Infineon technologies

OSRAM

STANDARD RED **SCDV5540**
YELLOW **SCDV5541**
HIGH EFFICIENCY RED **SCDV5542**
GREEN **SCDV5543**
HIGH EFFICIENCY GREEN **SCDV5544**

Vertical Format 0.123" 4-Character 5 x 5 Dot Matrix Serial Input Dot Addressable Intelligent Display® Devices

Dimensions in Inches (mm)

0.188 (4.78)

0.784 (19.91)

0.100 (2.54) non-cum. 12 plcs.

SCDV554X OSRAM YYWW   Z

0.150 (3.81)

0.400 ±.015 (10.16 ±.38)

0.160 (4.06) ±.020 (0.51)

0.200 (5.08)

△1 Dimension at Seating Plane
2. Display matrix & pins centered on the package outline.
3. Display matrix centered to pin array.
4. Tolerance: .XXX= ±.010 (.25)

△1 0.300 (7.62) ±.020 (0.51)
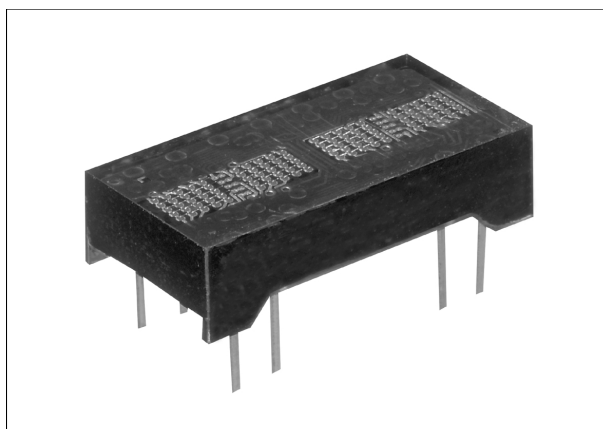
FEATURES

- **Vertical Format, Four 0.123" (3.12 mm) 5 x 5 Dot Matrix Characters in Red, Yellow, High Efficiency Red, Green, or High Efficiency Green**
- **Optimum Display Surface Efficiency (display area to package ratio)**
- **High Speed Data Input Rate: 5.0 MHz**
- **ROMless Serial Input, Dot Addressable Display Ideal for User Defined Characters**
- **Built-in Decoders, Multiplexers and LED Drivers**
- **Readable from 6.0 Feet (1.8 meters)**
- **Wide Viewing Angle, X Axis ±55°, Y Axis ±55°**
- **Attributes:**
  - **100 Bit RAM for User Defined Characters**
  - **Eight Dimming Levels**
  - **Power Down Model (<250 μW)**
  - **Hardware/Software Clear Functions**
  - **Lamp Test**
  - **Internal or External Clock**
- **3.3 V Capability**
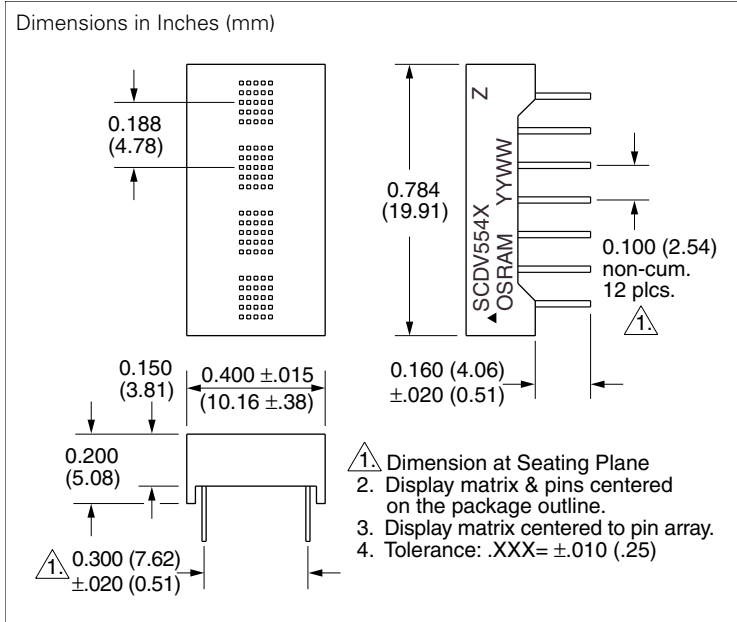
DESCRIPTION

The SCDV5540 (Red), SCDV5541 (Yellow), SCDV5542 (High Efficiency Red), SCDV5543 (Green), and SCDV5544 (High Efficiency Green) are four digit, dot addressable 5 x 5 dot matrix, serial input, alphanumeric Intelligent Display devices in a vertical format. The four digits are packaged in a rugged, high quality, optically transparent, plastic 14 pin DIP with 0.3" pin spacing.

The on-board CMOS has a 100 bit RAM, one bit associated with one LED, each to generate User Defined Characters. In Power Down Mode, quiescent current is <50 μA.

The SCDV554X is designed for work with the serial port of most common microprocessors. Data is transferred into the display through the Serial Data Input (DATA), clocked by the Serial Data Clock (SDCLK), and enabled by the Load Input (LOAD).

DESCRIPTION (continued)

The Clock I/O (CLK I/O) and Clock Select ($\overline{\text{CLKSEL}}$) pins offer the user the capability to supply a high speed external multiplex clock. This feature can minimize audio in-band interference for portable communication equipment or eliminate the visual synchronization effects found in high vibration environments such as avionics equipment.

Maximum Ratings

|	
DC Supply Voltage	–0.5 to +7.0 Vdc
Input Voltage Levels Relative to Ground	–0.5 to V_{CC} +0.5 Vdc
Operating Temperature	–40°C to +85°C
Storage Temperature	–40°C to +100°C
Maximum Solder Temperature 0.063" below Seating Plane, t<5.0 s	260°C
Relative Humidity at 85°C	85%
Maximum Number of LEDs at 100% Brightness	64
Maximum Power Dissipation	0.65 W
ESD (100 pF, 1.5 kΩ)	2.0 kV
Maximum Input Current	±100 mA

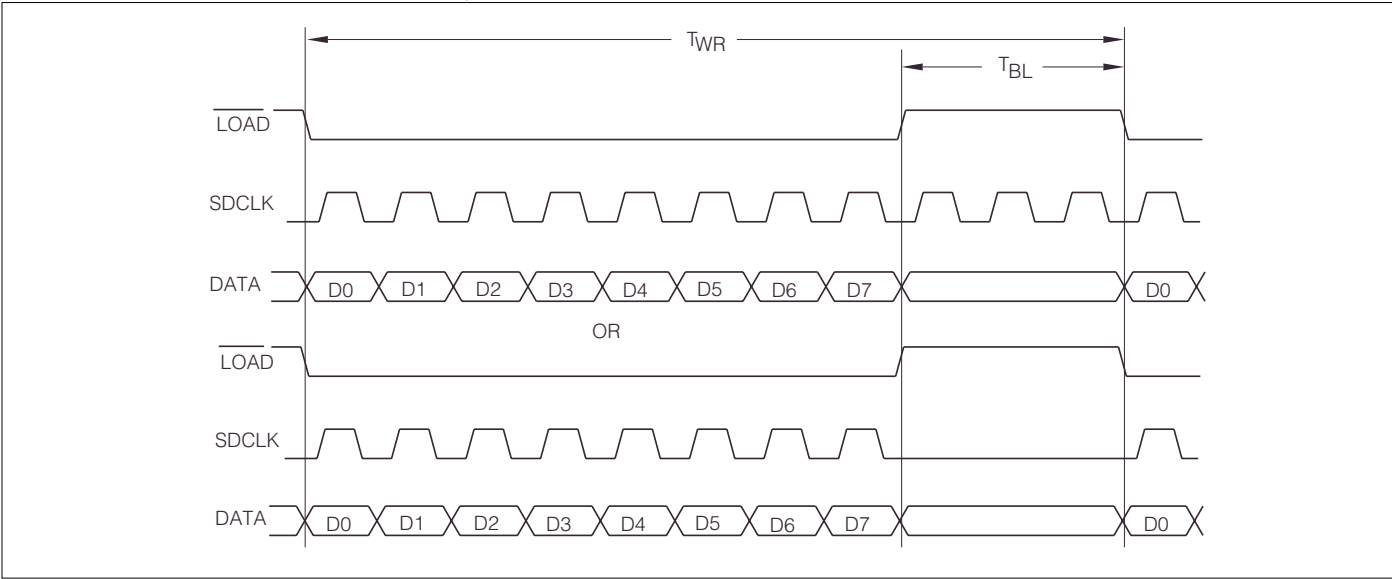**Figure 3. Top View**
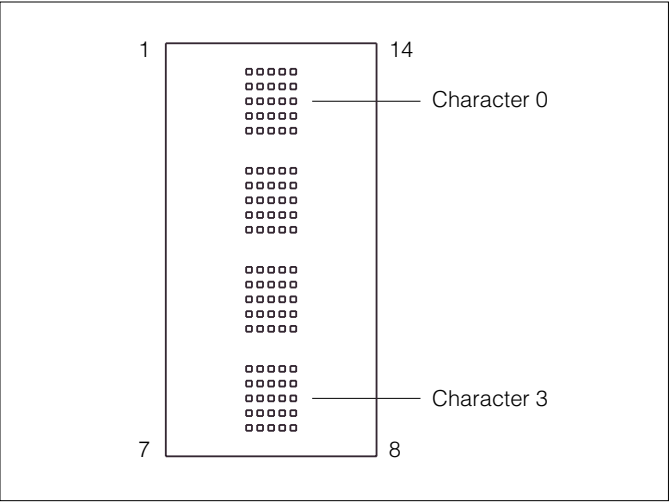
Figure 1. Timing Diagram—Data Write Cycle
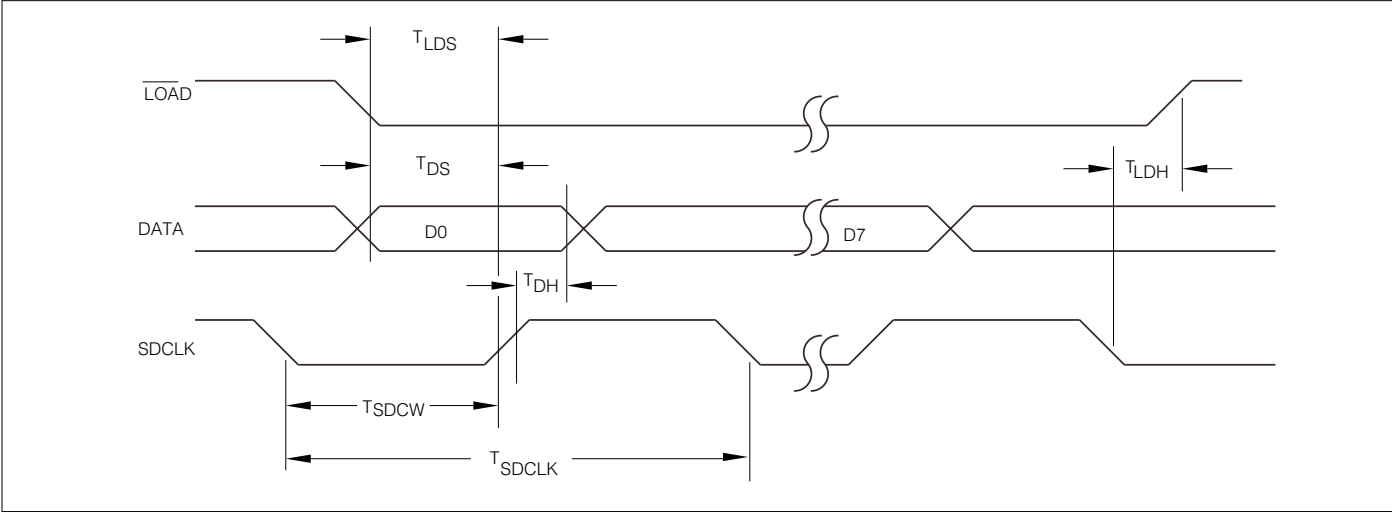
Figure 2. Timing Diagram—Instruction Cycle

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Electrical Characteristics (over operating temperature)

Parameter	Min.	Typ.	Max.	Units	Conditions
V_{CC}	4.5	5.0	5.5	V	—
I_{CC} (Pwr Dwn Mode)[4]	—	—	50	µA	V_{CC}=5.0 V, all inputs=0 V or V_{CC}
I_{CC} 4 digits 16 dots/character	—	100	140	mA	V_{CC}=5.0 V, "#" displayed in all 4 digits at 100% brightness at 25°C
I_{IL} Input current	—	—	−10	µA	V_{CC}=5.0 V, V_{IN}=0 V (all inputs)
I_{IH} Input current	—	—	10	µA	V_{CC}=V_{IN}=5.0 V (all inputs)
V_{IH}	3.5	—	—	V	V_{CC}=4.5 V to 5.5 V
V_{IL}	—	—	1.5	V	V_{CC}=4.5 V to 5.5 V
I_{OH} (CLK I/O)	—	−8.9	—	mA	V_{CC}=4.5 V, V_{OH}=2.4 V
I_{OL} (CLK I/O)	—	1.6	—	mA	V_{CC}=4.5 V, V_{OL}=0.4 V
$\theta_{JC\text{-}PIN}$	—	—	64	°C/W	—
F_{ext} External Clock Input Frequency	120	—	347	kHz	V_{CC}=5.0 V, $\overline{CLKSEL}$=0
F_{osc} Internal Clock Input Frequency	120	—	347	kHz	V_{CC}=5.0 V, $\overline{CLKSEL}$=1
Clock I/O Bus Loading	—	—	240	pF	—
Clock Out Rise Time	—	—	500	ns	V_{CC}=4.5 V, V_{OH}=2.4 V
Clock Out Fall Time	—	—	500	ns	V_{CC}=4.5 V, V_{OH}=0.4 V
FM, Digit	375	768	1086	Hz	—

Notes:
[1] Peak current $^5/_3$ x I_{CC}.
[2] Unused inputs must be tied high.
[3] Contact Infineon for 3.3 volt operation.
[4] External oscillator must be stopped if being used to maintain an I_{CC}<50 µA.

Input/Output Circuits

Figures 4 and 5 show the input and output resistor/diode networks used for ESD protection and to eliminate substrate latch-up caused by input voltage over/under shoot.
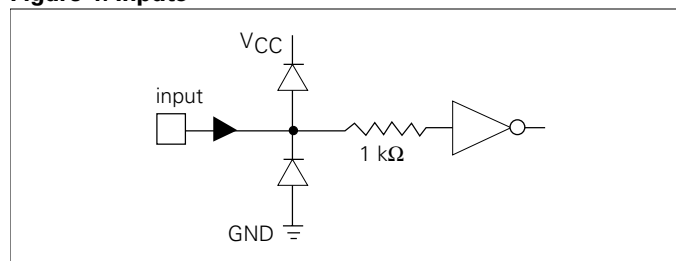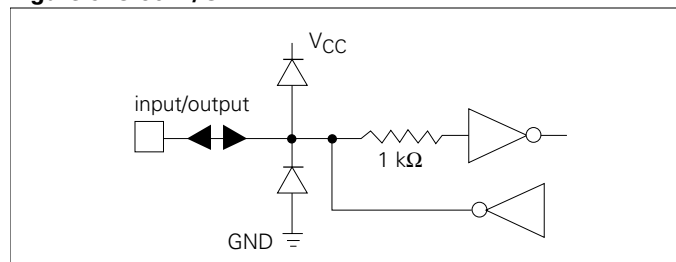
Figure 4. Inputs

Figure 5. Clock I/O

Optical Characteristics at 25°C
(V_{CC}=5.0 V at 100% brightness level, viewing angle: X axis ±55°, Y axis ±65°)

Red SCDV5540

Description	Symbol	Min.	Typ.	Units
Luminous Intensity Character Average (# displayed all digits)	I_V	0.48	1.8	mcd
Peak Wavelength	λ_{peak}	—	665	nm
Dominant Wavelength	λ_{dom}	—	639	nm

Yellow SCDV5541

Description	Symbol	Min.	Typ.	Units
Luminous Intensity Character Average (# displayed all digits)	I_V	1.8	5.4	mcd
Peak Wavelength	λ_{peak}	—	583	nm
Dominant Wavelength	λ_{dom}	—	585	nm

High Efficiency Red SCDV5542

Description	Symbol	Min.	Typ.	Units
Luminous Intensity Character Average (# displayed all digits)	I_V	1.8	5.4	mcd
Peak Wavelength	λ_{peak}	—	630	nm
Dominant Wavelength	λ_{dom}	—	620	nm

Green SCDV5543

Description	Symbol	Min.	Typ.	Units
Luminous Intensity Character Average (# displayed all digits)	I_V	1.8	5.4	mcd
Peak Wavelength	λ_{peak}	—	565	nm
Dominant Wavelength	λ_{dom}	—	570	nm

High Efficiency Green SCDV5544

Description	Symbol	Min.	Typ.	Units
Luminous Intensity Character Average (# displayed all digits)	I_V	2.1	6.4	mcd
Peak Wavelength	λ_{peak}	—	568	nm
Dominant Wavelength	λ_{dom}	—	574	nm

Notes:

1. Dot to dot intensity matching at 100% brightness is 1.8:1.
2. Displays are binned for hue at 2.0 nm intervals.
3. Displays within a given intensity category have an intensity matching of 1.5:1 (max.).

Pin Assignment

Pin	Function	Pin	Function
1	SDCLK	14	GND
2	$\overline{\text{LOAD}}$	13	DATA
3	NP	12	V_{CC}
4	NP	11	V_{CC}
5	NP	10	V_{CC}
6	$\overline{\text{RST}}$	9	$\overline{\text{CLKSEL}}$
7	GND	8	CLK I/O

Switching Specifications

(over operating temperature range and V_{CC}=4.5 V to 5.5 V)

Symbol	Description	Min.	Units
T_{RC}	Reset Active Time	600	ns
T_{LDS}	Load Setup Time	50	ns
T_{DS}	Data Setup Time	50	ns
T_{SDCLK}	Clock Period	200	ns
T_{SDCW}	Clock Width	70	ns
T_{LDH}	Load Hold Time	0	ns
T_{DH}	Data Hold Time	25	ns
T_{WR}	Total Write Time	2.2	µs
T_{BL}	Time Between Loads	600	ns

Note:

T_{SDCW} is the minimum time the SDCLK may be low or high. The SDCLK period must be a minimum of 200 ns.

Figure 6. Dot Matrix Format

0.095 (2.41)

0.028 (0.71)

0.123 (3.12)

0.021 (0.53)

Dimensions in inches (mm)
Tolerance: .XXX=±.010 (.25)
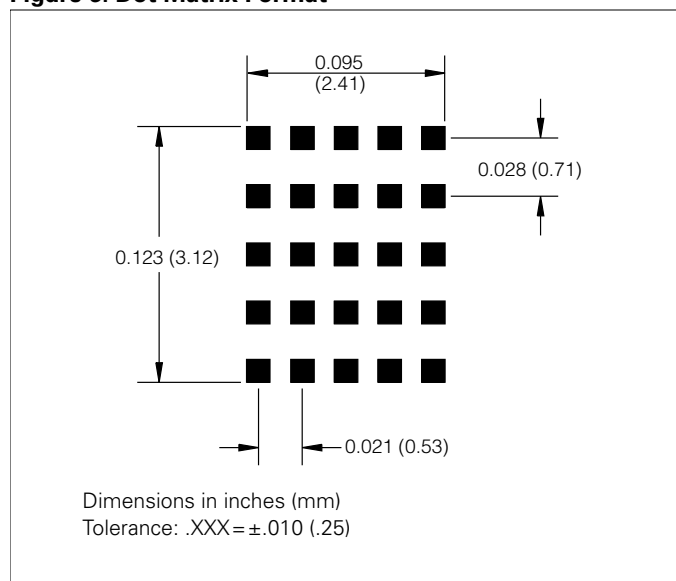
Pin Definitions

Pin	Function	Definitions
1	SDCLK	Loads data into the 8-bit serial data register on a low to high transition.
2	$\overline{\text{LOAD}}$	Low input enables data clocking into 8-bit serial shift register. When $\overline{\text{LOAD}}$ goes high, the contents of 8-bit serial Shift Register will be decoded.
3	NP	No pin
4	NP	No pin
5	NP	No pin
6	$\overline{\text{RST}}$	Asynchronous input, when low will clear the Multiplex Counter, User RAM and Data Register. Control Word Register is set to 100% brightness and the Address Register is set to select Digit 0. The display is blanked.
7	GND	Power supply ground
8	CLK I/O	Outputs master clock or inputs external clock.
9	$\overline{\text{CLKSEL}}$	H=internal clock, L=external clock
10	V_{CC}	Power supply
11	V_{CC}	Power supply
12	V_{CC}	Power supply
13	DATA	Serial data input
14	GND	Power supply ground

Display Column and Row Format

	C0	C1	C2	C3	C4
Row 0	1	1	1	1	1
Row 1	0	0	1	0	0
Row 2	0	0	1	0	0
Row 3	0	0	1	0	0
Row 4	0	0	1	0	0

1=Display dot "On"
0=Display dot "Off'

Column Data Ranges

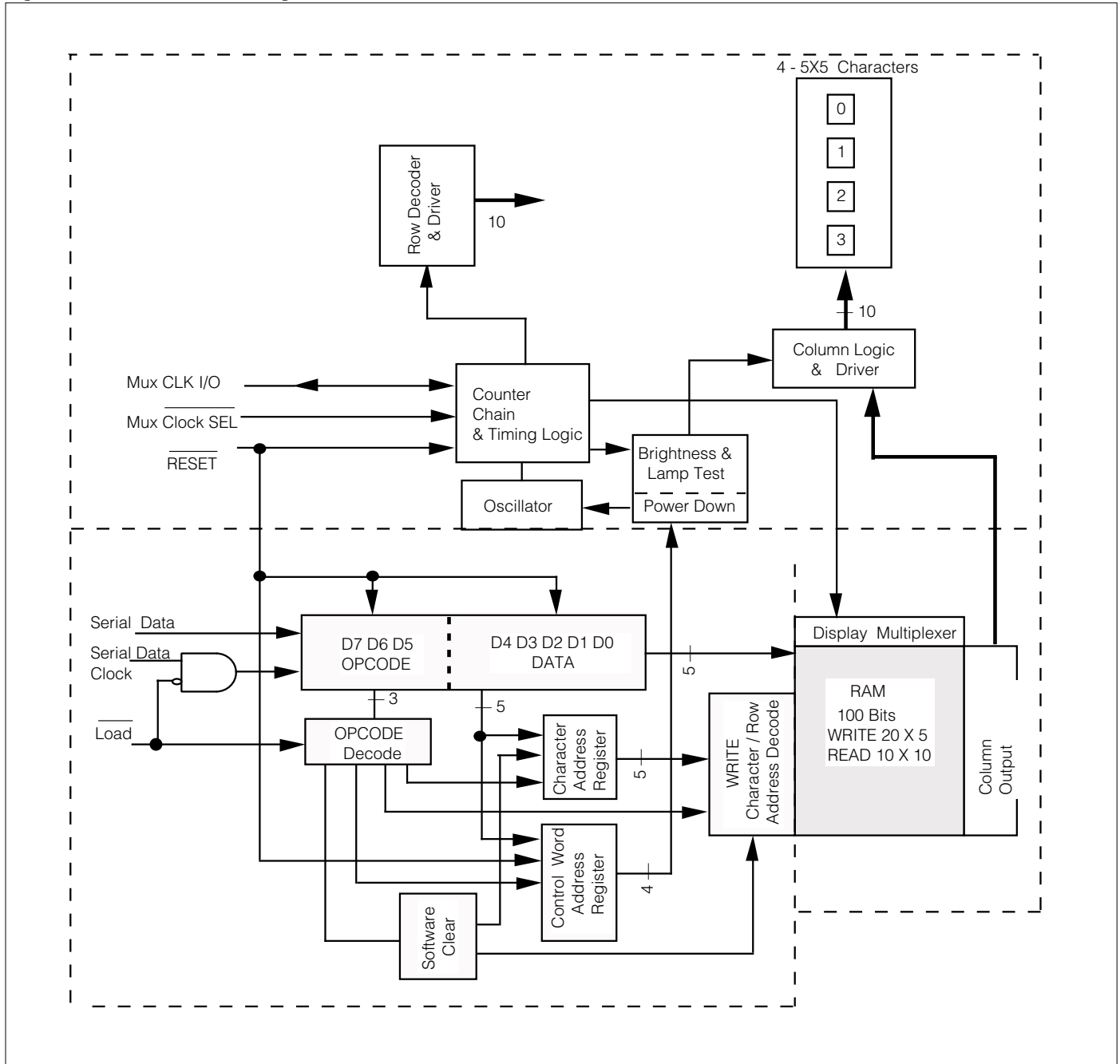| Row 0	00H to 1FH
Row 1	20H to 3FH
Row 2	40H to 5FH
Row 3	60H to 7FH
Row 4	80H to 9FH

Operation of the SCDV554X

The SCDV554X display consists of a CMOS IC containing control logic and drivers for four 5 x 5 characters. These components are assembled in a compact plastic package.

Individual LED dot addressablity allows the user great freedom in creating special characters or mini-icons. The User Definable Character Set examples illustrate 200 different character and symbol possibilities.

The serial data interface provides a highly efficient interconnection between the display and the mother board. The SCDV554X requires only four lines as compared to 15 for an equivalent four character parallel input part.

The on-board CMOS IC is the electronic heart of the display. The IC accepts decoded serial data, which is stored in the internal RAM. Asynchronously the RAM is read by the character multiplexer at a strobe rate that results in a flicker free display. Figure 7 shows the three functional areas of the IC. These include: the input serial data register and control logic, a 100 bits two port RAM, and an internal multiplexer/display driver.

Figure 7. SCDV554X Block Diagram

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The following explains how to format the serial data to be loaded into the display. The user supplies a string of bit mapped decoded characters. The contents of this string is shown in Figure 8a. Figure 8b shows that each character consists of six 8 bit words. The first word encodes the display character location and the succeeding five bytes are row data. The row data represents the status (On, Off) of individual column LEDs. Figure 8c shows that each that each 8 bit word is formatted to include a three bit Operational Code (OPCODE) defined by bits D7–D5 and five bits (D4–D0) representing Column Data, Character Address, or Control Word Data.

Figure 8d shows the sequence for loading the bytes of data. Bringing the $\overline{\text{LOAD}}$ line low enables the serial register to accept data. The shift action occurs on the low to high transition of the serial data clock (SDCLK). The least significant bit (D0) is loaded first. After eight clock pulses the $\overline{\text{LOAD}}$ line is brought high. With this transition the OPCODE is decoded. The decoded OPCODE directs D4–D0 to be latched in the Character Address register, stored in the RAM as Column data, or latched in the Control Word register. The control IC requires a minimum 600 ns delay between successive byte loads. As indicated in Figure 8a, a total of 264 bits of data are required to load all eight characters into the display.

The Character Address Register bits, D4–D0 (Table 2), and Row Address Register bits, D7–D5 (Table 3), direct the Column Data bits, D4–D0 (Table 3) to specific RAM location. Table 1 shows the Row Address for the example character "D." Column data is written and read asynchronously from the 200 bit RAM. Once loaded the internal oscillator and character multiplexer reads the data from the RAM. These characters are row strobed with column data as shown in Figures 9 and 10. The character strobe rate is determined by the internal or user supplied external MUX Clock and the IC's ÷ 320 counter.

Table 1. Character "D"

	Op code D7 D6 D5			Column Data D4 D3 D2 D1 D0 C0 C1 C2 C3 C4					Hex
Row 0	0	0	0	1	1	1	1	0	1E
Row 1	0	0	1	1	0	0	0	1	31
Row 2	0	1	0	1	0	0	0	1	51
Row 3	0	1	1	1	0	0	0	1	71
Row 4	1	0	0	1	1	1	1	0	9E

Figure 8. Loading Serial Character Data

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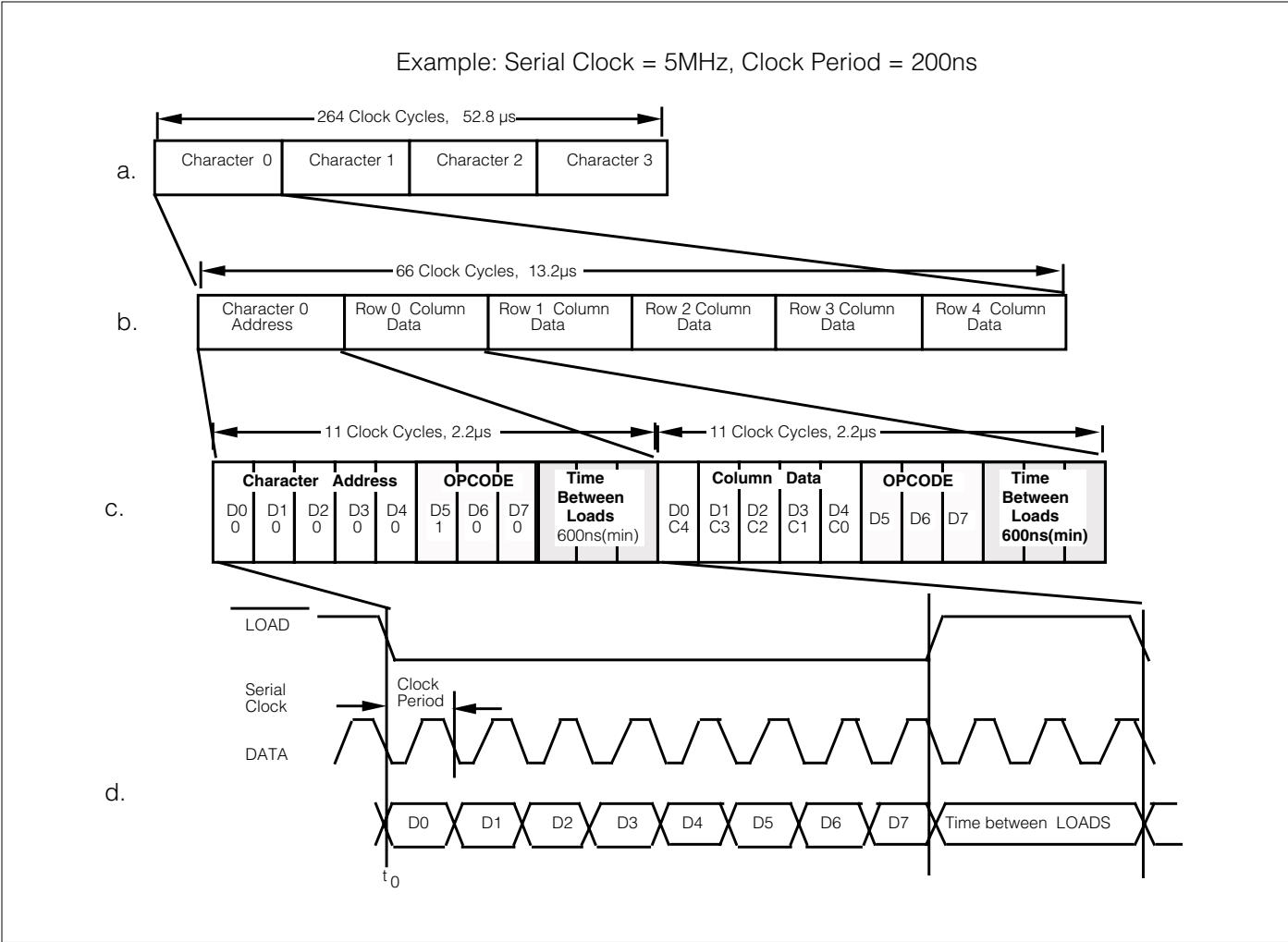
Table 2. Load Character Address

Op code D7 D6 D5			Character Address D4 D3 D2 D1 D0					Hex	Operation Load
1	0	1	0	0	0	0	0	A0	Character 0
1	0	1	0	0	0	0	1	A1	Character 1
1	0	1	0	0	0	1	0	A2	Character 2
1	0	1	0	0	0	1	1	A3	Character 3

Table 3. Load Column Data

Op code D7 D6 D5			Column Data D4 D3 D2 D1 D0					Operation Load
0	0	0	C0	C1	C2	C3	C4	Row 0
0	0	1	C0	C1	C2	C3	C4	Row 1
0	1	0	C0	C1	C2	C3	C4	Row 2
0	1	1	C0	C1	C2	C3	C4	Row 3
1	0	0	C0	C1	C2	C3	C4	Row 4

The user can activate four Control functions. These include: LED Brightness Level, Lamp Test, IC Power Down, or Display Clear. OPCODEs and five bit words are used to initiate these functions. The OPCODEs and Control Words for the Character Address and Loading Column Data are shown in Tables 2 and 3.

The user can select seven specific LED brightness levels, Table 4. These brightness levels (in percentages of full brightness of the display) include: 100% ($F0_{HEX}$), 53% ($F1_{HEX}$), 40% ($F2_{HEX}$), 27% ($F3_{HEX}$), 20% ($F4_{HEX}$), 13% ($F5_{HEX}$), and 6.6% ($F6_{HEX}$). The brightness levels are controlled by changing the duty factor of the row strobe pulse.

Table 4. Display Brightness

Op code D7 D6 D5			Control Word D4 D3 D2 D1 D0					Hex	Operation Level
1	1	1	1	0	0	0	0	F0	100%
1	1	1	1	0	0	0	1	F1	53%
1	1	1	1	0	0	1	0	F2	40%
1	1	1	1	0	0	1	1	F3	27%
1	1	1	1	0	1	0	0	F4	20%
1	1	1	1	0	1	0	1	F5	13%
1	1	1	1	0	1	1	0	F6	6.6%

The SCDV554X offers a unique Display Power Down feature which reduces ICC to less than 50 µA. When FF_{HEX} is loaded (Table 5) the display is set to 0% brightness and the internal multiplex clock is stopped. When in the Power Down mode data may still be written into the RAM. The display is reactivated by loading a new rightness Level Control Word into the display.

Table 5. Power Down

Op code D7 D6 D5			Control Word D4 D3 D2 D1 D0					Hex	Operation Level
1	1	1	1	1	1	1	1	FF	0% brightness

The Lamp Test is enabled by loading $F8_{HEX}$, Table 6, into the serial shift register. This Control Word sets all of the LEDs to a 53% brightness level. Operation of the Lamp Test has no affect on the RAM and is cleared by loading a Brightness Control Word.

Table 6. Lamp Test

Op code D7 D6 D5			Control Word D4 D3 D2 D1 D0					Hex	Operation Level
1	1	1	1	0	B	B	B		Lamp Test (OFF)
1	1	1	1	1	0	0	0	F8	Lamp Test (ON)

The Software Clear ($C0_{HEX}$), given in Table 7, clears the Address Register and the RAM. The display is blanked and the Character Address Register will be set to Character 0. The internal counter and the Control Word Register are unaffected. The Software Clear will remain active until the next data input cycle is initiated.

Table 7. Software Clear

Op code D7 D6 D5			Control Word D4 D3 D2 D1 D0					Hex	Operation Level
1	1	0	0	0	0	0	0	C0	CLEAR

Figure 9. Row and Column Locations

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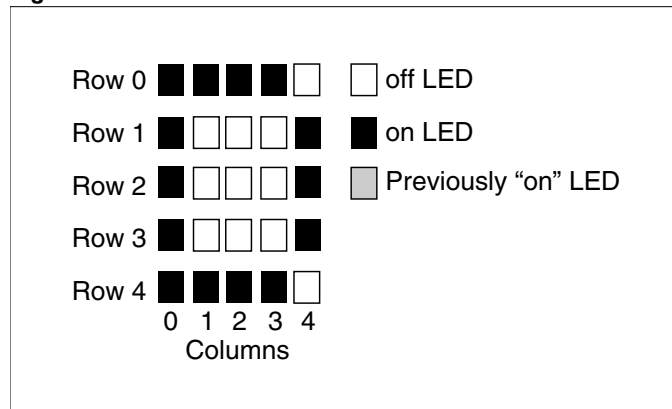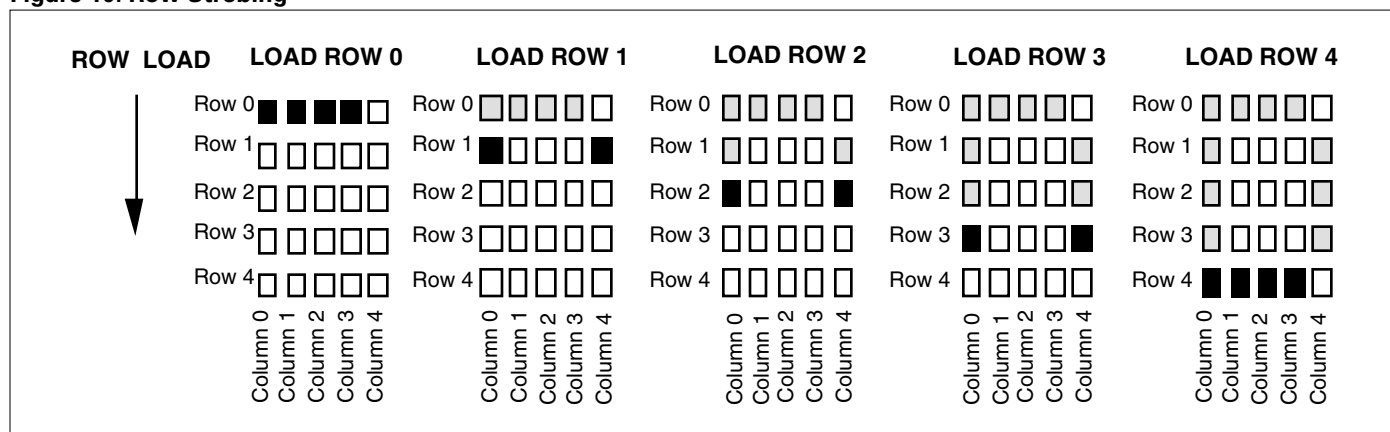www.osram-os.com • +49-941-202-7178

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Figure 10. Row Strobing

Multiplexer and Display Driver

The four characters are row multiplexed with RAM resident column data. The strobe rate is established by the internal or external MUX Clock rate. The MUX Clock frequency is divided by a 320 counter chain. This results in a typical strobe rate of 750 Hz. By pulling the Clock SEL line low, the display can be operated from an external MUX Clock. The external clock is attached to the CLK I/O connection (pin 8). The maximum external MUX Clock frequency should be limited to 1.0 MHz.

An asynchronous hardware Reset Pin is also provided. Bringing this pin low will clear the Character Address Register, Control Word Register, RAM, and blanks the display. This action leaves the display set at Character Address 0, and the Brightness Level set at 100%.

Electrical & Mechanical Considerations
Interconnect Considerations

Optimum product performance can be had when the following electrical and mechanical recommendations are adopted. The SCDV554X's IC is constructed in a high speed CMOS process, consequently high speed noise on the SERIAL DATA, SERIAL DATA CLOCK, $\overline{\text{LOAD}}$ and $\overline{\text{RESET}}$ lines may cause incorrect data to be written into the serial shift register. Adhere to transmission line termination procedures when using fast line drivers and long cables (>10 cm).

Good digital grounds (pins 7 and 14) and power supply decoupling (pins 10, 11 and 12) will insure that I_{CC} (<400 mA peak) switching currents do not generate localized ground bounce. Therefore it is recommended that each display package use a 0.1 μF and 20 μF capacitor between V_{CC} and ground.

When the internal MUX Clock is being used connect the $\overline{\text{CLKSEL}}$ pin to V_{CC}. In those applications where $\overline{\text{RESET}}$ will not be connected to the system's reset control, it is recommended that this pin be connected to the center node of a series 0.1, μF and 100 kΩ RC network. Thus upon initial power up the $\overline{\text{RESET}}$ will be held low for 10 ms allowing adequate time for the system power supply to stabilize.

ESD Protection

The input protection structure of the SCDV5540/1/2/3/4 provides significant protection against ESD damage. It is capable of withstanding discharges greater than 2.0 kV. Take all the standard precautions, normal for CMOS components. These include properly grounding personnel, tools, tables, and transport carriers that come in contact with unshielded parts. If these conditions are not, or cannot be met, keep the leads of the device shorted together or the parts in anti-static packaging.

Soldering Considerations

The SCDV5540/1/2/3/4 can be hand soldered with SN63 solder using a grounded iron set to 260°C.

Wave soldering is also possible following these conditions: Preheat that does not exceed 93°C on the solder side of the PC board or a package surface temperature of 85°C. Water soluble organic acid flux (except carboxylic acid) or rosin-based RMA flux without alcohol can be used.

Wave temperature of 245°C ±5°C with a dwell between 1.5 sec. to 3.0 sec. Exposure to the wave should not exceed temperatures above 260°C for five seconds at 0.063" below the seating plane. The packages should not be immersed in the wave.

Post Solder Cleaning Procedures

The least offensive cleaning solution is hot D.I. water (60°C) for less than 15 minutes. Addition of mild saponifiers is acceptable. Do not use commercial dishwasher detergents.

For faster cleaning, solvents may be used. Exercise care in choosing solvents as some may chemically attack the nylon package. For further information refer to Appnotes 18 and 19 at www.infineon.com/opto. See Appnote 19, Table 2, "Displays–Group 2" for the SCDV554X.

An alternative to soldering and cleaning the display modules is to use sockets. Naturally, 14 pin DIP sockets .300" wide with .100" centers work well for single displays. Multiple display assemblies are best handled by longer SIP sockets or DIP sockets when available for uniform package alignment. Socket manufacturers are Aries Electronics, Inc., Frenchtown, NJ; Garry Manufacturing, New Brunswick, NJ; Robinson-Nugent, New Albany, IN; and Samtec Electronic Hardward, New Albany, IN.

For further information refer to Appnote 22 at www.infineon.com/opto.

Optical Considerations

The 0.123" high character of the SCDV554X gives readability up to five feet. Proper filter selection enhances readability over this distance.

Using filters emphasizes the contrast ratio between a lit LED and the character background. This will increase the discrimination of different characters. The only limitation is cost. Take into consideration the ambient lighting environment for the best cost/benefit ratio for filters.

Incandescent (with almost no green) or fluorescent (with almost no red) lights do not have the flat spectral response of sunlight. Plastic band-pass filters are an inexpensive and effective way to strengthen contrast ratios. The SCDV5540/2 are red/high efficiency red displays and should be matched with long wavelength pass filter in the 570 nm to 590 nm range. The SCDV5543/4 should be matched with a yellow-green band-pass filter that peaks at 565 nm. For displays of multiple colors, neutral density grey filters offer the best compromise.

Additional contrast enhancement is gained by shading the displays. Plastic band-pass filters with built-in louvers offer the next step up in contrast improvement. Plastic filters can be improved further with anti-reflective coatings to reduce glare. The trade-off is fuzzy characters. Mounting the filters close to the display reduces this effect. Take care not to overheat the plastic filter by allowing for proper air flow.

Optimal filter enhancements are gained by using circular polarized, anti-reflective, band-pass filters. The circular polarizing further enhances contrast by reducing the light that travels through the filter and reflects back off the display to less than 1%.

Several filter manufacturers supply quality filter materials. Some of them are: Panelgraphic Corporation, W. Caldwell, NJ; SGL Homalite, Wilmington, DE; 3M Company, Visual Products Division, St. Paul, MN; Polaroid Corporation, Polarizer Division, Cambridge, MA; Marks Polarized Corporation, Deer Park, NY, Hoya Optics, Inc., Fremont, CA.

One last note on mounting filters: recessing displays and bezel assemblies is an inexpensive way to provide a shading effect in overhead lighting situations. Several Bezel manufacturers are: R.M.F. Products, Batavia, IL; Nobex Components, Griffith Plastic Corp., Burlingame, CA; Photo Chemical Products of California, Santa Monica, CA; I.E.E.-Atlas, Van Nuys, CA.

Figure 11. SCDV Interface to Siemens/Intel 8031 Microprocessor
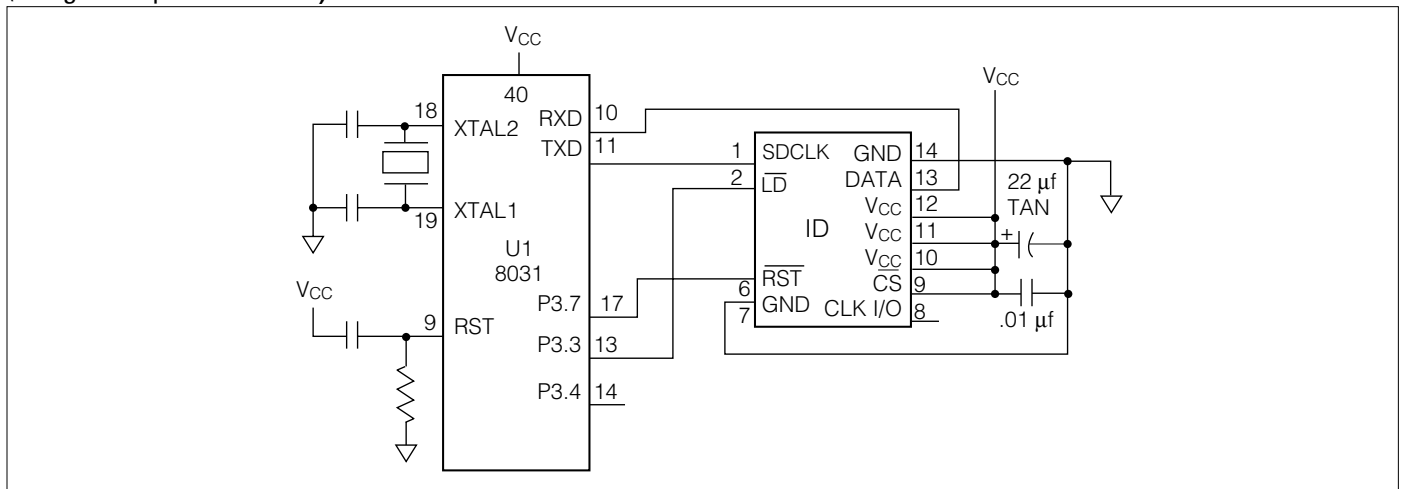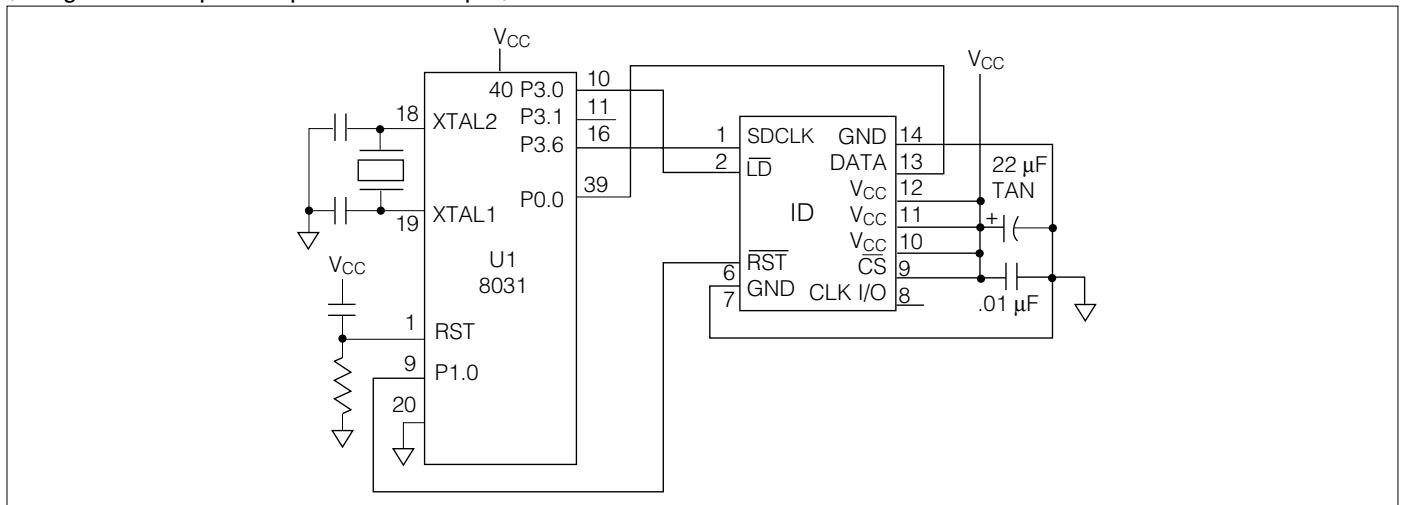(using serial port in mode 0**)**

Figure 12. SCDV Interface to Siemens/Intel 8031 Microprocessor
(using one bit of parallel port as serial input)

Microprocessor Interface

The microprocessor interface is through the serial port, SPI port or one out of eight data bits on the eight bit parallel port and also control lines $\overline{SDCLK}$ and $\overline{LOAD}$.

Power Up Sequence

Upon power up display will come on at random. Thus the display should be reset at power-up. The reset will set the Address Register to Digit 0, User RAM is set to 0 (display blank) the Control Word is set to 0 (100% brightness with Lamp Test off) and the internal counters are reset.

Cascading Multiple Displays

Multiple displays can be cascaded using the $\overline{CLKSEL}$ and CLK I/O pins as shown below. The display designated as the Master Clock source should have its $\overline{CLKSEL}$ pin tied high and the slaves should have their $\overline{CLKSEL}$ pins tied low. All CLK I/O pins should be tied together. One display CLK I/O can drive 15 slave CLK I/Os. Use $\overline{RST}$ to synchronize all display counters.

Figure 13. SCDV554X Interface with Motorola 68HC05C4 Microprocessor
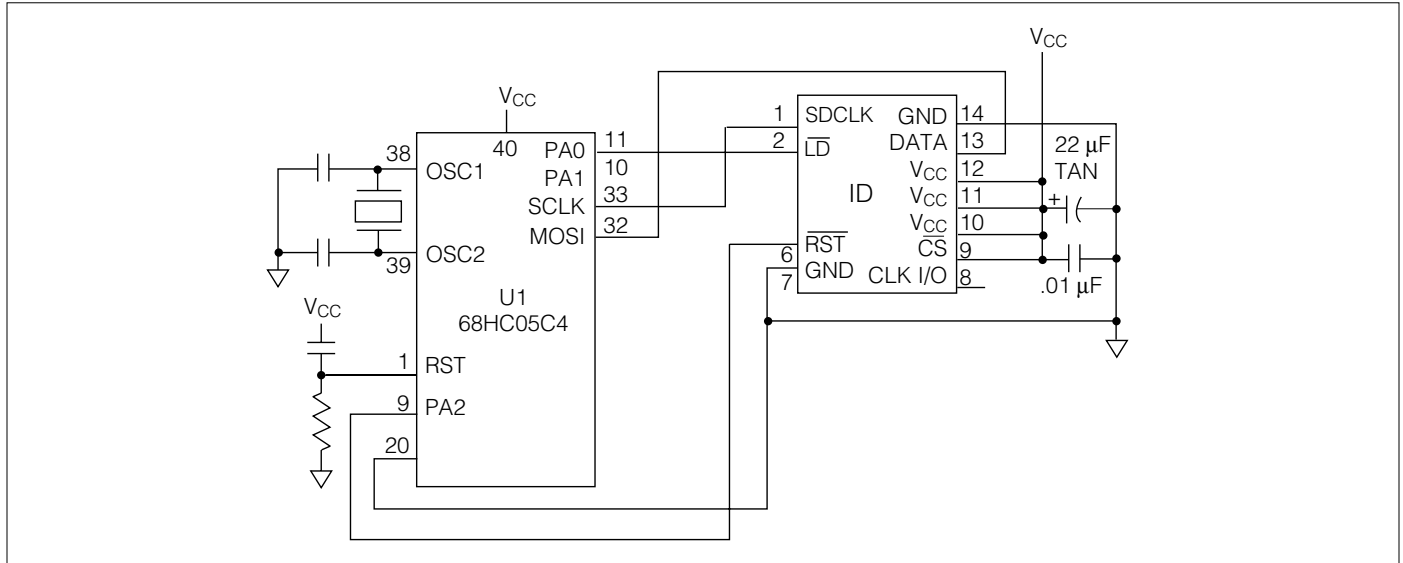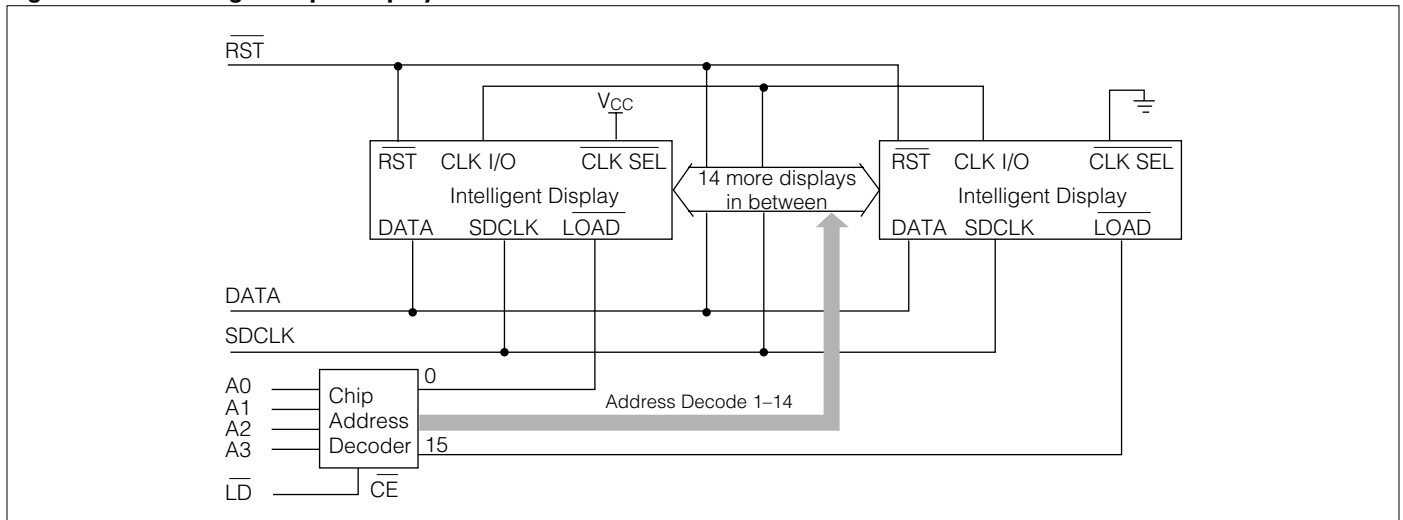(using SPI port)

Figure 14. Cascading Multiple Displays

Loading Data into the Display

Use following procedure to load data into the display:

1. Power up the display.

2. Bring $\overline{RST}$ low (600 ns duration minimum) to clear the Multiplex Counter, Address Register, Control Word Register, User Ram and Data Register. The display will be blank. Display brightness is set to 100%.

3. If a different brightness is desired, load the proper brightness opcode into the Control Word Register.

4. Load the Digit Address into the display.

5. Load display row and column data for the selected digit.

6. Repeat steps 4 and 5 for all digits.

Data Contents for the Display in a Vertical Format "↑AB↓"

Step	D7	D6	D5	D4	D3	D2	D1	D0	Function
A	1	1	0	0	0	0	0	0	CLEAR
B (optional)	1	1	1	1	0	B	B	B	BRIGHTNESS SELECT
1	1	0	1	0	0	0	0	0	DIGIT D0 SELECT
2	0	0	0	0	0	1	0	0	ROW 0 D0 (↑)
3	0	0	1	0	1	1	1	0	ROW 1 D0 (↑)
4	0	1	0	1	0	1	0	1	ROW 2 D0 (↑)
5	0	1	1	0	0	1	0	0	ROW 3 D0 (↑)
6	1	0	0	0	0	1	0	0	ROW 4 D0 (↑)
7	1	0	1	0	0	0	0	1	DIGIT D1 SELECT
8	0	0	0	0	0	1	0	0	ROW 0 D1 (A)
9	0	0	1	0	1	0	1	0	ROW 1 D1 (A)
10	0	1	0	1	1	1	1	1	ROW 2 D1 (A)
11	0	1	1	1	0	0	0	1	ROW 3 D1 (A)
12	1	0	0	1	0	0	0	1	ROW 4 D1 (A)
13	1	0	1	0	0	0	1	0	DIGIT D2 SELECT
14	0	0	0	1	1	1	1	0	ROW 0 D2 (B)
15	0	0	1	0	1	0	0	1	ROW 1 D2 (B)
16	0	1	0	0	1	1	1	0	ROW 2 D2 (B)
17	0	1	1	0	1	0	0	1	ROW 3 D2 (B)
18	1	0	0	1	1	1	1	0	ROW 4 D2 (B)
19	1	0	1	0	0	0	1	1	DIGIT D3 SELECT
20	0	0	0	0	0	1	0	0	ROW 0 D3 (↓)
21	0	0	1	0	0	1	0	0	ROW 1 D3 (↓)
22	0	1	0	1	0	1	0	1	ROW 2 D3 (↓)
23	0	1	1	0	1	1	1	0	ROW 3 D3 (↓)
24	1	0	0	0	0	1	0	0	ROW 4 D3 (↓)

Note:

If the display is already reset at Power Up, there is no need for Software Clear.

User Definable Character Set Examples*

Upper and Lower Case Alphabets

DOT ON = 1
DOT OFF = 0

Numerals and Punctuation

DOT ON = 1
DOT OFF = 0

*CAUTION: No more than 128 LEDs "on" at one time at 100% brightness.

User Definable Character Set Examples* (continued)

Scientific Notations, etc.

HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE	
06 2E 5E 6E 86		04 24 48 71 8E		1F 20 59 75 93		1F 20 56 79 91		0E 20 4A 64 8A		0D 32 52 72 8D		0C 32 56 71 96		0E 24 4E 71 8E		00 24 4A 71 9F	
10 3C 52 72 81		0E 31 5F 71 8E		10 28 44 6A 91		09 29 49 6E 90		01 2E 54 64 84		04 2E 55 6E 84		0E 31 51 6A 9B		01 2E 5A 6A 8A		0F 32 52 72 8C	
1F 28 44 68 9F		18 24 48 7C 80		1C 28 44 78 80		12 36 5A 67 80		06 21 5A 67 80		07 22 59 66 80		1C 34 5C 60 80		0F 28 48 78 88		04 2E 5F 6E 80	
00 24 4E 7F 8E		00 2E 5F 6E 84		0E 3F 4E 64 80		04 2F 5F 7E 84		04 2F 5F 6F 84		0E 2E 4E 6E 8E		00 3F 5F 7F 80		04 2E 55 64 84		04 24 55 6E 84	
04 22 5F 62 84		04 28 5F 68 84		1F 31 51 71 9F		08 2C 4A 78 98		0A 35 4A 75 8A		15 2A 55 6A 95		1F 35 5F 75 9F		00 3F 5F 7C 80		0E 3F 5B 7F 8E	
00 27 4F 78 9C		00 3C 5F 63 87		00 20 40 60 83		00 20 40 67 9F		00 23 5F 7F 9C		0C 3C 5C 7C 9C		15 2E 44 64 84					

DOT ON = 1
DOT OFF = 0

Foreign Characters

HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE		HEX CODE	
1F 21 5F 62 84		1F 21 46 64 88		01 22 46 6A 82		04 3F 51 61 86		00 3F 44 64 9F		02 3F 46 6A 92		08 3F 49 6A 88		1F 21 45 67 8C		02 3F 51 62 8C	
08 3F 49 69 92		04 3F 44 7F 84		0F 29 51 62 8C		08 2F 52 62 82		0F 21 41 61 9F		0A 3F 4A 62 8C		19 21 59 62 9C		0F 29 55 63 8C		01 3E 42 7F 86	
15 35 55 62 8C		0E 20 5F 64 98		08 28 4C 6A 88		04 3F 44 64 98		0E 20 40 60 9F		1F 21 4A 64 9A		04 24 44 6E 95		04 24 44 68 90		04 22 51 71 91	
10 3F 50 70 8F		1F 21 41 62 8C		0E 20 4E 60 8F		04 28 51 7F 8A		01 21 4A 64 8A		1F 28 5F 68 87		1E 22 42 62 9F		1F 21 5F 61 9F		0E 20 5F 61 8E	
12 32 52 64 88		04 34 54 75 96		1E 25 4F 74 8F		0F 34 5F 74 97		0F 30 4F 64 98		0F 33 55 79 9E		0F 34 57 74 8F		00 2A 5F 74 8B		08 24 4E 72 8F	
0A 2E 51 7F 91		02 24 4C 64 8E		04 2A 4E 71 8E		0A 34 52 7A 96		08 24 51 71 8E		02 24 51 71 8E		04 2A 51 71 8E					

DOT ON = 1
DOT OFF = 0

*CAUTION: No more than 128 LEDs "on" at one time at 100% brightness.