SIEMENS

Drivers For Light Emitting Displays Appnote 24

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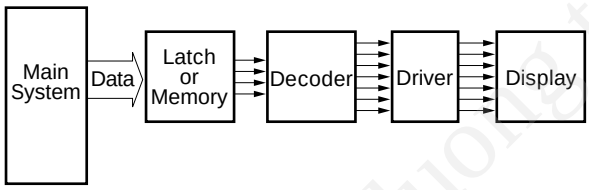
The purpose of this application note is to provide some information on the integrated circuits presently available to drive Light Emitting Diodes (LED) displays and how to interface them to the various displays.

Background

LED displays come in various sizes (0.1" to 0.8"), colors (red, high-efficiency red, green, yellow and blue), fonts (7/9/14/16 segment, dot-matrix, or bargraph), and types (common anode, common cathode, multi-digit). The brightness is essentially proportional to the current through an LED and each element within a display should have the same current or a brightness variation may be apparent. A display subsystem can be made up from several elements.

Figure 1. Display system



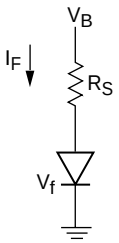
The partitioning of these elements are dependent on the drivers used; therefore the display driver chosen is dependent on the specifications of the display and the application. Also some types of displays require using a multiplexing technique because of the internal interconnections. This is only applicable for multi-digit displays.

Typical Circuits

Figure 2 shows a very basic circuit for driving an LED. The series resistance can be easily calculated from the following formula.

$$Rs = \frac{Vb - Vf}{If}$$

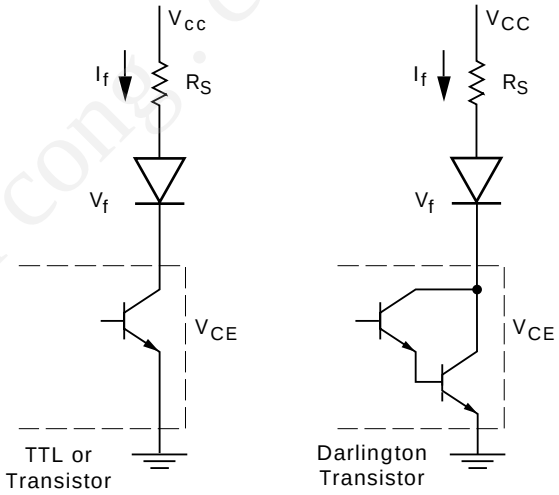
Figure 2. Basic circuit to drive an LED



For circuits using TTL logic or transistors, see Figure 3.

$$Rs = \frac{Vcc - Vce - Vf}{If}$$

Figure 3. Circuits for TTL or transistor and darlington transistor



It can be seen that Vce (saturation voltage) for the driver is going to be a factor in determining the series limiting resistor. Therefore a darlington versus a single output transistor will have different current limiting resistor values to maintain a constant current through the LED.

Figure 4. Common cathode display

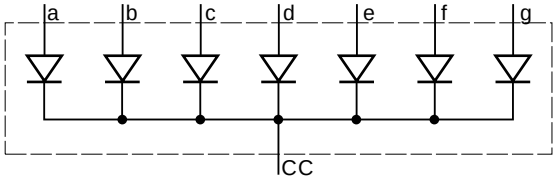


Figure 5. Common anode display

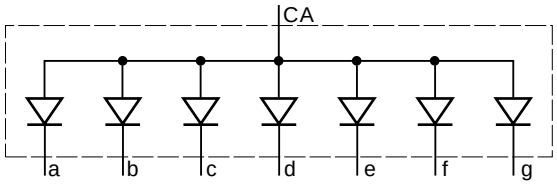


Figure 6. Common cathode display with driver

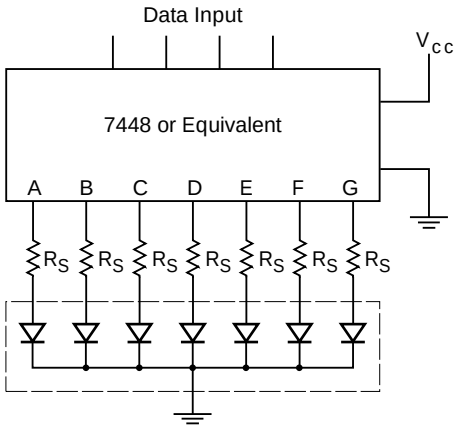


Figure 7. Common anode display with driver

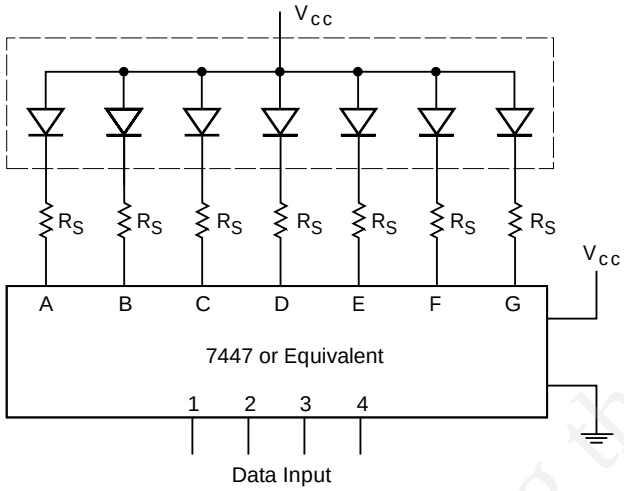


Figure 8. Open collector type driver with common anode display

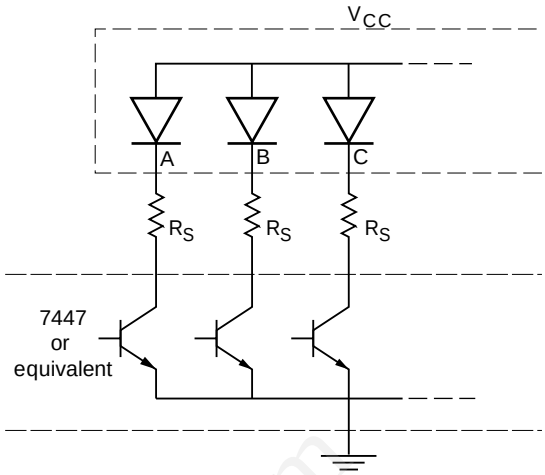
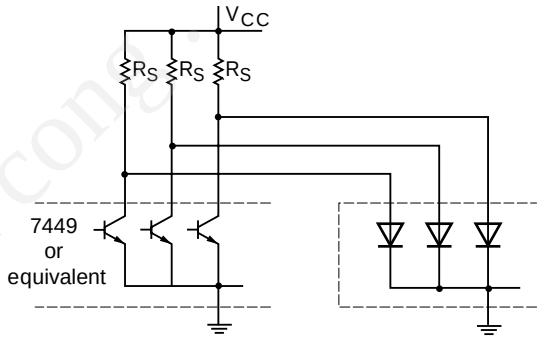


Figure 9. Open collector type driver with common cathode display



Selection

One factor in choosing the display and/or driver will be whether the display is a common cathode or common anode type display.

Another factor is that different drivers go low or high or can be wired into different configurations.

From Figures 6/7/8/9, it may appear obvious to combine the seven series resistors (Rs) into one common resistor in the common line. However this should not be done because of the possible variation in Vf from segment to segment. Variation in Vf can cause a variation in current, resulting in segment brightness differences.

Table 1 is list of some of the most common LED drivers available. Besides having different current drive capabilities, one product may have a feature which may make them easier to use in a particular application:

— Serial versus parallel input data
— Data latching type drivers
— Blanking
— Drive ripple blanking input (rbo) with pulse width modulation to vary brightness
— Multi-digit drivers
— Constant current drivers
— Advantage of a constant current driver as Vf may not affect brightness, important with different color LEDs.

Multiplexing

In a multiplex system, the corresponding segment of each digit is bussed together and driven from one segment drive via the usual current limiting resistors. The display data is presented serially by digit to the decoder driver together with the appropriate digit signal (Figure 10). For more information multiplexing, see Appnote 3 (Multiplexing LED Displays).

One way to simplify the design procedure for alphanumeric displays would be to consider Siemens Intelligent Displays. This device family incorporates all necessary interface control with drivers and memory built-in with the display. This means the designer need not be concerned about the memory, multiplex circuitry, character generator, or drivers for these are provided inside a modular unit. More information on these products is available in Siemens Optoelectronics Data Book.

Circuits shown in this Appnote are for reference only and are not the responsibility of Siemens Optoelectronics. Products are continually being improved by vendors and/or are obsoleted; therefore consult the factory.

Figure 10. Block diagram—4 digit multiplexed display

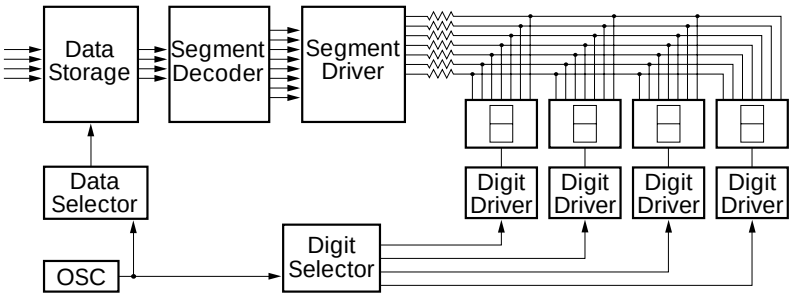


Table 1.

Single Digit Decoder/Drivers				
Part Number	**Manufacturer**	**If/Segment**	**Type**	**Comments**
7447 74247 7446	Fairchild Hitachi Motorola National Signetics Teledyne TI	40 mA	CA	BCD-to-7 segment, open coll, ripple blnkng
7448 74248	Fairchild Hitachi Motorola National Signetics TI	6 mA	CC	BCD-to-7 segment, int pull-up, ripple blnkng
7449 74249	Fairchild Hitachi Motorola National Signetics TI	8 mA	CC	BCD-to-7 segment, open coll, ripple blnkng
DS8857	National	60 mA	CA	BCD-to-7 segment, decoder, ripple blnkng
DS8858	National	50 mA	CC	BCD-to-7 segment, decoder, ripple blnkng
CD4511 4511 B MC14511	Fairchild National Motorola	25 mA	CC	BCD-to-7-segment, latched, blnkng
DS8647 DS8648	National	10 mA	CC	9 segment drivers
NE587	Signetics	50 mA	CA	BCD-to-7-segment, latched, blnkng, vari current
NE589	Signetics	50 mA	CC	BCD-to-7-segment, latched, blnkng, vari current
CA3161E	RCA	25 mA	CA	BCD-to-7-segment, constant current drivers
9368	Fairchild	20 mA	CC	BCD-to-7-segment, ripple blnkng
9374	Fairchild	15 mA	CA	BCD-to-7-segment, ripple blnkng

Table 1. (continued)

Multi-Digit Display Drivers				
Part Number	**Manufacturer**	**If/Segment**	**Type**	**Comments**
SDA2014	Siemens	12 mA	CC	2 or 4 digit, serial bcd input
SDA2131	Siemens	20 mA	CA	16 element serial input
MM5450	National	25 mA	CA	34 segment serial input, brightness control
MM5451	National	25 mA	CA	35 segment serial input, brightness control
MM74C912	National	100 mA	CC	6 digit, 7 segment+decimal, BCD decoder, output enble
MM74C911	National	100 mA	CC	4 digit, 8 segments controller/segment/driver
MM74917	National	100 mA	CC	6 digit, 7 segments+decimal, Hex decoder, output enble
DS8669	National	25 mA	CA	Dual BCD-to-7 segment decoder/driver
CA3168E	RCA	25 mA	CA	Dual BCD-to-7 segment decoder/driver
ICM7212 ICM7212A ICM7212M ICM7212AM	Intersil	8 mA	CA	4 digit, latched, 28 segment drivers, brightness cntl
ICM7218A	Intersil	20 mA	CA	8 digit, 8 segment (decoded/spcl), w/mem/drivers
ICM7218B	Intersil	10 mA	CC	8 digit, 8 segment (decoded/spcl), w/mem/drivers
ICM7218C	Intersil	20 mA	CA	8 digit, 8 segment (hex/bcd), w/mem/drivers
ICM7218D	Intersil	10 mA	CC	8 digit, 8 segment (hex/bcd), w/mem/drivers
ICM7218E	Intersil	20 mA	CA	8 digit, 8 segment (decoded/spcl), w/mem/drivers, cntls avble
TSC700A	Teledyne	11 mA	CA	4 digit decoder/driver, parallel output, brightness cntl
TSC7212A	Teledyne	5 mA	CA	4 digit decoder/driver, parallel output, brightness cntl
SAA1060	Signetics	40 mA	CA	16 element serial in/parallel out driver
Other Drivers				
XR-2000	Exar	400 mA	sink	5 darlington transistors, MOS-to-LED
XR-2201 XR-2202 XR-2203 XR-2204	Exar	500 mA	sink	7 darlington transistors, open collector w/diodes, TTL-to-LED, compatible to Sprague (ULN-xxxx)
CA3081	RCA	100 mA	sink	7 common emitter transistor array
CA3082	RCA	100 mA	source	7 common emitter transistor array
9665 9667	Fairchild	250 mA	sink	7 common emitter darlington transistor array
Bar Graph Drivers				
UAA180	Siemens	10 mA	n.a.	12 element bar driver
LM3914	National	2–20 mA	n.a.	10 element dot/bar linear output driver
LM3915	National	1–30 mA	n.a.	10 element dot/bar linear output driver