# 0.145'' 8-Character 5x5 Dot Matrix Serial Input Dot Addressable Intelligent Display® Devices

## Lead (Pb) Free Product - RoHS Compliant

| | |
|---|---|
| **Standard Red** | **SCD5580A** |
| **Yellow** | **SCD5581A** |
| **High Efficiency Red** | **SCD5582A** |
| **Green** | **SCD5583A** |
| **High Efficiency Green** | **SCD5584A** |

Slimline

### DESCRIPTION

The SCD5580A (Red), SCD5581A (Yellow), SCD5582A (Super-red), SCD5583A (Green) and SCD5584 (HEG) are eight digit dot addressable 5 x 5 matrix, Serial Input, Intelligent Display devices. The eight 3.68 mm (0.145") high digits are packaged in a transparent, 7,62 mm (0.3") pin spacing plastic DIP.

The on-board CMOS has a 200 bit RAM (one bit associated with one LED) to generate User Defined Characters. Due to the reduced LED count, power requirement and heat dissipation are reduced by 30%. Additionally in Power Down Mode quiescent current is <50 µA.

The SCD558XA is designed to work with the Serial port of most common microprocessors. 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 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.

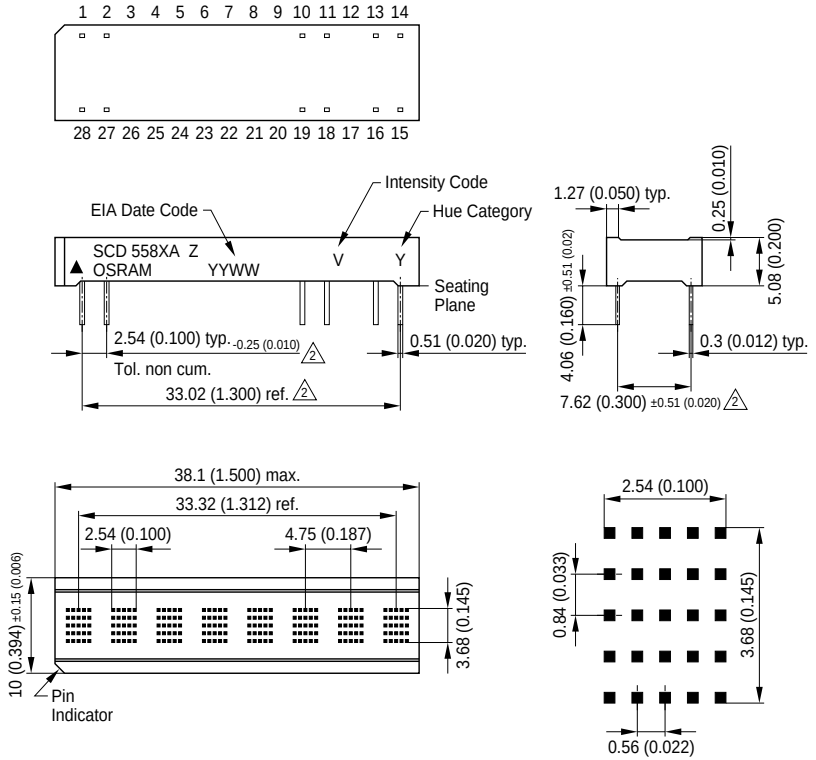
### FEATURES

- Low Profile Package: 60% Smaller than Industry Standard 8-Digit Display
- Eight 3.68 mm (0.145") 5 x 5 Dot Matrix Characters in Red, Yellow, Super-red, Green, or High Efficiency Green
- Optimum Display Surface Efficiency (display area to package ratio)
- Low Power–30% Less Power Dissipation than 5 x 7 Format
- 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 1.8 meters (6 Feet)
- Wide Viewing Angle, X Axis ± 55°, Y Axis ± 65°
- Attributes:
  - 200 bit RAM for User Defined Characters
  - Eight Dimming Levels
  - Power Down Mode (<250 µW)
  - Hardware/Software Clear Function
  - Lamp Test
- Internal or External Clock
- End-Stackable Dual-in-line Plastic Package
  - 3.3 V Capability

## Ordering Information

| Type | Color of Emission | Character Height mm (inch) | Ordering Code |
|---|---|---|---|
| SCD5580A | standard red | 3.68 (0.145) | Q68000A0994 |
| SCD5581A | yellow | | Q68000A0996 |
| SCD5582A | super-red | | Q68000A0997 |
| SCD5583A | green | | Q68000A0998 |
| SCD5584A | high efficiency green | | Q68000A1000 |

**Package Outlines** Dimensions in inch (mm)




Notes: Unless otherwise specified
1. Tolerances: ±0.254 (0.010)
2. Dimension at Seating Plane
3. Lead Dim. 0.018 wide x 0.012 thk.

IDOD5209

## Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Operating temperature range | $T_{op}$ | – 40 … + 85 | °C |
| Storage temperature range | $T_{stg}$ | – 40 … + 100 | °C |
| DC Supply Voltage | $V_{CC}$ | -0.5 to + 7.0 | V |
| Input Voltage Levels Relative to GND | | -0.5 to $V_{CC}$ to 0.5 | V |
| Solder Temperature<br>1.59 mm (0.063") below seating plane, t < 5.0 s | $T_S$ | 260 | °C |
| Relative Humidity | | 85 | % |
| ESD (100 pF, 1.5 kΩ) | $V_Z$ | 2.0 | kV |
| Input Current | | ± 100 | mA |
| Max. SDCLK Frequency | | 5.0 | MHz |
| Maximum Number of LEDs on at 100% Brightness | | 128 | |
| IC Junction Temperature | | 125 | °C |

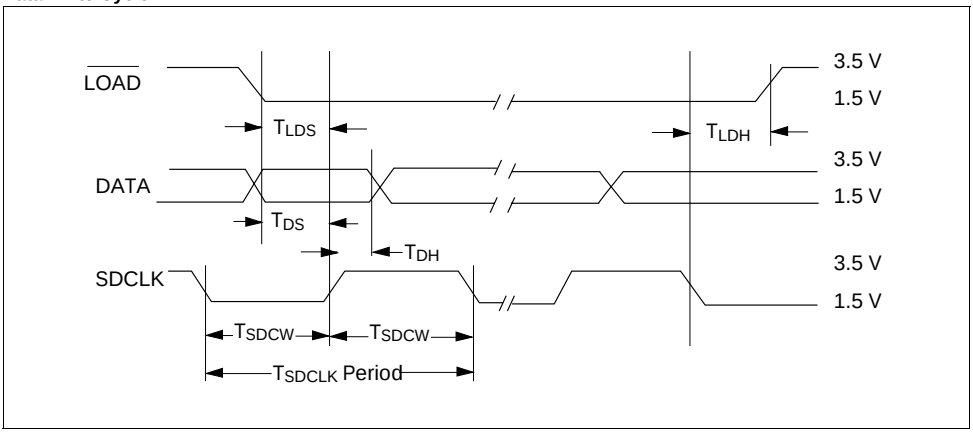
## Optical Characteristics at 25°C

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

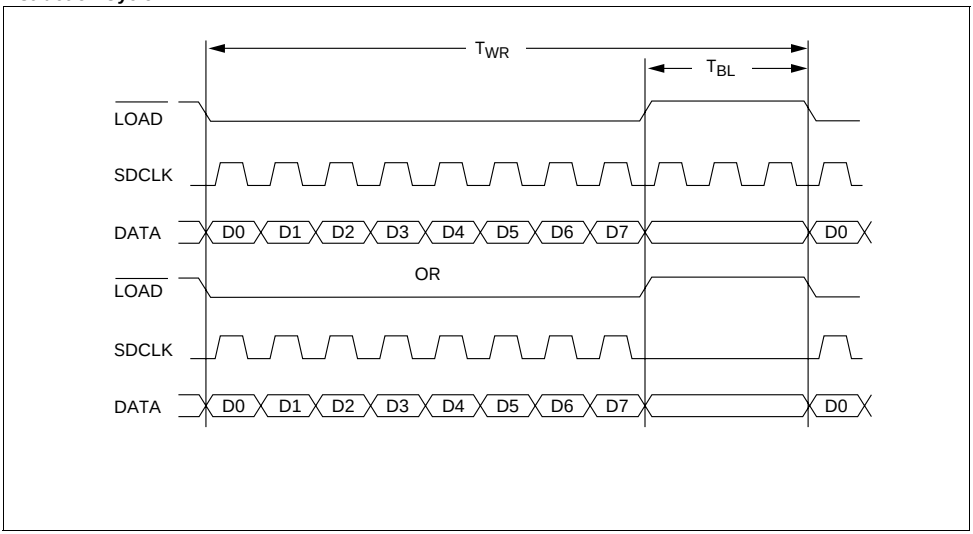
| Description | | Symbol | Values | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Red SCD5580A | Yellow SCD5581A | Super-red SCD5582A | Green SCD5583A | High Efficiency Green SCD5584A | |
| Luminous Intensity | (min.)<br>(typ.) | $I_V$ | 36<br>90 | 124<br>213 | 124<br>265 | 124<br>221 | 124<br>505 | µcd/dot<br>µcd/dot |
| Peak Wavelength | (typ.) | $\lambda_{peak}$ | 660 | 583 | 630 | 565 | 568 | nm |
| Dominant Wavelength | (typ.) | $\lambda_{dom}$ | 639 | 585 | 626 | 570 | 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.).

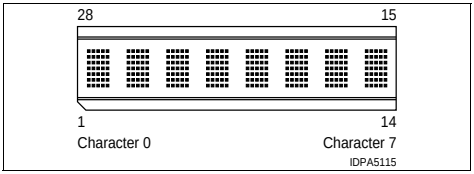
**Data Write Cycle**




**Instruction Cycle**



**Top View**




**Electrical Characteristics at 25°C**

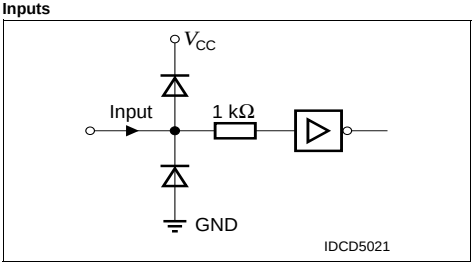
| Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|
| $V_{CC}$ | 4.5 | 5.0 | 5.5 | V | — |
| $I_{CC}$ (Pwr Dwn Mode)[1)2)] | — | 5.0 | — | µA | $V_{CC}$=5.0 V, all inputs=0 V or $V_{CC}$ |
| $I_{CC}$ 8 digits[3)]<br>16 dots/character | — | 200 | 240 | mA | $V_{CC}$=5.0 V, "#" displayed in all 8 digits at 100% brightness at 25°C |
| $I_{IL}$ Input current | — | — | –10 | µA | $V_{CC}$=5.0 V, $V_{IN}$=0 (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 |
| $\theta_{J\text{-}pin}$ | — | 35 | — | °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, $\overline{CLKSEL}$=1.0 |
| 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 |
| Digit Multiplex Frequency | 375 | 768 | 1086 | Hz | — |

Notes:
1) When an external clock is used it must be stopped.
2) Unused inputs must be tied high.
3) Peak current $^5/_3$ x$I_{CC.}$

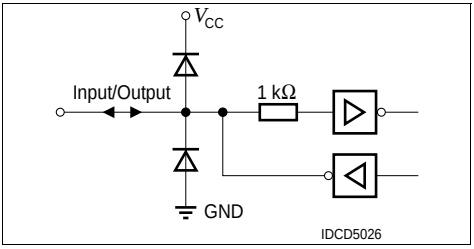
**Input/Output Circuits**

Figures „Inputs" and „Clock I/O" 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.

**Inputs**




**Clock I/O**



**Pin Assignment**

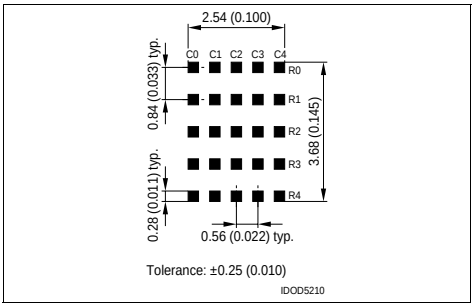
| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | SDCLK | 28 | GND |
| 2 | $\overline{\text{LOAD}}$ | 27 | DATA |
| 3 | NP | 26 | NP |
| 4 | NP | 25 | NP |
| 5 | NP | 24 | NP |
| 6 | NP | 23 | NP |
| 7 | NP | 22 | NP |
| 8 | NP | 21 | NP |
| 9 | NP | 20 | NP |
| 10 | NP | 19 | $V_{CC}$ |
| 11 | NP | 18 | NC |
| 12 | NP | 17 | NP |
| 13 | $\overline{\text{RST}}$ | 16 | $\overline{\text{CLKSEL}}$ |
| 14 | GND | 15 | 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 | 40 | ns |
| $T_{DS}$ | Data Setup Time | 40 | 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 | 20 | ns |
| $T_{WR}$ | Total Write Time | 2.2 | µs |
| $T_{BL}$ | Time Between Loads | 600 | ns |

Note: SDCLK duty cycle = 30% Min. and 50% Max.

**Dot Matrix Format**




**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 | NP | No pin |
| 7 | NP | No pin |
| 8 | NP | No pin |
| 9 | NP | No pin |
| 10 | NP | No pin |
| 11 | NP | No pin |
| 12 | NP | No pin |
| 13 | $\overline{\text{RST}}$ | 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. |
| 14 | GND | Power supply ground |
| 15 | CLK I/O | Outputs master clock or inputs external clock. |
| 16 | $\overline{\text{CLKSEL}}$ | H=internal clock, L=external clock |
| 17 | NP | No pin |
| 18 | NC | No connection |
| 19 | $V_{CC}$ | Power supply |
| 20 | NP | No pin |
| 21 | NP | No pin |
| 22 | NP | No pin |
| 23 | NP | No pin |
| 24 | NP | No pin |
| 25 | NP | No pin |
| 26 | NP | No pin |
| 27 | DATA | Serial data input |
| 28 | 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 |

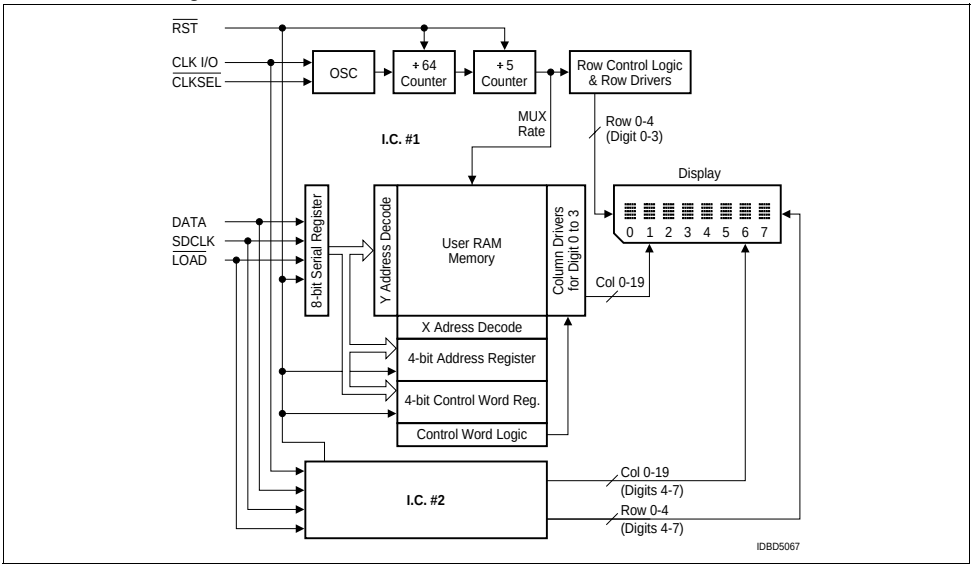
**Operation of the SCD558X**

The SCD558X display consists of 2 CMOS IC containing control logic and drivers for eight 5 x 5 characters. These components are assembled in a compact (38 mm x 10 mm) 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 use of a serial data interface provides a highly efficient interconnection between the display and the mother board. The SCD558X requires only 4 lines as compared to 15 for an equivalent 8 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 „SCD558X Block Diagram“ (***page 7***) shows the three functional areas of the IC. These include: the input serial data register and control logic, a 200 bits two port RAM, and an internal multiplexer/display driver.

### SCD558XA Block Diagram



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 „Loading Serial Character Data a“ (***page 8***). Figure „Loading Serial Character Data b“ (***page 8***) shows that each character consist 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 „Loading Serial Character Data c“ (***page 8***) shows 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.

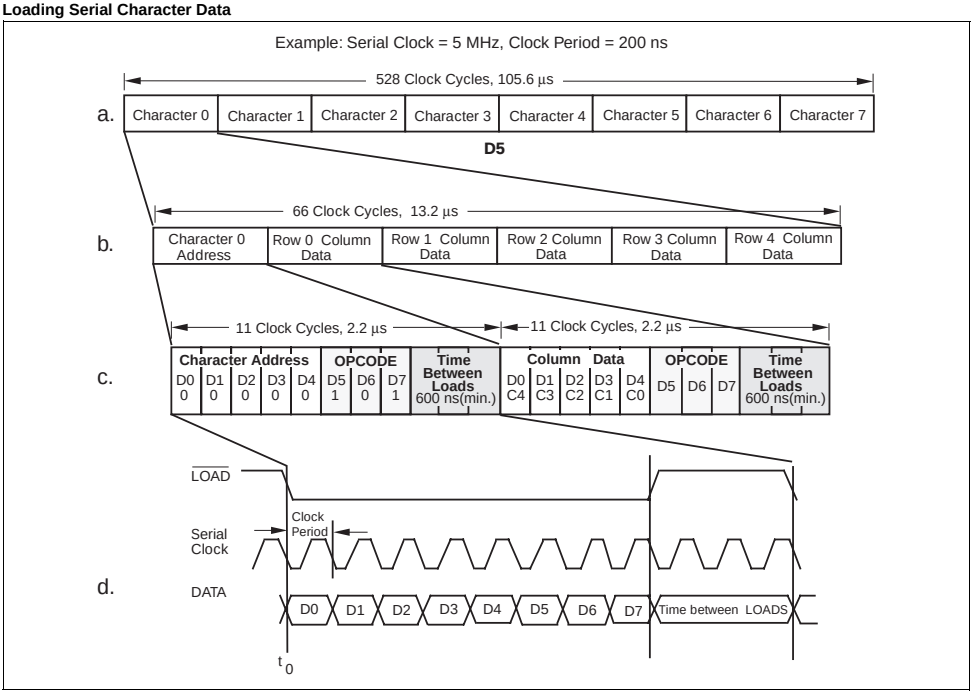
Figure „Loading Serial Character Data d“ (***page 8***) shows the sequence for loading the bytes of data. Bringing the $\overline{\text{LOAD}}$ line low enables the serial register to accept data. The shift action occurs on the low to high transition of the serial data clock (SDCLK). The least significant 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 „Loading Serial Character Data a“ (***page 8***), a total of 528 bits of data are required to load all eight characters into the display.

The Character Address Register bits, D4–D0 (Table „Load Character Address“ (***page 9***)) and Row Address Register bits, D7–D5 (Table „Load Column Data“ (***page 9***)) direct the Column Data bits, D4–D0 (Table „Load Column Data“ (***page 9***)) to specific RAM location. Table „Character 'D'“ (***page 8***) 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 „Row and Column Location“ (***page 9***) and „Row Strobing“ (***page 10***). The character strobe rate is determined by the internal or user supplied external MUX Clock and the IC's ÷320 counter.

**Character “D”**

| | Op code D7 | D6 | D5 | Column Data D4 C0 | D3 C1 | D2 C2 | D1 C3 | D0 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 |

**Loading Serial Character Data**



**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 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | A4 | Character 4 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | A5 | Character 5 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | A6 | Character 6 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | A7 | Character 7 |

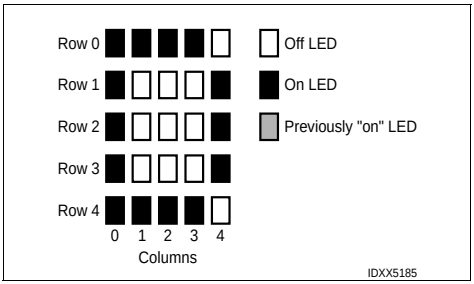
**Load Column Data**

| 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 „Load Character Address“ (***page 9***) and „Load Column Data“ (***page 9***).

The user can select seven specific LED brightness levels, Table „Display Brightness“ (***page 9***). 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.

**Row and Column Location**




**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 SCD558XA offers a unique Display Power Down feature which reduces $I_{CC}$ to less than 50 µA. When $FF_{HEX}$ is loaded, as shown in Table „Power Down“ (***page 9***), 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 Brightness Level Control Word into the display.

**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 „Lamp Test“ (***page 9***), 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.

**Lamp Test**

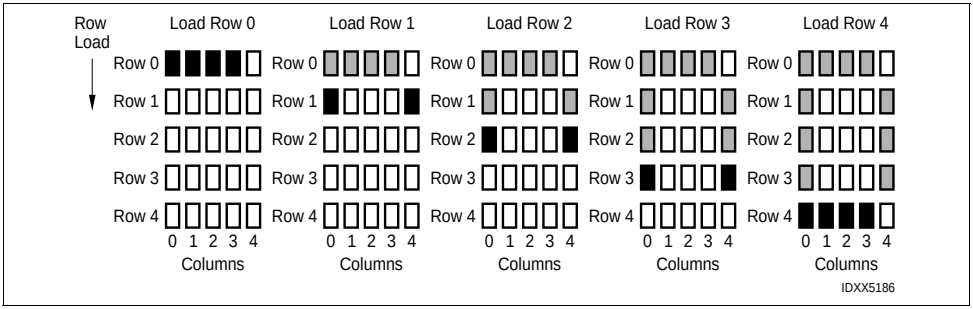
| Op code D7 | D6 | D5 | Control Word D4 | D3 | D2 | D1 | D0 | Hex | Operation Level |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 0 | B | B | B | | Lamp Test (OFF) |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | F8 | Lamp Test (OFF) |

The Software Clear ($C0_{HEX}$), given in Table „Software Clear“ (***page 9***), 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.

**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 |

### Row Strobing




#### Multiplexer and Display Driver

The eight 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 15). The maximum external MUX Clock frequency should be limited to 1.0 MHz.

An asynchronous hardware Reset (pin 13) 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%.

#### Thermal Considerations

The SCD558XA has been designed to provide lowest thermal resistance from the CMOS to the ground pin.

The heat is then conducted through the traces on the users circuit board to free air. The max. IC operating temperature is 125°C. Maximum. IC junction temperature is calculated using the following equation:

$T_J$ (IC) Max.=$T_A$+($P_D$ Max.) ($R\theta_{J\text{-}PIN}$+$R\theta_{PIN\text{-}A}$)

where $R\theta_{J\text{-}PIN}$=35°C/W.

$P_D$ Max. =$V_{CC}$ Max.x $I_{CC}$ Max

=5.5 Vx0.240=1.32 W.

$R\theta_{PIN\text{-}A}$ will depend on ground trace thickness, whether parts are soldered to the pcb or socketed and on air circulation.

#### Electrical & Mechanical Considerations

#### Interconnect Considerations

Optimum product performance can be had when the following electrical and mechanical recommendations are adopted. The SCD558XA'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 14, 28) and power supply decoupling (pins 6, 9, 20, 23) 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 SCD558XA 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 SCD558XA 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 1.59 mm (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. Maximum exposure should not exceed two minutes at elevated temperatures. Acceptable solvents are TF (trichlorotrifluorethane), TA, 111 Trichloroethane, and unheated acetone.[1)]

Note:

1) Acceptable commercial solvents are: Basic TF, Arklone, P. Genesolv, D. Genesolv DA, Blaco-Tron TF and Blaco-Tron TA.

Unacceptable solvents contain alcohol, methanol, methylene chloride, ethanol, TP35, TCM, TMC, TMS+, TE, or TES. Since many commercial mixtures exist, contact a solvent vendor for chemical composition information. Some major solvent manufacturers are: Allied Chemical Corporation, Specialty Chemical Division, Morristown, NJ; Baron-Blakeslee, Chicago, IL; Dow Chemical, Midland, MI; E.I. DuPont de Nemours & Co., Wilmington, DE.

For further information refer to Appnotes 18 and 19 at www.osram-os.com

An alternative to soldering and cleaning the display modules is to use sockets. Naturally, 28 pin DIP sockets 7.62 mm (0.300") wide with 2.54 mm (0.100") 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.osram-os.com

### Optical Considerations

The 3.68 mm (0.145") high character of the SCD558XA gives readability up to eight 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 SCD558XA are red/super-red displays and should be matched with long wavelength pass filter in the 570 nm to 590 nm range. The SCD558XA 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.

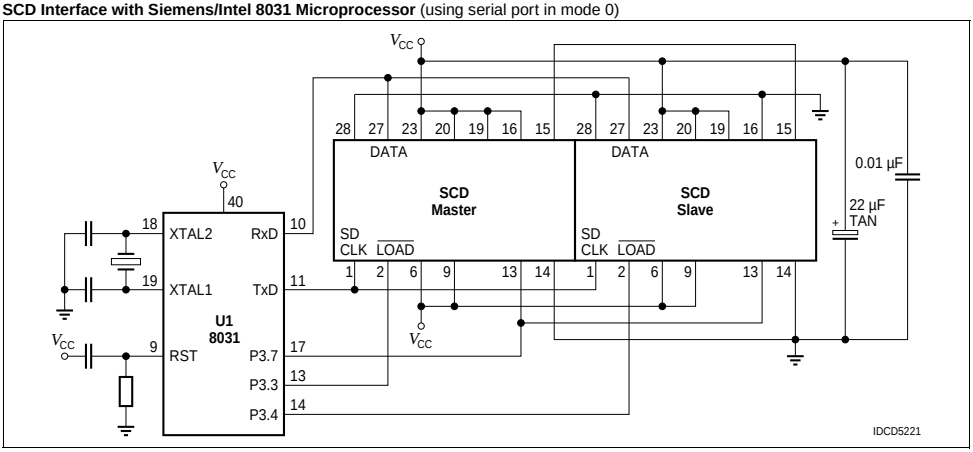
### Microprocessor Interface

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 $\overline{LOAD}$.

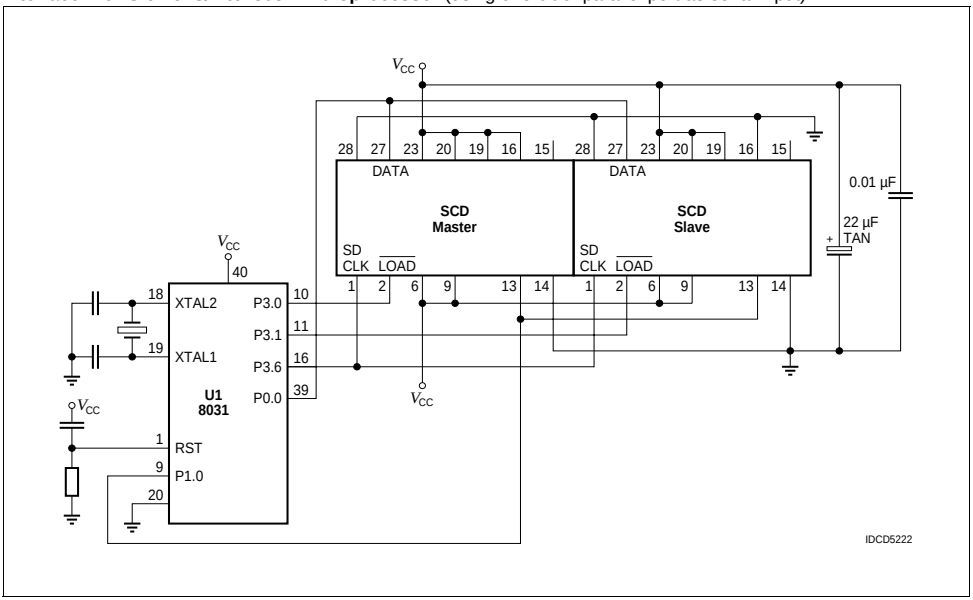
### Power Up Sequence

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.

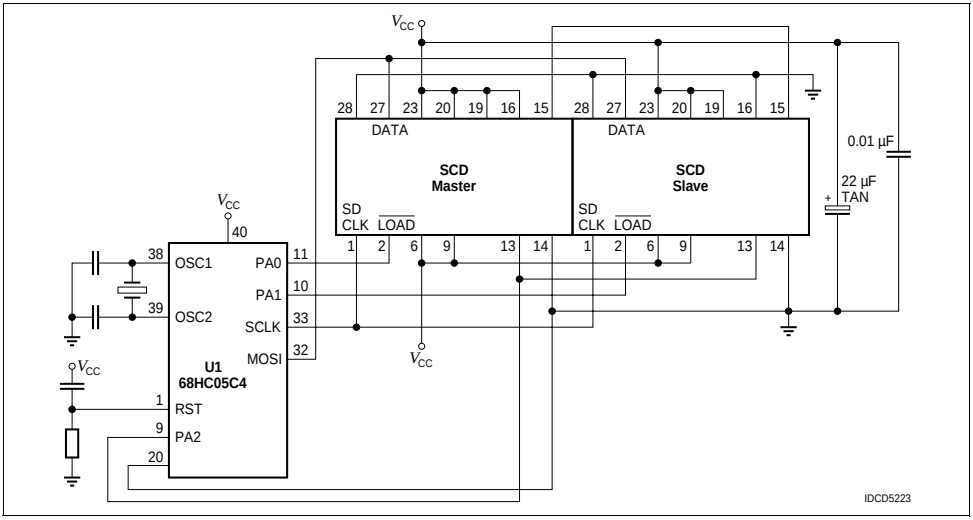
**SCD Interface with Siemens/Intel 8031 Microprocessor** (using serial port in mode 0)



**Interface with Siemens/Intel 8031 Microprocessor** (using one bit of parallel port as serial input)



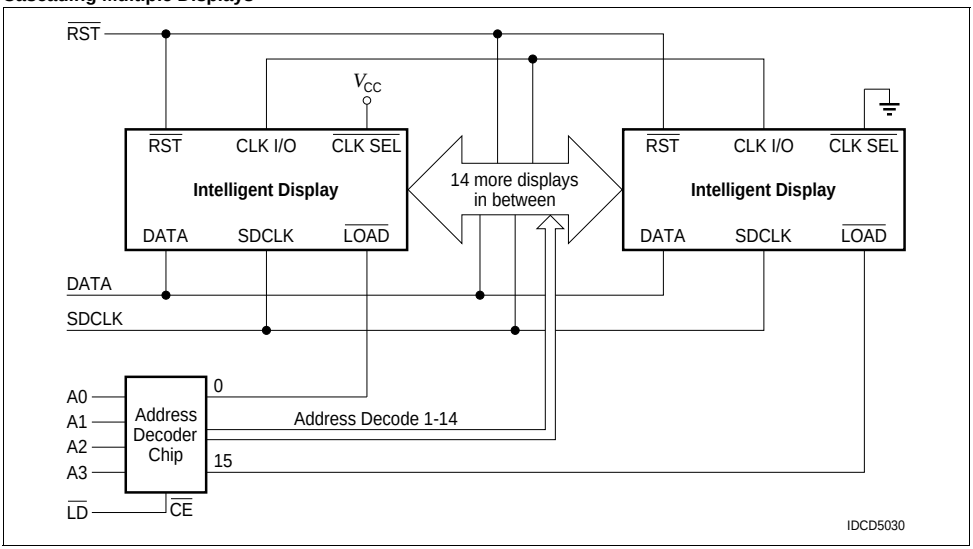

**Interface with Motorola 68HC05C4 Microprocessor** (using SPI port)



**Cascading Multiple Displays**

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

**Cascading Multiple Displays**




**Loading Data Into the Display**

Use following procedure to load data into the display:

1. Power up the display.
2. Bring $\overline{\text{RST}}$ 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.

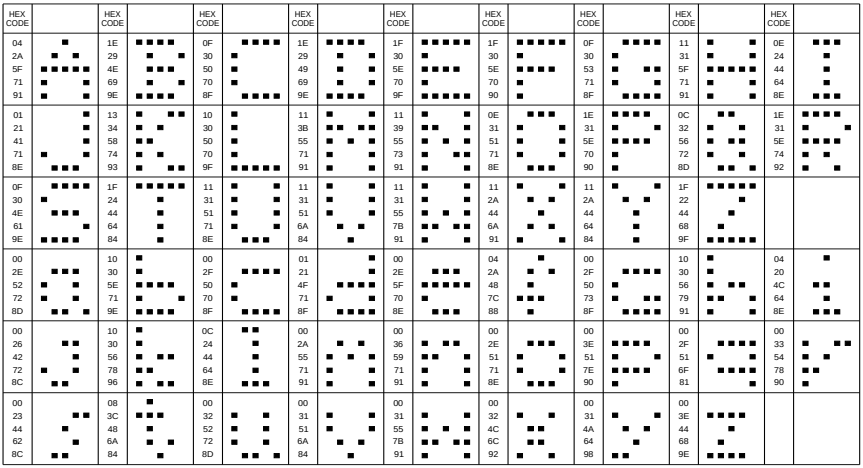
**Data Contents for the Word “Displays”**

| 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 | 1 | 0 | 0 | 0 | 0 | DIGIT D0 SELECT |
| 2 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 0 D0 (D) |
| 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | ROW 1 D0 (D) |
| 4 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | ROW 2 D0 (D) |
| 5 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | ROW 3 D0 (D) |
| 6 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 4 D0 (D) |
| 7 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | DIGIT D1 SELECT |
| 8 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | ROW 0 D1 (I) |
| 9 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | ROW 1 D1 (I) |
| 10 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | ROW 2 D1 (I) |
| 11 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | ROW 3 D1 (I) |
| 12 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | ROW 4 D1 (I) |
| 13 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | DIGIT D2 SELECT |
| 14 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | ROW 0 D2 (S) |
| 15 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | ROW 1 D2 (S) |
| 16 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | ROW 2 D2 (S) |
| 17 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | ROW 3 D2 (S) |
| 18 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 4 D2 (S) |
| 19 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | DIGIT D3 SELECT |
| 20 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 0 D3 (P) |
| 21 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | ROW 1 D3 (P) |
| 22 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 2 D3 (P) |
| 23 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | ROW 3 D3 (P) |
| 24 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | ROW 4 D3 (P) |
| 25 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | DIGIT D4 SELECT |
| 26 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | ROW 0 D4 (L) |
| 27 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | ROW 1 D4 (L) |
| 28 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | ROW 2 D4 (L) |
| 29 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | ROW 3 D4 (L) |
| 30 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | ROW 4 D4 (L) |
| 31 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | DIGIT D5 SELECT |
| 32 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | ROW 0 D5 (A) |
| 33 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | ROW 1 D5 (A) |
| 34 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | ROW 2 D5 (A) |
| 35 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | ROW 3 D5 (A) |
| 36 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | ROW 4 D5 (A) |
| 37 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | DIGIT D6 SELECT |
| 38 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | ROW 0 D6 (Y) |
| 39 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | ROW 1 D6 (Y) |
| 40 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | ROW 2 D6 (Y) |
| 41 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | ROW 3 D6 (Y) |
| 42 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | ROW 4 D6 (Y) |
| 43 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | DIGIT D7 SELECT |
| 44 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | ROW 0 D7 (S) |
| 45 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | ROW 1 D7 (S) |
| 46 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | ROW 2 D7 (S) |
| 47 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | ROW 3 D7 (S) |
| 48 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | ROW 4 D7 (S) |

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

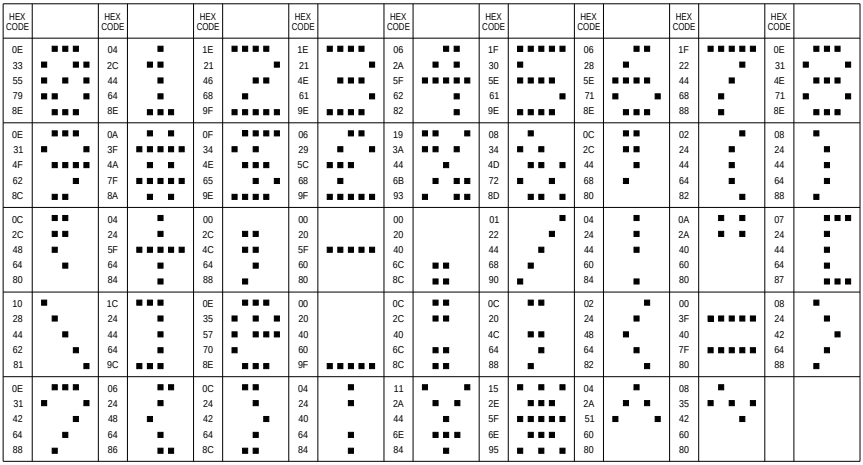
### User Definable Character Set Examples*

### Upper and Lower Case Alphabets



IDCS5089

### Numerals and Punctuation

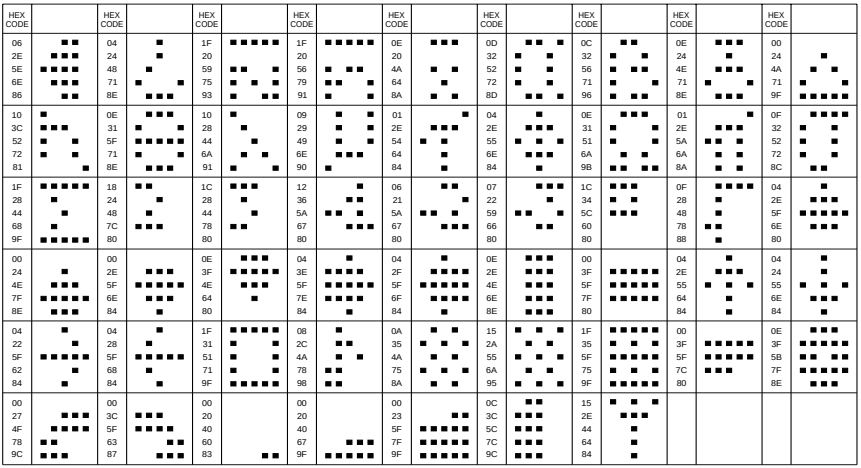


IDCS5090

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

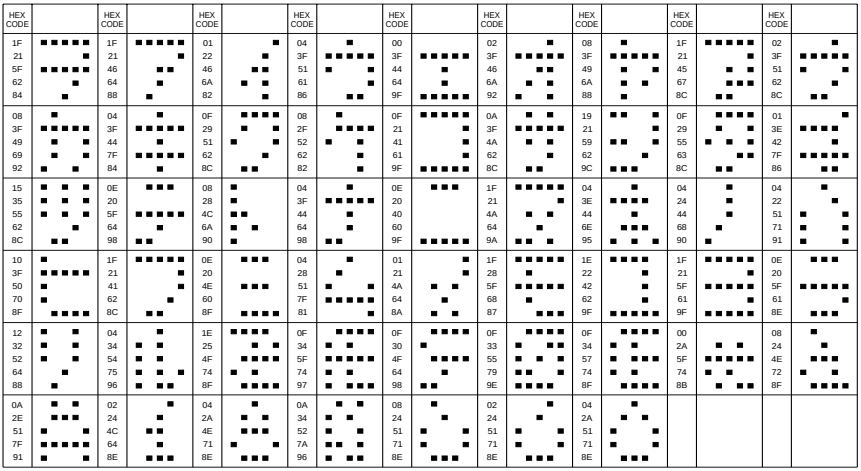
**User Definable Character Set Examples*** (continued)

**Scientific Notations, etc.**



IDCS5091

**Foreign Characters**



IDCS5092

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

**Revision History: 2006-01-23**
Previous Version: 2005-01-10

| Page | Subjects (major changes since last revision) | Date of change |
|---|---|---|
| all | Lead free device | 2006-01-23 |
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