Manufactured and designed by:
Comm Tech Research
801 Avenue K Suite 11
Plano, Texas 75074
972-516-0810

Super LCD Module Command Protocol

Command Protocol:

Communication between the module and the host controller is accomplished by a standard RS232 interface using 8N1 at either 57600 or 9600(Baud rates are selectable depending on the dip switch settings on power up, see hardware manual). The default mode for the module is text mode unless specified differently per the customer's request. The unit has seven different operating modes. These modes are **Text Mode**, **Mixed Mode1, Mixed Mode2, Graph1, Graph2, Graph3,** and **Graph4.** Sending structured packets to the module easily changes between these modes. The packet structure is as follows:

Start of Frame: The start of frame byte is always 0xFF.

Num of Total Bytes: The total number of bytes in the frame.

Command Byte: The Command byte indicates which command is being sent (See command Table).

Data Bytes: Data bytes for commands (not necessary for all commands).

Checksum: The checksum is the twos complement of all of the bytes in frame, added together. The checksum results in a number that when all of the bytes in the frame are added together, including the checksum, the result ends in 0x00.

The following table lists the available commands that can be sent to the module:

Command	Command #	Returns
TEXT_MODE	0x00	ACK/NAK
GRAPH_MODE1	0x01	ACK/NAK
GRAPH_MODE2	0x02	ACK/NAK
GRAPH_MODE3	0x03	ACK/NAK
GRAPH_MODE4	0x04	ACK/NAK
MIXED_MODE1	0x05	ACK/NAK
MIXED_MODE2	0x06	ACK/NAK
STORE_MODE	0x07	ACK/NAK
SET_DIG_DIRECTION	0x08	ACK/NAK
SET_DIG_VALUE	0x09	ACK/NAK
READ_DIG_VALUE	0x0A	DIG_VALUE_RETURN
READ_FILTERD_ANALOG	0x0B	FILTERED_ANALOG_RETURN
READ_RAW_ANALOG	0x0C	RAW_ANALOG_RETURN
BACKLIGHT*	0x0D	ACK/NAK
READ_TEMP	0x0E	TEMP_RETURN
READ_PEAK	0x0F	PEAK_RETURN
SET_PEAK	0x10	ACK/NAK
STORE_PEAK	0x11	ACK/NAK

The following table lists the commands that are sent to the host controller:

Command	Command #
ACK	0x06
NAK	0x15
DIG_VALUE_RETUN	0x0A
FILTERED_ANALOG_RETURN	0x0B
RAW_ANALOG_RETURN	0x0C
TEMP_RETURN	0x0E
PEAK_RETURN	0x0F

Each Command/Return is documented as follows:

TEXT_MODE: This mode allows simple text to be entered without the need to packetize each character. Each byte between 0 and 126 is printed directly to the screen (see Character Table). When the screen width is reached the text is then printed on the bottom line. When the bottom line's screen width is reached, all characters on the bottom line are moved to the top and the text is continued on the left side of the bottom line (auto scrolling). There are two special characters that can be entered while in this mode. The first special character is the "goto" character, 128 decimal or 0x80 hexadecimal. Issuing this character followed by a location number allows the cursor to go to any location on the display. The next special character is the "clear screen" character, 129 decimal or

0x81 hexadecimal. Issuing the "clear screen" command clears the screen and moves the cursor to the starting position.

The screen format of TEXT_MODE is as follows:

" Any Text	"
" Any Text	"

Issuing the following packet enters text mode:

Start of Frame	Num of Bytes	Command	Checksum
0xFF	0x04	0x00	0xFD

GRAPH_MODE1: This mode allows the graphing of two separate analog or channels to be displayed. Display channel A is displayed on the top line while display channel B is displayed on the bottom line. Display channels A and B can be selected from any of the 8 available physical channels ranging from 0 through 7. Each graph can be followed by a suffix. Display suffixes A and B can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffixes are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. Any graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares when channel 8 or 9 are used).

The screen format of GRAPH_MODE1 is as follows:

[----------"CHANNEL #A"----------"SUFFIX A"]
[----------"CHANNEL #B"----------"SUFFIX B"]

An example packet to change to GRAPH_MODE1 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA	ChannelB	SuffixB	Checksum
0xFF	0x08	0x01	0-9	0-3	0-9	0-3	?

GRAPH_MODE2: This mode allows the graphing of three separate analog channels to be displayed. Display channel A and B are displayed on the top line while display channel C is displayed on the bottom line. Display channels A, B, and C can be selected

from any of the 8 available physical channels ranging from 0 through 7. Each graph can be followed by a suffix. Display suffixes A, B, and C can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffixes are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. Any graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares when channel 8 or 9 are used).

The screen format of GRAPH_MODE2 is as follows:

[-------"CHANNEL #A"------- "SUFFIX A"] [-------"CHANNEL #B"-------"SUFFIX B"]
[---------- "CHANNEL #C"----------"SUFFIX C"]

An example packet to change to GRAPH_MODE2 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA
0xFF	0x0A	0x02	0-9	0-3

ChannelB	SuffixB	ChannelC	SuffixC	Checksum
0-7	0-3	0-9	0-3	?

GRAPH_MODE3: This mode allows the graphing of three separate analog channels to be displayed. Display channel A is displayed on the top line while display channels B and C are displayed on the bottom line. Display channels A, B, and C can be selected from any of the 8 available physical channels ranging from 0 through 7. Each graph can be followed by a suffix. Display suffixes A, B, and C can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffixes are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. Any graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares when channel 8 or 9 are used).

The screen format of GRAPH_MODE3 is as follows:

[----------"CHANNEL #A"----------"SUFFIX A"]
[-------"CHANNEL #B"-------"SUFFIX B"] [-------"CHANNEL #C"-------"SUFFIX C"]

An example packet to change to GRAPH_MODE3 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA
0xFF	0x0A	0x03	0-7	0-3

ChannelB	SuffixB	ChannelC	SuffixC	Checksum
0-9	0-3	0-9	0-3	?

GRAPH_MODE4: This mode allows the graphing of four separate analog channels to be displayed. Display channels A and B are displayed on the top line while display channels C and D are displayed on the bottom line. Display channels A, B, C, and D can be selected from any of the 8 available physical channels ranging from 0 through 7. Each graph can be followed by a suffix. Display suffixes A, B, C, and D can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffixes are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. Any graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares when channel 8 or 9 are used).

The screen format of GRAPH_MODE4 is as follows:

[-------"CHANNEL #A"------- "SUFFIX A"] [-------"CHANNEL #B"-------"SUFFIX B"]
[-------"CHANNEL #C"-------"SUFFIX C"] [-------"CHANNEL #D"-------"SUFFIX D"]

An example packet to change to GRAPH_MODE4 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA	ChannelB
0xFF	0x0C	0x04	0-9	0-3	0-9

SuffixB	ChannelC	SuffixC	ChannelD	SuffixD	Checksum
0-3	0-9	0-3	0-9	0-3	?

MIXED_MODE1: This mode allows the combination of text and the graphing of a single analog channel. The text is displayed on the top line, while the graph is displayed on the bottom line. The text characteristics are the same as in TEXT_MODE except for the scrolling. When the text cursor reaches the end of the first line all characters are

shifted left by one, and the new character is displayed at the right most position(left to right scrolling). Display channel A is displayed on the bottom line. Display channel A can be selected from any of the 8 available physical channels ranging from 0 through 7. The graph can be followed by a suffix. Display suffix A can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffix are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. The graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares when channel 8 or 9 are used).

The screen format of MIXED_MODE1 is as follows:

" Any Text "
[----------"CHANNEL #A"----------"SUFFIX A"]

An example packet to change to MIXED_MODE1 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA	Checksum
0xFF	0x06	0x05	0-9	0-3	?

MIXED_MODE2: This mode allows the combination of text and the graphing of a two analog channels. The text is displayed on the top line, while the graphs are displayed on the bottom line. The text characteristics are the same as in TEXT_MODE except for the scrolling. When the text cursor reaches the end of the first line all characters are shifted left by one, and the new character is displayed at the right most position. Display channel A and B are displayed on the bottom line. Display channel A and B can be selected from any of the 8 available physical channels ranging from 0 through 7. The graph can be followed by a suffix. Display suffix A and B can be selected from the four available suffixes (Voltage, Percent, Channel, or None). The values for the suffix are as follows Voltage = 0, Percent = 1, Channel = 2, and None = 3. The Voltage suffix displays the voltage rounded to the nearest tenth of a volt. The Percent suffix displays the percent of the 5 volt value. The Channel suffix displays the current channel that is being displayed. The None suffix does not display any suffix and the graph takes up the entire area. Any graph may be replaced by a temperature reading, if a temperature sensor is present. The temperature measurements are selected by selecting channel 8 for Celsius or channel 9 for Fahrenheit (the suffix values are don't cares in when channel 8 or 9 are used).

The screen format of MIXED_MODE2 is as follows:

“ Any Text “	
[-------“CHANNEL #A”------- “SUFFIX A”] [-------“CHANNEL #B”-------“SUFFIX B”]	

An example packet to change to MIXED_MODE2 is as follows:

S.O.F.	#Bytes	Command	ChannelA	SuffixA	ChannelB	SuffixB	Checksum
0xFF	0x08	0x06	0-9	0-3	0-9	0-3	?

STORE_MODE: This variable length command stores the default value of the module. When the module first powers up the mode that is selected is the mode that was set by this command. If this command was never issued the default mode is TEXT_MODE. The STORE_MODE command is issued by sending the store mode command followed by the desired default mode (including the default channel and suffix parameters). (NOTE: After this command is sent, there must be a one second delay before sending any other commands.)

An example packet to STORE_MODE is as follows: (example for default value set to GRAPH_MODE1 with ChannelA = 0, SuffixA = 1, ChannelB = 1, SuffixB = 2)

S.O.F.	#Bytes	Command	Default Mode	ChannelA
0xFF	0x09	0x07	0x01	0x00

SuffixA	ChannelB	SuffixB	Checksum
0x01	0x01	0x02	0xEC

SET_DIG_DIRECTION: This command sets the pin directions for the digital I/O port. The directions of the pins correspond to values in the bit positions of the data field in the command. Bit 0 corresponds to pin 0 and bit 7 corresponds to pin 7. An input is represented as a 1 and an output is represented as a 0. (Note: on power up all pins are configured as inputs)

An example Packet for SET_DIG_DIRECTION is as follows: (All inputs except pin0 and pin1)

Start of Frame	#Bytes	Command	Pin Directions	Checksum
0xFF	0x05	0x08	0xFC	0xF8

SET_DIG_VALUE: This command sets the pin values for the digital I/O port. The values of the pins correspond to values in the bit positions of the data field in the command. Bit 0 corresponds to pin 0 and bit 7 corresponds to pin 7. A high is

represented as a 1 and a low is represented as a 0. Pins that are set up as inputs are don't cares in data byte.

An example packet for SET_DIG_VALUE is as follows: (All high except pin0 and pin1)

Start of Frame	#Bytes	Command	Pin Directions	Checksum
0xFF	0x05	0x09	0xFC	0xF7

READ_DIG_VALUE: This command requests a DIG_VALUE_RETURN packet.

An example packet for READ_DIG_VALUE is as follows:

Start of Frame	Num of Bytes	Command	Checksum
0xFF	0x04	0x0A	0xF3

READ_FILTERED_ANALOG: This command requests a FILTERED_ANALOG_RETRUN packet.

An example packet for READ_FILTERED_ANALOG is as follows:

Start of Frame	Num of Bytes	Command	Channel	Checksum
0xFF	0x05	0x0B	0-7	?

READ_RAW_ANALOG: This command requests a RAW_ANALOG_RETURN packet.

An example packet for READ_RAW_ANALOG is as follows:

Start of Frame	Num of Bytes	Command	Channel	Checksum
0xFF	0x05	0x0C	0-7	?

READ_TEMP: This command requests a TEMP_RETURN packet.

An example packet for READ_TEMP is as follows:

Start of Frame	Num of Bytes	Command	Checksum
0xFF	0x04	0x0E	0xEF

BACKLIGHT: This command turns on and off the LCD backlight (note: not all models have this feature). The value in the bit 0 slot of the data byte determines the status

of the L.E.D backlight. A one in the bit 0 slot turns the backlight on, while a zero in the bit 0 slot turns the backlight off.

An example packet for BACKLIGHT is as follows: (turns backlight on)

Start of Frame	#Bytes	Command	Backlight	Checksum
0xFF	0x05	0x0D	0x01	0xEE

READ_PEAK: This command requests a PEAK_RETURN packet and resets the stored peak value in the module.

An example packet for READ_PEAK is as follows: (turns backlight on)

Start of Frame	Num of Bytes	Command	Channel	Checksum
0xFF	0x05	0x0F	0-7	?

SET_PEAK: This command turns on and off the peak meter, sets the peak delay, and turns on and off the peak trailer on the graphs. The value in the first 6 bits of the data byte determines the peak delay (how long the peak is displayed) in 80ms increments. If the value of the first 6 bits is set to 0 the peak meter is disabled (factory default). The value in the bit 7 slot of the data byte determines the status of the peak trailer. A one in the bit 7 slot turns the peak trailer on, while a zero in the bit 7 slot turns the peak trailer off. The peak trailer is a feature that allows the peak to slowly fall to the current level after the peak delay has been reached. If the peak trailer is disabled, the peak goes directly to the current level after the peak delay has been reached.

An example packet for SET_PEAK is as follows: (peak trailer is on with a peak delay of 15, or 1.2 sec).

Start of Frame	#Bytes	Command	Peak	Checksum
0xFF	0x05	0x10	0x8F	0x6E

STORE_PEAK: This command stores the default peak value of the module. The data byte is the same as in the SET_PEAK command. When the module first powers up the peak that is selected is the peak that was set by this command. If this command was never issued the default mode is no peak meter.

An example packet for STORE_PEAK is as follows: (stored value is peak trailer on with a peak delay of 15, or 1.2 sec).

Start of Frame	#Bytes	Command	Peak	Checksum
0xFF	0x05	0x11	0x8F	0x5C

ACK: The ACK packet is sent a response to a successful packet reception.

An example packet for an ACK is as follows:

Start of Frame	Num of Bytes	Command	Checksum
0xFF	0x04	0x06	0xF7

NAK: The NAK packet is sent a response to a unsuccessful packet reception. (i.e. incomplete packet or checksum error)

An example packet for an NAK is as follows:

Start of Frame	Num of Bytes	Command	Checksum
0xFF	0x04	0x15	0xE8

DIG_VALUE_RETUN: This packet is sent as a response to a READ_DIG_VALUE packet. It contains the pin values of the digital inputs. The values of each bit in the data byte correspond to the pin values. Bit 0 corresponds to the value of pin 0 and bit 7 corresponds to pin 7, if configured as an inputs. If a pin is configured as an output the value that is returned will be the latched value for that output.

An example packet for DIG_VALUE_RETUN is as follows: (all low except pin 0)

Start of Frame	#Bytes	Command	Pin Directions	Checksum
0xFF	0x05	0x0A	0x01	0xF1

FILTERED_ANALOG_RETURN: This packet is sent as a response to a READ_FILTERD_ANALOG packet. It contains the average of the last 5 analog reads (each analog channel is read every 80mS) in a 10bit analog value of the channel selected.

An example packet for FILTERED_ANALOG_RETURN is as follows:

S.O.F.	#Bytes	Command	Channel	MSB	LSB	Checksum
0xFF	0x07	0x0B	?	?	?	?

RAW_ANALOG_RETURN: This packet is sent as a response to a READ_RAW_ANALOG packet. It contains the 10bit analog value that was last read of the channel selected (each analog channel is read every 80mS).

An example packet for RAW_ANALOG_RETURN is as follows:

S.O.F.	#Bytes	Command	Channel	MSB	LSB	Checksum
0xFF	0x07	0x0C	?	?	?	?

TEMP_RETURN: This packet is sent as a response to a READ_TEMP packet. It contains the 9bit temperature value that was last read from the temperature sensor (temperature sensor is read once every second). The temperature value that is returned is per "Dallas Semiconductor's" data sheet on the DS1920:

"The temperature reading is provided in a 16-bit, sign-extended twos complement reading. Table 1describes the exact interface. The temperature is "in terms of ½ degree Celsius LSB, yielding the following 9-bit format:

MSB								LSB
1	1	1	0	0	1	1	1	0

=-25 degrees Celsius

The most significant (sign) bit is duplicated into all of the bits in the upper MSB of the 2-byte temperature register in memory. This "sign extension" yields the 16-bit temperature readings as shown in Table 1.

Temperature/Data Relationships Table1

Temperature	Digital Output (Binary)	Digital Output (Hex)
+100 deg C.	00000000 11001000	0x00C8
+25 deg C.	00000000 00110010	0x0032
+ ½ deg C.	00000000 00000001	0x0001
+0 deg C.	00000000 00000000	0x0000
- ½ deg C.	11111111 11111111	0xFFFF
-25 deg C.	11111111 11001110	0xFFCE
-55 deg C.	11111111 10010010	0xFF92

An example packet for TEMP_RETURN is as follows:

Start of Frame	#Bytes	Command	MSB	LSB	Checksum
0xFF	0x06	0x0E	?	?	?

PEAK_RETURN: This packet is sent as a response to a READ_PEAK packet. It contains the 10bit analog peak value since the last time the value was read of the channel selected (each analog channel is read every 80mS).

An example packet for RAW_ANALOG_RETURN is as follows:

S.O.F.	#Bytes	Command	Channel	MSB	LSB	Checksum
0xFF	0x07	0x0F	?	?	?	?

Character Table: **UPPER 4BITS**

	0000	0010	0011	0100	0101	0110	0111
0000	|	<space>	0	@	P	\	p
0001	||	!	1	A	Q	a	q
0010	|||	"	2	B	R	b	r
0011	||||	#	3	C	S	c	s
0100	N/A	$	4	D	T	d	t
0101	N/A	%	5	E	U	e	u
0110	N/A	&	6	F	V	f	v
0111	N/A	'	7	G	W	g	w
1000	|	(	8	H	X	h	x
1001	||	)	9	I	Y	i	y
1010	|||	*	:	J	Z	j	z
1011	||||	+	;	K	[	k	{
1100	N/A	,	<	L	N/A	l	|
1101	N/A	-	=	M	]	m	}
1110	N/A	.	>	N	^	n	→
1111	N/A	/	?	O	_	o	←