REV:	PAGE:	REVISION DESCRIPTION	APPR:	DATE:
A	-	Released.	GRW	6/20/90
B	4	Changed height dimension from 11.6mm Max. to 12.0mm Max.	GRW	8/28/90
C	all 3 4 6	Converted to new format and edited. Added Sec. 2.0, Applicable Documents. Changed 12.0mm max. height dimension to 13.0mm max. due to a new spacer. Changed 1.5+/-.5mm spacer dimension to 2.5mm. Changed 132.00 pattern length designation to correct value of 132.40. Changed operating temperature range.		

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***FUTABA* CORPORATION OF AMERICA SCHAUMBURG, IL.**		DRAWING TITLE: PRODUCT SPECIFICATION	
		PART NUMBER: US16MY02AA	
DESIGNED BY: John Peroutka	ENGINEERING APPROVAL:	CUSTOMER NAME / PART NUMBER: STANDARD PRODUCT	
CHECKED BY:	MFG & MATERIALS APPROVAL:	DATE DRAWN: 01/17/94	FILE NAME: 16MY02A.DOC
CUSTOMER APPROVAL: N/A	QA APPROVAL:	DATE PRINTED: 01/05/98	SHEET: 1 OF 14

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Figures

1.0 INTRODUCTION

The US16MY02AA VFD module is an integrated display module utilizing the 16-MY-02GK single row 16 digit alphanumeric VFD. An on board converter supplies the DC and AC voltages necessary to drive the VFD. Display driver circuitry provides character generation for 64 characters as well as 32 dimming levels. Control of the module is via a simple synchronous serial interface.

2.0 APPLICABLE DOCUMENTS

Futaba America Engineering Standard FAES 801, Printed Circuit Board Markings.

Futaba Vacuum Fluorescent Display Specification 16-MY-02GK.

3.0 SPECIFICATIONS

3.1 GENERAL

Item	Description
Number of Characters	16
Character Format	14 segment Alphanumeric
Character Height	11.1
Character Width	6.4
Character Tilt	5 degrees
Peak Wavelength of Illumination	505 nm x = 0.235, y = 0.405
Luminance	200 fL typ

3.2 MECHANICAL

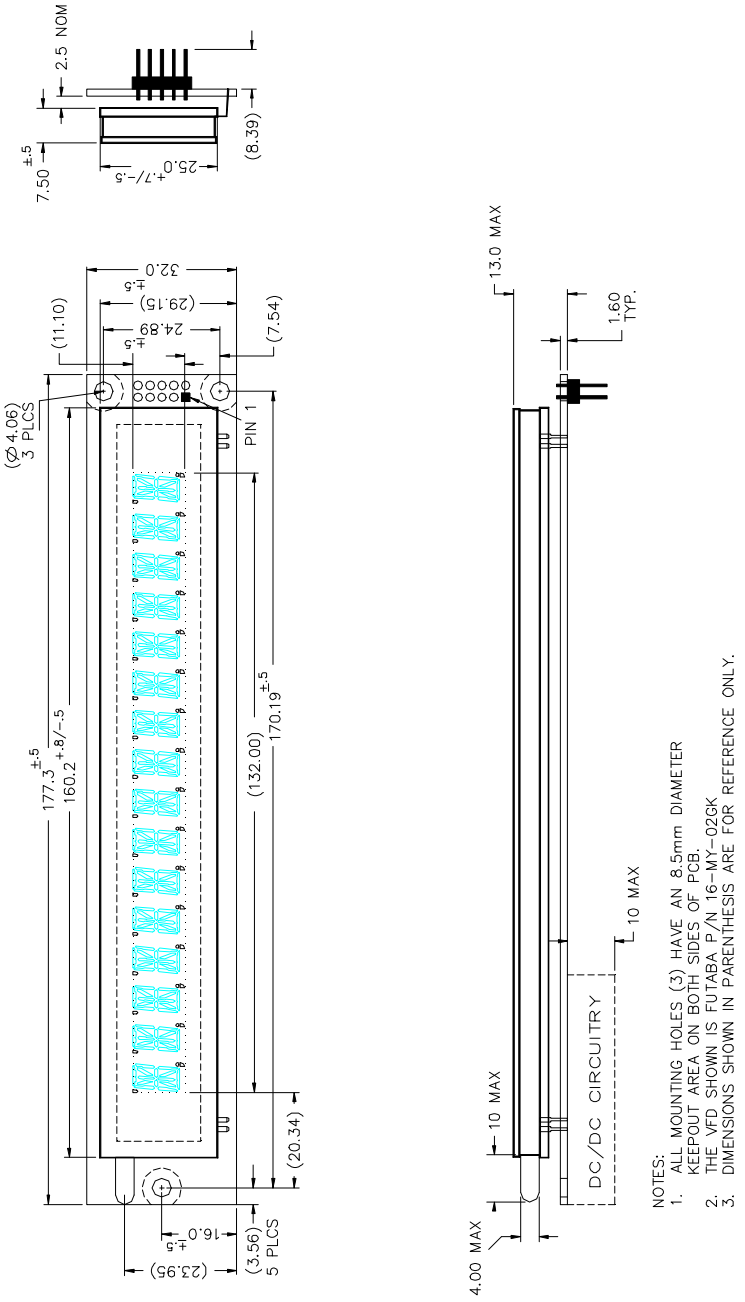


Figure 1. Mechanical Drawing

3.3 BLOCK DIAGRAM

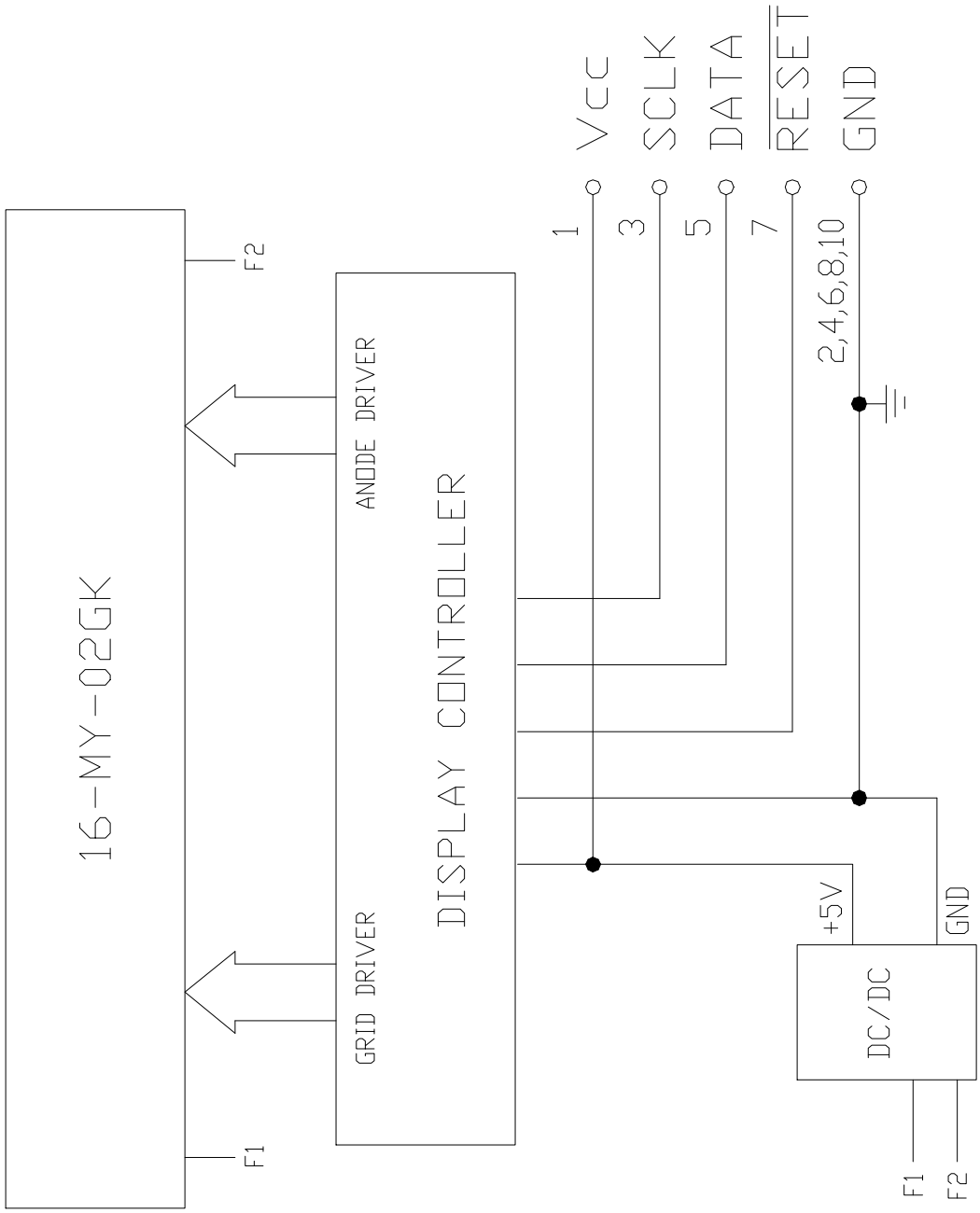


Figure 2. Block Diagram

3.4 ENVIRONMENTAL

Item	Symbol	Min	Max	Unit
Operating Temperature	T_{OPR}	-20	+70	°C
Storage Temperature	T_{STG}	-30	+85	°C
Relative Humidity (Operating)	H_{OPR}	20	85	%
Relative Humidity (Storage)	H_{STG}	20	90	%
Vibration (10-55 Hz)	-	-	4.0	G
Shock	-	-	40	G

3.5 ABSOLUTE MAXIMUM ELECTRICAL RATINGS

Item	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	-0.3	6.5	V
Input Signal Voltage	V_{IN}	-0.3	Vcc+0.3	V

3.6 DC ELECTRICAL CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Supply Current	I_{CC}	-	350	500	mA
High Level Input Voltage	V_{IH}	3.6	-	V_{CC} + 0.3	V
High Level Input Current (V_{IH}=5V)	I_{IH}	-	-	10	µA
Low Level Input Voltage	V_{IL}	0	-	1.0	V
Low Level Input Current (V_{IL}=0V)	I_{IL}	-	-	-0.7	mA

3.7 AC ELECTRICAL CHARACTERISTICS (see Figures 3,4,5)

(V_{CC} = 5V)

Item	Symbol	Min	Max	Unit
SCLK high pulse width	t_{on}	1	20	µs
SCLK low pulse width	t_{off}	1	-	µs
Set-up Time DATA Before SCLK	t_{su}	200	-	ns
Hold Time DATA After SCLK	t_{hd}	100	-	ns
Wait time between bytes	t_{wait}	40	-	µs
LSB to LSB time	t_{bb}	120	-	µs
Reset\ pulse width	t_{rst}	100	-	µs
Reset to Data time	t_{rd}	100	-	µs

TIMING DIAGRAMS

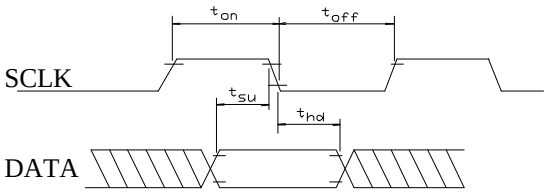


Figure 3. SCLK and DATA Timing Diagram

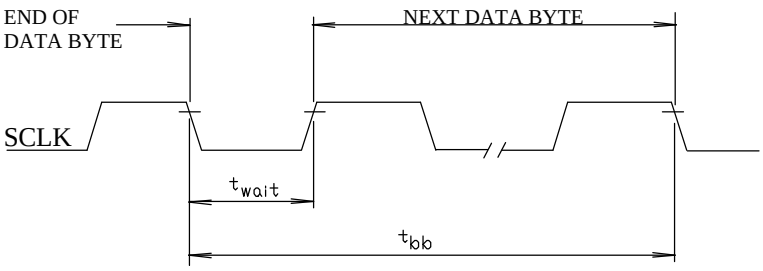


Figure 4. Byte to Byte Timing Diagram

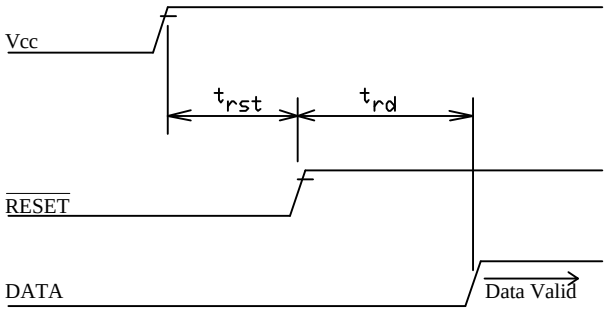


Figure 5. Power-up and Reset\ Timing Diagram

4.0 FUNCTIONAL DESCRIPTION

Input data from the host system is loaded into the module's display buffer via the serial data input channel. The internal timing and control system synchronizes the signal and digit output signals to provide correct timing for the multiplexing operation. A 16 x 64 bit programmable logic array (PLA) is provided for segment decoding of the full upper-case ASCII character set. Input data from the host system is loaded as a series of 8-bit data bytes clocked in on the high to low transition of the clock.

Control and Character Data Bytes
The most significant bit (bit 7) is loaded first and is referred to as the control bit (C-bit). If the C-bit of any byte is logical 1, the byte is a control data byte; if it is logical 0, the byte is a character data byte. The functions and formats of control and character data bytes are described in detail below.

4.1 WRITING CONTROL DATA BYTES

When the C-bit of the loaded byte is logical 1, bits 6 and 5 are decoded into one of three control commands, while data associated with the command function is decoded from bits 4 to 0. The three display functions controlled by bits 7 to 4 are tabulated below (note: the duty cycle control byte uses bits 7 to 5).

8-BIT CONTROL BYTE 7 6 5 4 3 2 1 0	FUNCTION
1 0 1 0 X X X X	Load Buffer Pointer (position of character to be defined)
1 1 0 0 Y Y Y Y	Load Digit Counter (number of characters to be displayed)
1 1 1 Z Z Z Z Z	Load Duty Cycle (luminance level control)

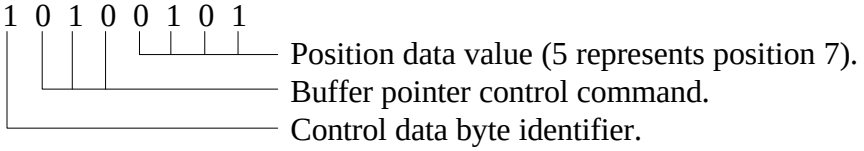
NOTES:
1. "XXXX" - 4 bit binary value of the digit position to be written to.
2. "YYYY" - 4 bit binary value of the number of characters to be displayed.
3. "ZZZZZ" - 5 bit binary value divided 31 times 100% equals luminance level.

4.1.1 BUFFER POINTER

The buffer pointer control byte requires bits 7,6,5 and 4 to be set to 1010, respectively. This allows any specific character within the display to be modified. The character to be modified is represented by the value of bits 3 to 0, the actual value being the decimal value of the position minus 2. If no buffer pointer control byte is specified, the controller will default to position 1. For a complete list of buffer pointer values see the table below.

Hex byte	Pointer Value	Character Controlled
A0	0	2
A1	1	3
A2	2	4
A3	3	5
A4	4	6
A5	5	7
A6	6	8
A7	7	9
A8	8	10
A9	9	11
AA	10	12
AB	11	13
AC	12	14
AD	13	15
AE	14	16
AF	15	1

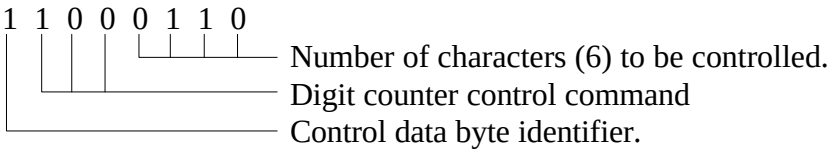
For example, to point to character position number 7, a decimal value of 5 is entered; hence, the 8-bit byte would be:



4.1.2 DIGIT COUNTER

The digit counter control byte requires bits 7,6,5 and 4 to be set to 1100, respectively. This is used to define the number of character positions to be controlled. This byte is normally used only during initialization routines. The binary value of the data corresponding to bits 3 thru 0 determines the actual number of characters to be controlled. When all 16 characters are to be controlled, bits 3 thru 0 should be set to 0. If less than 16 characters are used, a number corresponding to the actual number of characters to be controlled should be entered.

For example, if six characters are to be controlled, the full 8 bit byte would be:

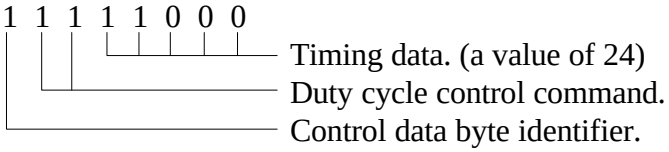


4.1.3 DUTY CYCLE COUNTER CONTROL

The duty cycle control byte requires bits 7,6, and 5 to be set to 111, respectively. The value of the data corresponding to the remaining bits determines the luminance level of the display.

The duty cycle control byte contains a five bit numeric field (bits 4 to 0) that allows the 'on' time for all digits to be modified. Luminance levels are available in 1/31 or 3.2% steps. A binary value of 31 represents maximum luminance, while a value of 0 places the output drivers into the "off" state and blanks the display.

For example, a binary value of 24 would force the display's luminance level to be 77% of maximum luminance, and the full 8-bit byte would be:



4.2 WRITING CHARACTER DATA BYTES

Character data bytes are loaded into the data buffer as 8 bit bytes, with the C-bit (bit 7) set to 0. The 64 available data bytes are shown in Figure 6 on page 13, with their corresponding ASCII characters.

The display buffer pointer is automatically incremented before each character data byte is stored. Decimal points and commas will not cause the buffer pointer to increment, and are therefore always associated with the character data byte previously entered.

If it is desirable to place characters out of sequence, that is not from position 1 to 16, then each character data byte must be preceded by the appropriate positional data through the use of the buffer pointer control byte.

4.3 POWER-ON RESET

Once Vcc has stabilized after power up, a 100us active low pulse must be applied to the RESET\ input to initialize the module. The following conditions are established after a RESET\ pulse has been applied.

1) The duty cycle is set to 0 (this blanks the display).
2) The digit counter is set to 16 characters.
3) The buffer pointer is set to point to the left most character (position 1).

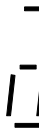
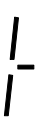
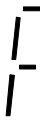
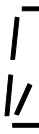
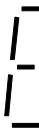
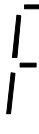
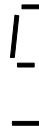
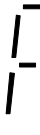
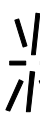
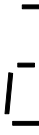
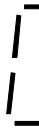
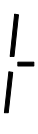
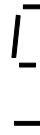
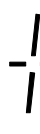
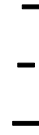
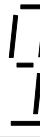
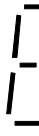
MSD / LSD	0X000	0X001	0X010	0X011	0X100	0X101	0X110	0X111
000								
001								
010								
011								
100								
101								
110								
111								

Figure 6. Character Codes

5.0 INTERFACE CONNECTIONS

Connector J1 Bergstick P/N: 67996110

PIN #	PIN FUNCTION
1	Vcc
2	Ground
3	SCLK
4	Ground
5	Data
6	Ground
7	Reset\
8	Ground
9	N.C.
10	Ground