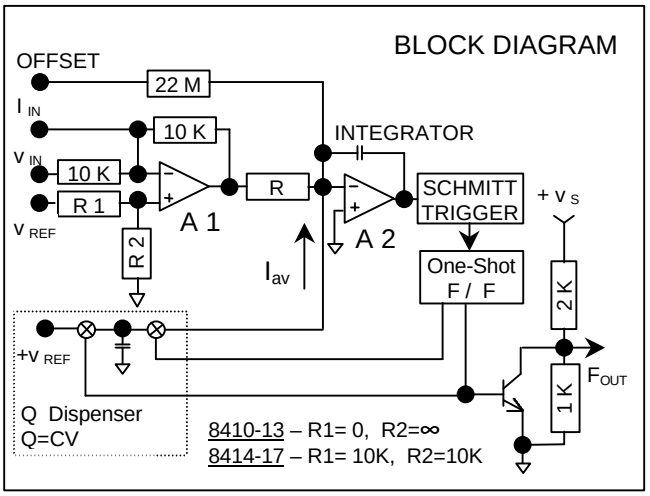
DYMEC Fiber Optic Solutions for Industry

1 MHz Voltage to Frequency Converters

S.E. Models 8410, 8412, 8413
Diff. Models 8414, 8417



Features:

- ***Guaranteed Minimum / Maximum Specifications***
- ***Wide Dynamic Range***
  - ***> 1,000,000:1 > 120 dB***
- ***Excellent Linearity***
  - ***0.001% FS***
  - ***±0.02% of input***
- ***Excellent Stability***
  - ***10 mV / °C offset***
  - ***10 ppm / °C gain***
- ***Buffered Frequency Output***
  - ***10 TTL loads***
- ***Self-contained Subsystem***
  - ***2"x 2"x 0.4" module***
- ***Low Power***
  - ***< 0.95 W***

Applications:

- ***Analytical Instrumentation***
- ***Medical Instrumentation***
- ***Telemetry***
- ***Data Recording***
- ***Weighing Systems***

Description

The **8400 Series** are high performance, high precision 1MHz full scale Voltage-to Frequency Converters intended for applications which require high resolution, very high linearity, and a six decade dynamic range. Units are available with varying gain drift performance over temperature in both single-ended and differential input configurations. The Single-ended analog voltage input of all units is 10 µV to 10 V full scale with a 10% over-range capability. The differential input signal is either a positive or negative 10 µV to 10 V full scale, with common-mode signals attenuated by 60 dB minimum. The input signal is converted to an output proportional to the full scale frequency, within 0.001% linearity, utilizing the long-proven charge balance technique. A buffered TTL-compatible frequency output with a 10 TTL-load fanout is provided that will drive up to 200 pF capacitive loads.

Stability of the **8400 Series** over temperature is excellent, with a 40 µV / °C maximum offset and 15 ppm / °C maximum (**8413**) gain tempco. Warm-up time to 0.02% accuracy is less than two (2) minutes. In applications that require slightly different specifications such as different full scale output frequency, or where fixed offset or different full scale voltages would be convenient, **custom frequencies** and/or **custom trimming** can be easily accommodated. Other variations such as ratio-metric operation, FET input op-amp, or extended temperature range can also be accommodated. Please contact the factory to discuss your specific requirements.

The **8400 Series** are packaged in a 2.00"x 2.00" x 0.40" modular package. Power dissipation is less than 0.95 W maximum, and operation to rated performance is over the 0° C to +70° C temperature range.

8400 Series Specifications

(Unless otherwise noted, specifications are at 25° C and are subject to change without notification)

Analog Input

Input Range ± 10 µV to ± 10 V
Current Range + 1 nA to +1 mA
Overrange 10% minimum
Configuration
8410, 8412, 8413 Single-ended
8414, 8417 Differential
Common-Mode Voltage Range
8414, 8417 ±10 V minimum
Common-Mode Rejection Ratio
8414, 8417 60 dB minimum, 66 dB typical; (See Note 1)
Offset Voltage ± 3 mV typical ± 10 mV maximum adjustable to zero

Input Bias Current 100 nA maximum

Impedance ($+V_{in}$) 10 KΩ, ±1%

Impedance (V_{ref})
8410, 8412, 8413 500 KΩ minimum
Impedance (Differential)
8414, 8417 40 KΩ, ± 1%
Overvoltage Protection (I_{in} Terminal) ± V_S without damage
Overvoltage Protection (V_{ref} Terminal) ± 2 V_S without damage

Transfer Characteristics

Full Scale Frequency Output (F_{out}) 1 MHz + 10% over-range
Transfer Characteristics 1 MHz (V_{in} / 10 V)
Full Scale Factor 1 mA ± 0.1%, or 10 V trimmable to 1 MHz
Non-Linearity ± 0.001% FS, ± 0.02% of input maximum not specified under overrange conditions
Full Scale Step Response (to 0.01%) 2 cycles of new frequency plus 15 µs
Overload Recovery 6 cycles of new frequency

Note 1: CMRR specification given assumes zero (0) ohms for GAIN ADJUST potentiometer. With GAIN ADJUST potentiometer at 200 Ω, CMRR is 34 dB.

Stability

Gain - Tempco
8410, 8414 60 ppm FS / °C typical - 100ppm FS / °C maximum
8412 15 ppm FS / °C typical - 25ppm FS / °C maximum
8413, 8417 10 ppm FS/°C typical - 15ppm FS / °C maximum
Gain - PS Sensitivity 100 ppm / 1% change in supply voltage
Gain - Drift Per Day ± 100 ppm FS maximum
Gain - Drift Per Month ± 200 ppm FS maximum
Offset – Tempco ± 10 µV typical - ± 40 µV maximum
Offset - PS Sensitivity 20 µV / V change in supply voltage
Offset - Drift Per Day ± 10 µV typical
Offset - Drift Per Month ± 20 µV typical
Warm-up Time ≤ 2 minutes to 0.02% accuracy

Output

Pulse Polarity Positive
Pulse Width 500ns ± 100ns
Logic Levels
Logic "1" (High) + 4.0 V ± 0.5 V
Logic "0" (Low) < 0.4 V @ 16 mA sink
Load ≤ 200 pF for rated performance
Fanout 10 TTL loads
Short Circuit Protection Indefinite to ground without damage

Power Requirements

($+V_s$) + 15V, ± 5% 40 mA maximum
($-V_s$) - 15V, ± 5% 20 mA maximum
Power Dissipation 0.95W maximum

Environmental And Mechanical

Operating Temperature (to Rated Performance) 0° C to +70° C
Operating Temperature to 50% Derated TC, Linearity, and Fanout) - 25° C to + 85° C
Storage Temperature - 55°C to + 125° C
Humidity 0 - 85%, non-condensing up to 40° C
Dimensions 2.00"x 2.00"x 0.40" (50.8 x 50.8 x 10.16 mm)

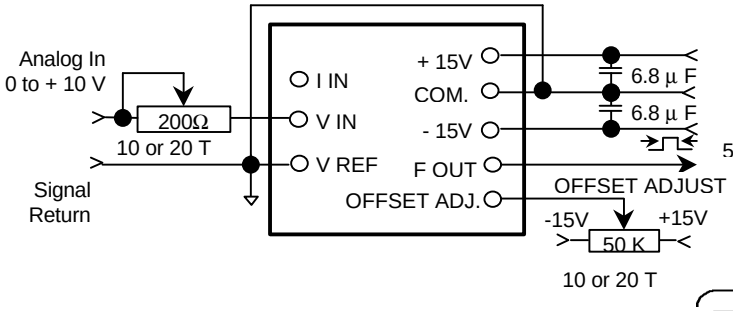


Fig. 1. Normal 8400 Series Input Configuration

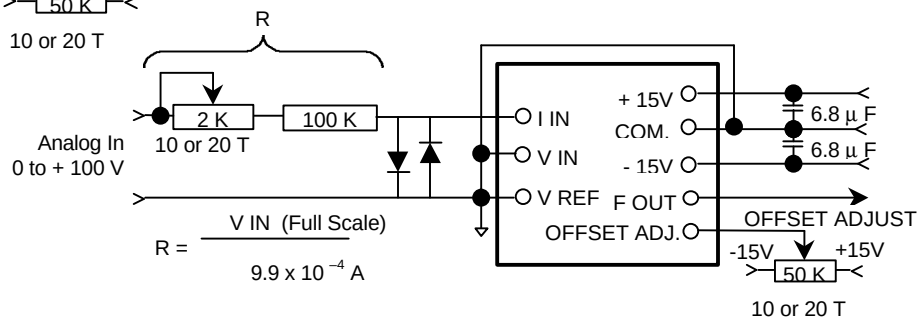


Fig. 2. Expanded Input Range

Note: This configuration is also useful for adding or subtracting currents, off-setting the input for a bipolar signal, or presetting a minimum frequency output.

Voltage to Frequency Converters

Using The 8400 Series of V/F Converters

General Considerations

Figure 1 depicts a typical circuit configuration for the **8400 Series**. The layout should be clean, with output pulses routed as far away from the input analog signals as possible. For maximum performance, bypass capacitors, as shown in Figure 1, should be mounted right at the appropriate pins of the **8410**.

Grounding

The Analog and Digital grounds are internally separate in the **8400 Series**. The use of ground plane is not necessary for proper operation; however, a ground plane is recommended with any analog signal conditioning circuitry that may be used in front of the V/F, especially if this circuitry involves high gains. Any amplifiers used in front of the **8410** should be de-coupled to eliminate potential problems with the high frequency output of the V/F.

Offset and Gain Trimming

The OFFSET adjustment potentiometer should be a 50 KΩ, 10-turn unit. With this pot in the circuit, initial offsets of up to ± 10 mV may be trimmed to zero. The GAIN adjustment potentiometer should be a 200 Ω, 10-turn unit with a recommended temperature coefficient of 100 ppm or better. With this pot in the circuit, initial gain errors of up to ± 2% may be trimmed to zero.

Offset and Gain Calibration

Offset calibration should be performed prior to gain calibration. With a + 1 mV analog signal at the input of the 8400 Series, adjust the OFFSET potentiometer until a frequency of 100 Hz is observed on the output pin.

With a full scale analog input voltage of + 10.00 V, adjust the GAIN potentiometer until a full scale frequency of 1.000 MHz is observed on the output pin.

Input Considerations

Single-ended Inputs

The Vin pin accepts a 0 V to + 10 V analog input, and has an impedance of 10 KΩ. Figure 2 provides a recommended configuration for expanded or contracted input ranges.

High Impedance Inputs (8410-8413 only)

Figure 3 shows the input configuration for a high impedance, 0 V to – 10 V input. This configuration is differential, referenced to the Vref input. An input of -10 V will produce a frequency approximately 10 kHz above 1 MHz. The GAIN ADJUST potentiometer will only trim the output frequency higher.

Differential Inputs

The input can be configured as a differential input as shown in Figure 4. The differential input impedance is 40 KΩ. The maximum common mode voltage is ± 10 V.

Negative Input Currents (8410-8413 only)

Figure 5 shows the input configuration for negative input currents. No degradation in performance will occur for full scale frequencies of 1 MHz with input voltages ($-I_{in} \times R_L$) from -10 V down to - 1 V. If some degradation of dynamic range and stability can be tolerated, an input voltage as low as - 1 mV can be used. This degradation is due to the input voltage drift and bias current when compared to signal voltage and current levels. The input configuration is differential, referred to the Vref input.

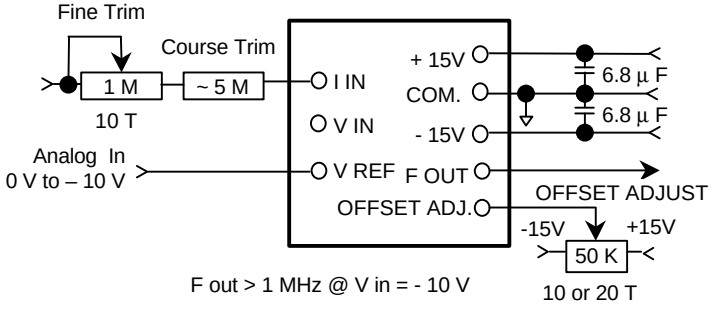


Fig. 3. High Impedance Inputs (8410, 8412, 8413 Only)

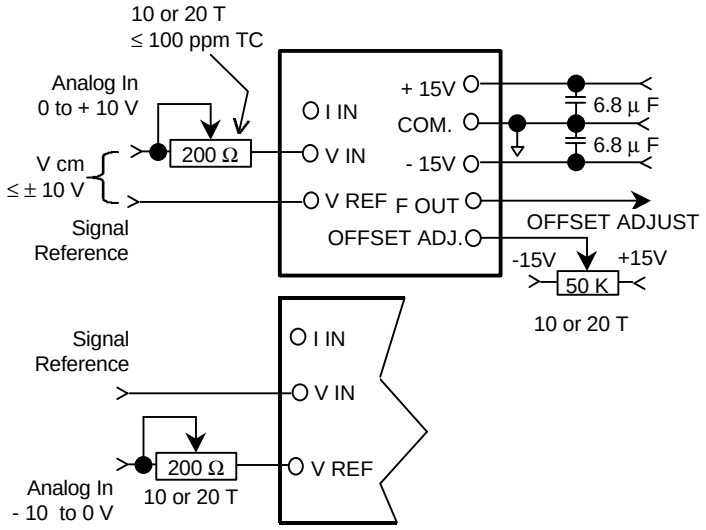
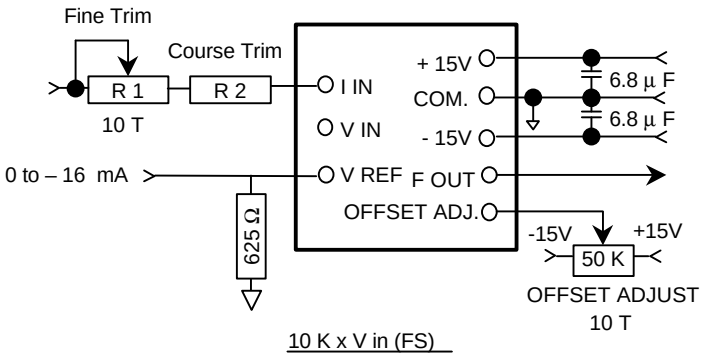


Fig. 4. Differential Inputs (8414, 8417 Only)

Useful Configurations (cont.)

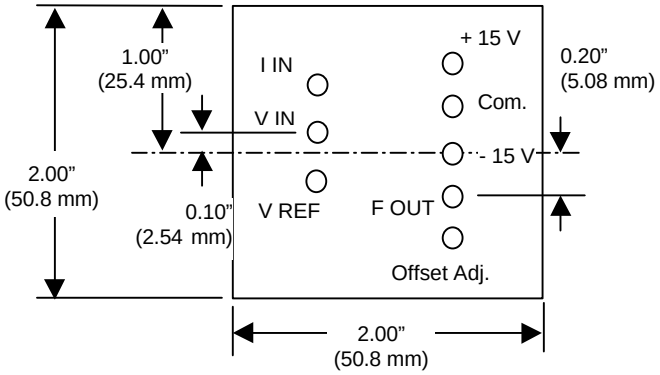


$$R1 = \frac{10\text{ K} \times V\text{ in (FS)}}{10.02 - V\text{ in (FS)}}$$

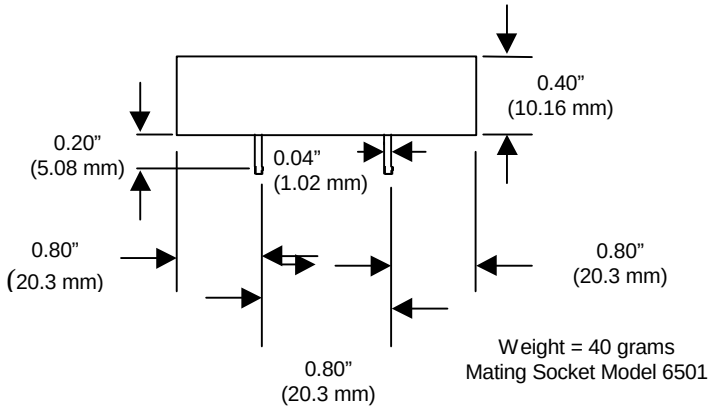
$$R2 = 0.02 \times R1$$

Fig. 5. Negative Input Currents (8410, 8412, 8413 Only)

Mechanical Dimensions and Pin Key



Bottom View



Side View

Ordering Information

Voltage to Frequency Converters	Model	Input	Input Frequency Range
	8410	Single-ended	100 ppm FS / °C maximum Gain Drift
	8412	Single-ended	25 ppm FS / °C maximum Gain Drift
	8413	Single-ended	15 ppm FS /°C maximum Gain Drift
	8414	Differential	100 ppm FS / °C maximum Gain Drift
	8417	Differential	15 ppm FS / °C maximum Gain Drift

Accessories	Model	Description
	6501	Socket

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