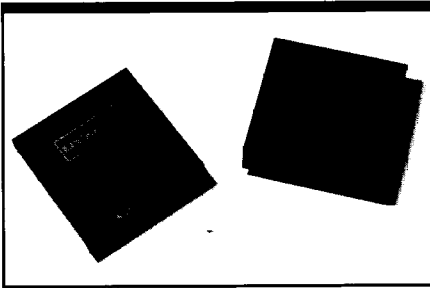


# 500kHz Bandwidth Analog Data Link Modulator/Demodulator



## Description

The **Model 5501** and **5502** are precision, wide bandwidth V/F and F/V converters respectively, intended to be used as the modulator and demodulator for an analog fiber optic data link. The **5501** accepts a  $-10\mu\text{V}$  to  $-10\text{V}$  full scale analog input at a 500kHz bandwidth. An offset adjust pin is provided which can be used to bias the **5501** input to allow bipolar operation. The input voltage is converted into a TTL-compatible frequency output

over the dc to 5MHz range. This TTL output can then be used to modulate the optical transmitter in an existing digital fiber optic data link, or to implement a stand-alone analog data link, either wire or fiber optic based.

The **Model 5502** demodulator performs the reverse process, converting a dc to 5MHz TTL frequency input into an analog output voltage over the range of 0V to  $-10\text{V}$  full scale. Again, an offset pin is provided to allow the recovery of bipolar voltages. Analog linearity through the modulator/demodulator system is  $\pm 0.1\%$  FS for signals up to 500kHz in bandwidth.

The **5501** and **5502** are packaged in 2.0"x2.0"x0.4" plastic shells. Operating temperature range is  $0^\circ\text{C}$  to  $+70^\circ\text{C}$ . Power dissipation is 2.2W for either the **5501** or **5502** on  $\pm 15\text{V}$  power supplies.

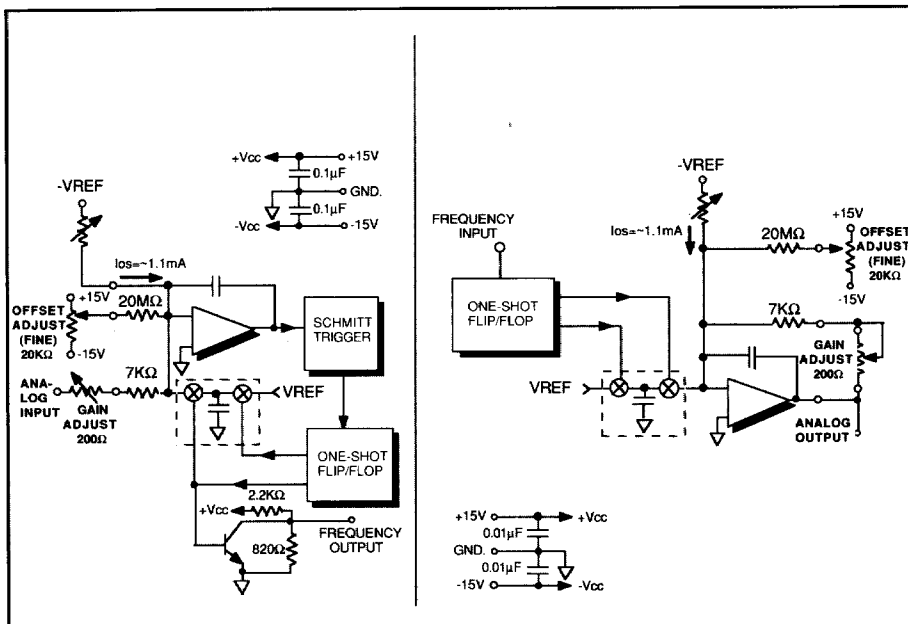


Figure 1. 5501/5502 Block Diagram

## FEATURES

- Wide Analog Bandwidth**  
500kHz
- Good Link Linearity**  
0.1% End-to-End
- Course and Fine Offset Inputs**  
Allows bipolar operation
- Good Stability**  
 $\pm 100\text{ppm}/^\circ\text{C}$  Gain T.C.
- Convenient Interfacing**  
TTL Compatible
- PC-Mounted Module**  
2.0"x2.0"x0.4" Plastic Pack-  
age

## APPLICATIONS

- Analog Transmission on Existing Digital Data Links**
- Wide Bandwidth Analog Data Links**
- Wide Bandwidth, Low Speed A/D Converters**

# Specifications

All Specifications Guaranteed at 25°C Unless Otherwise Noted

## 5501 MODULATOR

### ANALOG INPUT

#### Input Voltage

-10 $\mu$ V to -10V,  
 $\pm$ 10V with suitable offset voltage

#### Input Overrange

10% minimum

#### Maximum Input Voltage

$\pm V_{CC}$  without damage

#### Input Impedance

7k $\Omega$  nominal

### OFFSET VOLTAGE INPUT

#### Input Impedance

Direct to integrator summing node

#### Offset Adjustment Range

$\pm$ 10V by insertion of  $\pm$ 1.4mA into  
Course Offset Adjust input

### TRANSFER CHARACTERISTICS

#### Full Scale Frequency Output ( $F_{out}$ )

5MHz, +10% overrange

#### Transfer Function

5MHz( $V_{IN}/10V$ ),  $\pm F_{OFFSET}$ ;

$F_{OFFSET} = -4\text{MHz} \times I_{IN}$  (in mA), where  $I_{IN}$

is applied to the Course Offset Adjust pin

#### Non-Linearity

$\pm$ 0.25% FS maximum, dc to 5MHz;

$\pm$ 0.1% FS maximum, 3.75-5.25MHz

#### Gain Error

$\pm$ 1%, adjustable to zero

#### Full Scale Step Response

2 cycles of new frequency plus 2 $\mu$ s

#### Overload Recovery

12 cycles of new frequency

### FREQUENCY OUTPUT

#### Output Pulse Width

100ns  $\pm$ 40ns

#### Logic Levels

**Logic 1 ("Low")**      **Logic 0 ("High")**

<0.4V @ 16mA sink      >3.5V

#### Fanout

100 TTL loads

#### Short Circuit Protection

Indefinite without damage

### STABILITY

(Exclusive of external components)

#### Gain - Tempco

$\pm$ 100ppm/ $^{\circ}$ C FS maximum

#### Gain - Power Supply Sensitivity

200ppm/% change in supply voltage

#### Offset - Tempco

50 $\mu$ V/ $^{\circ}$ C maximum

### POWER REQUIREMENTS

**+15V,  $\pm$ 5%**

**-15V,  $\pm$ 5%**

55mA maximum

25mA maximum

#### Absolute Power Supply Limits

$\pm$ 13V to  $\pm$ 18V

### ENVIRONMENTAL AND MECHANICAL

#### Operating Temperature Range (Rated

Performance)

0 $^{\circ}$ C to +70 $^{\circ}$ C

#### Operating Temperature Range

(50% Derated TC, Linearity and Fanout)

-25 $^{\circ}$ C to +85 $^{\circ}$ C

#### Storage Temperature

-25 $^{\circ}$ C to +95 $^{\circ}$ C

#### Dimensions

2.0"x2.0"x0.4"

Plastic module

## 5502 DEMODULATOR

### FREQUENCY INPUT

#### Input Pulse Width

30ns minimum, 85ns typical; positive pulse

#### Logic Levels

**Logic 1 ("Low")**      **Logic 0 ("High")**

<0.4V @ 16mA sink      >3.5V

#### Input Load

1TTL load

### TRANSFER CHARACTERISTICS

#### Full Scale Frequency Input ( $F_{IN}$ )

dc to 5MHz, +5% overrange

#### Transfer Function

-10V( $F_{IN}/5\text{MHz}$ ),  $\pm V_{OFFSET}$ ;

#### Non-Linearity

$\pm$ 0.25% FS maximum, dc to 5MHz;

$\pm$ 0.1% FS maximum, 3.75-5.25MHz

#### Gain Error

$\pm$ 1%, adjustable to zero

#### Full Scale Step Response

2 cycles of new frequency plus 2 $\mu$ s

#### Overload Recovery

12 cycles of new frequency

## Specifications (continued)

All Specifications Guaranteed at 25°C Unless Otherwise Noted

<p><b>ANALOG OUTPUT</b></p> <p><b>Output Voltage</b> 0V to -10V; ±10V with suitable offset voltage</p> <p><b>Output Overrange</b> 10% minimum</p> <p><b>Output Impedance</b> &lt;0.01Ω nominal</p> <p><b>Ripple Voltage</b> ±500mV typical at carrier frequency; assumes no low pass filter present on output</p> <p><b>OFFSET VOLTAGE INPUT</b></p> <p><b>Input Impedance</b> Direct to integrator summing node</p> <p><b>Offset Adjustment Range</b> ±10V by insertion of ±1.4mA into Course Offset Adjust input</p> <p><b>STABILITY</b> (Exclusive of external components)</p> <p><b>Gain - Tempco</b> ±100ppm/°C FS maximum</p>	<p><b>Gain - Power Supply Sensitivity</b> 200ppm/% change in supply voltage</p> <p><b>Offset - Tempco</b> 50μV/°C maximum</p> <p><b>POWER REQUIREMENTS</b></p> <table><tr><td><b>+15V, ±5%</b> 55mA maximum</td><td><b>-15V, ±5%</b> 25mA maximum</td></tr></table> <p><b>ENVIRONMENTAL AND MECHANICAL</b></p> <p><b>Operating Temperature Range (Rated Performance)</b> 0°C to +70°C</p> <p><b>Operating Temperature Range (50% Derated TC, Linearity and Fanout)</b> -25°C to +85°C</p> <p><b>Storage Temperature</b> -25°C to +95°C</p> <p><b>Dimensions</b> 2.0"x2.0"x0.4" Plastic module</p>	<b>+15V, ±5%</b> 55mA maximum	<b>-15V, ±5%</b> 25mA maximum
<b>+15V, ±5%</b> 55mA maximum	<b>-15V, ±5%</b> 25mA maximum		



## Using the 5500 Analog Modulator/Demodulator

### General Considerations

As with any high precision conversion circuitry, the use of a ground plane is strongly recommended. The layout should be clean, with output pulses routed as far away as possible from the input analog signals. As shown in Figure 1, bypass capacitors should be mounted as close as possible to the power supply pins of the **5501** or **5502**.

### Offset and Gain Calibration

The V/F OFFSET adjustment potentiometer should be a 20KΩ, 10-turn unit. With this pot in the circuit, initial offsets of up to ±10mV may be trimmed to zero.

The V/F GAIN adjustment

potentiometer should be a 200Ω, 10-turn unit with a recommended temperature coefficient of 100ppm/°C or better. With this potentiometer in the circuit, initial gain errors of up to ±2% may be trimmed to zero.

To calibrate the **5501**, the offset is adjusted prior to adjusting the gain. With a voltage at the analog input of -10mV signal at  $V_{IN}$ , adjust the OFFSET pot until an output frequency of 5.000kHz is obtained at the pin. With a full scale voltage of -10.000V at  $V_{IN}$  of the V/F, adjust the gain pot for an output frequency of 5.000MHz. Calibration is now completed.

To calibrate the **5502**, the offset is adjusted prior to adjusting the gain. With a TTL frequency at the input to the **5502** of 5.000kHz, adjust the OFFSET pot until an output voltage of 0.000V is present

on the output pin. With a TTL frequency of 5.000MHz on the input, adjust the GAIN pot until the output voltage equals -10.000V. Please refer to the section entitled "**Low-Pass Filtering Output Ripple**" for additional information.

### Grounding

The Analog and Digital grounds are internally connected within the **5501/5502** circuitry.

The use of a ground plane is recommended. If a ground plane is not feasible, then a single-point ground ("star" ground) must be used. Significant performance degradation will result if these grounding schemes are not utilized.

# Using the 5500 Analog Modulator/Demodulator (continued)

## Low-Pass Filtering of 5502 Output Ripple

The 5502 analog output has an ac component that is composed of the carrier frequency. Unfiltered,

this ripple voltage can be as large as 2Vp-p on a  $\pm 10V$  full scale output. To filter this ripple voltage and maintain the overall link analog bandwidth for the intended application, a capacitor is connected between the OUTPUT and OFFSET

ADJUST pins of the F/V converter. The value of this feedback capacitor is dependent on the bandwidth to be preserved and the required settling time of the receiver circuit. Representative values are given in Table 1.

$F_{IN}$ (IDEAL)	$V_{OUT}$	$C_F=330pF$	$C_F=66pF$	$C_F=33pF$	$C_F=470pF//10K\Omega$	$C_F=33pF//10K\Omega$
5kHz	-0.01V	0.6V	2.2V	2.2V	450mV	3.9V
500kHz	-1.00V	0.6V	2.2V	2.2V	450mV	3.9V
1.5MHz	-3.0V	0.6V	1.2V	1.3V	400mV	1.9V
2.5MHz	-5.0V	0.5V	0.8V	0.8V	275mV	0.9V
3.5MHz	-7.0V	0.5V	0.6V	0.6V	200mV	0.6V
5MHz	-10.0V	0.3V	0.4V	0.4V	110mV	0.4V
-3dB Freq., (0V to -10V)		80kHz	470kHz	488kHz	—	—

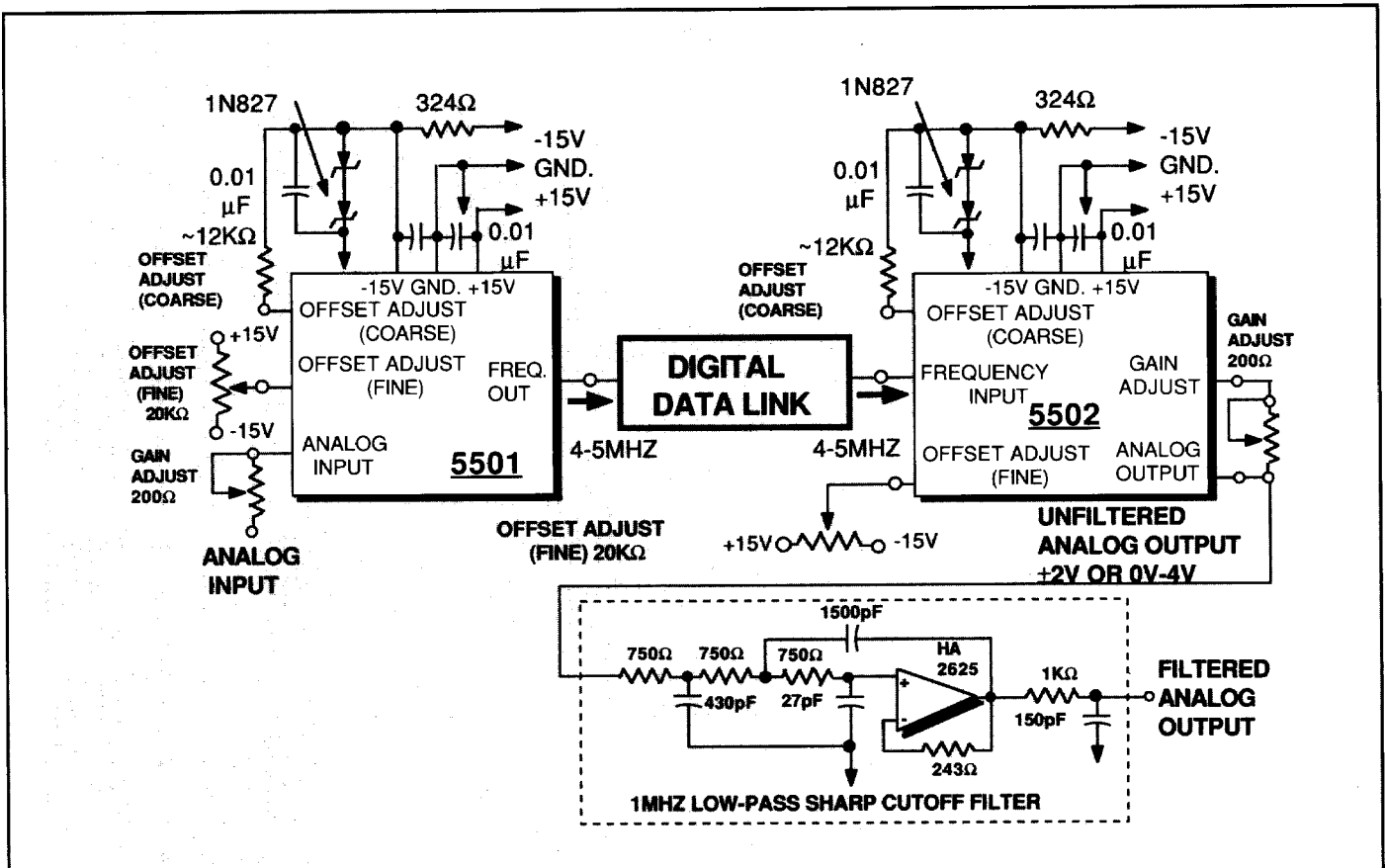
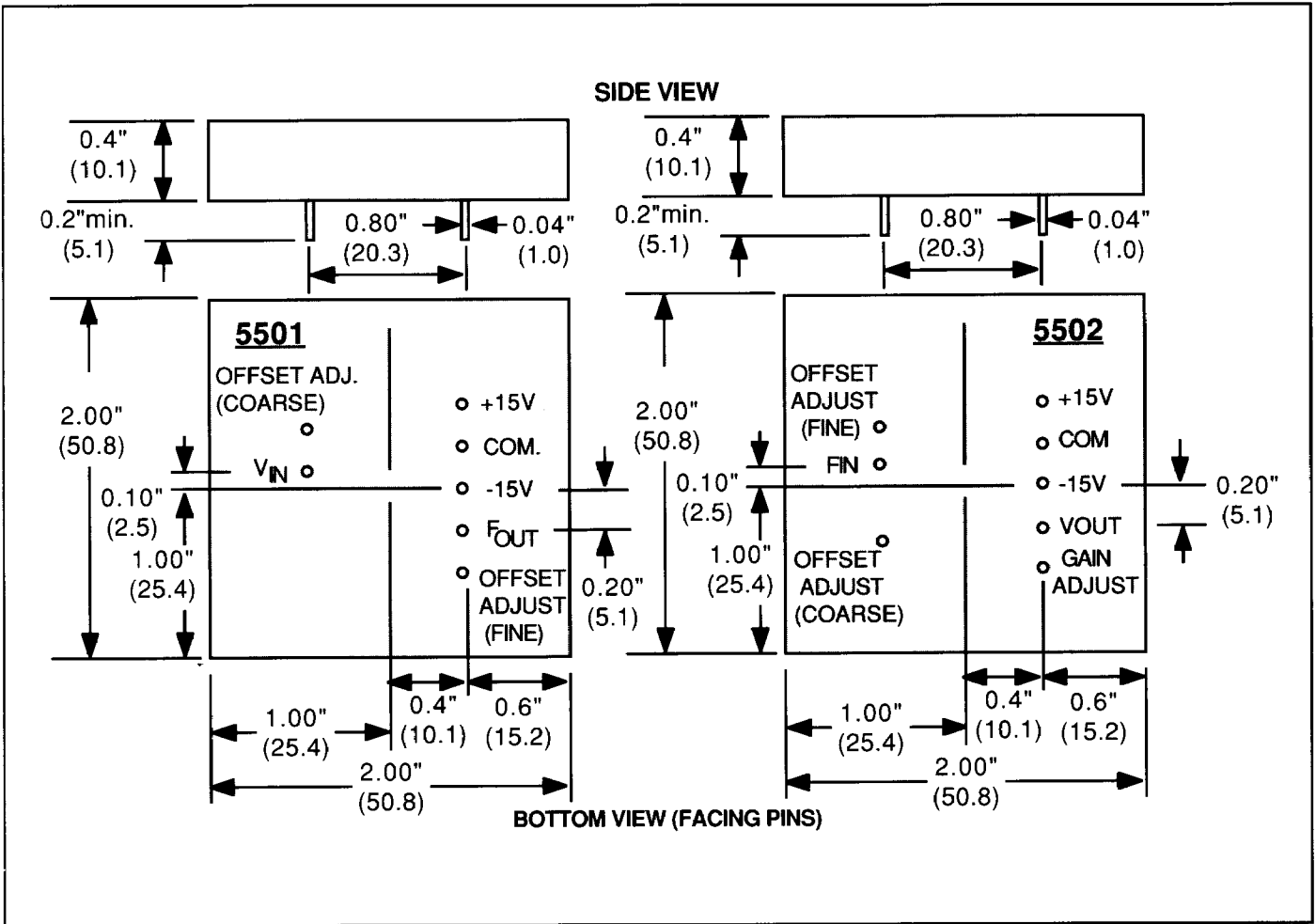


Figure 2. Typical Interconnection Scheme

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# Mechanical Dimensions & Pinout



**ORDERING INFORMATION**

**500kHz Bandwidth,  $\pm 0.1\%$  Linearity**  
**Analog Modulator**  
**Analog Demodulator**

**Order Model:**  
**5501**  
**5502**



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