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9826

DATA AND SPECIFICATIONS
DESCRIPTION AND INSTRUCTIONS

Optical Electronics Incorporated

LOW PROPAGATION DELAY OPERATIONAL AMPLIFIER

FEATURES

- SLEW RATE: ±1000V/μsec
- GAIN BANDWIDTH PRODUCT X100: 1 GHz
- OUTPUT DRIVE: ±5V, ±50mA
- SETTLING TIME: 12ns to 0.1%
- CLOSED LOOP BANDWIDTH: 150 MHz
- TEMPERATURE DRIFT: ±50 μV/°C MAX

APPLICATION

- PULSE GENERATOR
- DATA ACQUISITION
- TEST EQUIPMENT
- VIDEO A/D, D/A, S/H
- RADAR AND SONAR

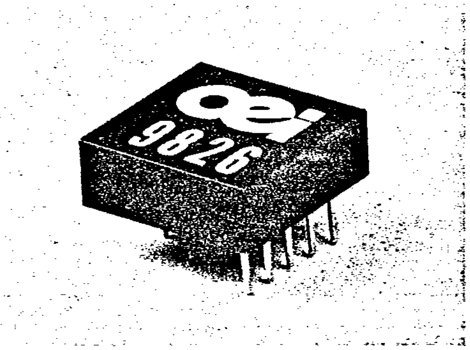
DESCRIPTION

The 9826 operational amplifier is designed to provide minimal propagation delay. The output settles to 0.1% of its intended value within 12ns when a voltage step is applied to the input. This rapid response is available without any feed-forward techniques, which means that there are no pole and zero cancelation in the gain vs. frequency function to contend with. Its bipolar front end provides for high speed and wide bandwidth characteristics, an input impedance of 10K ohm as well as low noise and a low capacitance.

The 9826 exhibits a Gain Bandwidth Product of 1GHz. At 10MHz a 40dB gain is possible, and the unity gain is measured at 200MHz. This makes the device very useful in many high frequency applications. These impressive AC characteristics are coupled with very good DC parameters. For example, the input offset voltage is specified at ±20mV maximum and the voltage drift is a max ±50mV/°C. Of course, these parameters must be considered in any circuit and an appropriate design must be chosen.

If proper mounting and wiring precautions are taken, the device is capable of a slewing rate of 1000V/μs and the delay is a mere 2ns. This is equivalent to a phase margin of less than 1°.

The output parameters of the 9826 match the other parameters in performance. At a 100 ohm output load, a full ±50mA drive current is available at ±5 V. This then makes the device attractive in circuits where long driver lines are required.



Also, applications which need relatively high drive currents can be served.

As a further advantage, the device is designed with FET's on both power supply lines, which allows short circuiting of the output with no detrimental effects.

The device measures 1.125 x 1.125 x 0.5 inches and fits into the 11028 socket, available from OEI. To obtain maximum performance, the socket should be soldered directly to the printed circuit board. The pin spacing allows the use of vector board for evaluation purposes. In a final design a printed circuit board is recommended. For further design consideration, consult the application section of this data sheet.

The device is also available in a militarized version. The order number is then 9826M5.

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SPECIFICATIONS

ELECTRICAL

Specifications at T_A = +25°C, V_{CC} = ±15VDC unless otherwise noted.

MODEL		9826			
PARAMETER	**CONDITION**	**MIN**	**TYP**	**MAX**	**UNITS**
OPEN LOOP GAIN, DC					
Full Load	Vo = ±5V; R_L = 100Ω		55		dB
No Load	Vo = ±5V	60	64		dB
RATED OUTPUT					
Voltage	Io = ±50mA	±5			V
Current	Vo = ±5V	±50			mA
Output Resistance	Open Loop		20		Ω
Short Circuit Current	Internal Limits		±100		mA
Capacitive Load			±22		pF
DYNAMIC RESPONSE					
Gain-Bandwidth Product					
A_{CL} = 100			1000		MHz
A_{CL} = −1			200		MHz
Slew Rate	R_L = 100Ω, Vo = ±5V		±1000		V/μsec
A_{CL} = −1					
Full Power Bandwidth	R_L = 100Ω, Vo = ±5V		30		MHz
	A_{CL} = −1				
Settling Time, A_{CL} = −1	R_L = 100Ω				
	Vo = ±5V				
ϵ = 1%			10		nsec
ϵ = 0.1%			12		nsec
Small-Signal Overshoot	A_{CL} = −1, R_L = 100Ω		20		%
INPUT OFFSET VOLTAGE					
Initial Offset			±10	±20	mV
vs Temperature	−55°C to +85°C			±50	μV/°C
vs Supply Voltage				±300	μV/V
INPUT BIAS CURRENT					
Initial Bias				±50	μA
vs Temperature	−55°C to +85°C			±100	nA/°C
VOLTAGE NOISE DENSITY Rs ≤ 100Ω					
	f_O = 10KHz		20		nV/√Hz
INPUT IMPEDANCE					
Differential					
Resistance			10		kΩ
Capacitance			2		pF
Common-Mode					
Resistance			1		MΩ
Capacitance			3		pF
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range			±1*		V
Common-Mode Rejection	at 1KHz		50		dB
POWER SUPPLY					
Rated Voltage		±10	±15	±20	VDC
Quiescent Current	Vcc = ±15V			±15	mA
TEMPERATURE RANGE					
Specification					
Operating		-55		+85	°C
Storage		-65		+100	°C

*Note: 9826 1) ±1V for inverting mode; ±7V for non-inverting mode.

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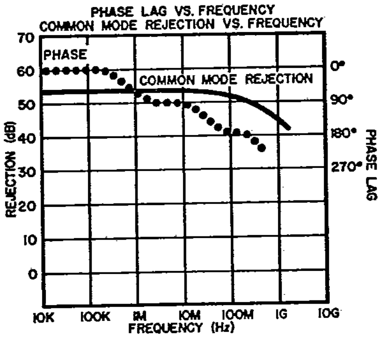
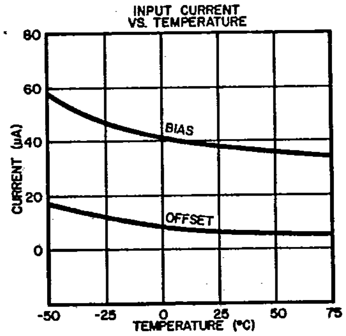
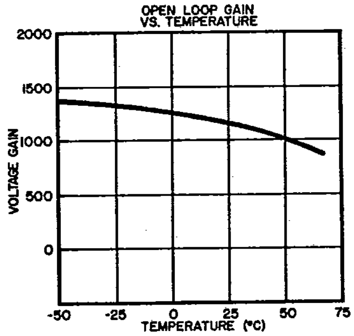
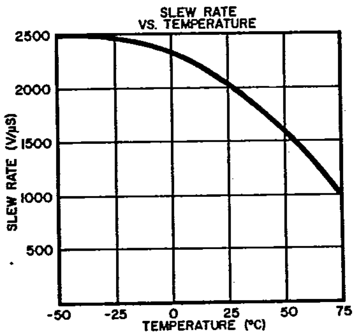
9826
TYPICAL PERFORMANCE CURVES

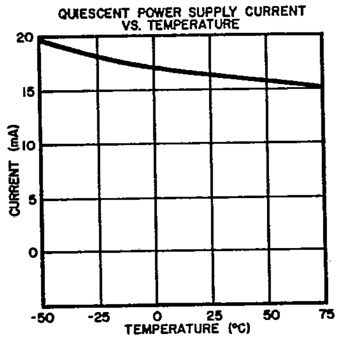
(T_A = +25°C, V_{CC} = ±15VDC unless otherwise noted)

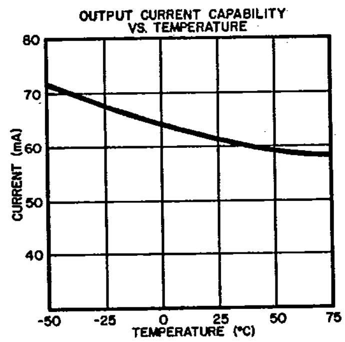


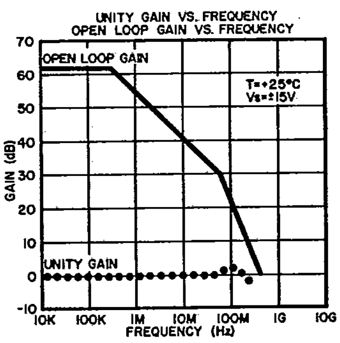




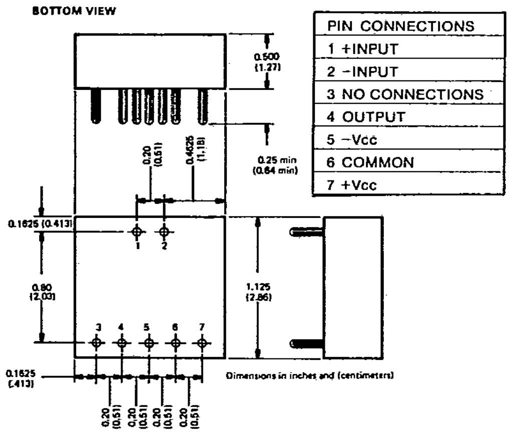








MECHANICAL DESCRIPTION: The case is made of glass-fiber-filled diallyl-phthalate and is filled with an epoxy encapsulant. Its pins are gold-plated per MIL-G-45204, Type 2, Class 2. They are 0.040 inches (0.102 cm) in diameter.



PIN CONNECTIONS
1 +INPUT
2 -INPUT
3 NO CONNECTIONS
4 OUTPUT
5 -Vcc
6 COMMON
7 +Vcc

APPLICATIONS

When the designer is faced with wide bandwidth, minimal propagation delay, and high drive capabilities requirements, the 9826 is an excellent choice. Even at 10MHz a 40dB gain is possible and the unity gain frequency of 200MHz allows its use in a variety of high speed, wide bandwidth applications. The basic connections of the device are shown in figure 1.

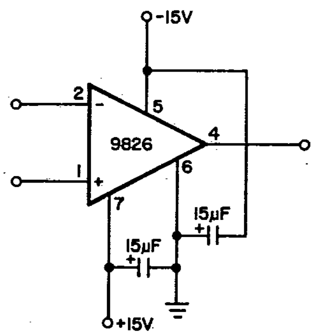


FIGURE 1. BASIC CONNECTIONS

As with all high speed devices, layout considerations are extremely important because of stray capacitances. This is particularly true for the inputs to the 9826. Certain measures can be taken to minimize the effects of these capacitive loads. They will be discussed in the following application notes. An example of a typical layout is provided at the end of this section. Generally, use of metal film resistors is recommended because of their superior performance at high frequencies. The same caution regarding stray capacitance is applicable on the output of the device. The power supply leads of the 9826 are internally compensated. This compensation should be sufficient. However, external compensation is recommended if more than one device is connected to the power supply. As shown, two 15μF capacitors, connected between the positive and negative rails and ground, will provide the necessary bypass capacitance. If noise on the line is still a problem, additional parallel capacitors may be needed. Recommended values would be .1μF and 330pF to promote filtering at medium and high frequencies. This paralleling of capacitors on the power supply leads is particularly important if digital devices are connected to the same supply.

HIGH SPEED PULSE AMPLIFIER

Because of its excellent AC parameters, the 9826 can be successfully used as a high speed pulse amplifier as is shown in the schematic diagram of figure 2.

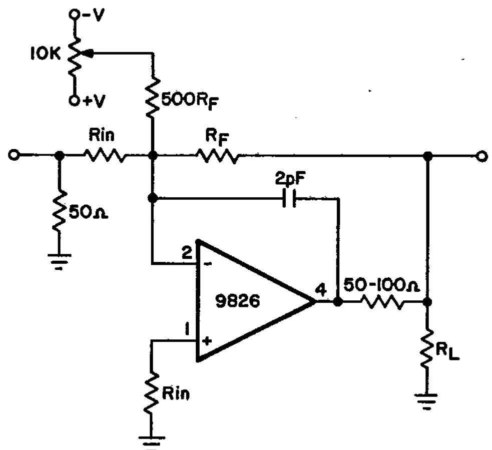


FIGURE 2. HIGH SPEED PULSE AMPLIFIER

This example is given here to show how the inherent offset of the device can be coped with despite the absence of an offset adjustment pin. In this case, the summing node is used and the necessary adjustment is produced by a linear pot which is connected between the two power supply rails. The wiper is connected to the inverting input via a resistor with a value that should be approximately 500 times the value of the feedback resistor R_F.

Also shown in this application is a 50 ohm resistor at the signal input point to the input resistor R_{in}. This resistor helps to keep potential input stray capacitances in check. The gain of the

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stage is, as usual, determined by the ratio of the input resistor R_{in} and the feedback resistor R_F. The resistor between the noninverting input should reflect the input resistor in value and should not be smaller than R_{in} and R_F in parallel.

The resistor of 50 to 100 ohms shown in the output lead dampens the amplified pulse slightly, thus improving the overshoot the signal may have. This, together with the 2pF capacitor connected in the feedback loop, speeds up the device, i.e. it provides for a faster settling time than would otherwise be possible.

The value of the output load resistor R_L depends on the current and amplitude requirements. At R_L = 50 ohms an output voltage of ±2.5V can be available. With R_L = 100 ohms the voltage swing will go to ±5V. Both voltages obviously have their attendant drive currents determined by the load resistor. The low output impedance can be used to advantage in a 50 ohm system and is less noise susceptible than a high impedance drive. Performance of ±1000V/μs can easily be obtained with this circuit.

D/A CONVERSION

The 9826 can be used very successfully in high speed Digital to Analog and Analog to Digital conversion units. An example of the former is shown in figure 3. Here the device is used in connection with a type 8528 DAC from the Data Devices Corp. This device has a very high speed current output that settles within 60ns. The voltage output has a longer settling time of 1000ns. The 9826 with its 12ns settling time (to 0.1%) provides an ideal match in this application. Generally, bipolar devices are not used in current to voltage conversions, because the bias currents are larger than those with FET front ends. However, in this case, where the DAC easily provides 4mA and the bias current of the operational amplifier is only ±50μA, the ratio is nearly 100:1 or 1 percent, an error that generally can be tolerated.

This is particularly true, when the most important parameter is the very high speed which is possible with this combination.

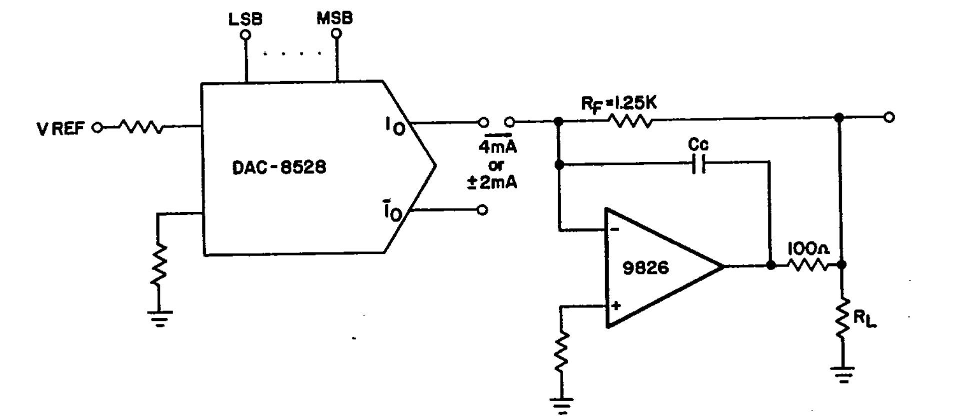

FIGURE 3. D/A CONVERSION

As can be seen from figure 3, either a 4mA or a ±2mA differential current is available from the 8528. The OEI device is used as a transconductance amplifier and R_F is determined by current mode used. In the case shown, a 4mA drive with the 1.25K ohm resistor will give a negative 5 volt output. The resistor connected to the noninverting input should have a value of 1.25K ohms. The feedback capacitor again would be chosen to allow fastest settling time and would be in the order of 2 to 5 pF. The 100 ohm resistor in the output helps speed up the device as explained previously. R_L in turn is chosen for the required output characteristics.

TEST EQUIPMENT

Figure 4 shows the 9826 in an application where high speed at a relatively low gain is required. This example is given to show how to cope with the parasitic oscillations the device might exhibit, when gains of less than 10 are needed. The input and feedback resistor ratio will provide a gain of 5. In this case it is advisable to employ a lead/lag network between the inverting and noninverting inputs. The values of R_X and C_X indicated in the diagram are typical.

With the values given, this circuit can operate comfortably at frequencies of 20MHz. If, however, a lower gain is needed, it might be advisable to connect a small capacitor (1 to 5 pF) between the output and the inverting input to aid in the suppression of parasitic oscillations. The example shows an output filter consisting of a 5pF capacitor parallel to a 100 ohm resistor. This filter was needed in this particular application which closely resembles one used in a radar device.

The remaining resistor of 10 ohms at the output has, as explained previously, a damping effect which helps suppress signal overshoot.

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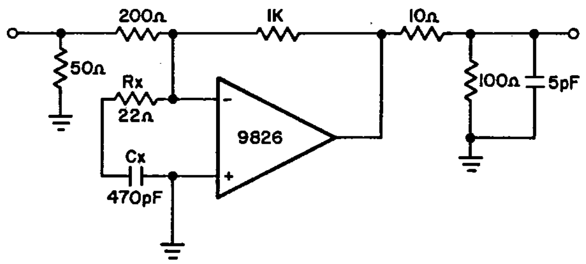

FIGURE 4. TEST EQUIPMENT

Figure 5 shows a typical layout that has been used successfully. The component layout is critical and can adversely influence the performance of the device. Good standard practices, that emphasize short connections and good grounds, are imperative.

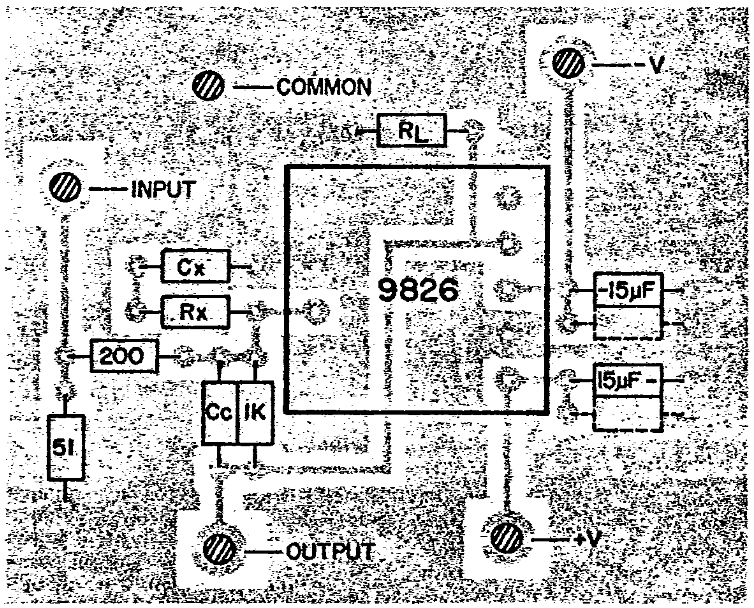

FIGURE 5. TYPICAL COMPONENT LAYOUT

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