Using the Voltage Interceptor with a frequency output air-flow meter

The Digital Fuel Adjuster featured in "Performance Electronics for Cars" and the updated Voltage Interceptor version from SILICON CHIP, December 2009, are ideal for altering the signal from MAF (Mass Air Flow) sensors which produce a voltage output. However, they do not work with air-flow sensors that produce a frequency signal.

One such sensor is the Karman Vortex. If you want to know more about this meter, point your web browser to: **http://www.wellsmfg-corp.com/pdf/Counterpoint3_3.pdf** and **www.autoshop101.com/forms/h34.pdf**

Its output is typically about 30-40Hz at idle, rising to between five and 10 times that frequency at full throttle and maximum RPM.

To use this sensor with the Digital Fuel Adjuster or the Voltage Interceptor, its frequency signal must be converted to a voltage. Then, after being processed by the Voltage Interceptor, the modified voltage output must be converted back to a frequency, suitable for the car's ECU AFM (airflow meter) input.

This add-on circuit does both conversions, as depicted in the block diagram. Conversion from the AFM frequency output to voltage utilises an LM2917 frequency-to-voltage converter (IC1). The frequency signal is applied to a filter comprising a 10kΩ resistor and 10nF capacitor. A 10kΩ resistor ties the signal to ground when there is no signal or connection. The filtered signal is connected to the non-inverting input of a Schmitt trigger at pin 1.

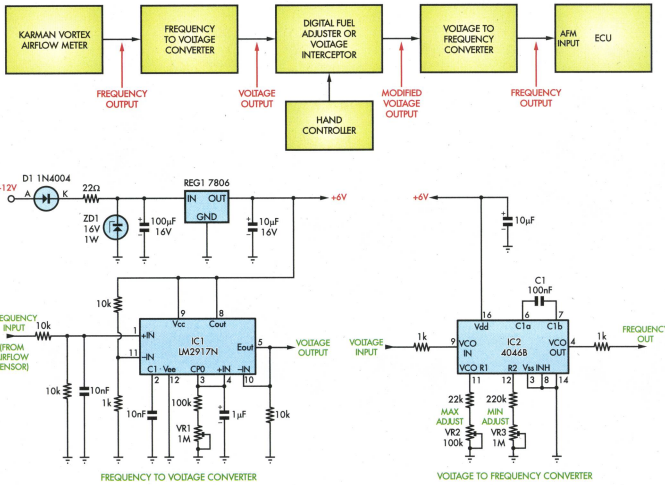
The Schmitt trigger's threshold input (pin 11) is set to about 0.55V by the 10kΩ and 1kΩ voltage divider connected across the 6V supply. The output from the Schmitt trigger drives a charge pump circuit involving the 10nF capacitor at pin 2 and the 1µF capacitor at pin 3. The charge pump voltage at pin 3 is applied to the non-inverting input of an internal op amp which functions as a unity gain buffer. Its output voltage is proportional to the input frequency.

Trimpot VR1 adjusts the output voltage range to suit the frequency range (note: more information on the LM2917 can be found in the Twin Engine Speed-Match Indicator article, SILICON CHIP, November 2009).

The voltage-to-frequency converter circuit uses the Voltage Controlled Oscillator (VCO) within a 4046 CMOS phase lock loop IC (IC2). Voltage is applied to the VCO's input at pin 9 and the output frequency is available at pin 4. The operating frequency is set by capacitor C1 and the resistances connected to the R1 and R2 inputs, pins 11 & 12.

When the VCO's input is at 0V, trimpot VR3 sets the minimum frequency. Conversely, when the VCO's input is at maximum voltage, VR2 sets the maximum frequency.

When setting up the frequency-to-voltage converter and voltage-to-frequency converters, the output from the frequency-to-voltage converter (IC1) is connected directly to the input of the voltage-to-frequency converter (IC2). Trimpot VR1 is then adjusted to give about 4V when the Karman Vortex airflow meter is producing its maximum frequency, ie, when the engine is running at maximum RPM and wide-open throttle (caution: the engine must be



loaded, as when driving up a hill).

Trimpot VR3 is then adjusted so that the frequency output from IC2 matches that of the Karman Vortex sensor at idle. Finally, VR2 is adjusted so that IC2's output frequency matches the Karman Vortex's maximum frequency.

In some cases, it may be possible to adjust the trimpots on the voltage-to-frequency converter so that the Karman Vortex frequency is modified sufficiently without having to use the Digital Fuel Adjuster or the Voltage Interceptor at all. You will be able to shift the idle frequency output by adjusting VR2 and the actual range of frequency output by adjusting VR1.

Note that when using the Digital Fuel Adjuster or the Voltage Interceptor with these converters, the minimum and maximum frequency output from the voltage-to-frequency converter is set by VR2 and VR3. If you want a wider frequency range, these trimpots will need to be adjusted accordingly. The Digital Fuel Adjuster or the Voltage Interceptor can then be used to alter the frequency output within the minimum and maximum frequency extremes.

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