

# 64 SEGMENT LIQUID CRYSTAL DISPLAY DRIVER PARALLEL INTERFACE

## FEATURES

- Drives up to 64 segments
- Standard parallel interface
- Operates over a wide temperature range
- External contrast control
- Low power CMOS

## DESCRIPTION

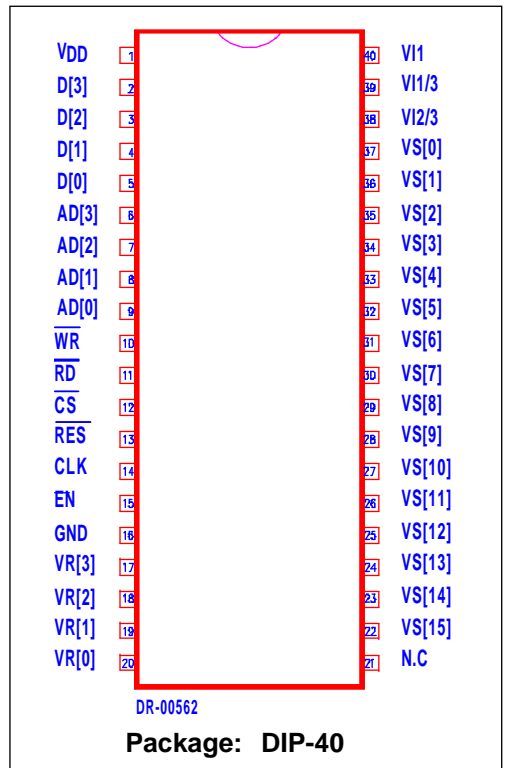
The SAMES SA8806A Liquid Crystal Display (LCD) Driver is capable of driving up to 64 LCD segments and is designed for displays having 4 track multiplexed backplanes.

The SA8806A includes an on-chip oscillator. The device may be programmed from a standard  $\mu$ P or  $\mu$ C Bus.

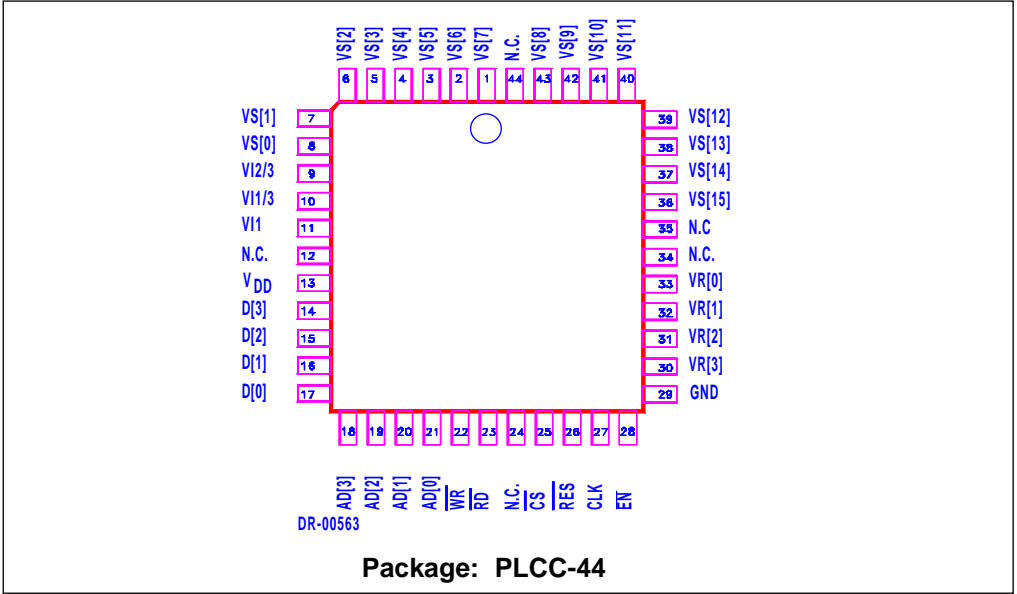
This LCD driver is ideal for any  $\mu$ -Controller based system requiring up to an 8 digit LCD display.

The SA8806A integrated circuit is available in both 40 pin dual-in-line plastic (DIP-40), as well as 44 pin plastic leaded chip carrier (PLCC-44) package types.

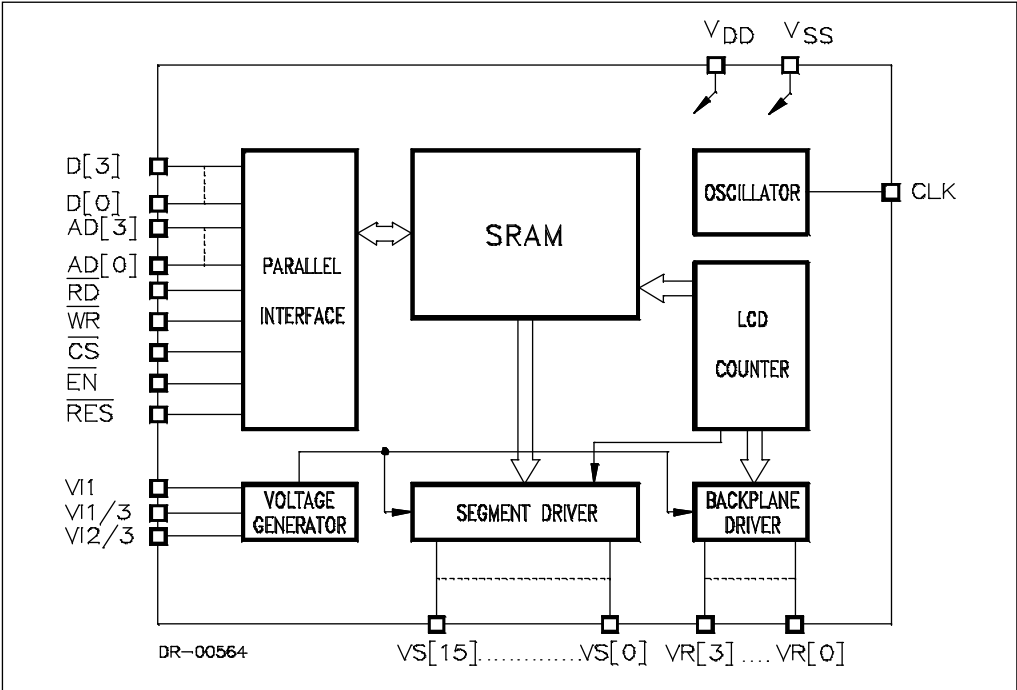
## PIN CONNECTIONS



PIN CONNECTIONS



BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATINGS\***

| Parameter             | Symbol            | Min  | Max  | Unit |
|-----------------------|-------------------|------|------|------|
| Supply Voltage        | $V_{DD} - V_{SS}$ | -0.3 | 6.0  | V    |
| Current on any pin    | $I_{PIN}$         | -100 | +100 | mA   |
| Storage Temperature   | $T_{STG}$         | -40  | +125 | °C   |
| Operating Temperature | $T_O$             | -25  | +85  | °C   |

\* Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only. Functional operation of the device at these or any other condition above those indicated in the operational sections of this specification, is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

**ELECTRICAL CHARACTERISTICS**

(Over the temperature range -10°C to +70°C<sup>#</sup>,  $V_{DD} = 5V$ ,  $V_{SS} = 0V$  unless otherwise specified.)

| Parameter        | Symbol            | Min | Typ                                  | Max | Unit | Condition |
|------------------|-------------------|-----|--------------------------------------|-----|------|-----------|
| Supply Voltage   | $V_{DD} - V_{SS}$ | 4.5 | 5.0                                  | 5.5 | V    |           |
| Supply Current   | $I_{DD}$          |     |                                      | 100 | μA   |           |
| LCD ON Voltages  | $V_{ON}$          |     | $V_{DD} \text{ \& \ } V_{SS}$        |     | V    |           |
| LCD OFF Voltages | $V_{OFF}$         |     | $1/3V_{DD} \text{ \& \ } 2/3 V_{DD}$ |     | V    |           |

<sup>#</sup> Extended Operating Temperature Range available on request.



## PIN DESCRIPTION

| Pin<br>PLCC-44 | Pin<br>DIP-40 | Designation      | Description                    |
|----------------|---------------|------------------|--------------------------------|
| 29             | 16            | GND              | Ground                         |
| 13             | 1             | V <sub>DD</sub>  | Positive Supply Voltage        |
| 17             | 5             | D[0]             | Data inputs/outputs            |
| 16             | 4             | D[1]             |                                |
| 15             | 3             | D[2]             |                                |
| 14             | 2             | D[3]             |                                |
| 21             | 9             | AD[0]            | Data address inputs            |
| 20             | 8             | AD[1]            |                                |
| 19             | 7             | AD[2]            |                                |
| 18             | 6             | AD[3]            |                                |
| 22             | 10            | $\overline{WR}$  | Write Enable input, active low |
| 23             | 11            | $\overline{RD}$  | Read Enable input, active low  |
| 25             | 12            | $\overline{CS}$  | Chip Select input, active low  |
| 26             | 13            | $\overline{RES}$ | Reset input, active low        |
| 27             | 14            | CLK              | Oscillator Input               |
| 8              | 37            | VS[0]            | LCD segment driver outputs     |
| 7              | 36            | VS[1]            |                                |
| 6              | 35            | VS[2]            |                                |
| 5              | 34            | VS[3]            |                                |
| 4              | 33            | VS[4]            |                                |
| 3              | 32            | VS[5]            |                                |
| 2              | 31            | VS[6]            |                                |
| 1              | 30            | VS[7]            |                                |
| 43             | 29            | VS[8]            |                                |
| 42             | 28            | VS[9]            |                                |
| 41             | 27            | VS[10]           |                                |
| 40             | 26            | VS[11]           |                                |
| 39             | 25            | VS[12]           |                                |
| 38             | 24            | VS[13]           |                                |
| 37             | 23            | VS[14]           |                                |
| 36             | 22            | VS[15]           |                                |

## PIN DESCRIPTION (Continued)

| Pin<br>PLCC-44 | Pin<br>DIP-40 | Designation            | Description                                  |
|----------------|---------------|------------------------|--|
| 33             | 20            | VR[0]                  | LCD backplane driver outputs                 |
| 32             | 19            | VR[1]                  |  |
| 31             | 18            | VR[2]                  |  |
| 30             | 17            | VR[3]                  |  |
| 28             | 15            | $\overline{\text{EN}}$ | LCD Voltage Divider Enable input, active low |
| 11             | 40            | VI1                    | Optional external LCD voltage inputs         |
| 10             | 39            | VI1/3                  |  |
| 9              | 38            | VI2/3                  |  |
| 34             | 21            | NC                     | Not connected                                |
| 12             |               | NC                     |  |
| 24             |               | NC                     |  |
| 35             |               | NC                     |  |
| 44             |               | NC                     |  |

## FUNCTIONAL DESCRIPTION

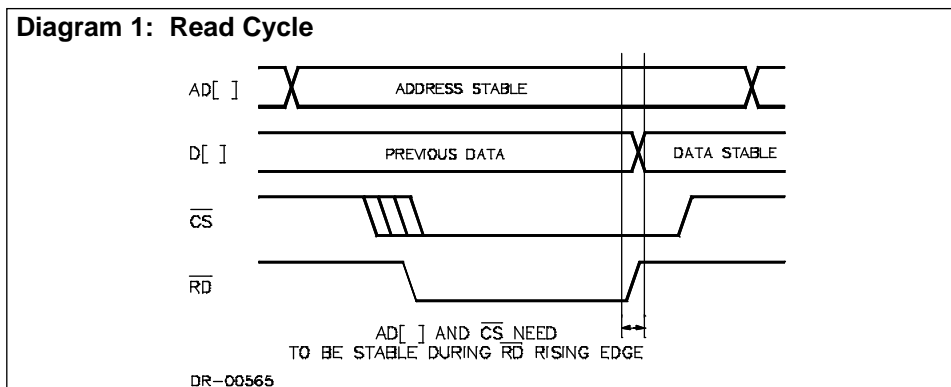
The SA8806A is a CMOS Liquid Crystal Display Driver integrated circuit for displays, having 4 track multiplexed backplanes and up to 64 LCD segments.

The integrated circuit has a parallel interface, with external contract control and a low power mode.

## 1. Parallel Interface

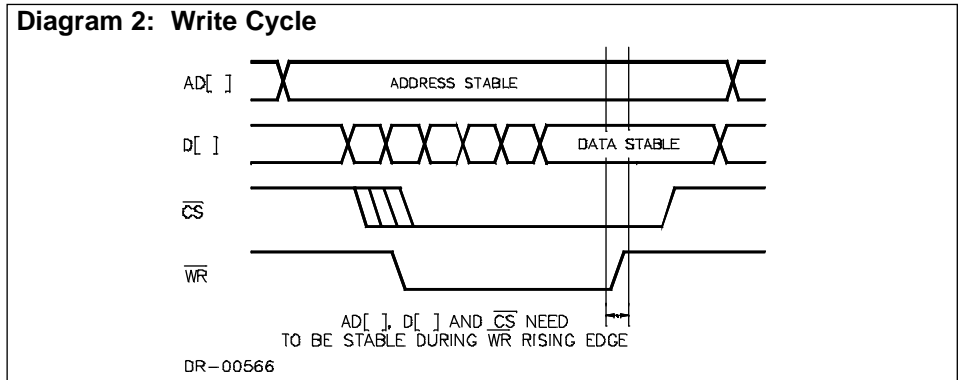
**Read Mode:** With  $\overline{\text{CS}}$  and  $\overline{\text{RD}}$  both active (low), the data corresponding to the selected address, is switched to the output.

The Read cycle timing diagram is given below:



**Write Mode:** With  $\overline{\text{CS}}$  and  $\overline{\text{WR}}$  both active (low), the data corresponding to the address selected, is latched into memory.

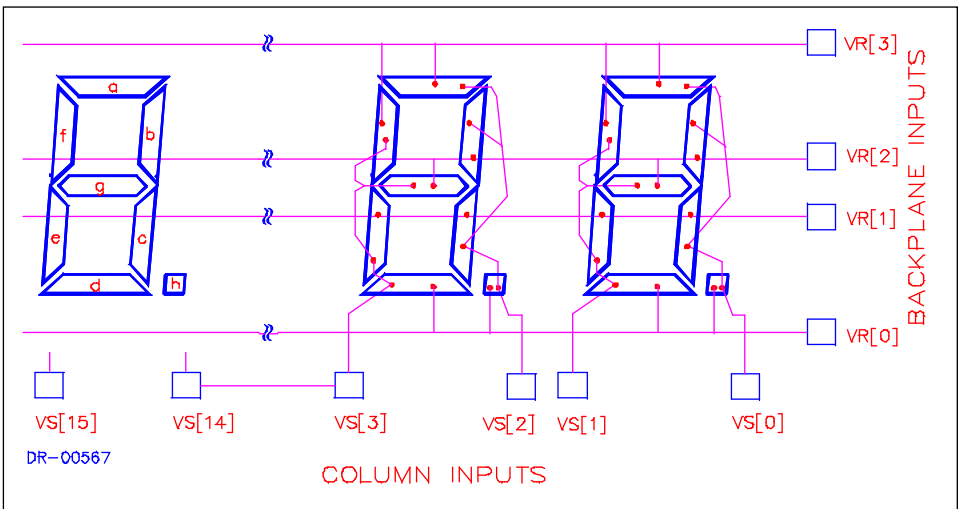
The Write cycle timing diagram is given below:



## 2. LCD Display

The SA8806A LCD Driver is capable of driving a 4 backplane, 8 digit (7 segment) display, plus decimal points.

The most significant digit is addressed by columns VS[14] and VS[15] and the least significant digit; by VS[0] and VS[1]. The display segments addressed via the column outputs are given in a typical configuration below:

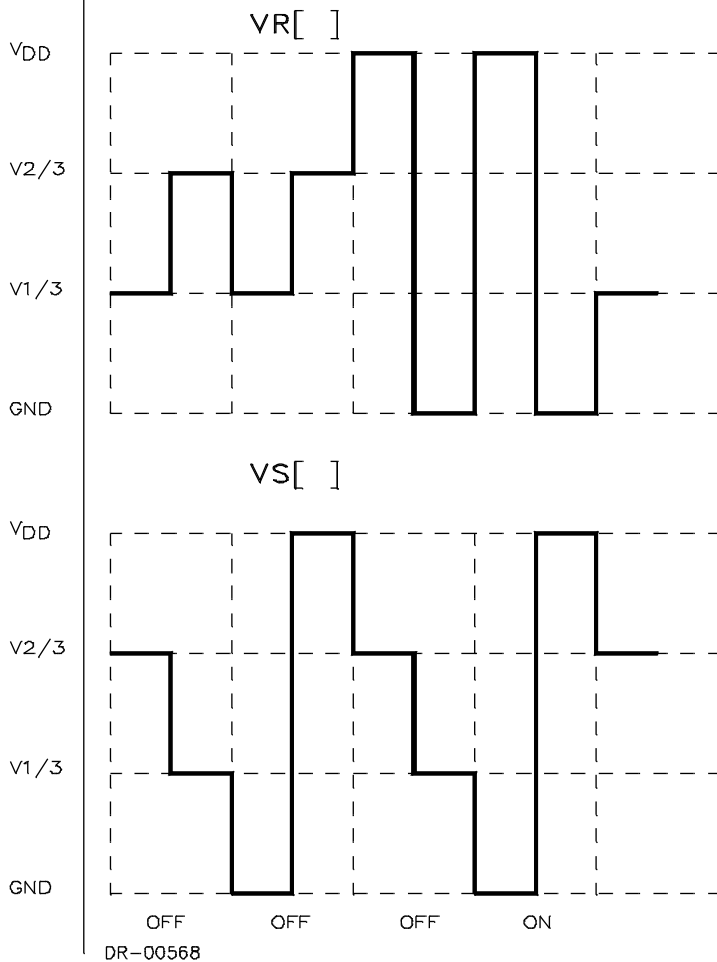


The data in memory is constantly being displayed on the liquid crystal display. New data is displayed as soon as it is latched into memory.

When a high level (+5V) on a backplane driver output corresponds with a low level (0V) on a segment driver output (or vice versa), the LCD segment to which they are connected, will be activated (see Diagram 3).

The backplane multiplex rate is determined by the clock frequency on the CLK input.

**Diagram 3: LCD Driving Signals**



### 3. LCD Character Mapping

The device has 16 address locations, A0 - A15 which correspond to VS[0] - VS[15]. Each location contains 4 bits, D[3] to D[0] which correspond to VR[3] - VR[0].

The mapping is detailed in the table below:

| SEG   | VS[0] | VS[1] | VS[2] | VS[3] | ..... | VS[12] | VS[13] | VS[14] | VS[15] |
|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|
| VR[0] | 0-0   | 1-0*  | 2-0   | 3-0   | ..... | 12-0   | 13-0   | 14-0   | 15-0   |
| VR[1] | 0-1   | 1-1   | 2-1   | 3-1   | ..... | 12-1   | 13-1   | 14-1   | 15-1   |
| VR[2] | 0-2   | 1-2   | 2-2   | 3-2   | ..... | 12-2   | 13-2   | 14-2   | 15-2   |
| VR[3] | 0-3   | 1-3   | 2-3   | 3-3   | ..... | 12-3   | 13-3   | 14-3   | 15-3   |

Note: A '1' switches the corresponding segment on.

\* The address number and bit number of the byte is given, e.g. 1-0 is address 1 and bit 0 (LSB).

### 4. On-Chip LCD Voltage Divider Disable

The integrated divider for the LCD voltages can be disabled by applying a high level on the  $\overline{EN}$  input ( $\overline{EN} = 1$ ).

### 5. Contrast Setting

The contrast may be adjusted in two ways:

An external resistor divider supplying the LCD voltage inputs V11, V11/3, V12/3, with the internal divider disabled as described in paragraph 4.

Applying an external LCD voltage on input V1, with the internal voltage divider activated.

### 6. Oscillator

The on-chip oscillator circuit requires one external capacitor for operation. The capacitor value is calculated as follows:

$$C = 7\mu\text{F} \cdot 1\text{Hz}/f$$

f = Required oscillator frequency

The multiplex rate is 64 times lower than the clock frequency.

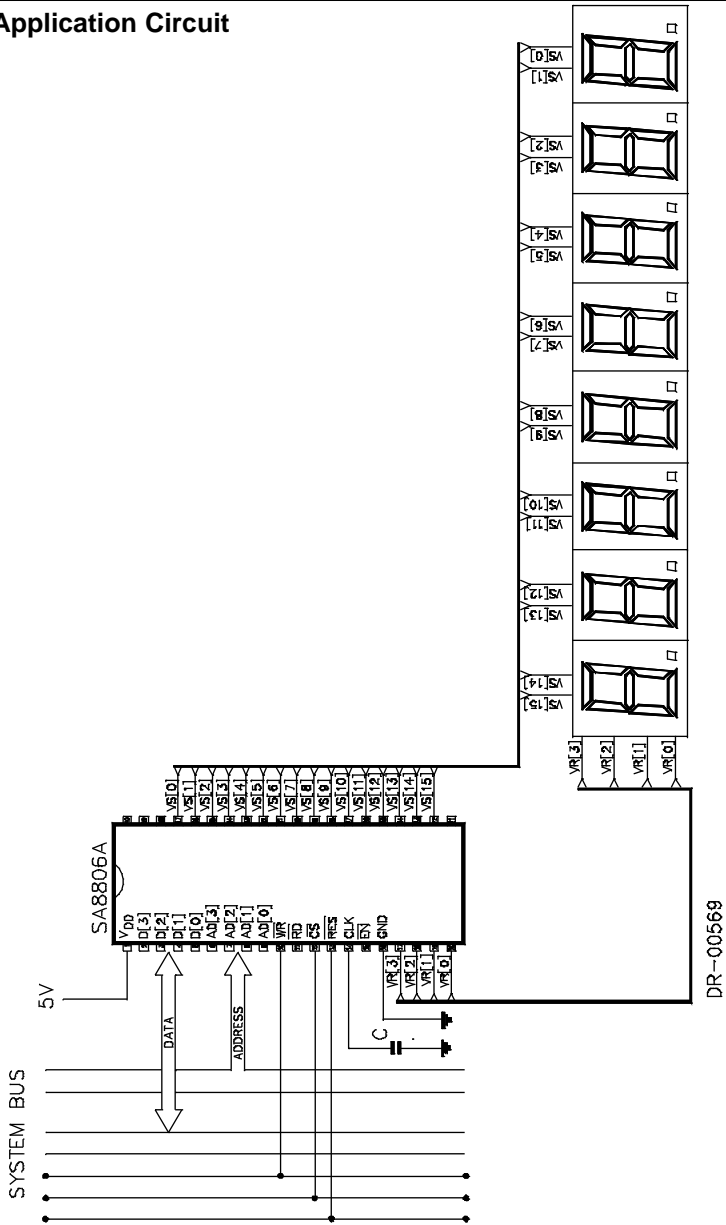
## TYPICAL APPLICATION

The Application Circuit (Figure 1) shows the connections for a typical application utilising an 8 digit (7 segment) display, plus decimal points.





Figure 1: Application Circuit



ORDERING INFORMATION

| Part Number | Package |
|-------------|---------|
| SA8806APA   | DIP-40  |
| SA8806AFA   | PLCC-44 |

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