

2 MHz Voltage-to-Frequency Frequency-to-Voltage Converter Family



Description

The 3802 and 3822 Families are high performance, precision 2 MHz full scale Voltage-to-Frequency Converters, intended for those applications which require maximum performance at the most economical cost. Variations among the models include single-ended or differential analog voltage inputs, and selection for gain stability. All models feature the same 126 dB dynamic range, $\pm 0.01\%$ linearity, and $\pm 5\%$ overrange capability.

All 3802 and 3822 model converters accept a $100\ \mu\text{V}$ to 10V Full Scale analog input signal which is converted to an output signal proportional to the full scale frequency, within 0.01% linearity utilizing the long-proven charge balance technique. Buffered complementary TTL-compatible frequency outputs are provided that will drive up to 50 pF capacitive loads.

The 3802 models, in addition to functioning as V/F converters, can also be used as F/V converters. In this configuration, the 3802 models will accept frequencies from dc to 2 MHz and will produce proportional output voltages from 0V to -10V single-ended.

Stability over temperature to match the intended application environment can be selected from among the various models, with offset tempcos of $10\ \mu\text{V}/^\circ\text{C}$ typical, and $30\ \mu\text{V}/^\circ\text{C}$ maximum for all models, and gain tempcos ranging from 15 to

Features

- Guaranteed minimum/maximum specifications
- Wide Dynamic Range
 $>2,000,000:1$
 $>126\ \text{dB}$
- Excellent Linearity
 $0.01\% \text{ FS } \pm 0.01\% \text{ of input}$
- Excellent Stability
 $10\ \mu\text{V}/^\circ\text{C}$ offset
 $10\ \text{ppm}/^\circ\text{C}$ gain
- Differential or Single-ended Inputs
- Voltage or Current Inputs
- Complementary Frequency Outputs
 TTL/CMOS Compatible
- Small Size
 24-pin Double-DIP
- Low Power
 $<0.75\text{W}$

V/F Applications

- Precision Integration
- Digital Data Transmission
- Frequency Synthesis
- Analytical Instrumentation
- Medical Instrumentation
- Telemetry
- Data Recording
- Weighing Systems

F/V Applications

- Tachometers
- Accelerometers
- Flow Meters
- Robotics

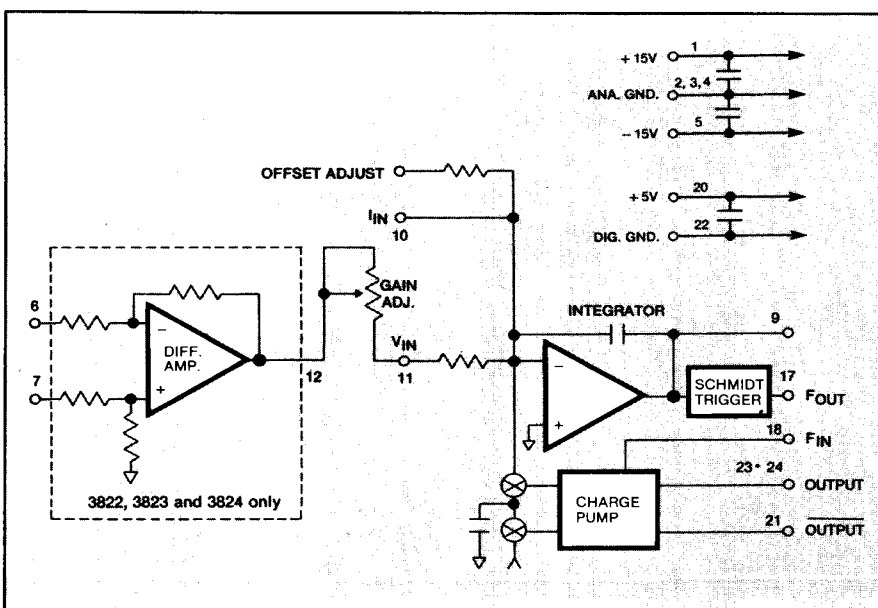


Figure 1. 3802/3822 Block Diagram

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Specifications

All Specifications Guaranteed at 25°C Unless Otherwise Noted

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Analog Input

Input Range

3802, 3803, 3804
– 100 μ V to – 10V, single-ended
3822, 3823, 3824
 \pm 100 μ V to \pm 10V, differential

Overrange

5% minimum

Common Mode Voltage Range

(3822, 3823, 3824 only)
 \pm 10V minimum

Common Mode Rejection Ratio

(3822, 3823, 3824 only)
80 dB minimum, 100 dB typical

Impedance

| | |
|-------------------------|---|
| 3802, 3803, 3804 | 3822, 3823, 3824 |
| 15 K Ω | 25 K Ω , single-ended, 50 K Ω , differential |

Offset Voltage

\pm 7 mV typical, \pm 10 mV maximum; adjustable to zero

Overvoltage Protection

\pm Vs without damage

Transfer Characteristics

Full Scale Frequency Output (Fout)

2 MHz \pm 5% overrange, minimum

Transfer Characteristic

2 MHz (Ein/10V)

Gain Error

| | |
|-----------------------------|-----------------------------|
| 3802, 3803, 3804 | 3822, 3823, 3824 |
| \pm 1%, trimmable to zero | \pm 2%, trimmable to zero |

Non-Linearity

\pm 0.01% FS, \pm 0.01% of input maximum; not specified under overrange conditions

Full Scale Step Response

(to 0.01%)
2 cycles of new frequency, plus 20 μ S

Overload Recovery

8 cycles of new frequency

Stability see Note 1

Gain — Tempco

| | |
|---|---|
| 3802, 3822 | 3803, 3823 |
| 50 ppm/°C typical, 75 ppm/°C maximum | 35 ppm/°C typical, 50 ppm/°C maximum |
| 3804, 3824 | |
| 10 ppm/°C typical, 15 ppm/°C maximum | |

Gain — PS Sensitivity

200 ppm per 1% change in power supply voltage

Offset — Tempco

10 μ V/°C typical,
30 μ V/°C maximum

Offset — PS Sensitivity

10 μ V/1% change in supply voltage

Warmup Time

3802, 3803, 3804
 \leq 2 minutes to specified accuracy
3822, 3823, 3824
5 minutes to specified accuracy

Output

Pulse Polarity

Positive and negative

Pulse Width

250 \pm 50 ns

Logic Levels (Vcc = + 5V)

| | |
|-------------------------|------------------------|
| Logic "1" (High) | Logic "0" (Low) |
| + 4.0V \pm 0.5V | < 0.4V @ 3 mA sink |

Load

\leq 50 pF for rated performance

Power Requirements

3802, 3803, 3804

| | |
|------------------------|------------------------|
| (+ Vs) + 15V, \pm 3% | (– Vs) – 15V, \pm 3% |
| 20 mA maximum | 10 mA maximum |

(Vcc) + 5V, \pm 5%

45 mA maximum

Power Dissipation

0.7W maximum

3822, 3823, 3824

| | |
|------------------------|------------------------|
| (+ Vs) + 15V, \pm 3% | (– Vs) – 15V, \pm 3% |
| 25 mA maximum | 10 mA maximum |

(Vcc) + 5V, \pm 5%

45 mA maximum

Power Dissipation

0.75W maximum

Environmental and Mechanical

Operating Temperature

0°C to + 70°C; See Note 2

Storage Temperature

– 65°C to + 150°C

Humidity

0-85%, non-condensing up to 40°C

Dimensions

1.31" X 0.80" X 0.15"
(33.2 X 20.3 X 3.8 mm)

NOTES: 1. Gain and Offset temperature coefficients given are exclusive of external components

2. Extended temperature range units are available. Please consult the factory.

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Description (continued)

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75 ppm/°C maximum. Warm-up time to fully specified accuracy is less than two (2) minutes for the **3802** models, and five (5) minutes for the **3822** models.

In applications where overall system throughput must be maintained at a specific rate, or where fixed offset, or different full scale

voltages would be more convenient, **custom frequencies and/or custom trimming** can be easily accommodated. By increasing the full scale output frequency by 10-20%, for example, additional time would be available for the system micro-processor to access the results of each conversion. Please contact the factory to discuss your specific

system timing requirements.

All of the **3802** and **3822** series are packaged in a 1.31" X 0.80" X 0.15" 24-pin DIL ceramic package. Pin spacing is 0.6" (double DIP). Power dissipation is less than 0.75W maximum, and operation to specified accuracy is over the 0°C to +70°C temperature range.

Using the 3802 and 3822 Family of V/F Converters

General Considerations

Typical circuit configurations for the **3802** and **3822** models used as both V/F and F/V converters are depicted in Figures 2 and 3 respectively. The layout should be clean, with output pulses routed as far away from the input analog signals as possible. To obtain maximum performance, bypass capacitors, as shown in both figures, should be mounted right at the appropriate pins of the converters.

Offset and Gain Trimming

The OFFSET adjustment potentiometer should be a 20 k Ω , 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. To insure that the temperature coefficient of the potentiometer does not become significant relative to the overall gain tempco specification, a 100 ppm or better potentiometer is recommended. With this pot in the circuit, initial gain errors of up to $\pm 2\%$ may be trimmed to zero.

If the GAIN adjustment potentiometer is **not** used on the **3822** V/Fs, pins 11 and 12 must be shorted together.

Grounding

The Analog and Digital grounds are internally separate in the **3802** and **3822** models. The use of ground plane is not necessary for proper

operation of the **3802** or **3822**; however, a ground plane is recommended with any analog signal conditioning circuitry that may be used in a V/F application, especially if this circuitry involves high gains. Any amplifiers used ahead of the **3802** or **3822** should have decoupling capacitors on their power supply pins to help eliminate potential problems with the high frequency output of the V/F.

Offset and Gain Calibration

Offset Calibration

Offset calibration should be performed prior to gain calibration. With a -1 mV analog input signal at pin 11 of the **3802** or on pin 6 referenced to pin 7 (**3822**), adjust the OFFSET

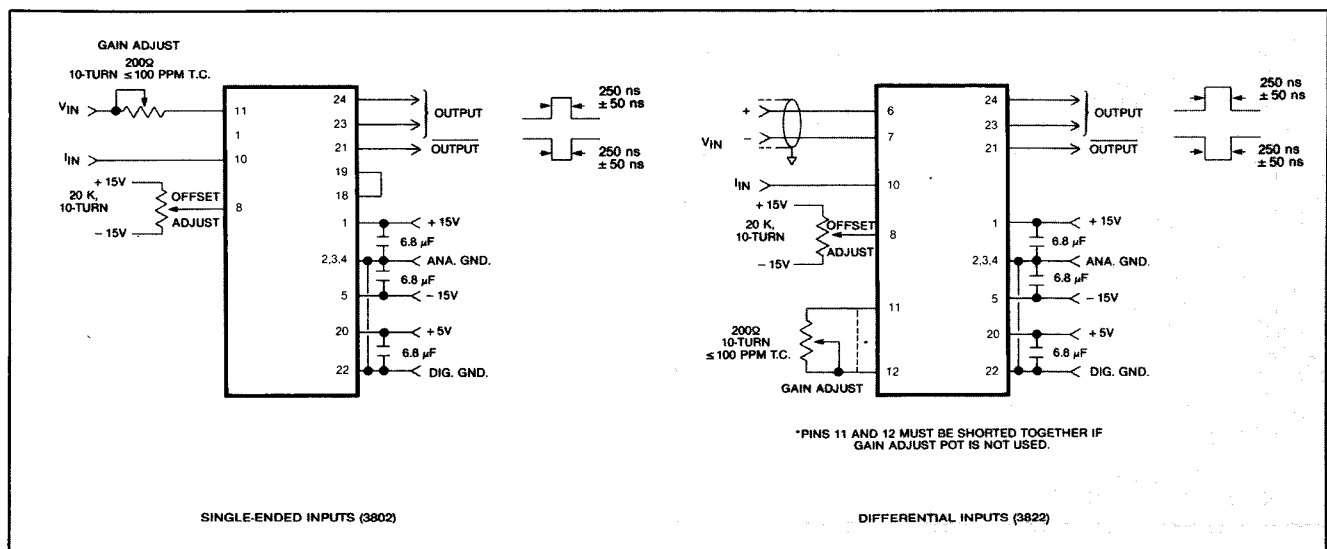


Figure 2. V/F Converter Configuration.

Using the Family
of V/F Converters (continued)

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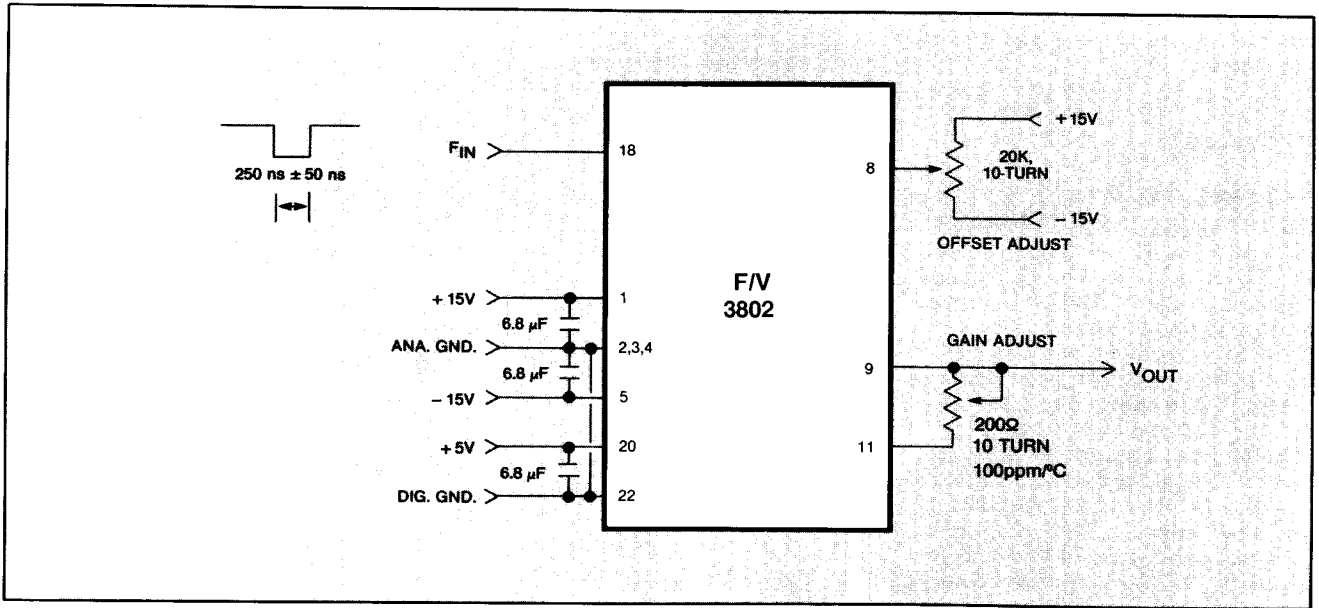


Figure 3. F/V Converter Configuration (3802 only).

(continued)

potentiometer until a frequency of 200 Hz is observed on output pins 21, 23 or 24.

Gain Calibration

With a full scale analog input voltage of -10.00V on pin 11 (3802) or +10.00V on pin 6 referenced to pin 7 (3822), adjust the GAIN potentiometer until a full scale frequency of 2.000 MHz is observed on output pins 21, 23 or 24.

N/C Pins

Pins marked as N/C (no connection) have no electrical connection to the internal circuitry of the 3802 or 3822.

Output Pins

Pins 23 and 24 are tied together internally. Either or both may be used as the source of the frequency output of the 3802 or 3822, as long as the load specifications are not exceeded. Pin 21 provides a complementary signal relative to pins 23 and 24 with similar loading limits.

V/F Mode

Analog Inputs

Single-Ended Inputs (3802, 3803, 3804)

Single-ended analog inputs from 0 to -10V are applied to pin 11 of the V/F converter through the GAIN adjustment potentiometer.

Differential Inputs (3822, 3823, 3824)

Differential analog inputs ($\pm 10V$) are applied to pins 6 and 7. For positive inputs (0V to +10V), the input is ap-

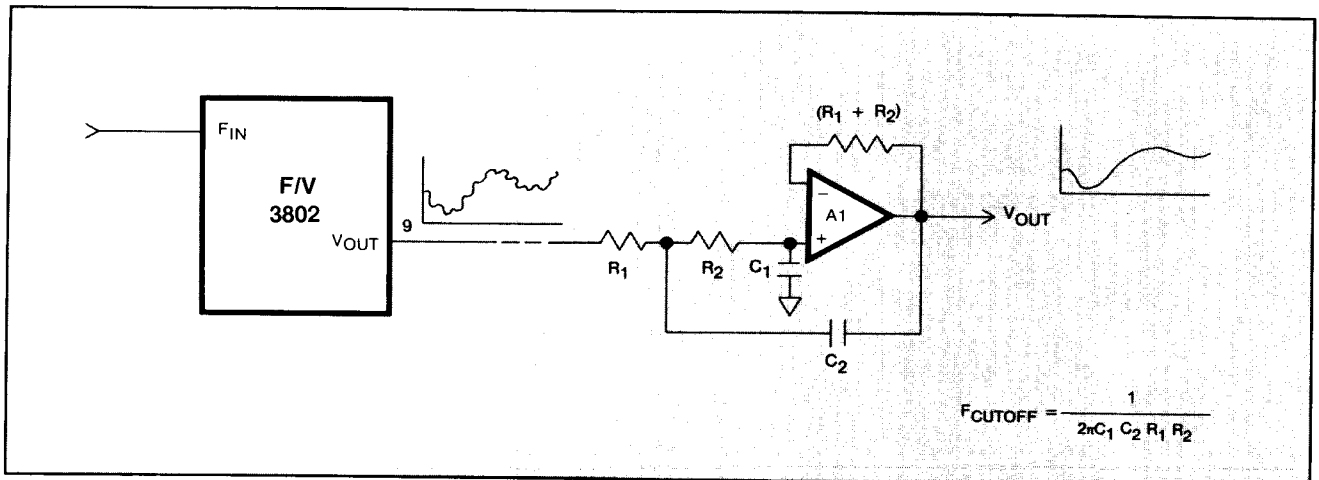


Figure 4. Typical 2-Pole Active Filter

Using the Family of V/F Converters *(continued)*

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plied to pin 6 and pin 7 is grounded; for negative inputs (0V to -10V), the input is applied to pin 7 and pin 6 is grounded.

F/V Mode

(3802, 3803, 3804 Only)

Figure 3 depicts the typical circuit configuration for the 3802 used in the F/V mode. In this mode, the 3802 will accept a 0 to 2 MHz input pulse train, with negative-going pulses, 250 ± 50 ns in width, and will produce a voltage output proportional to the input frequency. Riding on the output voltage will be a ripple voltage. Additional filtering of the output voltage by the use of a 2-pole active filter will reduce the output ripple as shown in Table 1. A representative 2-pole active filter circuit is shown in Figure 4. Suitable component values are listed in Table 1. It is recom-

| F _{CUTOFF} | C ₁ (pF) | C ₂ (pF) | R ₁ (K Ω) | R ₂ (K Ω) | Resultant Output Ripple (mV) |
|---------------------|---------------------|---------------------|------------------------------|------------------------------|------------------------------|
| 20 kHz | 180 | 470 | 18.2 | 46.4 | 70 mV |
| 25 kHz | 150 | 330 | 21.0 | 39.2 | 80 mV |
| 30 kHz | 150 | 330 | 17.4 | 27.4 | 60 mV |
| 50 kHz | 88 | 180 | 16.9 | 48.7 | 50 mV |
| 100 kHz | 33 | 100 | 14.3 | 53.6 | 80 mV |

ended that a high input impedance, low noise opamp be used, and that offset nulling be done in order to obtain accurate dc performance.

V/F/V Analog Data Link

Figure 5 depicts the 3802 used as

both the V/F and F/V in an analog data link. Low-level analog data may be transmitted over considerable distances with no degradation due to noise using this system, and with total system linearity of 0.02%.

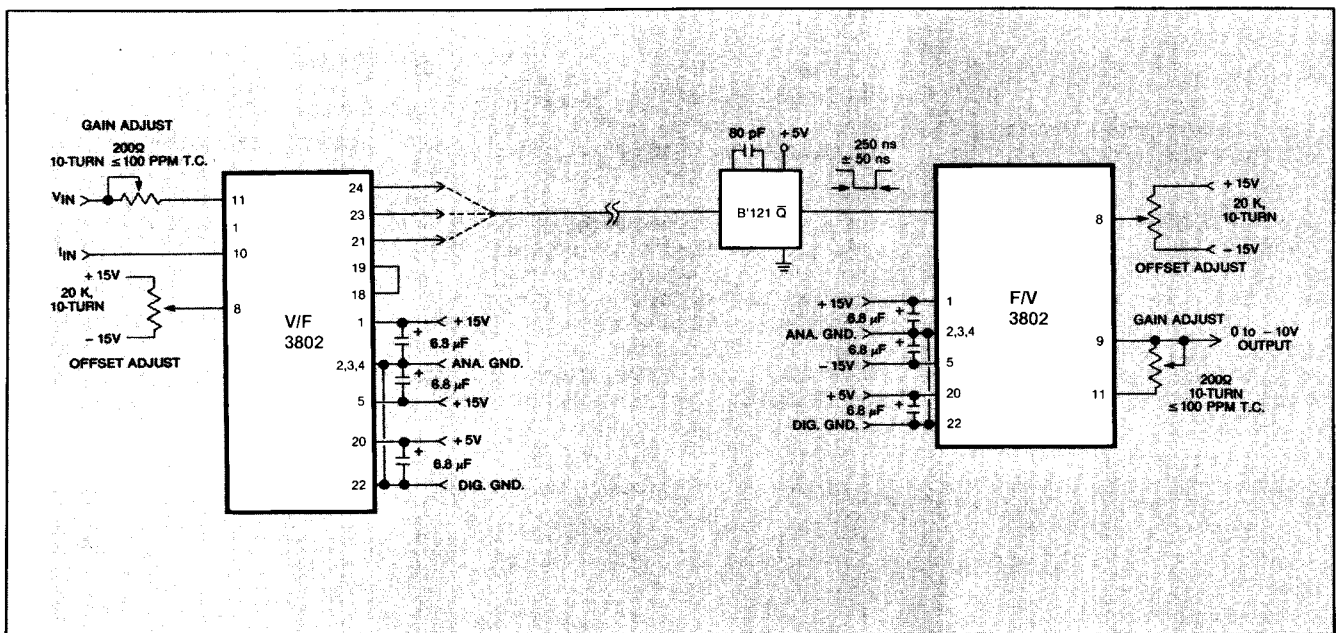


Figure 5. 2 MHz Analog Data Link.

Mechanical Dimensions & Pinout

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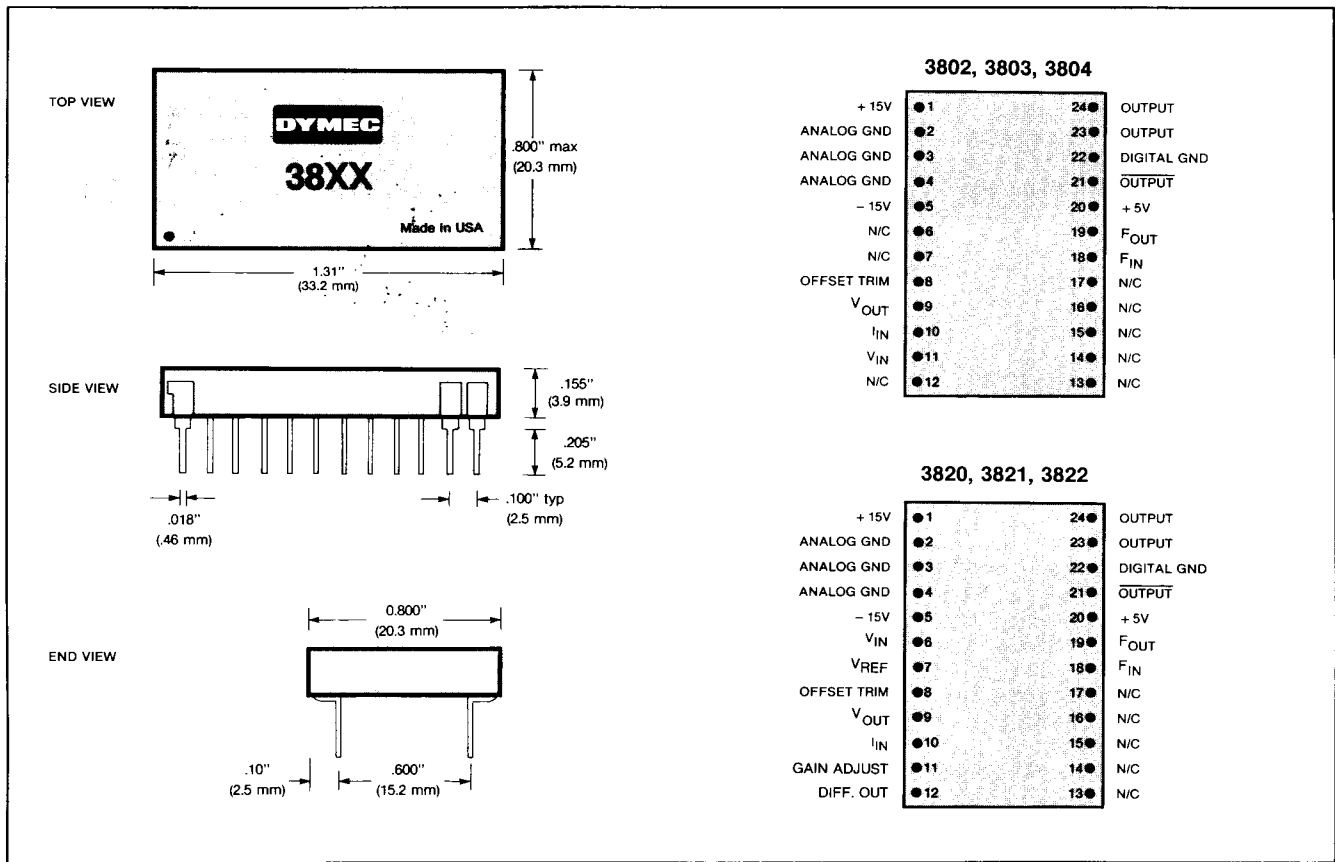


Figure 6. 38XX Mechanical & Pinout.

| Ordering Information | |
|-----------------------------------|------|
| 2 MHz V/F/V Converter.....Specify | |
| Single-ended Analog Input: | |
| 75 ppm/°C Gain T.C. | 3802 |
| 50 ppm/°C Gain T.C. | 3803 |
| 15 ppm/°C Gain T.C. | 3804 |
| Differential Analog Input: | |
| 75 ppm/°C Gain T.C. | 3822 |
| 50 ppm/°C Gain T.C. | 3823 |
| 15 ppm/°C Gain T.C. | 3824 |



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