TelCom Semiconductor, Inc.

APPLICATION NOTE 37

TC7136/TC9400 — DIGITAL READOUT FREQUENCY METER

By Ted Dabney

Two low-cost integrated circuits can be combined to create a simple digital frequency meter. The combination of a frequency-to-voltage converter (FVC) and a dual-slope, analog-to-digital display converter (ADC) makes a small 2-chip frequency meter that can be run from one 9-volt battery.

The ADC (TS7136) generates the voltage required by the FVC (TC9400) with internal regulators. The TEST output of the TC7136 is regulated to 5 volts below the positive battery terminal (V+) and the ANALOG COMMON output is regulated to 3V below V+. The TC7136 is designed to directly drive a 3-1/2 digit, non-multiplexed LCD display so no digital conversion is required.

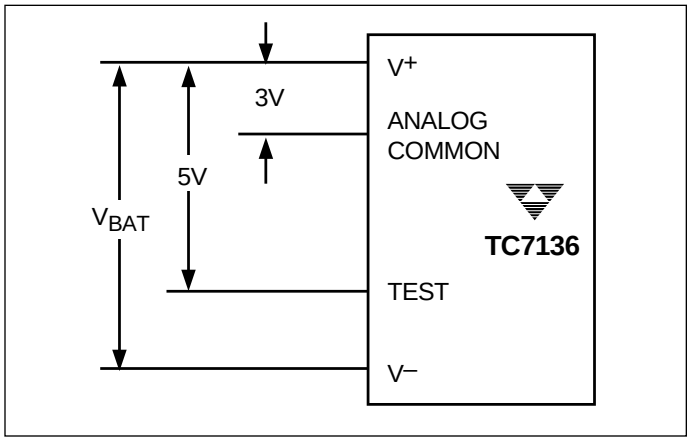

Figure 1. TC7136 Regulated Outputs

The test voltage is used as the reference supply for the TC9400 and ANALOG COMMON serves as the "ground" for the comparator and the integrating amplifier.

TC7136 ANALOG-TO-DIGITAL CONVERTER

The TC7136 will have a maximum positive input of about 2V since the input is referenced to ANALOG COMMON which is only 3V below V+. The internal voltage swing of the integrator does not have the same limitation because a positive input results in a negative swing of the integration. A fully charged battery will give a range of about 6V. The integration components (R4 and C6) are selected, in conjunction with the oscillator frequency to have an integrator ramp amplitude of about -3V with a 2V input from the TC9400.

The oscillator is set up to run at 48kHz (R3 and C2) for maximum rejection of stray power-line pickup. This will result in the TC7136 running at 3 conversions per second.

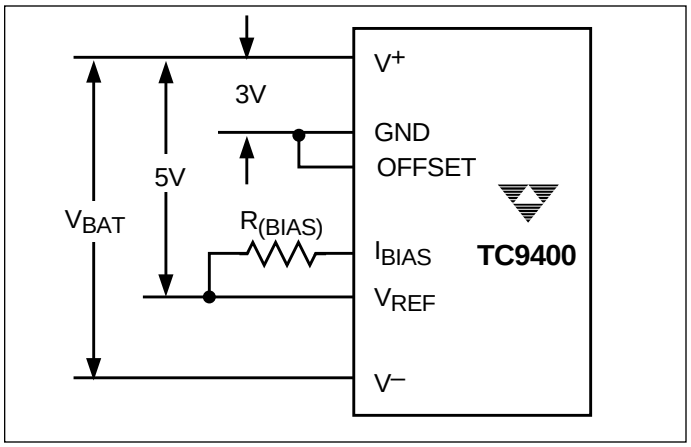

Figure 2. TC9400 Supply and Reference Voltages

TC9400 FREQUENCY-TO-VOLTAGE CONVERTER

The "non-standard" voltages or the TC9400 require some creativity be used in setting up the range for the frequency-to-voltage mode.

The gain (V_{OUT} vs. $FREQ_{IN}$) of the TC9400 is determined by the charge-balance capacitor (C9) and the integrator feedback resistor (R10) which have been selected for an output of approximately +2V (referenced to ANALOG COMMON) with frequency input of 20kHz. The bias resistor (R9) determined the input threshold of the comparator and has been selected fro an input sensitivity range of 250mV to 10V pk-pk of a sine or square wave on the input of the FVC.

The input circuit is made up of a current limit resistor (R6), a DC blocking capacitor (C7), a clamping diode (D1), and a biasing resister (R1). The diode acts as a soft clamp to prevent negative going transitions from latching the comparator input. R6 limits the current during the positive transitions.

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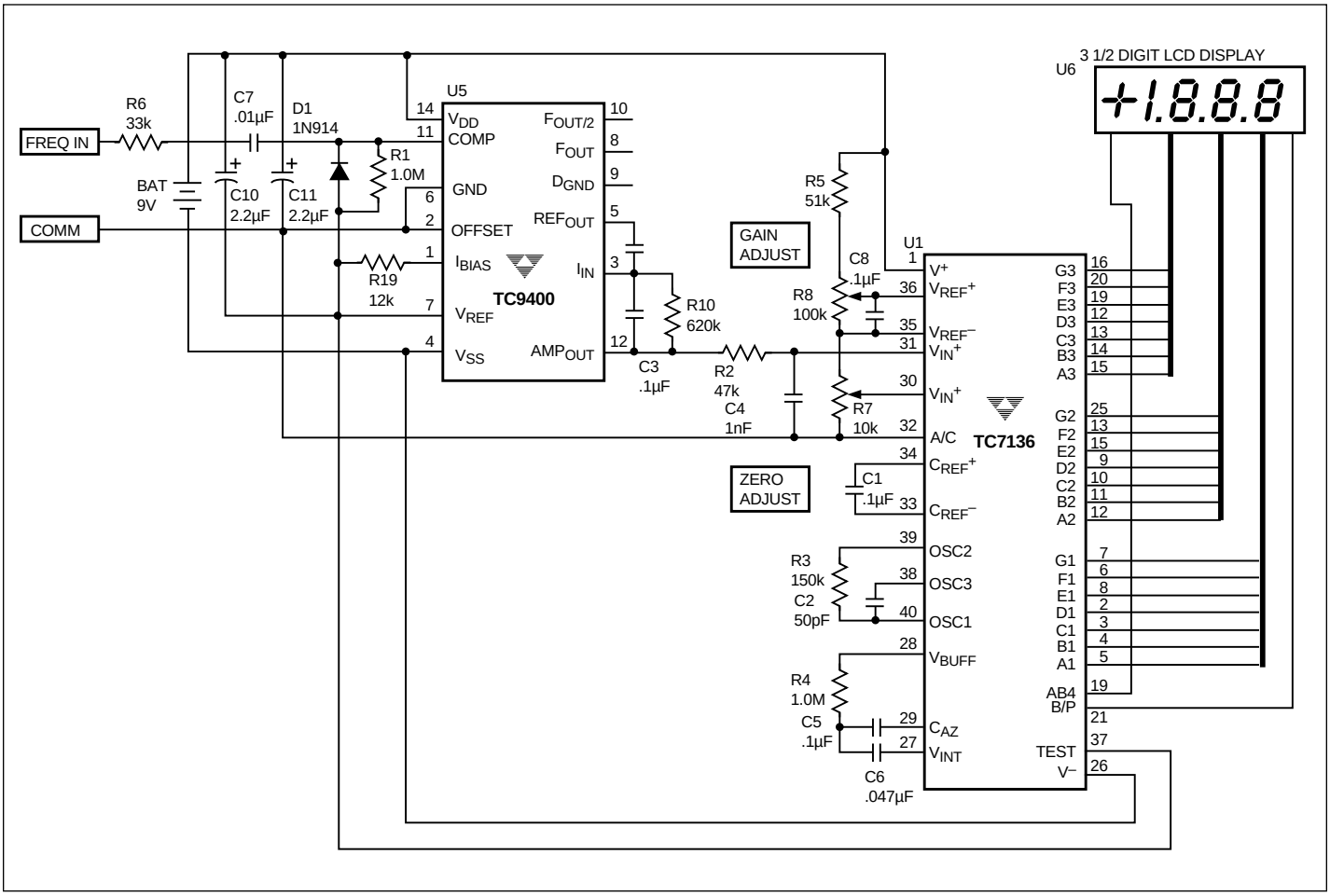

Figure 3. Schematic: Battery Powered Frequency Meter (0 to 20kHz)

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