B for Current into Pin No.11

Fig.3 - Regulator voltage, device dissipation, quiescent operating current, and current at 6 volts into Pin No. 11.

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MAXIMUM VOLTAGE RATINGS

The following chart gives the range of voltages which can be applied to the terminals listed horizontally with respect to the terminals listed vertically. For example, the voltage range between horizontal terminal 5 and vertical terminal 3 is +6 to 0 volts.

TERMINAL No.	1	2	3	4	5	6	7	8	9	10	11	12
1		+4 -4	0 -5	*	*	*	*	*	*	0 -5	*	Note(1)
2			0 -3	*	*	*	*	*	*	0 -3	*	*
3				+6 0	+6 0	+15 +2	+6 0	+6 0	+6 0	0	Note(2)	+3 0
4					+2 -4	*	*	*	*	0 -6	*	*
5						*	*	*	*	0 -6	+6 0	*
6							*	*	*	-2 -15	*	*
7								Note(1)	*	0 -6	*	*
8									*	0 -6	*	*
9										0 -6	*	*
10											Note(2) 0	+3 0
11												*
12												

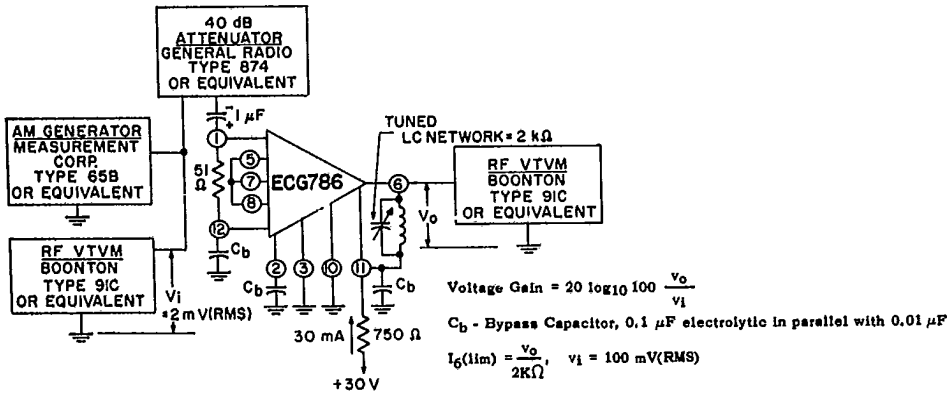
MAXIMUM CURRENT RATINGS

TERMINAL No.	I_{IN} mA	I_{OUT} mA
1	-	-
2	-	-
3	0.1	40
4	-	20
5	-	-
6	-	-
7	-	-
8	-	-
9	-	20
10	0.1	40
11	40	0.1
12	-	-

Note 1: These terminals should be connected through a dc resistance to any terminal which does not exceed 100 ohms.

Note 2: Pin 11 may be connected to any positive voltage source through a suitable resistor provided its current rating is not exceeded.

* Voltages are not normally applied between these terminals. Voltages appearing between these terminals will be safe if the specified limits between all other terminals are not exceeded.



Voltage Gain = $20 \log_{10} 100 \frac{V_o}{V_i}$

C_b - Bypass Capacitor, 0.1 μF electrolytic in parallel with 0.01 μF

$I_6(lim) = \frac{V_o}{2K\Omega}$, v_i = 100 mV(RMS)

* Output circuit should be completely shielded from the input circuit at the socket.

Fig.4 - Voltage gain test circuit.

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ELECTRICAL CHARACTERISTICS at T_A = 25°C

CHARACTERISTICS	SYMBOLS	SPECIAL TEST CONDITIONS	TEST CIRCUIT AND PROCEDURE	LIMITS TYPE CA3043			UNITS	TYPICAL CHARACTERISTICS CURVES
			Fig.	Min.	Typ.	Max.		Fig.
STATIC CHARACTERISTICS								
Current Drain at 6V into Pin No.11	I_{11}	V_{CC} = +6V	3	10	16	20	mA	-
Regulator Voltage Pin No.11	V_{11}	V_{CC} = +30V, R_L = 750 Ω	3	6.9	7.4	8	V	-
Total Device Dissipation	P_T		3	200	225	260	mW	-
Quiescent Operating Current into Pin No.6	I_6		3	-	0.65	-	mA	-
DYNAMIC CHARACTERISTICS at V_{CC} = +30V, R_L = 750 Ω, f = 10.7 MHz								
Voltage Gain	A_V		4	72	80	-	dB	5
Input Limiting Voltage (knee)	v_i(lim)	v_o(af) at -3 dB point	6	-	50	-	μV (RMS)	7
Limiting Current from Pin No.6	I_6(lim)		4	-	0.42	-	mA (RMS)	-
Recovered AF Voltage	v_o(af)	v_i = 1 mV (RMS) f (modulating) = 1 kHz Deviation = ± 75 kHz	6	75	110	150	mV (RMS)	-
Amplitude-Modulation Rejection	AMR	v_i = 10 mV f (modulating) = 1 kHz % modulation = 50%	8	-	58	-	dB	-
Total Harmonic Distortion	THD	v_i = 1 mV (RMS)	6	-	1	-	%	-
Input Impedance Components:								
Parallel Input Resistance	R_{IN}		-	-	7	-	kΩ	-
Parallel Input Capacitance	C_{IN}		-	-	5	-	pF	-

DEFINITIONS OF TERMS

Amplitude-Modulation Rejection (AMR)

The ratio of the recovered AF output voltage produced by a specified frequency deviation of an FM input signal to the recovered AF output voltage produced by an amplitude-modulated input signal having the same carrier frequency, expressed in dB.

Input Impedance

The ratio of a change in input voltage to a change in input current, measured at the input terminal of the device, with respect to ground.

Input Limiting Voltage (Knee) [v_i(lim)]

The input signal voltage which will cause the output signal to decrease 3 dB from its maximum level.

Quiescent Operating Current

The average (dc) value of the current in either output terminal.

Recovered AF Voltage [v_o(af)]

The rms value of the AF output voltage of the device produced by a specified frequency deviation of an FM input signal.

Total Device Dissipation (P_T)

The total power drain of the device with no signal applied and no external load current.

Total Harmonic Distortion (THD)

The ratio of the total rms voltage of all harmonics to the rms voltage of the fundamental, expressed in per cent. These voltages are measured at the af output terminal of the device, with respect to ground.

Voltage Gain (A)

The ratio of the signal voltage developed at the output of the device to the signal voltage applied to the input, expressed in dB.

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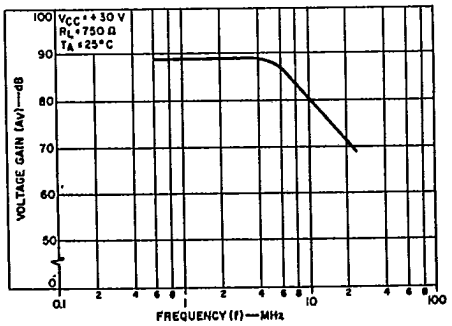

Fig.5 - Voltage gain vs frequency.

PROCEDURE:

1. Recovered Audio Voltage $v_{o(af)}$ –
   Set input frequency to 10.7 MHz,
   v_i = 1 mV(RMS), modulating frequency = 1 kHz
   Deviation = ±75 kHz
   Record v_o as measured on the Distortion Analyzer meter scale.
   This is the recovered Audio Voltage $v_{o(af)}$
2. 3 dB Limiting Sensitivity $v_{i(lim)}$ –
   Reduce v_i until $v_{o(af)}$ drops 3 dB.
   Record this value of v_i as $v_{i(lim)}$
3. Total Harmonic Distortion THD –
   Reset v_i to 1 mV(RMS) and operate Distortion Analyzer per manufacturer's instructions to measure THD.

* See Fig.9 for details on Discriminator Transformer.

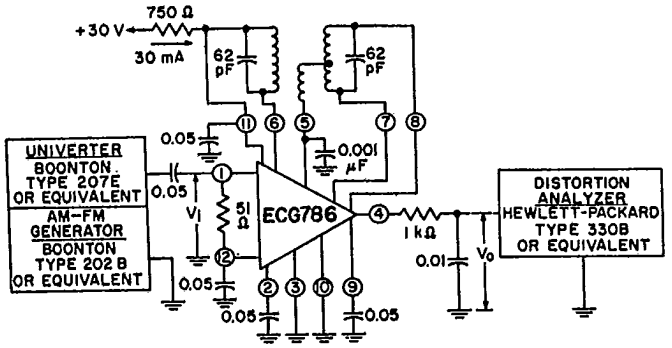

Fig.6 - Input limiting voltage (knee), recovered AF voltage, and total harmonic distortion test circuit.

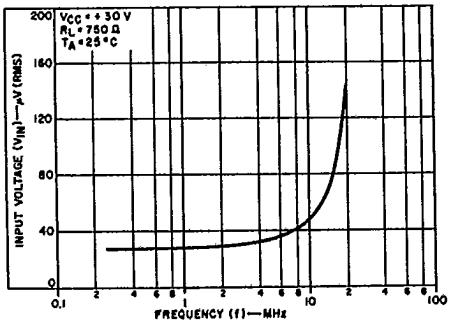

Fig.7 - Input limiting voltage (knee) at -3 dB point vs frequency.

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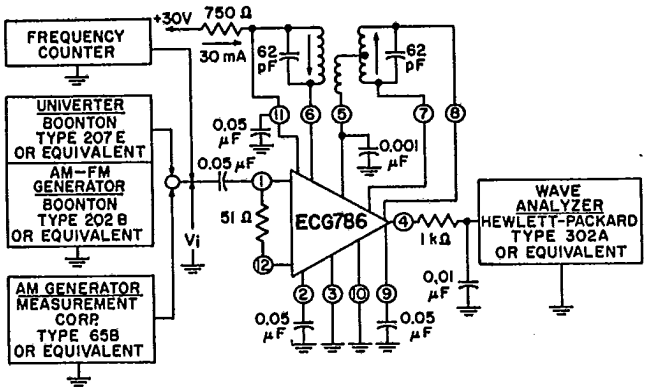


PROCEDURE:

A. Connect FM Generator to ECG786 input.

Set frequency to 10.7 MHz, v_i = 10 mV, modulating frequency = 1 kHz

Deviation = ±75 kHz.

Tune Wave Analyzer to peak reading at 1 kHz and record recovered Audio Voltage $V_{o(af)FM}$.

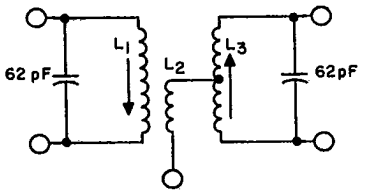
B. Disconnect FM Generator and Connect AM Generator to ECG786 input.

Set frequency to 10.7 MHz, v_i = 10 mV, modulating frequency = 1 kHz, percent modulation = 50%.

Tune Wave Analyzer to peak reading and record recovered audio voltage $V_{o(af)AM}$

Amplitude Modulation Rejection Ratio = $20 \log_{10} \frac{V_{o(af)FM}}{V_{o(af)AM}}$

Fig.8 - Amplitude modulation rejection test circuit.



Coil Form, Outside Diameter = 7/32"

Can = 1/2" square X 1-1/8" long

Slugs - Radio Industries Type MP34/MP100 Material

L_1 & L_3 = 20 Turns 5-44 litz wire universal wound

L_2 = 10 Turns 5-44 litz wire wound bifilar with L_1

L_1 & L_3 coupling adjusted to 520 kHz peak to peak separation on S curve when operated in circuit shown in Fig.6.

Fig.9 - 10.7 MHz discriminator transformer for ECG786.