APPLICATION		REVISIONS				
NEXT ASSY	**FINAL ASSY**	**LTR**	**DESCRIPTION**		**DATE**	**APPROVED**
		–	PRODUCTION RELEASE/E.O. 29226		3/19/93	D. Goodale
		A	E.O. 29434		6/3/93	D. Goodale
		B	E.O. 29653		11/30/93	D. Goodale
		C	E.O. 36743, Revised and Redrawn		2/12/02	D. Goodale

Specification

4 X 20 Daystar Nova LCD Module

with

Serial Data Input Option

Model 03805–06–0200

REV	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

REVISION STATUS

PROJ. NO. 411	**CONTRACT**		**INDUSTRIAL ELECTRONIC ENGINEERS, INC.** **VAN NUYS, CALIFORNIA**
	DRAWN R. January 3–19–93		SERIAL DATA INPUT 4 X 20 LCD MODULE
	CHECK		

APPROVED

D. Goodale 3-19-93

APPROVED

SIZE **A**	**CODE IDENT NO.** **05464**	**S03805–06–0200**
SCALE		SHEET 1 OF 23

IEE

Table of Contents

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 2

Table of Contents

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200	
Van Nuys, California	SCALE N/A	REV C	SHEET 3	

List of Figures

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200	
Van Nuys, California	SCALE N/A	REV C	SHEET 4	

1.0 GENERAL INFORMATION

1.1 Introduction

This specification describes the serial interface Daystar Nova model 03805–06–0200, a 4–line supertwisted liquid crystal display (LCD) with 20 characters per line.

Model Number Designation System

03805	–	06	–	0	2	0	0
Reflective STN LCD		4x20 Format		Reserved	1 = Parallel Data Input *	0 = No Backlight	0 = Color N/A
					2 = Serial Data Input		

* Parallel standard, Serial optional

1.2 Application

Daystar Nova modules provide alphanumeric information which is easily readable in high ambient light or in darkness with optional backlight. The low power requirements of the modules make them suitable for portable battery operated equipment. The wide operating temperature range (–30° to +80°C) is ideal for most outdoor applications. The choice of a preferential viewing hemisphere is not necessary because of the excellent wide angle viewing characteristics of the new Super Bi–refringent Effect (SBE) liquid crystal cell used in this display.

The serial data input model of the 03805–06 Daystar Nova display allows communication between a host processor and the display by means of a serial RS–232C interface. This provides the capability to communicate over a longer distance than is possible with the parallel model. The RS–232 interface is a two wire communication link.

1.3 Standard Features

- Serial data communication via RS–232C
- Multiple baud rates: 1200, 2400, 4800, and 9600
- Low power consumption
- Wide temperature range
- Built–in diagnostics
- Down–loadable special characters

1.4 Description

The serial input Daystar Nova module includes an on–board CMOS microprocessor which translates serial data into parallel data and provides other enhancements over the parallel model. The serial data may be set by a jumper to accommodate speeds of 1200, 2400, 4800, and 9600 baud. Parity may also be set by jumper for odd, even, or no parity. The electrical interface is RS–232C compatible.

A single +5 Volt nominal power supply is required for operation. The unit operates from 4.50 Volts to 5.50 Volts. The typical power requirement for the module is 120mW.

The module weighs 9.1 ounces (257.7 grams).

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**		**S03805–06–0200**
Van Nuys, California	SCALE N/A	REV C		SHEET 5

2.0   LOGICAL STRUCTURE AND FUNCTION

2.1   Module Block Diagram

Figure 1 illustrates the major components of the serial option Daystar Nova module. The module provides means for an external viewing angle adjustment potentiometer (V_{BIAS} Adj.) at Pin 4, and connections for optional RESET and self–test switches at Pins 3 and 5. The external viewing angle adjustment potentiometer should be connected to the same +5 Volt supply as the display module. RESET and TEST pull down to ground to activate the function. All three inputs may be left open if not used. The V_{BIAS} test point is used at the factory to preset the viewing angle.
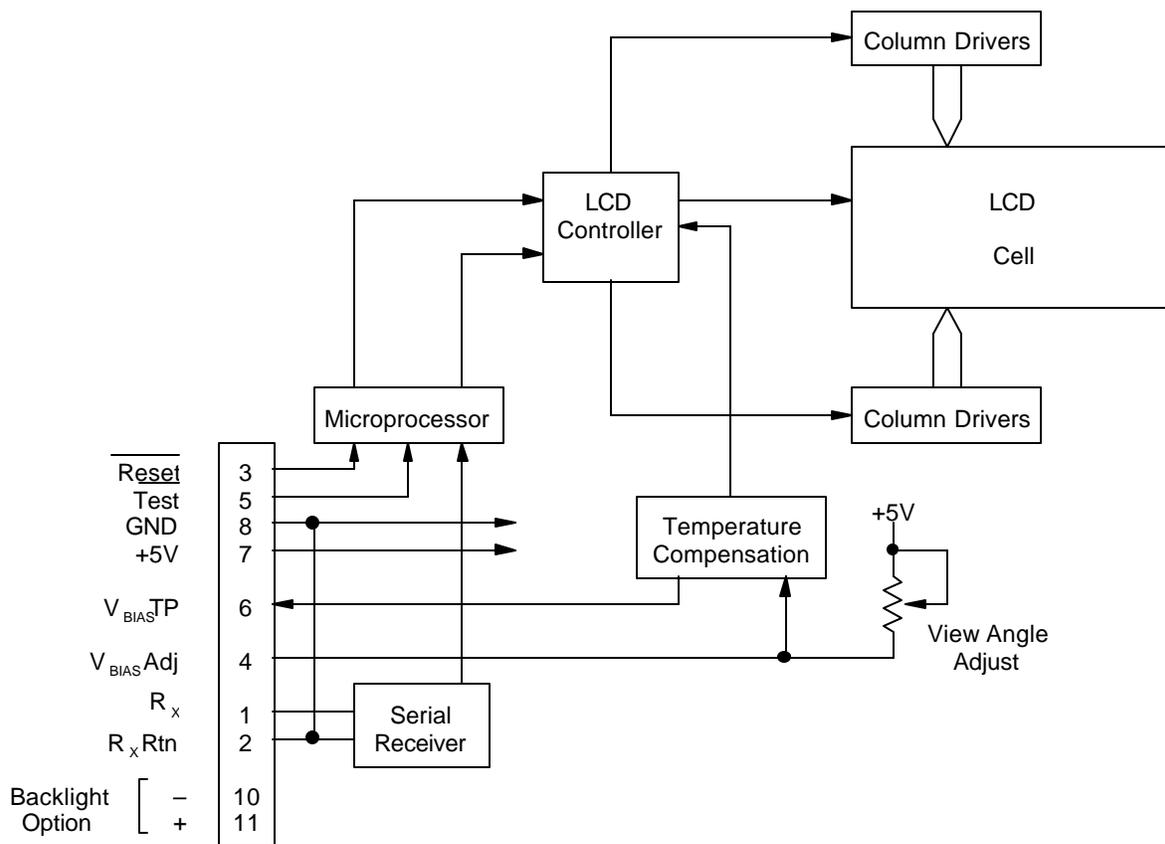
Figure 1   Module Block Diagram

2.1.1   Signal Description

Signal Name	Number Of Lines	Input/Output	Connected
RESET	1	I	MPU
TEST	1	I	MPU
V_{BIAS} TP	1	O	Temp. Comp. Ckt.
V_{BIAS} Adj.	1	I	Temp. Comp. Ckt.
RX	1	I	Serial Receiver
RX Rtn	1	I	Serial Receiver
V_{CC}	2	–	Power
GND	7	–	–

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 6

2.2   LCD Controller

The LCD Controller includes all of the circuitry necessary to take parallel input data and create the necessary control functions and characters. The block diagram of the controller is shown in Figure 2 below. The remaining subparagraphs of Section 2 describe the major function blocks.
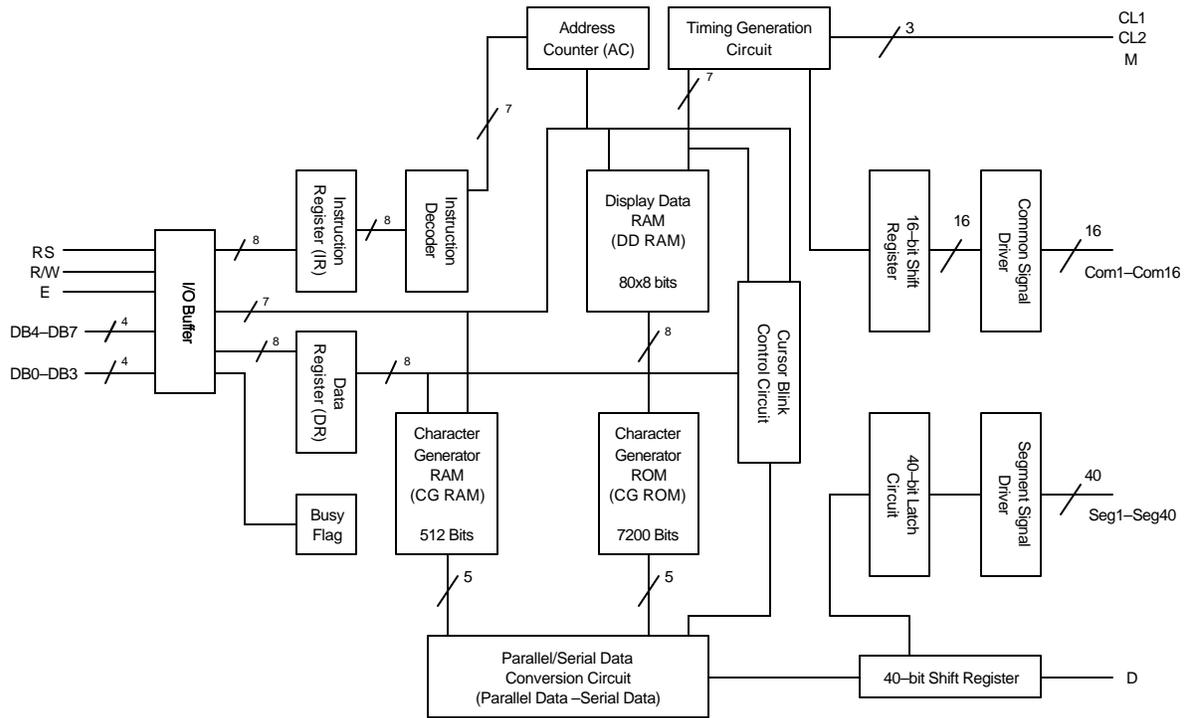
Figure 2   LCD Controller Block Diagram

2.2.1   Instruction Register (IR)

The IR stores instruction codes such as display clear and cursor shift, and address information of the display data RAM (DD RAM) and character generator RAM (CG RAM). The IR can be written from the MPU, but not read.

2.2.2   Data Register (DR)

The DR temporarily stores data to be written into or read from the DD RAM or the CG RAM.

2.2.3   Busy Flag

When the Busy Flag is a "1", the module is in an internal operating mode and ignores any additional instructions (Refer to Read Busy Flag and Address instruction).

2.2.4   Address Counter (AC)

The AC determines the address of the DD RAM or CG RAM in which new data is stored. After writing into (or reading from) the DD RAM or CG RAM, the AC is incremented or decremented as defined by the Increment/Decrement bit (Refer to Entry Mode Set instruction).

2.2.5   Display Data RAM (DD RAM)

The DD RAM contains 80 X 8 bits and represents 80 characters. The relationship between the DD RAM address and position of the characters in the display can be controlled by the user (Refer to Entry Mode Set and Cursor or Display Shift instructions).

2.2.6 Character Generator ROM (CG ROM)

The CG ROM generates character patterns of 5 X 7 dots from 8 bit character codes. The 192 5 X 7 dot matrix characters are illustrated in Figure 3.

Figure 3   Correspondence Between Character Codes and Character Patterns

Note: Addresses 00h through 0Fh are reserved for CG RAM Addressing. Addresses 10h through 1Fh and 80h through 9Fh are not used.

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464		S03805–06–0200
Van Nuys, California	SCALE N/A	REV C		SHEET 8

2.2.7 Character Generator RAM (CG RAM)

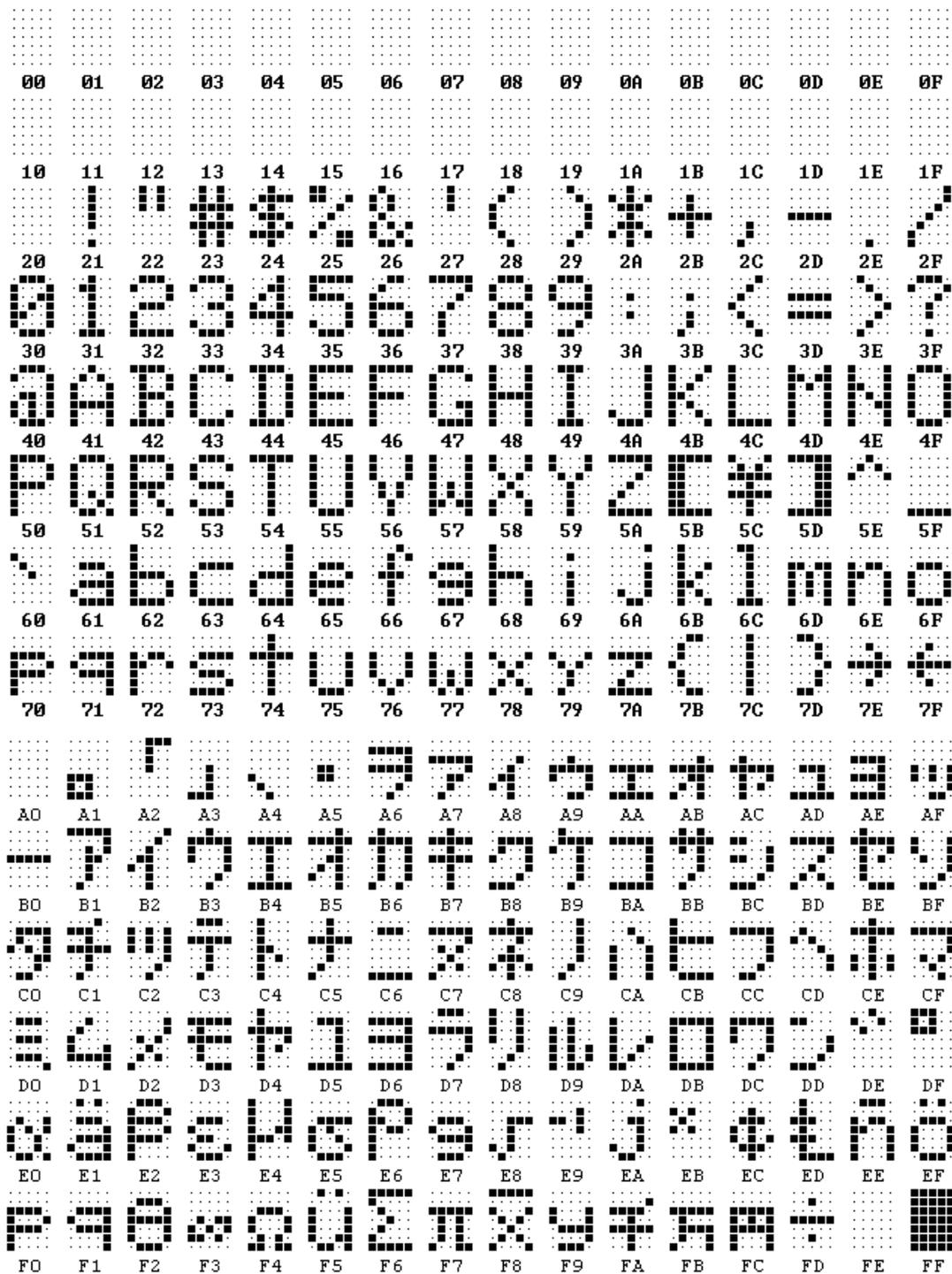The CG RAM allows the user to define 8 types of 5 X 7 character patterns. Figure 4 shows the relationship between CG RAM addresses and data patterns (Refer to Set CG RAM Address and Write to CG or DD RAM instructions).

Character Codes (DD RAM Data)	CG RAM Address	Character Patterns (CG RAM Data)	
7 6 5 4 3 2 1 0	5 4 3 2 1 0	7 6 5 4 3 2 1 0	
←Higher Order Bits	←Higher Order Bits	←Higher Order Bits	
Lower Order Bits→	Lower Order Bits→	Lower Order Bits→	
	0 0 0	* * * 1 1 1 1 0	
	0 0 1	1 0 0 0 1	
	0 1 0	1 0 0 0 1	Character
	0 1 1	1 1 1 1 0	Pattern
0 0 0 0 * 0 0 0	0 0 0 1 0 0	1 0 1 0 0	Example
	1 0 1	1 0 0 1 0	
	1 1 0	1 0 0 0 1	
	1 1 1	* * * 0 0 0 0 0	←Cursor

**Figure 4 Relationship Between CG RAM Address, Character Codes (DD RAM)
and Character Patterns (CG RAM Data)**

NOTES:

1) The CG RAM consists of 64 bytes. Any bytes not used for character pattern information can be used for general purpose data RAM. The 5, 6 and 7 bits are never used for character pattern information and are always available for use.

2) The 0, 1 and 2 bits of character code correspond to the 3, 4 and 5 bits of the CG RAM address.

3) The 0, 1 and 2 bits of the CG RAM address specify the row of the character pattern.

4) The 8th row of the character pattern corresponds to the cursor character pattern. If any bit in the row is "1", then the corresponding cursor bit is a "1" regardless of cursor position. (For most applications, the data should be "0" in this row, which allows for normal cursor operation on the character.)

5) Since bit 3 is a "don't care", two character codes represent the same special character. For example, a character code of 07 (hexadecimal) selects the same character pattern as OF (hexadecimal).

2.2.8 Parallel/Serial Data Conversion Circuitry, Timing Generator Circuitry

These blocks control the interface to the LCD drivers.

3.0   THEORY OF OPERAT ION

The serial input option was designed to allow users to send data and control codes to the display module via the industry standard RS–232C serial interface. This follows the interface protocol of the parallel input Daystar Nova display modules with few exceptions.

3.1   Serial Interface

The serial input module is a receive only device. Consequently, it is impossible for the host to read data or status from the LCD controller. This precludes reading of data from the Data Display (DD) RAM, Character Generator (CG) RAM, or address counter (AC). It is not necessary to read the controller busy flag because a large serial data input buffer prevents overflow at 9600 baud.

The serial interface requires one start bit, and may be jumper selected to operate with (1) either 7 or 8 data bits per character and (2) either odd or even parity with one stop bit, or no parity and two stop bits.

Since two command characters and numerous data characters are 8 bits in length, it is recommended to operate in 8 bit mode if the host has this capability. Where this is not possible, 7 bit mode should be jumper selected (see section 4.2) and a special command character (19h) must be sent prior to each 8 bit command or data character; i.e., characters where $B_7 = 1$.

Figure 5 represents serial data formatted as one start bit, eight data bits, an odd or even parity with one stop bit, or 2 stop bits if no parity.
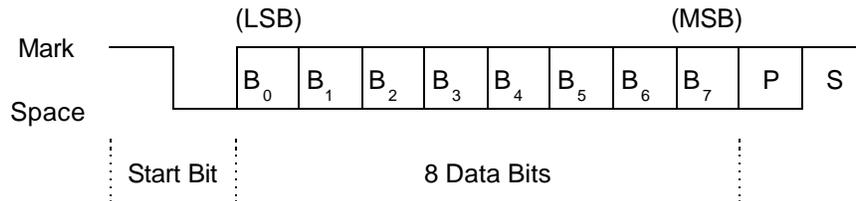
Figure 5   8–bit Serial Data Format

A logic "1" represents a "mark" condition and a logic "0" represents a "space" condition. For RS–232C the "mark" and "space" conditions are defined as –3.0 to –25.0 Volts and +3.0 to +25.0 Volts, respectively.

3.2   Error Detection and Reporting

During normal operation, the module will detect and display all parity and framing errors (see Section 3.8). Each character received in error is replaced with one of the following symbols:

    Parity Error   "&"
    Framing Error   "@"

If the display shows an "@" after power–up, the polarity of the serial interface may be reversed and should be checked.

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**	**S03805–06–0200**	
Van Nuys, California	SCALE N/A	REV C		SHEET 10

3.3 Power–up Sequence

Upon power–up, the serial Daystar Nova display module is automatically initialized to the format defined by the jumper settings and default values shown in Figure 6. The power–up sequence takes about 0.5 second.

Baud rate:	Jumper defined (per section 4.2)
Parity bit present:	"
Parity checking enable:	"
Parity (Odd or Even):	"
7 or 8 data bits	"
Multiplex rate of LCD:	"
Display clear:	YES
Display ON/OFF:	ON
Cursor location:	Position 0
Cursor:	OFF
Entry mode set:	Shift cursor right after character entry
Controller:	1
Data/Instructions:	Data

Figure 6   Default Configuration at Power–up

3.4 Transmission Sequence for Instructions

Figures 7 and 8 depict the recommended sequence for each data or instruction transmission.

11h					

Byte   1   2   3   4   n

Figure 7   Instruction Sequence

12h					

Byte   1   2   3   4   n

Figure 8   Data Sequence

3.5 Instruction Set

Instruction	Code								Description	Execution Time (Max)
	DB$_7$	DB$_6$	DB$_5$	DB$_4$	DB$_3$	DB$_2$	DB$_1$	DB$_0$		
Clear Display	0	0	0	0	0	0	0	1	Clears entire display and sets DD RAM to 0	1.64 ms
Return Home	0	0	0	0	0	0	1	*	Sets DD RAN counter to 0. If the display has been shifted, characters are returned to their initial positions. DD RAM contents remain unchanged.	1.64 ms
Entry Mode Set	0	0	0	0	0	1	I/D	S	Sets shift register direction and cursor movement direction which occur during data read and write operations	40µs
Display ON/OFF Control	0	0	0	0	1	D	C	B	Turns ON/OFF the entire display (D), cursor) and cursor blink attribute (B).	40µs
Cursor or Display Shift	0	0	0	1	S/C	R/L	*	*	Moves cursor or shifts entire display one position. DD RAM contents are unchanged.	40µs
Function Set	0	0	1	DL	1	0	*	*	Sets Interface Data Length.	40µs
Set CG RAM Address	0	1							Sets CG RAM address. CG RAM data is sent or received after this is set.	40µs
Set DD RAM Address	1								Sets DD RAM address. DD RAM data is sent or received after this is set.	40µs
Read Busy Flag and Address	BF								Reads Busy Flag (BF) and Address Counter	0µs
Write Data to CG or DD RAM									Writes data into CG RAM or DD RAM.	40µs
Read Data from CG or DD RAM									Reads data from CG RAM or DD RAM.	40µs
Controller 1 Instructions	0	0	0	1	0	0	0	1	Subsequent data is Display Module Instructions for controller 1.	
Controller 1 Data	0	0	0	1	0	0	1	0	Subsequent data is Display Module data for controller 1.	
Controller 2 Data	0	0	0	1	0	1	1	0	Subsequent data is Display Module data for controller 2.	
Controller 2 Instructions	0	0	0	1	0	1	0	1	Subsequent data is Display Module Instructions for controller 2.	
8 Bit Data Instructions	0	0	0	1	1	0	0	1	Causes microprocessor to add B$_7$=1 to the next character received.	
Down Load Special Character	0	0	0	1	0	1	1	1	Subsequent 2 characters define ROM address of characters, and its down load DD Ram address	

I/D=1:	Increment	DD RAM:	Display Data RAM
I/D=0:	Decrement	CG RAM:	Character Generator RAM
S=1:	Enable Shift Operation	A$_{CG}$	CG RAM Address
S/C=1:	Shift Display	A$_{DD}$	DD RAM Address
S/C=0:	Shift Cursor		(Corresponds to cursor address)
R/L=1:	Shift Right	AC	Address Counter
R/L=0:	Shift Left		(used for both CG and DD RAM)
DL=1:	8–bit operation	*	Don't Care

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**		**S03805–06–0200**
Van Nuys, California	SCALE N/A	REV C		SHEET 12

DL=0: 4–bit operation

BF=1: Operating internally

BF=0: Can accept instruction

Figure 9   Instruction Set

3.5.1 Instruction Summary

Hex Code	Command
01h	Clear Display
02h	Home Cursor
04h	Disable Shift And Decrement
05h	Enable Shift And Decrement
06h	Disable Shift And Increment
07h	Enable Shift And Increment
08h	Turn Display Off
0Ch	Turn Display On And Cursor Off
0Eh	Turn Display On And Cursor On
0Fh	Turn Display On And Blink Cursor
10h	Shift Cursor To The Left
14h	Shift Cursor To The Right
18h	Shift Display To The Left
1Ch	Shift Display To The Right
11h	Subsequent Data Is Controller 1 Instruction(S)
12h	Subsequent Data Is Controller 1 Display Data
15h	Subsequent Data Is Controller 2 Instruction(S)
16h	Subsequent Data Is Controller 2 Display Data
17h	Subsequent Data Down Loads Special Characters
19h	Subsequent Data Is 8 Bit Length Character

3.5.2 Sample Instructions In BASIC

The following instructions are provided as an example to illustrate the correct form and to assist the user to rapidly see his display operate.

```
10  CLOSE #1                                          'Close if open
20  OPEN "COM1:9600,N,8,2,CS,DS" AS #1                'Setup serial port
30  PRINT #1, CHR$(&H4A); CHR$(&H61); CHR$(&H6E)      'Display date
40  PRINT #1, CHR$(&H2D); CHR$(&H32); CHR$(&H2D)
50  PRINT #1, CHR$(&H39); CHR$(&H36)
60  PRINT #1, CHR$(&H11); CHR$(&H0F)                  'Blink cursor
70  PRINT #1, CHR$(&H84)                              'Move cursor to day
80  PRINT #1, CHR$(&H12)                              'Prepare to change day
90  SYSTEM
```

The display should appear as follows:

Jan–2–96

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 14

3.6   Down–Loadable Special Characters

An added feature of the serial input module is the inclusion of a group of 206 special characters stored in its memory. These supplement the character library of the LCD module and may be easily down loaded (up to eight at a time) into the CG RAM of the display module for use in one display frame of the display. Thus, in addition to being able to input his own character designs as described in Paragraph 2.2.7, the user has these additional preformatted characters available. Note that all down loaded character data is lost and must be reloaded after power has been removed.

To facilitate the use of these characters, a "subsequent data" instruction (17h) is used to inform the microprocessor that the following two bytes of data identify (1) the location of the special character to be down loaded, and (2) the CG RAM location where it is to be loaded. This instruction sequence is as follows.

17h			

(1)	(2)
Character	CG RAM
Locations	Locations
00h − E5h	00h − 07h

Figure 10 defines the format of these special characters and their memory location used to select them. The eight CG RAM locations to which they may be sent are from 00h to 07h.

Figure 10   Down–loadable Special Characters

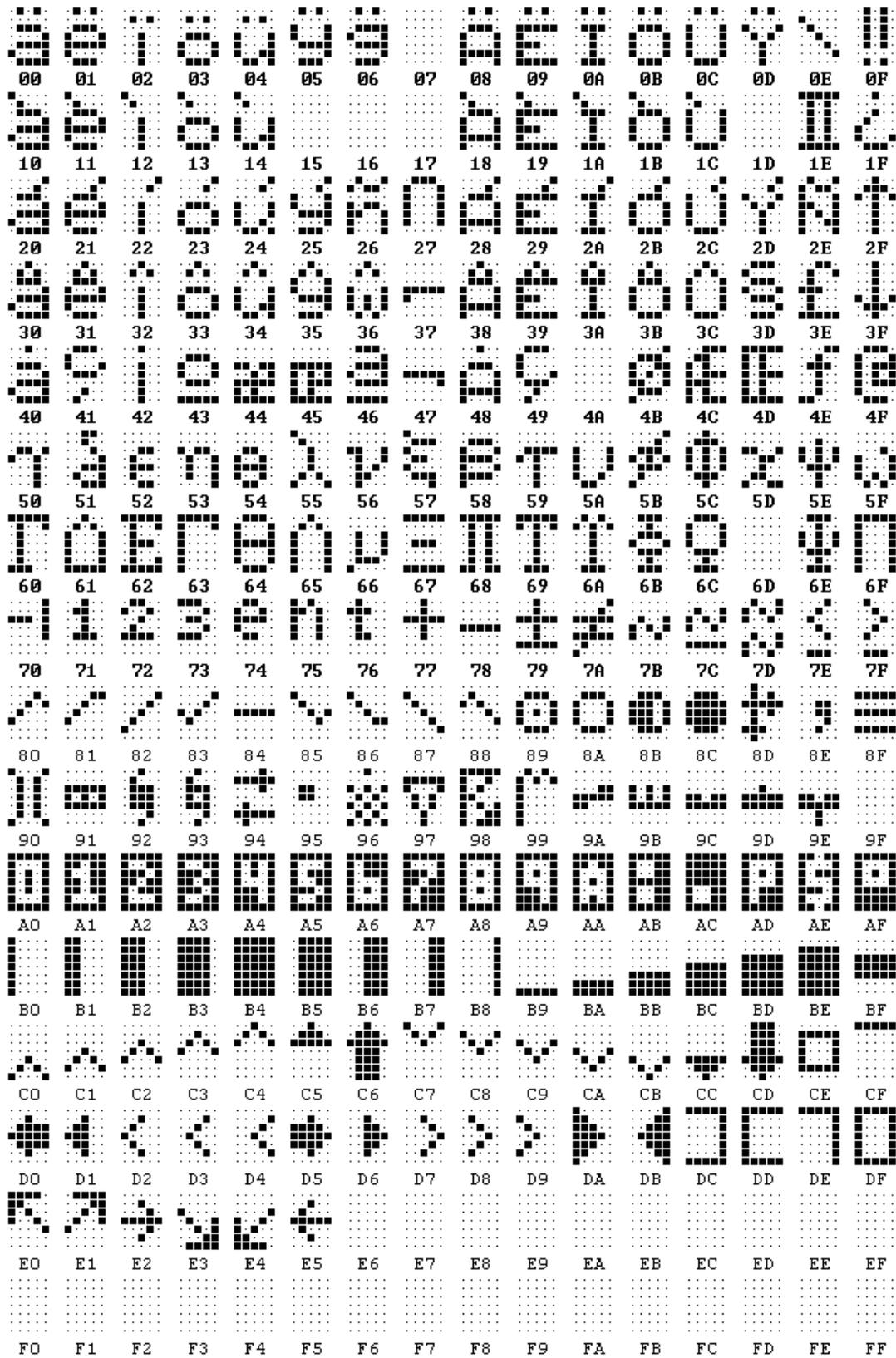| Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 16

3.7   Self–test

The serial input display module can be operated independently from the host by using the "Self–test" option.

1. Check the multiplex jumper for proper setting (Section 4.2).
2. Connect a +5V power supply and potentiometer as discussed in Paragraph 2.1 and Figure 1.
3. Momentarily short the self–test line to GND (P2 pin 5 to pin 8).
4. All character positions should display the character "H".
5. The module can be stepped through the remaining test display frames by using the self–test line as in Step 3 (above). The display will advance from frame to frame each time the self–test line is momentarily shorted to ground. The remaining frames display: I, #, all pixels on, jumper settings in HEX (with jumper #8 being the LSB, see Section 4.2), firmware version number, and then resumption of normal operation.
6. Upon completion of "Self–test", the module is returned to the normal mode of operation with its previous controller and data/instruction (RS bit) settings.

3.8   Diagnostics

1. The display module can be operated by the host in a HEX dump mode. This diagnostic mode provides for the HEX display of all serial data received. While operating in this mode, the module will ignore the multiplex jumper setting and operate the display in a 1/8 multiplex mode.
2. Check the module jumpers for proper baud speed and parity settings (Section 4.2).
3. With power "OFF" short the self–test line to GND (P2 pin 5 to pin 8).
4. While the self–test line is shorted to ground, apply +5 Volts to the display module. The self–test line is now ineffective and may be allowed to float.
5. All serial data received will now be displayed in HEX. To return to the normal operating mode, remove power, allow the self–test line to float, and re–apply power.

If a parity or framing error should occur, the most significant nibble of the HEX code will be displayed as:

HEX Code	Parity Error	Framing Error
0X	GX	gX
1X	HX	hX
2X	IX	iX
3X	JX	jX
4X	KX	kX
5X	LX	lX
6X	MX	mX
7X	NX	nX
8X	OX	oX
9X	PX	pX
AX	QX	qX
BX	RX	rX
CX	SX	sX
DX	TX	tX
EX	UX	uX
FX	VX	vX

X = Least significant nibble

* Characters with parity and framing errors are displayed as framing errors only. Framing errors can occur due to loss of serial bit timing, improper baud rate and/or parity setting.

4.0   INTERFACE AND CONTROL

4.1   Connector Assignment (P2)

Pin No.	Function
P2–1	R_X Data
P2–2	R_X Data RTN (Signal Ground)
P2–3	RESET
P2–4	Adjust
P2–5	Self–Test
P2–6	V_{BIAS} (Factory Test Point)
P2–7	V_{CC} (+5 Volts)
P2–8	V_{SS} (Ground)
P2–9	No Connection
P2–10	Optional Backlight
P2–11	Optional Backlight

NOTE: The mating connector must be wired in a reverse pin sequence from its marking. (Pin 11 is Pin 1 etc.)

The mating connector is a Molex #22-01-2117 or equivalent. It uses crimp pins #08-50-0114.

4.2   Jumper Settings

Jumper No.	Pins	Jumper A = "0"	Jumper B = "1"
1	E1	4800 Baud	1200 Baud
2	E2	2 x Baud	1 x Baud
3	E3	Parity	No Parity♦
4	E4	Even Parity	Odd Parity
5	E5	7 Data Bits ***	8 Data Bits
6	E6	1/8 Mpx (N/A)	1/16 Mpx
7**		Not Used	
8**		Not Used	

*   Baud rate will default to "1" if no jumper is installed.
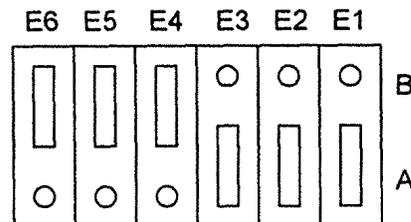
**   Jumper options 7, and 8 are omitted and will indicate as logic "1" when in self–test mode.

***   8 bit word preferred. When 7 bit word is selected see section 3.1.2 for use of instruction 19 Hex.

♦   Selection of NO PARITY requires use of two stop bits.

Example of jumpers installed
for: E1A   4800 Baud
        E2A   2X = 9600 baud
        E3A   Parity
        E4B   Odd Parity
        E5B   8 Data Bits
        E6B   1/16 Multiplex

5.0 ELECTRICALSPECIFICATIONS

5.1 Absolute Maximum Ratings

Power Supply Voltage (V_{CC}): –0.3 to +6.5 V_{DC}

Serial Input Voltage: –25.0 to +25.0 V_{DC}

5.2 Normal Operating Ratings

Power Supply Voltage (V_{CC}): +5.0 V_{DC} ±10%

Power Supply Current: 34 mA Max

5.2.1 Power–up Supply Requirements

Initialization may or may not be performed completely unless the rise time (t_{RCC}) of the power supply is correct at turn–on (1ms $\leq t_{RCC} \leq$ 10ms). Figure 11 represents the requirements of the power supply. Note that t_{OFF} stipulates the minimum time that power can be OFF ($t_{OFF} \geq$ 1ms) during a momentary dip or when the power supply cycles ON and OFF.
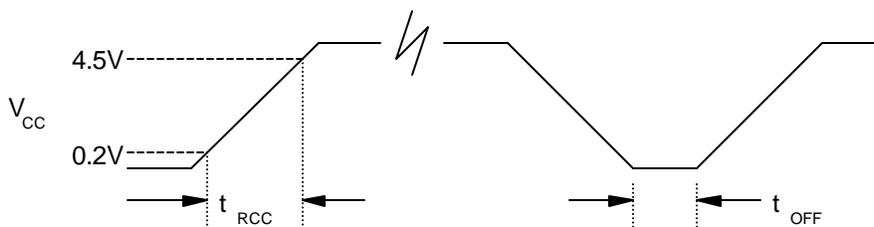

Figure 11   Power Supply Requirements

5.2.2 External Reset Requirements

To utilize the optional external reset, the RESET pin must be held at ground (<0.5 Volts) for at least 10 milliseconds after the power supply is within the voltage tolerance. Figure 12 shows the module Reset circuit.
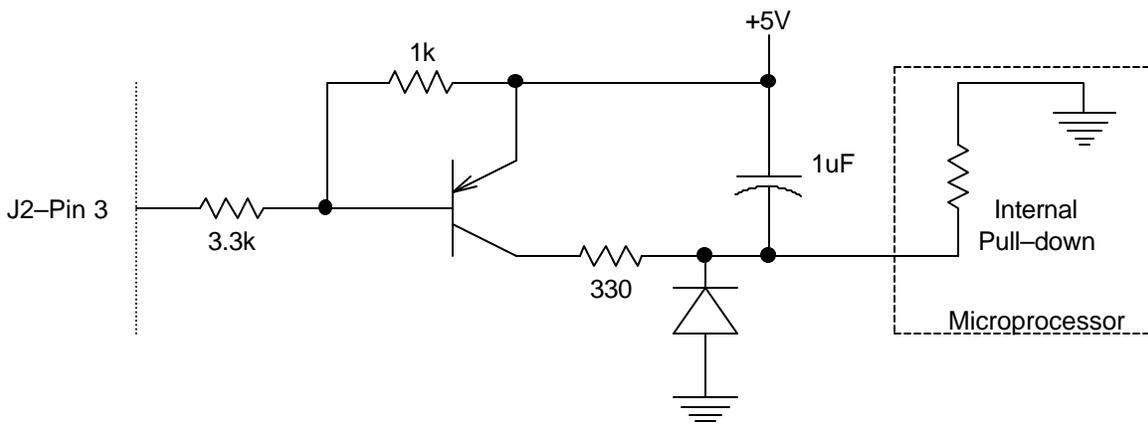

Figure 12   External Reset Circuit

Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 19

5.3 Interface Signals

5.3.1 Serial Interface Signals

The display is designed to be operated by a standard RS–232 serial interface. The user can operate the module with any interface which meets the following requirements for a "mark" condition and a "space" condition. The user should observe generally accepted design rules when interfacing to the display.

Space Voltage (V_{RX} Data – V_{RX} Data RTN) +3.0 to +25.0 Volts

Mark Voltage (V_{RX} Data – V_{RX} Data RTN) –25.0 to +0.8 Volts

6.0 ENVIRONMENTAL CHARACTERISTICS

6.1 Operating

Temperature:	–30 to +80°C
Humidity: (@ 40ºC)	95% RH (non–condensing)
Humidity (< 40°C):	Absolute humidity must be lower the humidity of 95% RH at 40°C
Vibration:	10g at 10 to 400Hz (3 axes)
Shock:	10g (all axes)

6.2 Non–Operating

Temperature: –40°C to +85°C

7.0 OPTICAL SPECIFICATIONS

7.1 Optical Characteristics

Format:	Four lines of 20 characters
Character Font:	5x7 dot matrix with cursor
Character Height w/ cursor:	0.48" (12.1mm)
Character Height w/o cursor:	0.39" (9.9mm)
Character Width:	0.24" (6.1mm)
Overall Active Area:	5.70" x 2.34" (144.9mm x 59.5mm)
Peak Vertical Viewing Angle:	20° below normal plane
Viewing Mode:	Reflective, light field

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing Angle–Vertical	$\phi1-\phi2$	CR=2.0, $\theta=0°$	100	120	–	deg.
Viewing Angle–Horizontal*	T	CR=2.0	±45	±55	–	deg.
Contrast ratio (Peak)**	CR	25°C	10	18	–	–
Response time (ON)**	t_r	25°C	–	100	150	mS
		–30°C	–	2000	–	mS
Response time (OFF)**	t_f	25°C	–	150	200	mS
		–30°C	–	4000	–	mS

* Measured at peak vertical angle, $\phi = -20°$

** Measured at peak viewing angles:

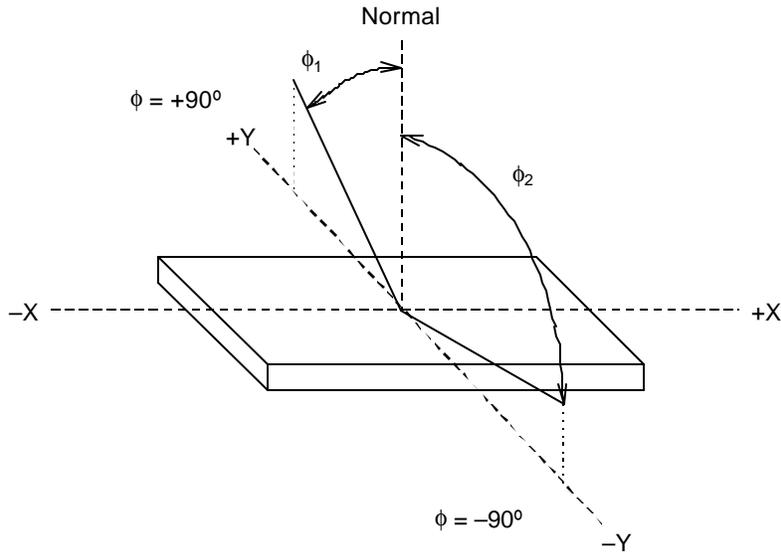| Industrial Electronic Engineers, Inc.	SIZE A	CODE IDENT NO. 05464	S03805–06–0200
Van Nuys, California	SCALE N/A	REV C	SHEET 20

Figure 13   Definition of Vertical Viewing Angle

Definition of Horizontal Viewing Angle–top Viewing Display (for Bottom Viewing Displays $\phi = -20°$ Typically)
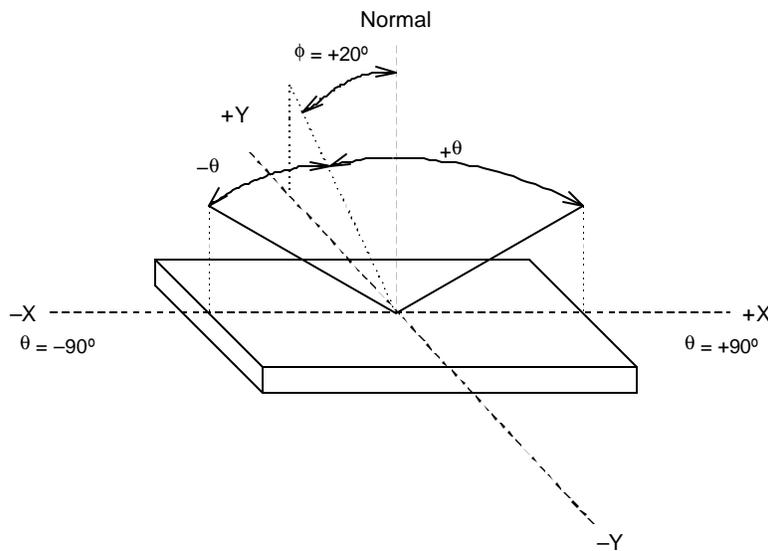

Figure 14   Definition of Horizontal Viewing Angle

Display contrast ratio is given by:

$$CR = \frac{B_2}{B_1}$$

Where: B_1 = Brightness of selected segment

B_2 = Brightness of non–selected segment

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**	**S03805–06–0200**
Van Nuys, California	SCALE N/A	REV C	SHEET 21

Brightness Curve for Selected Segment

B₂

Brightness Curve for Non–selected Segment

B₁

Setpoint Driving Voltage

Figure 15   Definition of Contrast Ratio (CR)

Definition of optical response.

10% ON

90% ON

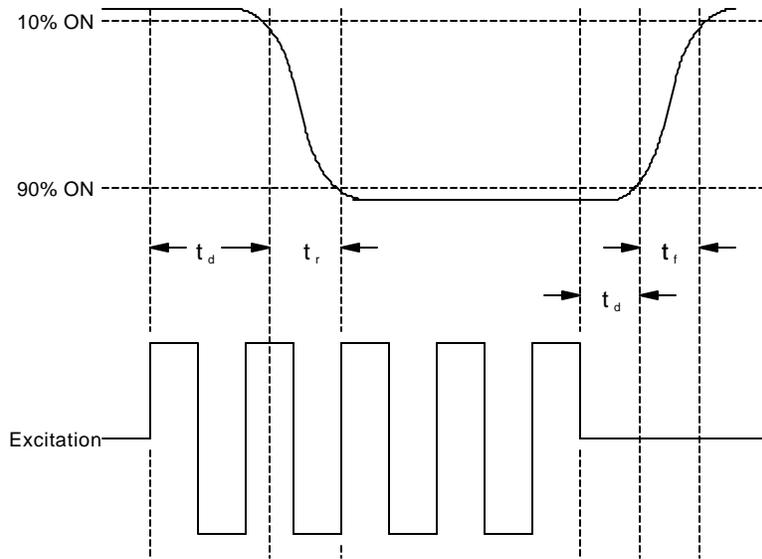t_d t_r t_f

t_d

Excitation

Figure 16   Definition of Optical Response

7.2   Viewing Angle Adjustment

The factory preadjusts the viewing angle of the display by setting the LCD bias voltage to 10.2 Volts using the on–board potentiometer. This is considered to be a nominal adjustment, but the user may prefer to vary this to optimize the viewing for a particular application. The bias voltage is measured between V_{CC} (pin #7) and V_{BIAS} (pin #6).

The viewing angle and contrast ratio may be externally controlled using an additional 10K ohm potentiometer. The potentiometer on the rear of the module must first be set to the maximum resistance by turning the adjustment fully counterclockwise. A 10K ohm potentiometer can then be connected between pin numbers 4 and 7 on the connector. Since the module has wide viewing angle characteristics and built–in temperature compensation of the viewing angle, the user may find that this external viewing control is unnecessary.

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**	**S03805–06–0200**	
Van Nuys, California	SCALE N/A		REV C	SHEET 22

8.0 INSTALLATION NOTE

To protect the front polarizer from accidental damage it is highly recommended that the LCD be mounted behind a clear glass or polycarbonate window material. It is also recommended that an air gap of at least .030" to .050" minimum be provided between the window material and the surface of the LCD to prevent the transfer of static charges to the front surface of the LCD. Supertwist LCD's may activate un–driven elements in response to a surface static charge on the front polarizer. It may take several minutes for such a surface static charge to dissipate.

9.0 ACCESSORIES

Part (Molex)	Mfr. Part No.	IEE Part No.
Power/Data Connector (11 Pin):	22–01–2117	45125–11
Connector Pins, (11 required)	08–50–0114	45126–01

10.0 OUTLINE AND INSTALLATION CHARACTERISTICS
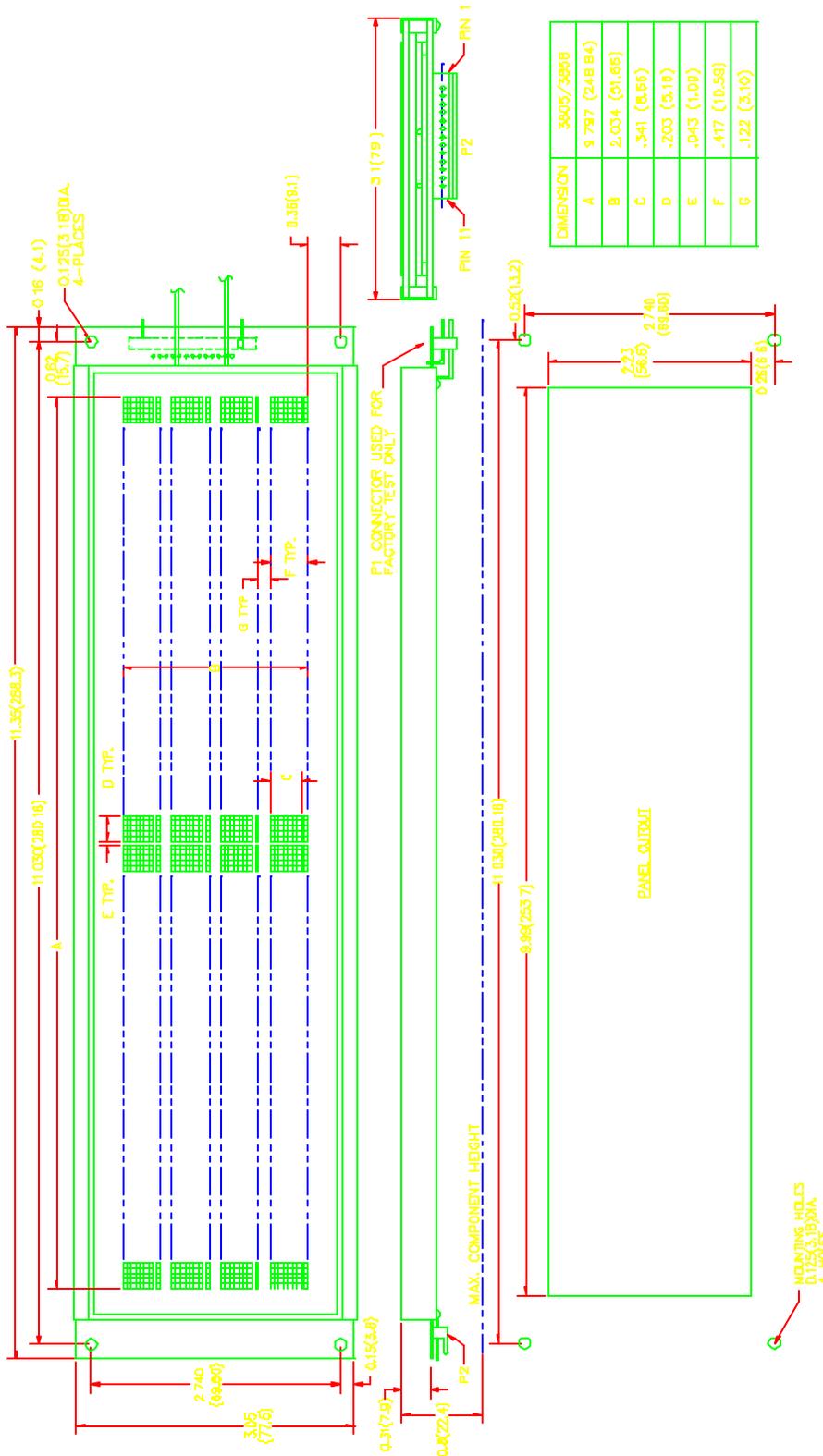
Figure 17   03805–06–0200 Outline Drawing

DIMENSION	3805/3805B
A	9.797 (248.84)
B	2.034 (51.65)
C	.341 (8.66)
D	.203 (5.16)
E	.043 (1.09)
F	.417 (10.59)
G	.122 (3.10)

Industrial Electronic Engineers, Inc.	SIZE **A**	CODE IDENT NO. **05464**	S03805–06–0200	
Van Nuys, California	SCALE N/A	REV C	SHEET 24	