Features

- Control 1 to 10 digits.
- Unused digits are disabled to save power.
- Sleep mode available to save power.
- Each digit is programmable for common anode or cathode control.
- 27 display control commands.
- Up to 11ma supply current per segment.
- Intelligent shifting of character left or right.
- Variable refresh rate.
- Variable blink rate.
- Individual digits can be selected for blink / no blink.
- Built in ASCII character may be used to convert displayed characters.
- SPI (mode 1,1) serial communication.

Description

The NeoLoch, LLC NLDC-10D7S-S1 display controller removes the overhead of operating a multiple digit 7 segment LED display from the MCU by handling display refresh, character conversion, and special effects.

The display controller can be configured to section out the display, allowing for multiple actions to be applied to the display while only effecting the desired digits. Features include:

Scrolling display data left or right and placing the supplied character in the LSB or MSB. Only those digits designated to be included in the scroll will be updated. This allows for display segmentation and the display / updating of multiple data sets.

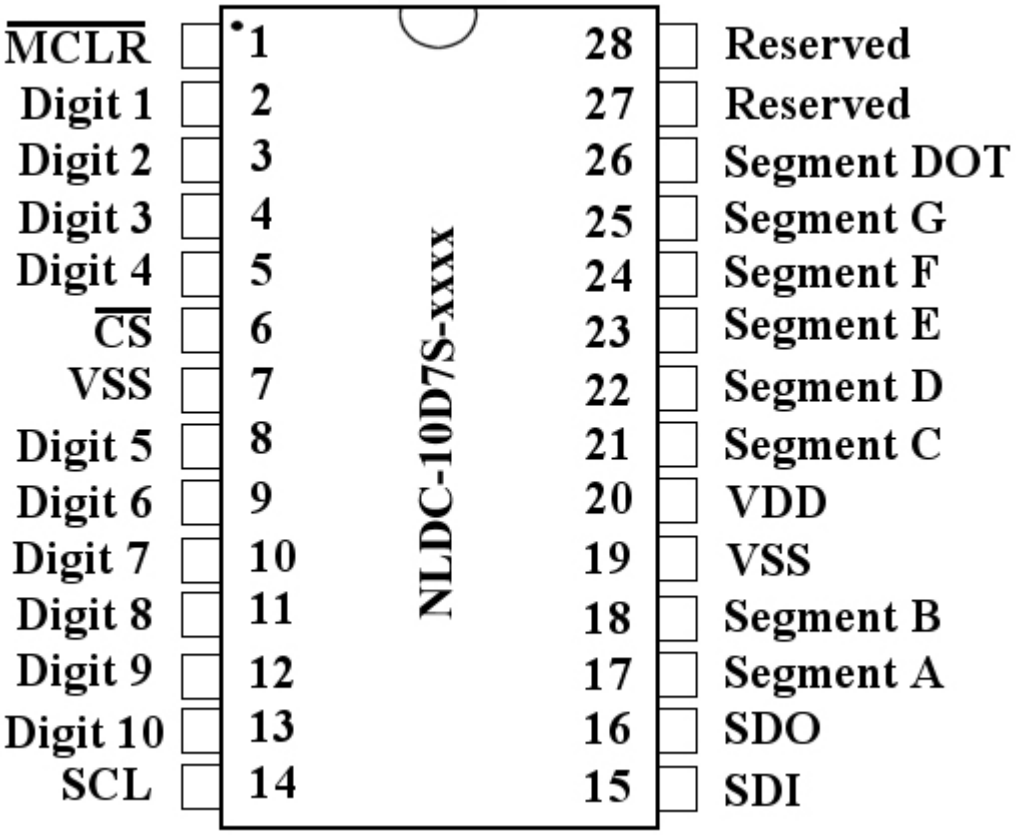
Each character can be configured to blink or not blink via several registers.

In addition, the display's refresh rate can be altered to suite specific application needs.

To add versatility to the display controller, the display controller supports common anode and common cathode 7 segment displays. Each individual digit can be configured as CA or CC, permitting the use off CA and CC displays at the same time.

Communication with the display controller is accomplished using SPI (mode 1,1).

Pin Diagram – 28 Pin DIP



Units	Inches		
Dimension Limits	Min	Nom	Max
Number of Pins		28	
Pitch		.100 BSC	
Package Width	.290	.310	.335
Overall Length	1.345	1.365	1.400
Lead Thickness	.008	.010	.015
Upper Lead Width	.040	.050	.070
Lower Lead Width	.014	.018	.022

Electrical Specifications

Absolute Maximum Ratings

Ambient temperature under bias..... -40° to +125°C
Storage Temperature..... -65° to +150°C
Voltage on VDD with respect to VSS..... -0.03V to ++5.5V
Voltage on all other pins with respect to VSS..... -0.03V to (VDD + 0.3V)
Total power dissipation..... 800 mW
Maximum current out of VSS pin..... 95mA
Maximum current into VDD pin..... 95mA
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > VDD$)..... ±11 mA
Output clamp current, I_{IK} ($V_I < 0$ or $V_I > VDD$)..... ± 11 mA
Maximum output current sunk by digit & segment pins..... ± 11 mA
Maximum input current sourced by digit & segment pins..... ± 11 mA

Power dissipation is calculated as follows:
$PDIS = V_{DD} \times \{I_{DD} - \Sigma I_{OH}\} + \Sigma \{(V_{DD} - V_{OH}) \times I_{OH}\} + \Sigma(V_{Ol} \times I_{OL})$.

Table of Contents

1.0 Device Overview

The NLDC-10D7S-xxxx display handles the updating and refreshing of a multiple digit 7 segment display, relieving processing time from the MCU. The display controller only needs to update what data is to be displayed via simple commands communicated to the display controller using the SPI protocol.

The display controller is able to work with common anode or common cathode seven segment displays. Each digit can be configured to operate as either CA or CC, allowing for the integration of multiple types of displays in a single circuit.

To simplify communication with the display controller, ASCII coded data bytes can be passed to the display controller and an internal process will convert the provided data into the appropriate display code.

Though designed to operate with a maximum of 10 digits, the NLDC-10D7S-xxxx display controller can be configured to operate with a single digit or up to 10 digits. Each digit that isn't active is removed from the processing cycle, thereby keeping the refresh rate on the active digits synchronized with very little off time in between refreshing the first digit and the last digit.

Each digit can also be configured to blink, this allows desired digits to blink while other digits don't.

The scroll feature allows for the scrolling of active display, either right or left, and then the insertion of a supplied character. Each character can be configured to be included or excluded from the scroll function, permitting a portion of the display to be scrolled while the rest of the display remains unchanged.

1.1 SPI Communication

The MCU communicated with the display controller using SPI (Serial Peripheral Interface) in mode 1,1.

A communication session consists of bringing CS low, transmitting the command byte, followed by the data byte. And then bringing CS high if more than one SPI device is on the communication buss.

Note: Some commands only require a single command byte, and don't require a data byte. See section 2.0 for a complete list of commands.

Whenever a command is transmitted to the display controller, the previous command's data byte will be transmitted back to the MCU. This data can be discarded or used to confirm correct command execution.

A NOP command is included in the command structure to provide a method of retrieving the last active command executed.

1.2 Device Start up

Upon device power up or reset, the display controller takes approximately 1ms to process internal configurations instructions. The display controller then enters sleep mode and waits for a SPI command byte.

The first command byte sent to the device must be the wake command. This will increase the internal operating frequency to 8 Mhz and configure the ports for display control.

Once the device is awake, configuration commands are required to set the device to the desired operational state.

2.0 Display Controller Commands Summary

Table 2-1: Display Controller Command List

Command Byte	Command	Description	Execution Time
00000000	D18OF	Turn on or off digits 1 – 8.	100 µs
00000001	D910OF	Turn on or off digits 9 – 10.	100 µs
00000010	BD18	Turn on or off the blink feature for digits 1 – 8.	100 µs
00000011	BD910	Turn on or off the blink feature for digits 9 – 10.	100 µs
00000100	BR	How fast the display blinks characters.	100 µs
00000101	CD	Clears the display*.	100 µs
00000110	M1	Memory location for digit 1.	100 µs
00000111	M2	Memory location for digit 2.	100 µs
00001000	M3	Memory location for digit 3.	100 µs
00001001	M4	Memory location for digit 4.	100 µs
00001010	M5	Memory location for digit 5.	100 µs
00001011	M6	Memory location for digit 6.	100 µs
00001100	M7	Memory location for digit 7.	100 µs
00001101	M8	Memory location for digit 8.	100 µs
00001110	M9	Memory location for digit 9.	100 µs
00001111	M10	Memory location for digit 10.	100 µs
00010000	SL	Shift digits to the left and place the value in the data byte into the rightmost included digit.	300 µs
00010001	SR	Shift digits to the right and place the value in the data byte in the leftmost included digit.	300 µs
00010010	SSD 18	Include or exclude digits 1 – 8 in shift function.	100 µs
00010011	SSD 910	Include or exclude digits 9 – 10 in shift function.	100 µs
00010100	Wake	Wake up the display controller.	100 µs
00010101	Sleep	Put the display controller to sleep.	100 µs
00010110	CACC18	Set digit to common anode or common cathode.	100 µs
00010111	CACC910	Set digit to common anode or common cathode.	100 µs
00011000	ASCII18	Enable / disable ASCII conversion for digits 1 – 8.	100 µs
00011001	ASCII910	Enable / disable ASCII conversion for digits 9 and 10.	100 µs
00011010	RR	Refresh Rate	100 µs
00011011		Reserved	
00011100		Reserved	
00011101		Reserved	
00011110		Reserved	
00011111	NOP	No operation – returns last active command / error.	100 µs

2.1 Digit On / Off: (Digits 1 – 8)

Command Byte: 00000000 (00h)
Data Byte: dddddddd

Enable (turn on) or disable (turn off) the corresponding digit. After the command byte is transmitted to the display controller, the data byte is transmitted to the display controller. If a bit is set, the the corresponding digit is turned on and is included in the refresh cycle. If a bit is clear, then the digit is turned off and is not included in the refresh cycle.

Table 2-2: Commands / Registers Associated With Digit On / Off.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
D18OF	00000000	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	00000000
D910OF	00000001	Digit 9	Digit 10	x	x	x	x	x	x	00000000

D18OF Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000000'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

D910OF Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000000'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.2 Blink Digits On / Off

Display blinking is controlled by 3 registers, 2 registers are used to define which digits will blink and the third controls the blink frequency. Each register operates independent of the others, so register write sequence can be adjusted to meet a applications specific needs.

Register BD18: Controls the blinking for digits 1 through 8. Setting the corresponding bit to 0 will turn off blinking for that digit while setting the corresponding bit to 1 will turn on blinking.

Register BD910: Controls the blinking for digits 9 and 10 and operates the same as register BD18. Note: Bits 5 – 0 are not used and data contained in these bits is discarded by the display controller.

Register BR: Controls the blink rate for all digits. The default value for on power up is 6Fh and this puts the blink rate at approximately 1 Hz. To customize the blink rate divide the desired frequency by .009 (Register Value = Freq / .009). The blink rate has a minimum frequency of 2.295 hz and a maximum frequency of 111 Hz.

Table 2-3: Commands / Registers Associated With Digit Blinking.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
BD18	00000010	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	00000000
BD910	00000011	Digit 9	Digit 10	x	x	x	x	x	x	00000000
BR	00000100	d	d	d	d	d	d	d	d	00000000

BD18 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000010'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

BD910 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000011'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

BR Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000100'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.3 Display Memory

Each display digit has it's own register in the display controller. To transmit display data to the display controller, first send the appropriate command to access the desired memory location and then transmit the 7 bit ASCII code placed in bits 6 – 0 to the display controller. Bit 7 controls the decimal point on the display digit.

Table 2-4: Commands / Registers Associated With Display Memory.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
M1	00000110	Dot	d	d	d	d	d	d	d	00000000
M2	00000111	Dot	d	d	d	d	d	d	d	00000000
M3	00001000	Dot	d	d	d	d	d	d	d	00000000
M4	00001001	Dot	d	d	d	d	d	d	d	00000000
M5	00001010	Dot	d	d	d	d	d	d	d	00000000
M6	00001011	Dot	d	d	d	d	d	d	d	00000000
M7	00001100	Dot	d	d	d	d	d	d	d	00000000
M8	00001101	Dot	d	d	d	d	d	d	d	00000000
M9	00001110	Dot	d	d	d	d	d	d	d	00000000
M10	00001111	Dot	d	d	d	d	d	d	d	00000000

BD18 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000110'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.4 Shift Digits Left

Shifting the digits to the left consists of sending the the command byte followed by the data byte. The command byte tells the display controller that the characters will be shifted to the left and the data byte provides the character that will be placed in the right most digit included in the shift sequence.

Registers SSD18 and SSD910 define which digits are to be included in the shift function. If a bit is set to 1, that digit is included in the shift sequence, if a bit is set to 0 then that digit is not included in the shift sequence. By default, all digits are assigned to be excluded from the shift sequence.

When a shift sequence is initiated, the display controller first looks for the left most included digit in the shift sequence and makes note of that digits location. The display controller then proceeds to find the next digit to be included in the scroll. Once found, it moves the contents of the second digit into the first digit and repeats the process. At the end of the shift sequence, the data provided by the MCU is loaded into the right most included digit in the shift sequence.

Table 2-5: Shift left command example:
Command is executed 6 times with a ASCII data value of “F”

SSD18 = '11100111' SSD910 = “00000000' Display = '88888888'	SSD18 = '10101010' SSD910 = “00000000' Display = '88888888'	SSD18 = '10101010' SSD910 = “01000000' Display = '88888888 88'
Execution 1: 8888888F Execution 2: 888888FF Execution 3: 88888FFF Execution 4: 88F88FFF Execution 5: 8FF88FFF Execution 6: FFF88FFF	Execution 1: 888888F8 Execution 2: 8888F8F8 Execution 3: 88F8F8F8 Execution 4: F8F8F8F8 Execution 5: F8F8F8F8 Execution 6: F8F8F8F8	Execution 1: 88888888 88 Execution 2: 88888888 F8 Execution 3: 888888F8 F8 Execution 4: 8888F8F8 F8 Execution 5: 88F8F8F8 F8 Execution 6: F8F8F8F8 F8

Table 2-6: Commands / Registers Associated With Shifting Digits Left.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
SL	00010000	d	d	d	d	d	d	d	d	00000000
SSD18	00010010	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	00000000
SSD910	00010011	Digit 9	Digit 10	x	x	x	x	x	x	00000000

2.5 Shift Digits Right

Shifting the digits to the right consists of sending the the command byte followed by the data byte. The command byte tells the display controller that the characters will be shifted to the right and the data byte provides the character that will be placed in the left most digit included in the shift sequence.

Registers SSD18 and SSD910 define which digits are to be included in the shift function. If a bit is set to 1, that digit is included in the shift sequence, if a bit is set to 0 then that digit is not included in the shift sequence. By default, all digits are assigned to be excluded from the shift sequence.

When a shift sequence is initiated, the display controller first looks for the right most included digit in the shift sequence and makes note of that digits location. The display controller then proceeds to find the next digit to be included in the scroll. Once found, it moves the contents of the second digit into the first digit and repeats the process. At the end of the shift sequence, the data provided by the MCU is loaded into the left most digit included in the shift sequence.

Table 2-7: Shift left command example:
Shift left command is executed 6 times with a ASCII data value of “F”)

SSD18 = '11100111' SSD910 = “00000000' Display = '88888888'	SSD18 = '10101010' SSD910 = “00000000' Display = '88888888'	SSD18 = '10101010' SSD910 = “01000000' Display = '88888888 88'
Execution 1: 8888888F Execution 2: 888888FF Execution 3: 88888FFF Execution 4: 88F88FFF Execution 5: 8FF88FFF Execution 6: FFF88FFF	Execution 1: 888888F8 Execution 2: 8888F8F8 Execution 3: 88F8F8F8 Execution 4: F8F8F8F8 Execution 5: F8F8F8F8 Execution 6: F8F8F8F8	Execution 1: 88888888 88 Execution 2: 88888888 F8 Execution 3: 888888F8 F8 Execution 4: 8888F8F8 F8 Execution 5: 88F8F8F8 F8 Execution 6: F8F8F8F8 F8

Table 2-8: Commands / Registers Associated With Shifting Digits Left.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
SR	00010001	d	d	d	d	d	d	d	d	00000000
SSD18	00010010	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	00000000
SSD910	00010011	Digit 9	Digit 10	x	x	x	x	x	x	00000000

Scroll Left or Right Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00010010'     ;move SSD18 command into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.

MOVLW   B'00010001'     ;move SR (Shift Right) command into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.6 Clear Display

Clears the display of all characters. This command does not require a data byte.

2.7 Wake

When a wake command is received, the display controller goes through several processes to prepare for displaying data. These steps include (but are no limited to):

1) Increase the internal clock frequency to 8 Mhz
2) Enable the display ports.
3) Begin processing stored information in internal display memory.

The display controller requires 1 ms to completely wake from sleep mode. Any commands send to the display controller during this time may be lost or ignored.

2.7 Sleep

When the sleep command is received, the display controller will disable display ports and then reduce the internal clock frequency to 1 Mhz. In sleep mode, the display controller consumes xx ma.

Table 2-9: Single Byte Commands

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Clear	00000101									
Wake	00010100									
Sleep	00010101									

Single Command Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00000101'     ;move Clear command into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.

or

CALL    WAIT            ;make sure x time passes before sending next command.
```

2.8 Common Anode / Cathode

Configure the display controller to use common anode or common cathode character set for each individual digit. Bit clear = use common cathode and bit set = use common anode.

Table 2-10: Commands / Registers Associated With Common Anode / Cathode.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
CACC18	00010110	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	11111111
CACC910	00010111	Digit 9	Digit 10	x	x	x	x	x	x	00000000

CACC18 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00010110'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

CACC910 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00010111'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.9 ASCII code convert on / off

Configure the display to convert supplied display value to ASCII or pass through to display unchanged. Bit clear = don't convert and bit set = Convert.

Table 2-11: Commands / Registers Associated With Common Anode / Cathode.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
ASCII18	00011000	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	11111111
ASCII910	00011001	Digit 1	Digit 2	x	x	x	x	x	x	00000000

ASCII18 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00010110'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

ASCII910 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00010110'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

2.9 Refresh Rate

The refresh rate can be adjusted to increase or decrease how fast the display controller refreshes the active display digits. And though in most cases the refresh rate will not need adjusting, there are exceptions. In these cases, it's recommended that refresh rate experimentation may resolve any issues that might arise.

For each increase or decrease of the value contained in the RR register, the display controller will increase / decrease the amount of time each digit is on by 0.026 ms (+- 5%). The amount of time each digit is on can range from 0.026 ms to 6.63 ms.

Use the following formula to calculate refresh rate.
RT = (0.000025 x Refresh Rate)* Number of Active Digits.

Example:
If the refresh rate is set to 0x29 (41 decimal & default setting) then the entire display will refresh every .008528 ms or 117.26 times a second.

.008528 ms = (0.000026 * 41) * 8

In most circumstances, the refresh rate will not need to be adjusted.

Table 2-12: Commands / Registers Associated With Common Anode / Cathode.

Name	Command Byte	Data Byte								Default Value
		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
RR	00011010	Digit 1	Digit 2	Digit 3	Digit 4	Digit 5	Digit 6	Digit 7	Digit 8	00101001

CACC18 Code Example:

```
BANKSEL SSP1BUF         ;select bank where SSPBUF is located.
MOVLW   B'00011010'     ;move command byte into w.
MOVWF   SSP1BUF         ;transmit command byte to display controller.
BTFSS   SSP1STAT,BF     ;is transmission complete?
GOTO    $-1             ;no – loop around and check again.
MOVF    DATA_BYTE,W     ;yes – move data byte into w.
MOVWF   SSP1BUF         ;transmit data byte to display controller.
CALL    WAIT            ;make sure x time passes before sending next command.
```

NOTES:

3.0 “Hello” Code Example

```
#DEFINE     CMD_DIGITS18_ON         0X00
#DEFINE     CMD_DIGITS9A_ON         0X01
#DEFINE     CMD_DIGITS18_BLINK      0X02
#DEFINE     CMD_DIGITS9A_BLINK      0X03
#DEFINE     CMD_BLINK_RATE          0X04
#DEFINE     CMD_CLEAR               0X05
#DEFINE     CMD_MEM1                0X06
#DEFINE     CMD_MEM2                0X07
#DEFINE     CMD_MEM3                0X08
#DEFINE     CMD_MEM4                0X09
#DEFINE     CMD_MEM5                0X0A
#DEFINE     CMD_MEM6                0X0B
#DEFINE     CMD_MEM7                0X0C
#DEFINE     CMD_MEM8                0X0D
#DEFINE     CMD_MEM9                0X0E
#DEFINE     CMD_MEM10               0X0F
#DEFINE     CMD_SHIFT_L             0X10
#DEFINE     CMD_SHIFT_R             0X11
#DEFINE     CMD_SET_SHIFT18         0X12
#DEFINE     CMD_SET_SHIFT9A         0X13
#DEFINE     CMD_WAKE                0X14
#DEFINE     CMD_SLEEP               0X15
#DEFINE     CMD_COMMON_18           0X16
#DEFINE     CMD_COMMON_9A           0X17
#DEFINE     CMD_ASCII_18            0X18
#DEFINE     CMD_ASCII_9A            0X19
#DEFINE     CMD_REFRESH             0X1A

DISP_VAR_SHR    UDATA_SHR
DISP_COUNTL         RES 1
DISP_COUNTH         RES 1
DISP_TEMP           RES 1
DISP_DATA           RES 1
```

```
START
   MOVLW    0X01
   CALL     DISP_WAIT     ;GIVE DISPLAY CHIP TIME TO STARTUP.
   CALL     DISP_WAKE     ;WAKE UP THE DISPLAY CHIP.

   MOVLW    0XFF          ;SEND COMMAND TO TURN ON DIGITS 1 - 8.
   MOVWF    DISP_DATA
   MOVLW    CMD_DIGITS18_ON
   CALL     DISP_SEND_CD

;-------------------------------------------------------------------------
; SETUP COMMON ANODE / CATHODE COMMANDS.
;-------------------------------------------------------------------------
   MOVLW    0XFF          ;SEND COMMAND TO SET DIGITS 1 - 8
   MOVWF    DISP_DATA     ;AS COMMON CATHODE.
   MOVLW    CMD_COMMON_18
   CALL     DISP_SEND_CD

;-------------------------------------------------------------------------
; SHOW “HELLO” ON THE DISPLAY.
;-------------------------------------------------------------------------
   MOVLW   " H"
   MOVWF   DISP_DATA
   MOVLW   CMD_MEM1
   CALL    DISP_SEND_CD

   MOVLW   " E"
   MOVWF   DISP_DATA
   MOVLW   CMD_MEM2
   CALL    DISP_SEND_CD

   MOVLW   " L"
   MOVWF   DISP_DATA
   MOVLW   CMD_MEM3
   CALL    DISP_SEND_CD

   MOVLW   "L"
   MOVWF   DISP_DATA
   MOVLW   CMD_MEM4
   CALL    DISP_SEND_CD

   MOVLW   "O"
   MOVWF   DISP_DATA
   MOVLW   CMD_MEM5
   CALL    DISP_SEND_CD
   GOTO    $             ;ENDLESS LOOP.
```

```
;-------------------------------------------------------------------------
; WAKE UP DISPLAY
;-------------------------------------------------------------------------
DISP_WAKE
   BANKSEL   DISP_TEMP
   MOVLW     CMD_WAKE    ;WAKE COMMAND
   CALL      DISP_XMIT
   MOVLW     0X05
   CALL      DISP_WAIT
   RETURN

;-------------------------------------------------------------------------
; SEND COMMAND AND DATA BYTE.
;-------------------------------------------------------------------------
DISP_SEND_CD
   BANKSEL   DISP_DATA
   CALL      DISP_XMIT
   CALL      DISP_WAIT_SHORT
   MOVF      DISP_DATA,W
   CALL      DISP_XMIT
   CALL      DISP_WAIT_SHORT
   RETURN

;-------------------------------------------------------------------------
 ;TRANSMIT DATA BYTE.
;-------------------------------------------------------------------------
DISP_XMIT
   BANKSEL   PORTA
   BCF       PORTA,2       ;CS = ON.
   BANKSEL   SSP1BUF
   MOVWF     SSP1BUF
   BANKSEL   SSP1STAT
   BTFSS     SSP1STAT,BF
   GOTO      $-1
   BANKSEL   SSP1BUF
   MOVF      SSP1BUF,W
   BANKSEL   PORTA
   BSF       PORTA,2       ;CS = OFF.
   RETURN

;-------------------------------------------------------------------------
; WAIT ROUTINES
;-------------------------------------------------------------------------
DISP_WAIT
   MOVWF   DISP_COUNT_TIME
   CLRF    DISP_COUNTL
```

```
    CLRF    DISP_COUNTH
    CALL    DISP_WAIT_SHORT
    DECFSZ  DISP_COUNTH,F
    GOTO    $-2
    DECFSZ  DISP_COUNT_TIME,F
    GOTO    $-4
    RETURN

DISP_WAIT_SHORT
    CLRF    DISP_COUNTL
    DECFSZ  DISP_COUNTL,F
    GOTO    $-1
    RETURN
```

Part Identification

Part Number	X	XX	X
Device	Temperature Range	Package Type	Reserved
Temperature Range	I =	-40 C° to +85° C (Industrial)	
	E =	-40 C° to +125° C (Extended)	
Package:	ML =	Quad Flat No Leads (QFN)*	
	PT =	Plastic Thin-Quad Flatpack (TQFP)*	
	SO =	Plastic Small Outline (SOIC) (7.5mm)*	
	SP =	Skinny (.300) Plastic DIP	
	SS =	Quad Flat No Leads (QFN)*	
* Special order only.			

Revision History

Revision A (5/21/2011)
Iniitial release of this data sheet.

Revision B (5/31/2011)
Added Part Identification