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ADVANCED ANALOG

A-8404 Single Supply Voltage-to-Frequency-to-Voltage Converter

DESCRIPTION

The **A-8404** is a low-cost monolithic voltage-to-frequency converter that provides linear conversion of analog signals to a digital pulse train whose repetition rate is proportional to the analog signal.

Key features of the **A-8404** V/F/V are its single power supply operation and the ability to be scaled over a 0 to +18V/0 to 1 MHz range and virtually achieve 11 bit accuracy with a minimum number of components.

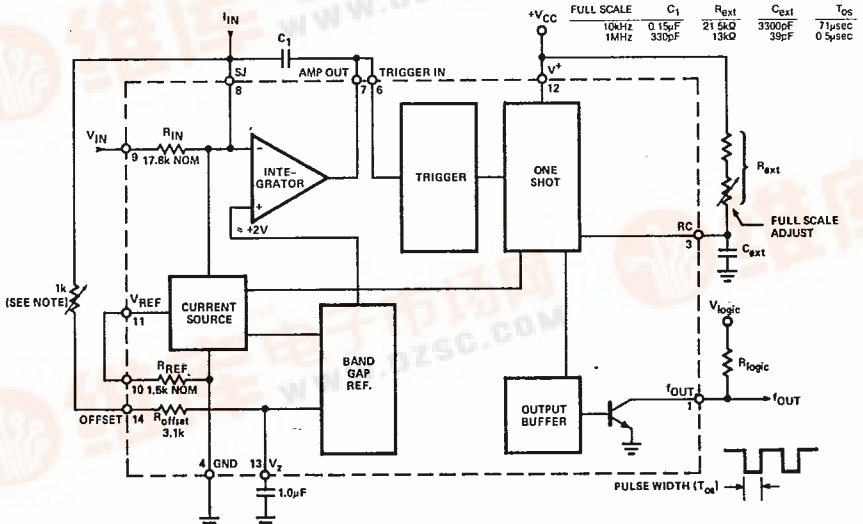
A maximum nonlinearity of ±0.05% (±0.4%) for the **A-8404** with a 10kHz (1MHz) full scale output and the versatility offered by the **A-8404** makes this low cost V/F/V converter an ideal choice for very accurate data encoding and decoding. When linked to a frequency-to-voltage converter such as the **A-8404,** connected for F/V operation, an accurate two-wire data link may be formed with the V/F as the transmitter and F/V as the receiver. The **A-8404** may also be linked to a binary counter which can perform approximately 390 8-bit digital conversions per second. The **A-8404** is especially suited for applications in data transmission, magnetic tape recording, servo loops and isolating analog from digital.

FEATURES

- Single Supply — +5 to +18 V_{CC}
- 0 to +V_{CC} Conversion to:
  1MHz, ±0.4% Accuracy
  10kHz, ±0.05% Accuracy
- LED Drive Capability
- DTL/TTL and CMOS Compatible Output/Input
- Small Size — 14 Pin DIP
- Low Cost

APPLICATIONS

- Remote Control or Monitoring
- 2-Wire Digital Transmission
- Telemetry
- Isolation
- Servo Loops
- Synchronous Speed Control
- Magnetic Tape Recording



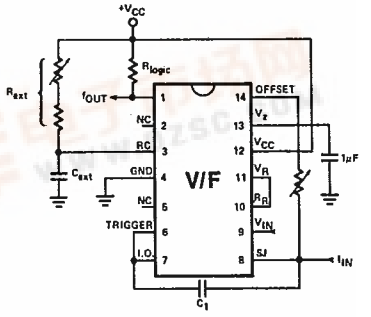
TRANSFER FUNCTION:

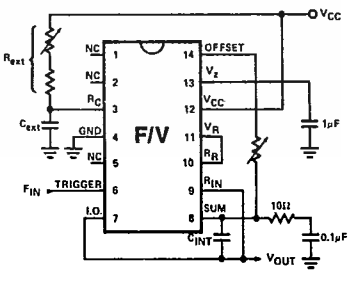
$$f_{OUT} = \frac{\left(\frac{V_{IN}}{R_{IN}} - \frac{2.5}{R_{offset}}\right)}{T_{os} I_R}, \quad R_{offset} \geq 3.1k + (25\% \times 1k\ pot), \quad I_R = \frac{V_R}{R_R}, \quad V_R = 1.25V, \quad R_R = 1.5k, \quad V_Z = 2.5V,$$

$$T_{os} = R_{ext} C_{ext}$$

NOTE TO ZERO ADJUST A-8404, SET V_{IN} = 10mV AND ADJUST 1k POT TO GIVE THEORETICAL f_{OUT} TO ADJUST FULL SCALE, USE A 5k POT IN SERIES WITH R_{ext} REPLACE 1k OFFSET POT WITH 240Ω FIXED RESISTOR FOR NOMINAL GND RANGE OPERATION FOR BEST TC PERFORMANCE. C_{ext} SHOULD BE NPO CERAMIC AND R_{ext} SHOULD BE METAL FILM CAPACITOR ON PIN 13 (V_Z) REQUIRED TO STABILIZE REFERENCE.

PIN CONNECTION





SPECIFICATIONS

(Typical @ +25°C and +12V Supply, Unless Otherwise Noted)

Parameter		A-8404
TRANSFER CHARACTERISTIC		$f_{out}=\frac{V_{IN}}{10}F_{full\ scale}$
ACCURACY[1]		
Resolution		5 decades
Linearity, FS		
10kHz bandwidth		±0.05% max
.1MHz bandwidth		±0.4% max
Monotonic		inherent
Scale Factor[2]		±15%
Offset		Note 2
STABILITY[1,8]		
Scale Factor		
vs. Temperature	typ	±50ppm/°C
@ 10kHz	max	±100ppm/°C
vs. Power Supply		±200ppm/%
vs. Time/day		±100ppm
vs. Time/month		±200ppm
Offset		
vs. Temperature	typ	±80ppm/°C
	max	±100ppm/°C
vs. Power Supply		±100μV/%
vs. Time/day		±15ppm
vs. Time/month		±30ppm
Bandgap Reference (V_Z=2.5V nom.)		±25ppm/°C
RESPONSE – V/F Mode		
Settling Time, to 0.01%, FS Step		2 cycles max[3]
Overload Recovery		10ms
RESPONSE – F/V Mode		Depends on $C_{INT}\cdot R_{IN}$ time constant
INPUT (V/F)/OUTPUT (F/V)		
Voltage Range[4,5]		0 to +10V
Current Range		0 to +450μA
Configuration		Single-ended
Impedance (voltage input)		17.8kΩ nominal
Overvoltage Protection (V_{IN})		$+V_{CC}$
OUTPUT (V/F)/INPUT (F/V)		
Frequency Range[4]		0 to 1MHz
Overrange		Depends on external RC time constant
Waveform[6]		Compatible with DTL, TTL & CMOS
Fan Out[7] – V_{sat}=0.4V		5 TTL Loads
– V_{sat}=1V		20mA
Short Circuit Protection		Indefinite to GND
TEMPERATURE		
Rated		0 to +70°C
Operating		–25 to +85°C
Storage		–55 to +125°C
POWER SUPPLY – V_{CC}		
Voltage – rated		+12V
– operate		+5 to +18V
Current		+20mA @ +12V

NOTES: 1. Applies to V/F & F/V modes. 2. Adjustable to zero error. 3. Of final frequency. 4. Adjustable to other full scale input/output levels. 5. F/V mode–min. V_{OUT}=0.4V. 6. Output level determined by external pull-up resistor. 7. One TTL load unit is –1.6mA at LO (+0.4V) and +40μA at HI (+2.4V). 8. Warm-up time = 5 min.

OPERATION

V/F Mode

An improved form of the charge-balancing technique is used in the **A-8404**. The analog input forces a current to flow through R_{IN} into C_1 causing the output of the integrator to move in a negative direction (see Figure 1). At a nominal .7 volt level, the comparator circuit triggers the timing reference network to turn the controlled current source on so that it discharges C_1. As the capacitor discharges, the output of the integrator moves in a positive direction. When the timing reference has finished discharging the capacitor, the output of the integrator is positive and ready to start the process again for the next cycle. For current inputs into the summing junction (Pin 8), it is recommended for good temperature stability that an external R_{REF} be used between Pin 11 and ground. It is also recommended that the internal R_{offset}, R_{REF} and R_{IN} be used together for good TC performance. T_{OS} influences frequency stability; therefore low TC components should be used.

F/V Mode

As a frequency-to-voltage converter, the **A-8404** accepts negative-going TTL-Level pulses into the trigger circuit which starts the one-shot cycle (period=T_{OS}=R_{ext} C_{ext}). (See Figure 2).

The current source forces current out of the summing junction for the one-shot period. The amplifier acts as a current-to-voltage integrator providing a voltage output proportional to the average current (also proportional to the input frequency). Output ripple is controlled by the integrating capacitor (C_{INT} – see Figure 2). A low pass filter is recommended on Pin 8. Pin 13 may be used for external referencing (maximum current drain <350μA).

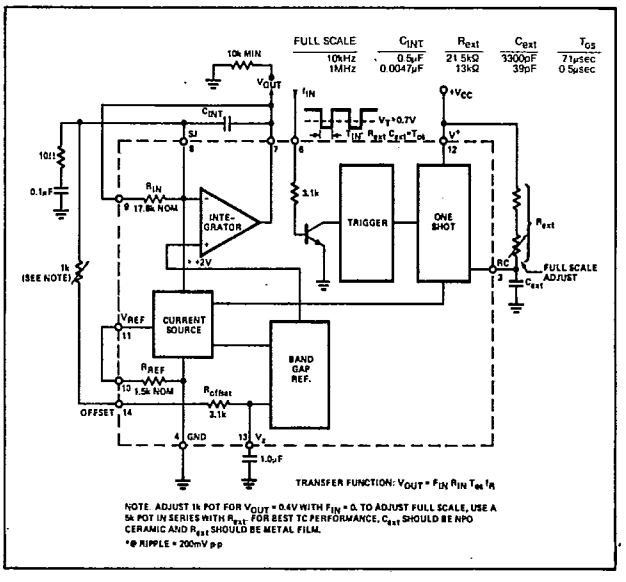


Figure 2. A-8404 Hook-Up — F/V Mode

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