GENNUM CORPORATION

High Performance AGC Amplifiers LC403, LD403

DATA SHEET

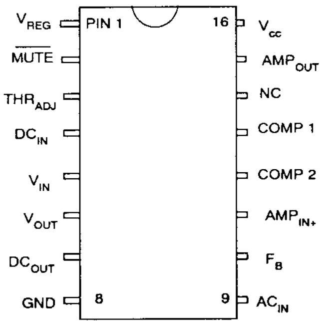
FEATURES

- high stability of output level
- 40 dB AGC operating range
- adjustable AGC threshold
- adjustable attack and release time
- levels adjustable with external components
- can be operated as a voltage controlled gain amplifier
- two gain blocks may be used separately
- maximum frequency 100 kHz
- threshold detector (squelch option)
- operates from standard 5V power supply

APPLICATIONS

- Voice recognition and voice control systems
- Public addresss systems
- Ground to air and ground to ground voice communication
- Airborne communications
- AM and FM broadcasting
- Intercom systems
- Special Telephone applications
- Security systems
- Ultrasound radars
- Sonar systems
- Proximity detectors
- and others

TOP VIEW



PIN CONNECTION
16 PIN DIP

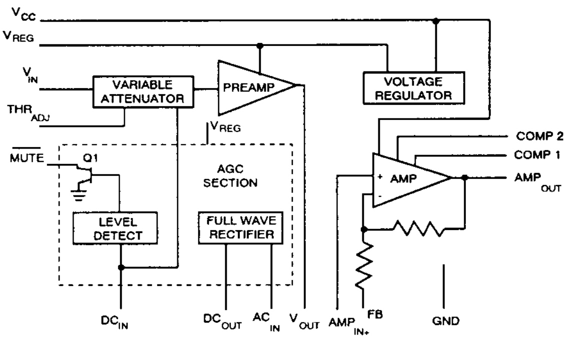


Fig.1 Functional Block Diagram

ORDERING INFORMATION

Part No.	16 Pin Package	Temperature Range
LC403D	PLASTIC	-25°C TO + 85°C
LD403D	CERAMIC	-55°C TO +125°C MIL 883B screened

ABSOLUTE MAXIMUM RATINGS

Parameter	Value & Units
Supply Voltage V_{cc}	10 V
Input Signal V_{IN}	4 Vpp (capacitive coupled)
Attenuator Control Input DC_{IN}	0.3 V to + 3.5 V
Amplifier Input AMP_{IN+}	0.3 V to V_{cc} + 0.3 V
Operating Temperature Range:	
LC403D	-25°C to +85°C
LD403D	-55°C to +125°C
Storage Temperature Range	-65°C $\leq T_S \leq$ 150°C
Lead Temperature (Soldering 10 sec)	260°C
Junction Temperature	150°C
Power Dissipation	(at T_A = 25°C) 500 mW

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CIRCUIT DESCRIPTION

General

The LC/LD403 contains six independent functional blocks, namely:

- Voltage Regulator
- Variable Altenuator
- Preamplifier
- AGC Section
- Level Detect Circuit
- Output Amplifier

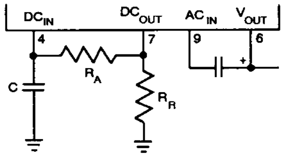


Fig. 2

The DC voltage developed on this capacitor is applied to the attenuator control circuit at DC_{IN}, which varies the attenuation to maintain the input signal to the preamplifier at a constant level. For performance and stability reasons, it is recommended that this capacitor be 2.2 µF minimum. The attack and release time constants are determined by R_A and R_R together with C. The minimum value for R_R is 1 MΩ.

The AGC threshold is set by a resistor (R_T) on pin 3 (THR_{ADJ}). A lower threshold represents higher initial gain, i.e.the attenuator-preamplifier reference gain setting is controlled by R_T . Refer to Fig.12 (R_T vs AGC Threshold V_T) and Fig.11 (AGC Characteristic).

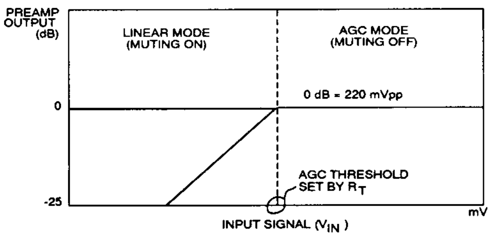


Fig. 3

Voltage Regulator

The voltage regulator powers the rest of the functional blocks with the exception of the output amplifier. It is a standard linear regulator using a series NPN transistor and differential pair amplifier. The reference voltage is provided by a temperature stable, bandgap voltage generator. The regulated voltage is brought out at pin 1 for capacitive filtering and external use. Up to 3 mA can be drawn from it. The regulated voltage is 3.65V ±5%.

Amplifier

The main amplifier is brought out on five pins as a separate component. COMP1, COMP2 are intended for a nominal 330 pF capacitor, which gives a bandwidth of 400 kHz. Access is provided to the non-inverting input (AMP_{IN+}) and the internal feedback network (FB). The gain is set at 18dB but this may be modified using the feedback pin FB.

The output stage of the amplifier is designed to drive a 600 Ω load to 2.3 Vpp (maximum), and can be biased by directly connecting the preamplifier output to the non-inverting amplifier input. This internal bias level is optimised for V_{CC} = 5 volts. The amplifier operates off V_{CC} and when V_{CC} > 5 volts, it may be advantageous to bias the input externally in order to obtain increased output voltage and symmetrical clipping. The optimum bias voltage versus V_{CC} is

$$\frac{V_{CC}}{2} - 0.5\ V$$

If external bias is used, a capacitor is necessary between the preamplifier output and amplifier input for DC isolation.

Attenuator - Preamplifier

The input signal to the attenuator (V_{IN}) must be connected through a capacitor. A direct connection will disturb the internal bias levels of the LC403. The attenuator is controlled by the automatic gain control (AGC) circuit. The gain of the preamplifier is +24 dB and the output is connected to the full wave rectifier through a capacitor. Because of current drive limitations, the minimum load resistance on the output of the preamplifier is 10 kΩ

AGC Section

When the signal at the input of the AC to DC converter (AC_{IN}) exceeds a reference threshold, both positive and negative peaks charge the AGC capacitor C.

At input levels less than the threshold, the attenuator and preamplifier operate in a linear mode with fixed gain. This gain is determined by R_T . Alternatively, a voltage can be applied at pin 4 (DC_{IN}) to control the gain, see Fig.13 (Attenuation Function of DC Control Voltage). When the input exceeds the AGC threshold, attenuation is increased to maintain the preamplifier output at a constant level. As the input varies, the attenuation tracks it with attack and release time constants set by R_A, R_R and C.

A Cautionary Note :
The resistor R_T sets up a current given by:

$$I_T = \frac{V_{CC} - 1.2\ V}{R_T + 5\ k\Omega}$$

This current is used to set the AGC threshold. V_{CC} must be well regulated and decoupled as close to the chip as possible.

ELECTRICAL CHARACTERISTICS

Limits apply over -25°C ≤ T_A ≤+85°C for the LC403 and -55°C ≤ T_A ≤ +125°C for the LD403. V_{CC} = 5V. Typical values are at T_A = 25°C. Parameters marked with a * are valid only at T_A = 25°C. The test circuit is shown in Figure 4.

SECTION	PARAMETER	CONDITIONS / NOTES	MIN	TYP	MAX	UNITS
General	V_{CC}	Supply Voltage	4.75	5.0	10.0	V
	I_{CC}	Supply Current, No Signal	-	12	16	mA
	V_{REG}	Regulated Output*	3.47	3.65	3.85	V
		Temperature Coefficient of V_{REG}*	-	100	-	ppm/°C
	I_{REG}	Max.Output Current for V_{REG}	-	-	3	mA
	C_{REG}	Decoupling Capacitor for V_{REG}	4.7	-	-	µF
	C_S	Power Supply Decoupling Capacitor	10	-	-	µF
	S / N	Signal To Noise Ratio at Amplifier Output with V_{IN} = 200mVpp at 1kHz AGC Mode, 300Hz -10kHz	-	65	-	dB
	THD	At Amplifier Output For V_{IN} = 100 -1000 mVpp at 1kHz	-	0.3	-	%
Amplifier	A2	Amplifier Gain with Internal Resistors	17	18	20	dB
		Temp. Coefficient Of Amplifier Gain	-	-	500	ppm/°C
	$Z_{IN\,2}$	Amplifier Input Impedance	10k	-	-	kΩ
	$Z_{OUT\,2}$	Amplifier Output Impedance at 1 kHz	-	-	10	Ω
	Clipping Voltage	600 Ω Load Internal Bias	-	3	-	Vpp
		2 kΩ Load External Bias	-	Vcc-1	-	Vpp
	Slew Rate	600 Ω Load	-	3	-	V/µs
	Input Bias	AMP_{IN+}	1	2	4	µA
	Output Current	Source	20	-	-	mA
		Sink	5	-	-	mA
	TCR	Feedback Resistor Temp. Coefficient	-	2000	-	ppm/°C
	Bandwidth	at -3 dB C_C = 330 pF	-	0.4	-	MHz
Attenuator/ Preamplifier	V_{IN}	Attenuator Input at 1 kHz, 0.3 % THD, AGC Threshold = 20 mV pp	-	-	1000	mVpp
	V_{OUT}	Preamp Output In AGC Mode. Minimum 10 kΩ Load	180	230	280	mVpp
	A1	Preamp Gain in Linear Mode	-	24	-	dB
	$Z_{IN\,1}$	Attenuator Input Impedance at 1kHz	10	-	-	kΩ
	$Z_{OUT\,1}$	Preamp Output Impedance at 1kHz	-	20	-	Ω
	Clipping Voltage	V_{OUT} (10 kΩ Load)		0.8	-	Vpp
	Slew Rate	V_{OUT} (10 kΩ Load)	-	1.5	-	V/µs
	Bias Level	Preamp Output DC Bias Level, No Signal	-	2.1	-	V
	R_S	Source Impedance for V_{IN}	-	-	5	kΩ
	Atten't'n Range	Not Including Preamp Gain	2	-	40	dB
	Output Current	Source	3	-	-	mA
		Sink	0.5	-	-	mA
	ΔV_{OUT}	Preamp Output Level Shift with Input Level Change V_{IN} = 20 to 1000 mV pp	-	0.2	-	dB

continued over

ELECTRICAL CHARACTERISTICS continued

SECTION	PARAMETER	CONDITIONS / NOTES	MIN	TYP	MAX	UNITS
AGC	Z_{IN3}	AC to DC Converter Input Impedance (AC_{IN})	5	-	-	kΩ
	Z_{IN4}	Attenuator Control Input Impedance (DC_{IN})	-	2000	-	kΩ
	C	Attack / Release Time - Constant Capacitor	-	2.2	-	µF
	R_A	Attack Time Constant Resistor	0	-	10	kΩ
	R_R	Release Time Constant Resistor	0.5	1	4.7	MΩ
	V	AGC Threshold $R_T = \infty$	-	20	-	mV pp
	IM	Muting Transistor Sink Current	-	-	1	mA

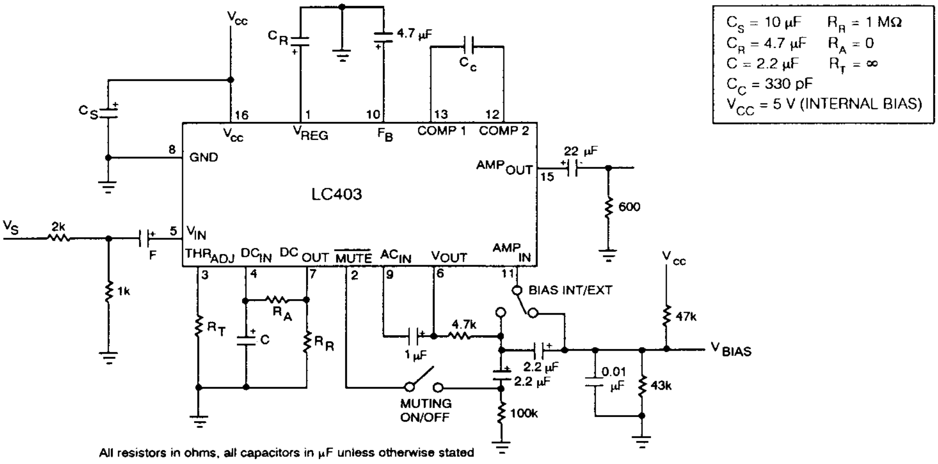


Fig.4 Test Circuit

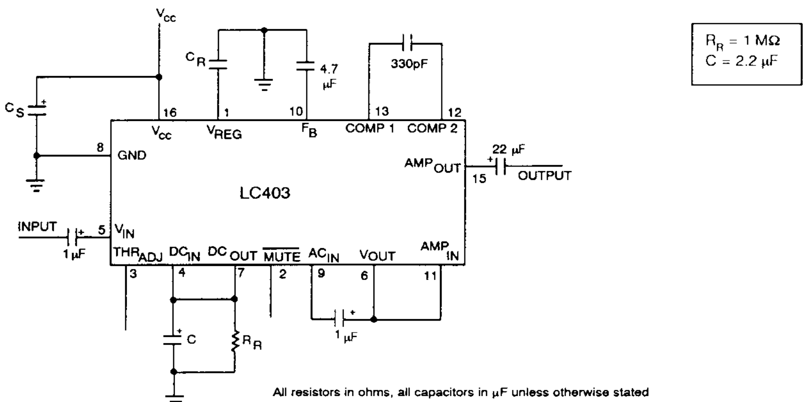


Fig.5 Minimum Components

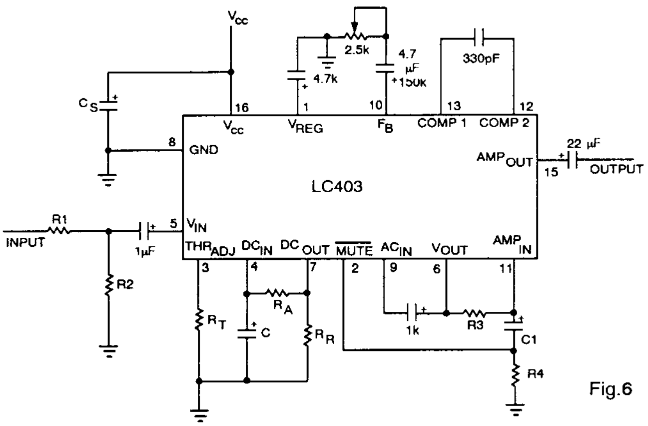
APPLICATION HINTS

The circuit in Fig. 5 represents an application for minimal external components. There is no provision for adjusting the output level or the input signal range. The attack time is set at minimum; however the release time can be controlled by selecting proper values for C and R_R

The circuit in Fig. 6 provides more flexibility in selecting levels. The input signal range, nominally 7 to 350 mV RMS can be shifted towards higher levels with the attenuator R1 and R2. The combination of R1 and R2 can also be used for matching the source impedance, where necessary. The output level can be reduced by up to 8 dB with the potentiometer. The input threshold is not affected. The attack time can be reduced with R_A. The threshold can be adjusted with R_T. The muting feature is obtained by R3, C1 and R4. When the input signal is under the threshold the mute pin is pulled down and C1 shorts the AC signals to ground, cutting off the noise when there is no input signal or the input signal is too low to be useful.

The level at which the muting operates can be adjusted by selecting the proper value for R_T.

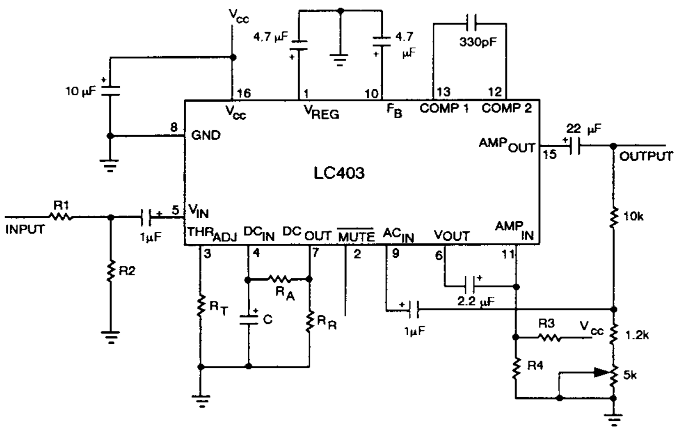
The circuit in Fig. 7 offers a few extra features. The amplifier input is biased from the power supply voltage. This will permit higher output levels when the power supply voltage is more than 5 volts. The AGC signal is taken from the amplifier output rather than from the preamplifier. Resistor R5 controls the output level, but in this case the AGC threshold is also affected. With this configuration, the total harmonic distortion can be reduced to 0.1% if , by adjusting the 5k potentiometer the output level is reduced to 1 Vpp or less. The delay time can be approximately calculated using Fig. 15. For example, for RR = 1MΩ and C = 4.7 μF, assuming that the input signal drops from 300 mV to 30 mV. The time corresponding to 300 mV is 1480 ms, the time corresponding to 30 mV is 800 ms, consequently, it will take 1480 - 800 = 680 ms for the input signal to reach the nominal value.



C = 2.2 μF
C 1 = 2.2 μF
R_A = 0.5 kΩ
R_R = 1 MΩ
R3 = 4.7 kΩ
R4 = 100 kΩ

All resistors in ohms, all capacitors in μF unless otherwise stated

Fig.6 Adjustable Characteristics with Muting



C_S = 10 μF	R_R = 1 MΩ
C_R = 4.7 μF	R_A = 0
C = 2.2 μF	R_T = ∞
V_{cc} = 5 -10V (EXTERNAL BIAS)	

All resistors in ohms, all capacitors in μF unless otherwise stated

Fig.7 Overall AGC Control / High Linearity

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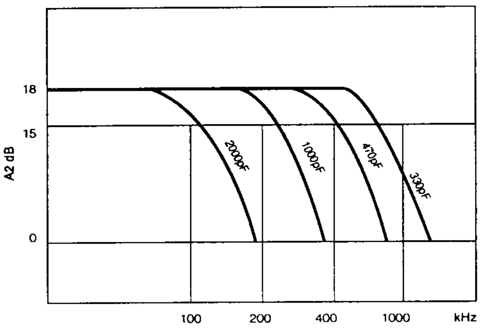


Fig.8 Amplifier Gain vs Frequency

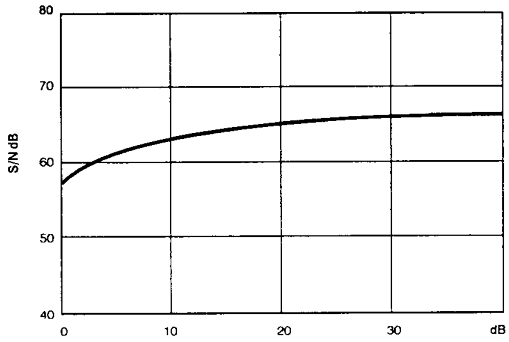


Fig.9 Output Signal to Noise vs Attenuation

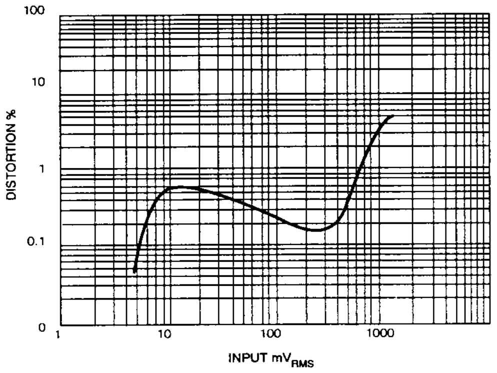
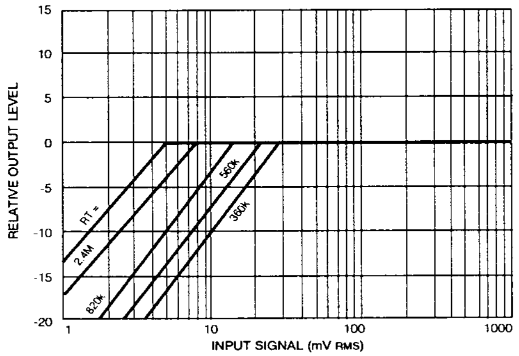


Fig.10 Distortion Function of Input Level (AGC Mode) ($R_T = \infty$)



Preamplifier Output = 86 mV RMS
Amplifier Output = 680 mV RMS
t = 27°C

Fig. 11 AGC Characteristic

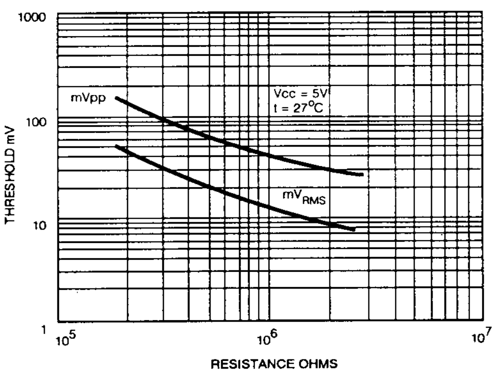


Fig. 12 R_T vs AGC Threshold V_T

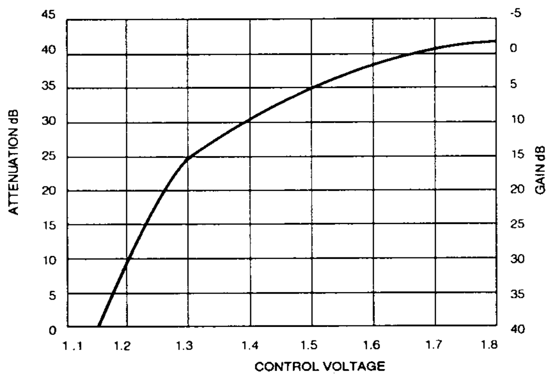


Fig. 13 Attenuation Function of DC Control Voltage

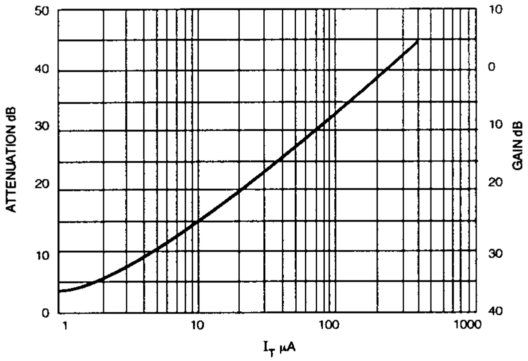


Fig.14 Attenuation vs Threshold Current I_T

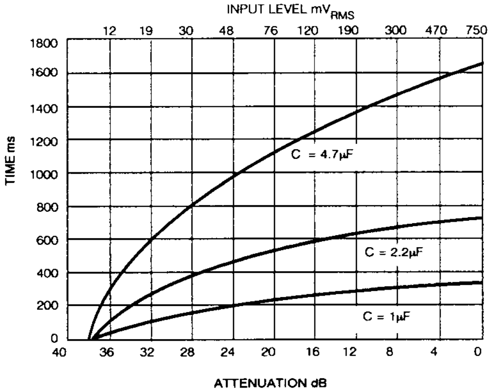


Fig.15 Release Time Characteristics
R_R = 1MΩ (R_T = ∞)

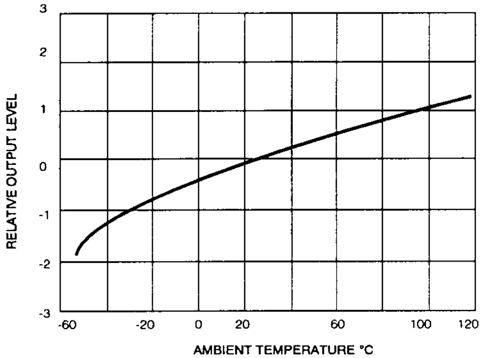


Fig. 16 Typical Output Level Function of Temperature (AGC Mode)

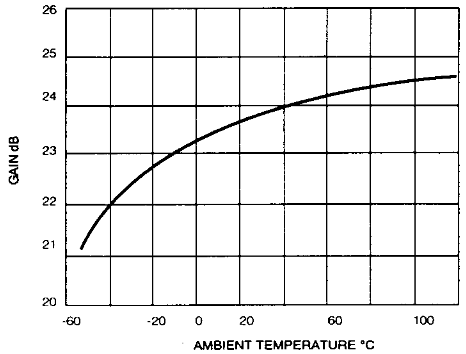


Fig.17 Typical Preamplifier Gain in Linear Mode (Attenuator Included)

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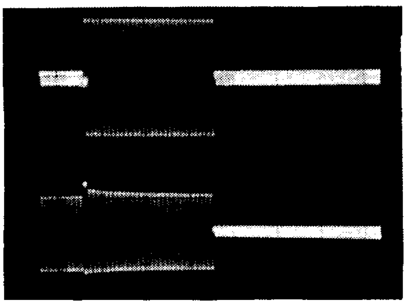
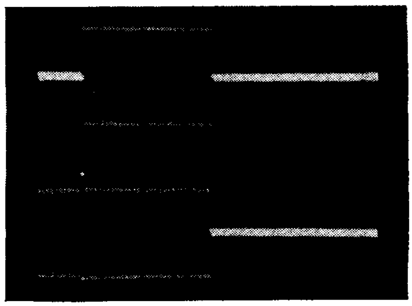


Higher Waveform: Input 0.1V/Division 1 kHz
Low Level 30mVpp
High Level 300mVpp

Lower Waveform: Output 1V/Division

Fig. 18 Transient Characteristic



Higher Waveform: Input 0.5V/Division 1kHz
Low Level 60mVpp
High Level 1.2Vpp

Lower Waveform: Output 1V/Division

Fig. 19 Transient Characteristic

AVAILABLE PACKAGING

16 pin PDIP

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