HEWLETT hp PACKARD

COMPONENTS

APPLICATION NOTE 946

5082-7430 Series Monolithic Seven Segment Displays

INTRODUCTION

The HP 5082-7430 series solid state displays are common cathode, 2 and 3 digit clusters capable of displaying numeric and selected alphabetic data. These GaAsP displays employ an integral magnification technique to increase both the character size and the luminous intensity of each monolithic digit. The resultant 0.11" (2,79mm) high character is viewable at distances of up to 5 feet when operated at as little as 0.5 mW per segment.

These displays are designed for strobed operation. In strobing, the decoder is timeshared among the digits in the display, which are illuminated one at a time. The digits in each cluster are electrically connected with like segments wired in parallel. This forms an 8 (7 segments and decimal point) x N (number of digits) array. Several clusters may be wired with the segment lines in parallel to form longer display strings. In operation, the appropriate segment enable lines are activated for the particular character to be displayed. At the same time a digit enable line is selected so that the character appears at the proper digit location. The strobe then progresses to the next digit position, activating the proper segments and digit enable line for that position.

Since the eye is a relatively slow sensor, the average viewer will perceive as continuous a repetitive visual phenomena which occurs at a rate in excess of about 60 events per second. Therefore, if the refresh rate for each digit is maintained at 100 times or more per second, the perceived display will appear flicker-free and easy to read. In displays subject to vibration, a minimum strobe rate of 5 times the vibration frequency should be maintained.

In addition to reducing the number of decoders and drivers, strobing requires less power than DC drive to achieve the same display intensity. This is due to a basic property of GaAsP where luminous efficiency (light output/unit current) increases with the peak current level (see Figure 1). Thus, for the same average current, use of lower duty cycles (and higher peak current levels) results in increased light output (see Figure 2). For example, in Figure 2, a typical segment operated at 1 mA DC would produce a luminous intensity of approximately 40 microcandelas. This same segment operated at 10 mA peak, 10% duty cycle will produce approximately 95 μcd time averaged luminous intensity. This is similar to a 10 digit strobed display operated at 1 mA average current. At current levels below 2 mA peak, device to device efficiency variations may produce interdigit matching problems. Operation at very low peak current levels is, therefore, not recommended.

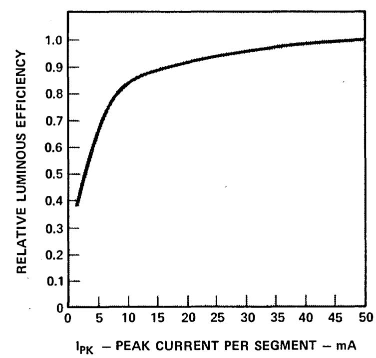

Figure 1. Relative luminous Efficiency vs. Peak Current per Segment.

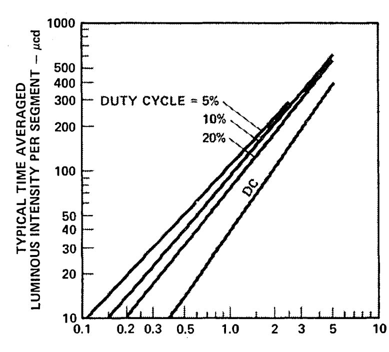

Figure 2. Typical Time Averaged Luminous Intensity per Segment (Digit Average) vs. Average Current per Segment.

TYPICAL APPLICATIONS

The 5082-7430 series devices are ideal for use in circuits where low power drain and high luminous intensity are important. Figure 3 depicts a battery operated electronic stopwatch circuit employing the Intersil ICM 7045 timer circuit, and four 5082-7432 displays. This circuit chip contains all of the logic necessary to implement the 8 digit timer with the addition of only the displays, an external frequency element, and control switches. When driven from a 3.6V NiCd battery, the 15mA peak (1.9mA average) segment current will provide adequate intensity for viewing even in bright outdoor lighting conditions. The push to read switch for the display will allow standard batteries to deliver many hours of satisfactory operation.

Figure 4 shows a battery-operated 4 digit event counter. This circuit utilizes the General Instrument AY-5-4007A 4 digit display driver/counter. On board electronics provide a 4 decade up/down counter, storage registers, multiplexing circuits, an internal oscillator for digit selection and a seven segment decoder/driver. This circuit utilizes a single 9 volt battery to supply V_{CC} (V_{SS}) with respect to V_{GG}. V_{GI} (ground) reference is supplied through a 270k resistor to V_{GG}. The digit drivers are buffered using a 2N4123 NPN transistor as a digit switch. Series resistors in the segment enable lines limit the segment current to 6mA peak, 1.2mA average. This current level will provide a satisfactory display for outdoor viewing. For indoor viewing, a 3mA peak current level using 4kΩ series resistors will be satisfactory. A switch in the emitter common of the digit enable transistors allows the display to be disabled in order to extend battery life.

Standard MOS calculator chips that source as little as 3mA peak will directly drive the 7430 series displays.

Figure 5 depicts a circuit using a minimum number of components for a 9 digit electronic four function calculator. Using the CAL TEX CT 5030 MOS chip, the segment lines may be driven directly at up to 10mA peak, 1 of 13 duty cycle. The segment current may be limited to as little as 250μA average through the use of a single resistor in the digit common line. The digit outputs are buffered using two 75492 Darlington drivers. As no V_{GG} supply is required and all clock signals are internally generated, a single 6 volt battery may be used to supply power for the entire circuit.

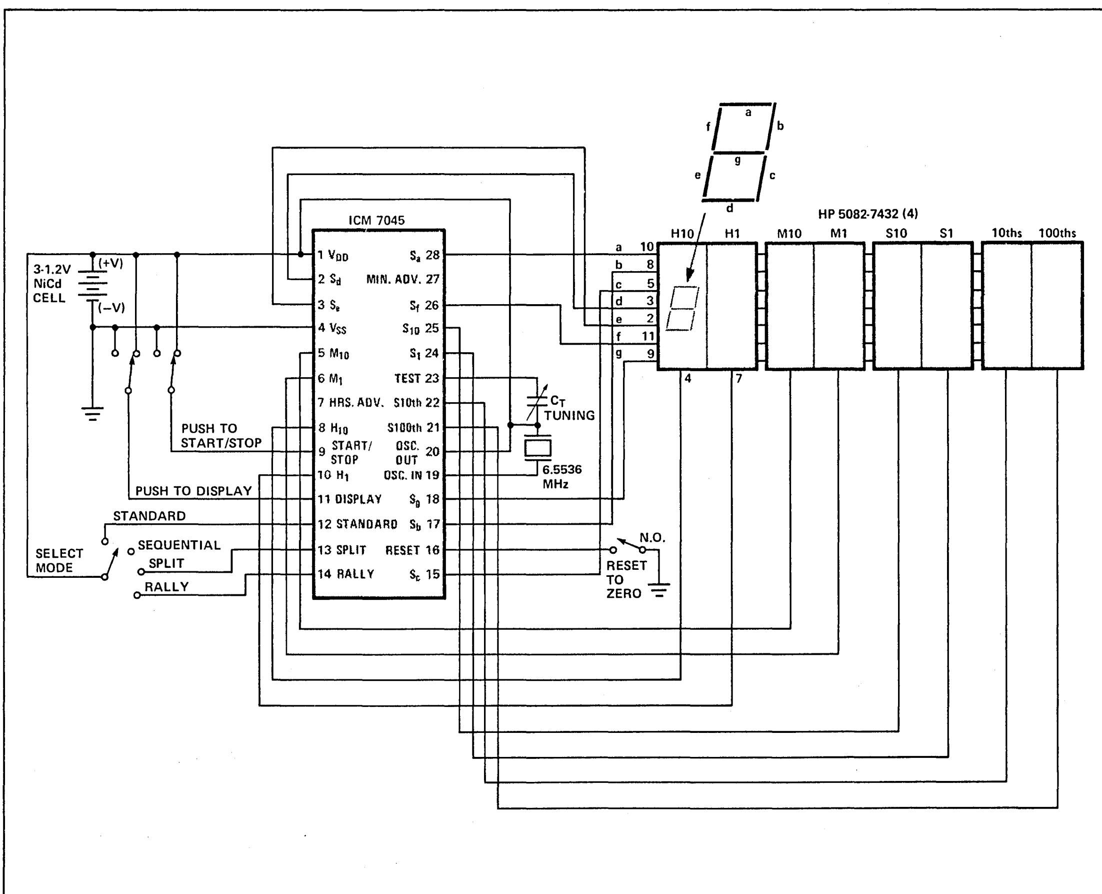

Figure 3. Electronic Stopwatch.

APPLICATION NOTES

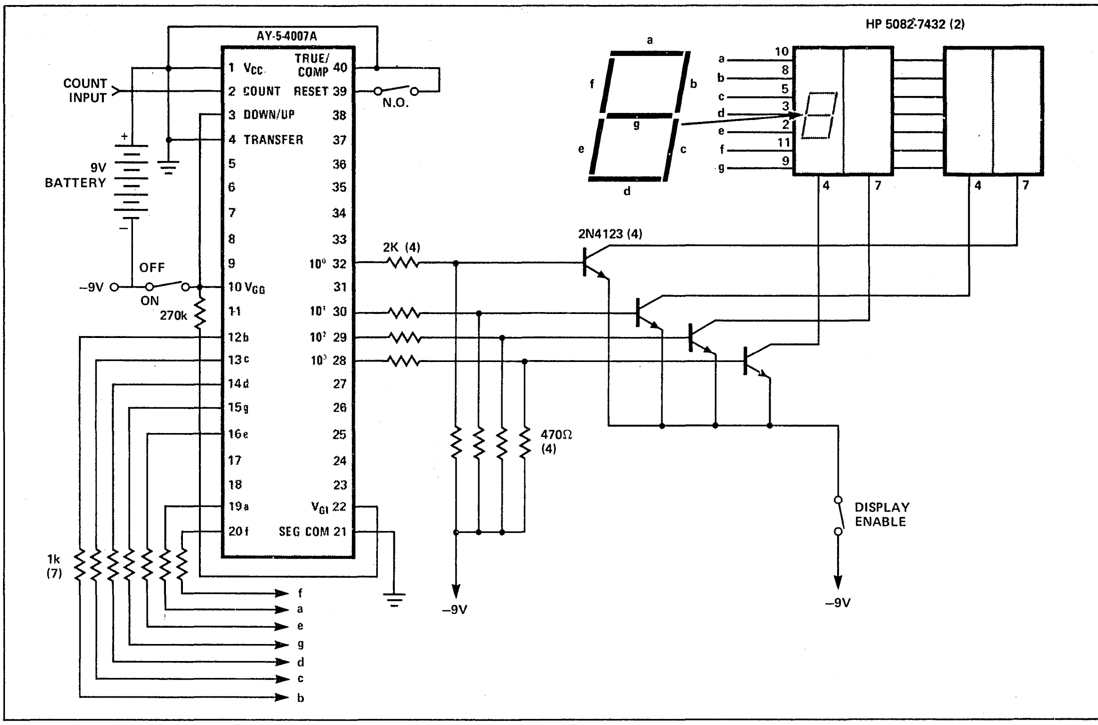

Figure 4. Battery Operated Event Counter.

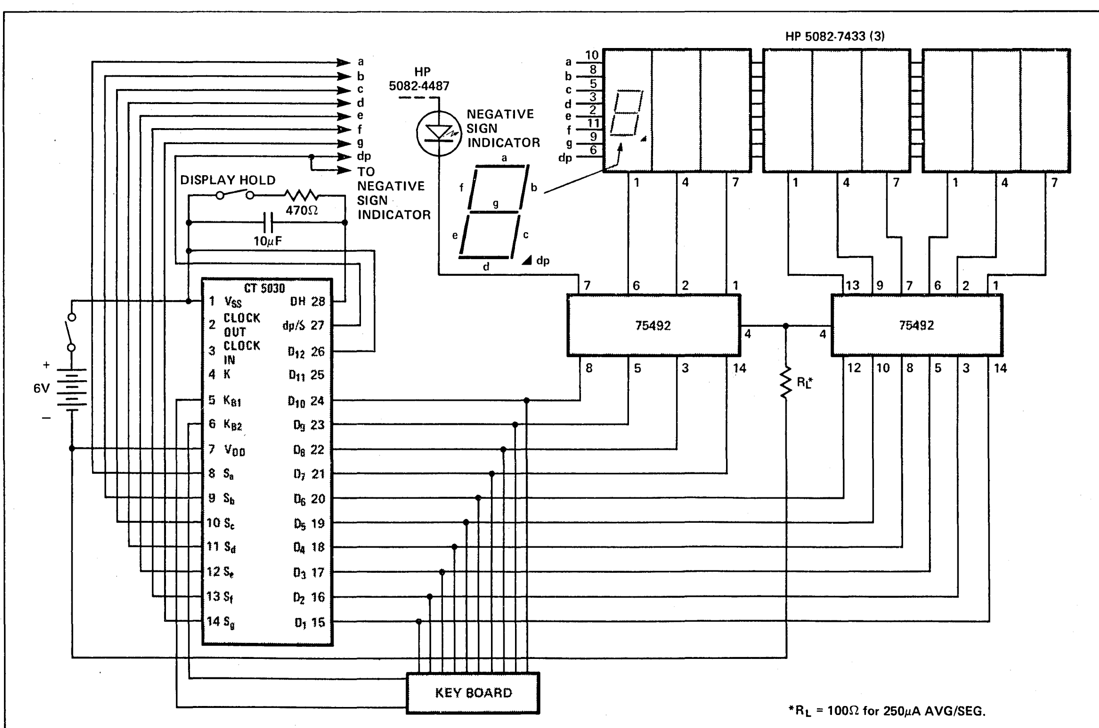

Figure 5. Four Function Calculator.

CONTRAST ENHANCEMENT

The quality of the perceived display is a function not only of the display intensity but also of ambient light intensity and contrast to the display background. When expected usage will be in relatively low ambient intensity areas (home or office) the display may be mounted near the surface of the instrument case and covered with an inexpensive red filter such as Plexiglass 2423 or a material having similar transmission characteristics. To improve contrast in bright ambient situations, the display may be recessed into the instrument case so as to provide a relatively dark background and thereby high display to background contrast. Contrast may be further enhanced through the use of polarizing filters such as Polaroid HRCP-red or louver type filters such as 3M display film. The latter material, though it may reduce viewing angle somewhat, will significantly reduce extraneous ambient light in the region of the display.

With proper mounting and anti-glare coatings (such as available from Panelgraphic Corp.) to reduce front panel reflections, satisfactory viewing may be achieved in bright ambient conditions.

MECHANICAL

The 5082-7430 series package utilizes a standard DIP lead frame with pin spacing of 0.100" between pins and 0.300" between rows.

The devices may be soldered for up to 5 seconds at a maximum solder temperature of 230°C (1/16" below the seating plane). In order to achieve the best possible display appearance, it is important that the individual display clusters be held in close alignment during soldering operations. Figure 6 shows a mounting fixture and loading block which will function both as an alignment aid and an insertion tool. This fixture will also act as a heat sink allowing a wider selection of soldering time and temperature parameters. Further alignment from cluster to cluster may be achieved with a mechanical alignment after soldering. The plastic encapsulant used in these devices may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operation.

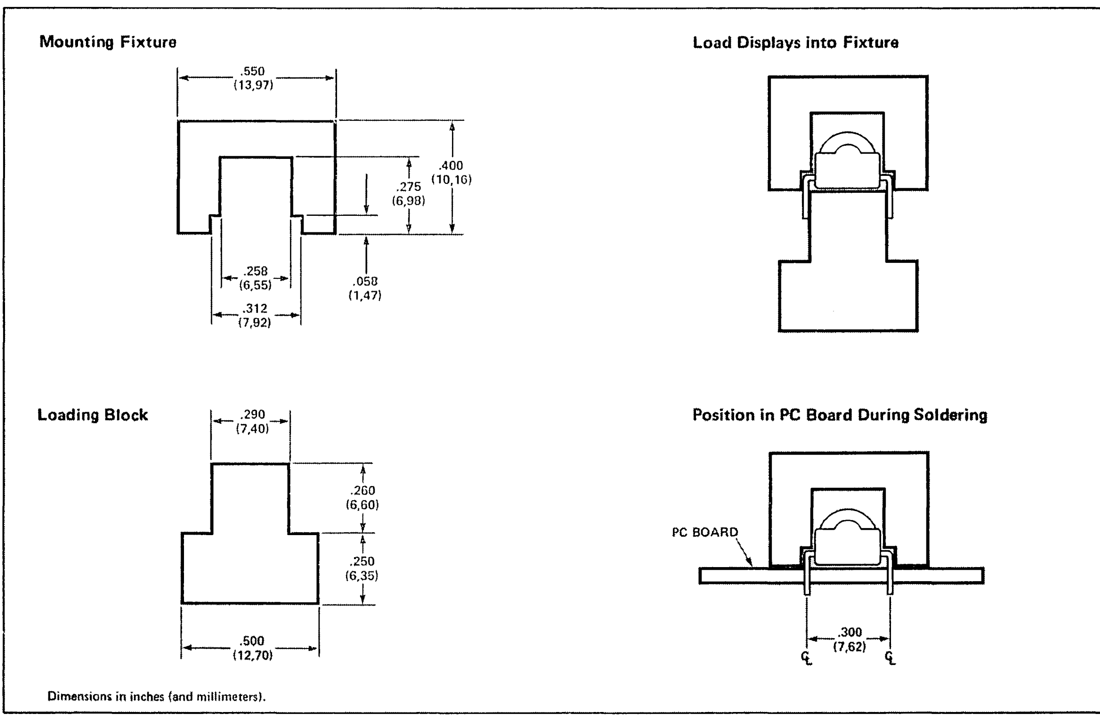

Figure 6. Mounting Fixture.