| REV: | PAGE: | REVISION DESCRIPTION | APPR: | DATE: |
|------|-------|----------------------|-------|-------|
| A | - | Released to production | GRW | 11-20-90 |
| - | 2, 3, 10 | Incorporated US16SY11BA | GRW | 04-04-95 |
| B | 3 | Changed dimensions on mechanical drawing: 7.93 was 7.60; 17.91 was 17.58; 1.83 was 1.50. (ECO 96-002) | | |

**FUTABA CORPORATION OF AMERICA**
**SCHAUMBURG, IL.**

| | |
|---|---|
| DRAWING TITLE: | PRODUCT SPECIFICATION |
| PART NUMBER: | US16SY11AB / US16SY11BB |

| DESIGNED BY: John Peroutka | ENGINEERING APPROVAL: | CUSTOMER NAME / PART NUMBER: STANDARD PRODUCT | |
|---|---|---|---|
| CHECKED BY: | MFG & MATERIALS APPROVAL: | DATE DRAWN: 01/30/96 | FILE NAME: 16SY11A.DOC |
| CUSTOMER APPROVAL: N/A | QA APPROVAL: | DATE PRINTED: 01/05/98 | SHEET: 1 OF 11 |

## 1.0 INTRODUCTION

This module is an integrated display module utilizing the 16-SY-11GK single row 16 character alpha numeric VFD. An on board converter supplies the DC and AC voltages necessary to drive the VFD from a single 5V supply. 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. The US16SY11B version does not have a connector.

## 2.0 APPLICABLE DOCUMENTS

**2.1** Futaba America Engineering Standard FAES 800, Printed Circuit Board Layout Criteria.

**2.2** Futaba Vacuum Fluorescent Display Specification Number 16-SY-11GK.

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

## 3.0 SPECIFICATIONS

## 3.1 GENERAL SPECIFICATIONS

| Item | Value |
|------|-------|
| Number of Characters | 16, 1 row |
| Character Configuration | 14 segment alphanumeric |
| Character Height | 5.0  mm |
| Character Width | 3.0 mm |
| Character Pitch | 5.5 mm |
| Character Tilt | 5° |
| Peak Wavelength | Green (505 nm) |
| Luminance | 200 fL typ. |

## 3.2    MECHANICAL  DRAWING
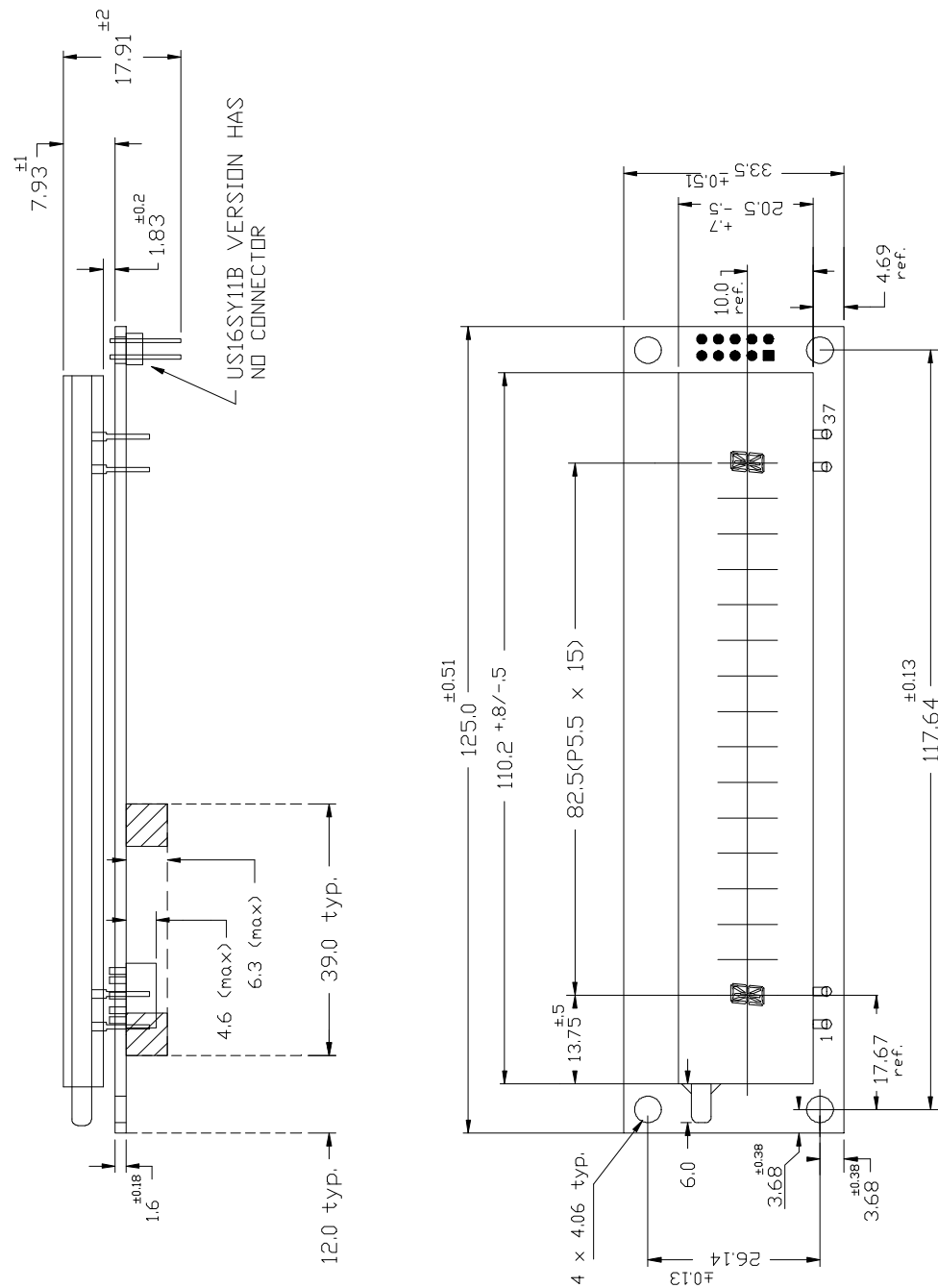


**Figure 1.**    Mechanical Drawing (Not to scale)

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## 3.3    SYSTEM BLOCK DIAGRAM
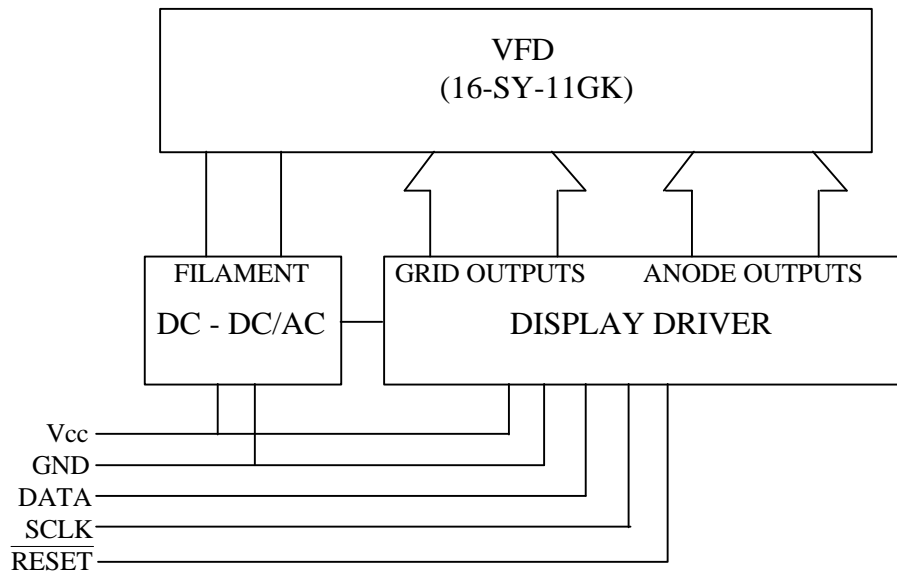


**Figure 2.**  Block Diagram

## 3.4    ENVIRONMENTAL SPECIFICATIONS

| Item | Symbol | Min. | Max. | Unit |
|------|--------|------|------|------|
| Operating Temperature | Topr | 0 | +70 | °C |
| Storage Temperature | Tstg | -30 | +85 | °C |
| Relative Humidity (Operating) | Hopr | 0 | 85 | % |
| Relative Humidity (Storage) | Hstg | 0 | 90 | % |
| Vibration   (Note 1) | - | | 4 | G |
| Shock   (Note 2) | - | | 40 | G |

Notes:
1.    Amplitude: 1.5mm; Frequency: 10 - 55 Hz; Sweep time: 1 min/cycle;
      Time: 2 hours/axis (x,y,z).
2.    Duration: 11ms; half sine wave; 3 times each (x,y,z).

### 3.5    ABSOLUTE MAXIMUM ELECTRICAL RATINGS

| Item | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Power Supply Voltage | Vcc | -0.3 | +6.5 | V |
| Input Signal Voltage | Vin | -0.3 | Vcc + 0.3 | V |

### 3.6    DC ELECTRICAL CHARACTERISTICS

| Item | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Power Supply Voltage | Vcc | 4.5 | 5.0 | 5.5 | V |
| Power Supply Current | Icc | | 150 | 200 | mA |
| High Level Input Voltage | Vih | 3.6 | | Vcc+0.3 | V |
| High Level Input Current (Vih=5V) | Iih | | | +10 | μA |
| Low Level Input Voltage | Vil | 0 | | 1.0 | V |
| Low Level Input Current (Vil=0V) | Iih | | | -0.4 | mA |

Note:    A surge current of up to 2 times maximum input current can occur upon power up.
The peak surge current amplitude and duration are dependent on the host power
supply characteristics.

### 3.7    AC ELECTRICAL CHARACTERISTICS

| Item | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Clock time high | Ton | 1.0 | 20.0 | μs |
| Clock time low | Toff | 1.0 | | μs |
| Data Setup Time | Tsu | 200 | | ns |
| Data Hold Time | Thd | 100 | | ns |
| Wait between Data words | Twait | 40 | | μs |
| Byte to Byte Time | Tbb | 120 | | μs |
| Reset time | Trst | 100 | | μs |
| Data ready | Trdy | 100 | | μs |

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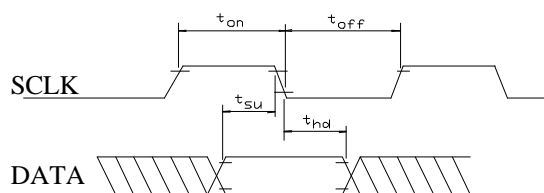
**TIMING DIAGRAMS**



**Figure 3.** SCLK and DATA timing diagram
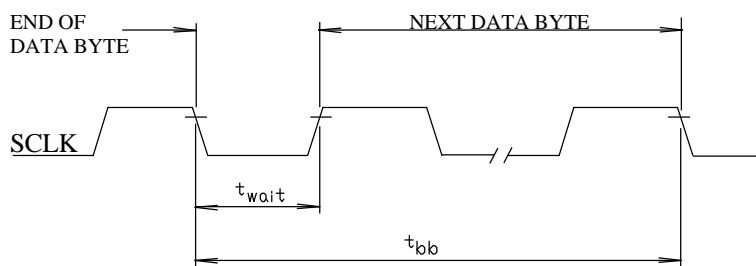


**Figure 4.** Byte to byte timing
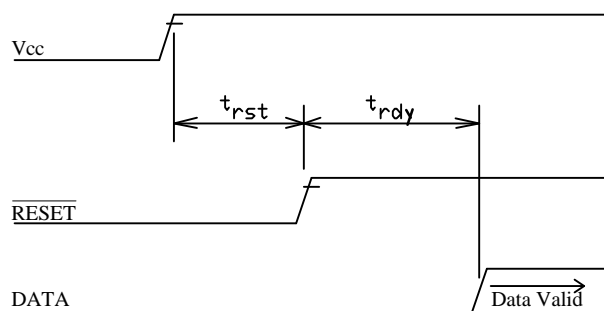


**Figure 5.** Power-up and Reset\ timing

## 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, it is recognized as a control data byte. See table below for the format and explanation of each..

| 8-BIT CONTROL BYTE<br>7 6 5 4 3 2 1 0 | FUNCTION |
|---|---|
| 1 0 1 0 X X X X | Load Buffer Pointer<br>(position of character to be defined) |
| 1 1 0 0 Y Y Y Y | Load Digit Counter<br>(number of characters to be displayed) |
| 1 1 1 Z Z Z Z Z | Load Duty Cycle<br>(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
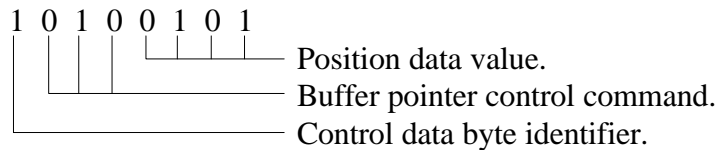3. "ZZZZZ" - 5 bit binary value divided by 31 times 100% equals luminance level.

### 4.1.1 LOAD BUFFER POINTER

The buffer pointer control byte requires bits 7 to 4 to be set to 1010. 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. For a complete list of buffer pointer values see the table below.

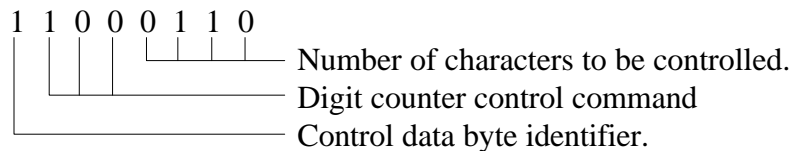| Control Byte | AF | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | AA | AB | AC | AD | AE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Character Controlled | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

For example, to point to character position number 7, a hex value of A5 is entered; hence, the 8-bit byte would be:

```
1 0 1 0 0 1 0 1
              └─┴─┴─┴── Position data value.
        └──────────── Buffer pointer control command.
└────────────────── Control data byte identifier.
```

### 4.1.2 LOAD DIGIT COUNTER

The digit counter control byte requires bits 7 to 4 to be set to 1100. 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 to 0 determines the actual number of characters to be controlled. 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, a hex value of C6 is entered; hence, the 8-bit byte would be:

```
1 1 0 0 0 1 1 0
              └─┴─┴── Number of characters to be controlled.
        └──────────── Digit counter control command
└────────────────── Control data byte identifier.
```

### 4.1.3 LOAD DUTY CYCLE

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

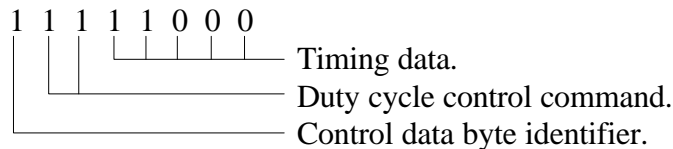| | FUTABA CORPORATION OF AMERICA SCHAUMBURG, IL. | PART NUMBER: US16SY11AB / BB | REV: B |
|---|---|---|---|
| | | DATE PRINTED: 01/05/98 | SHEET: 8 OF 11 |

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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 1/32 or 3.1% steps. A 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:

```
1 1 1 1 1 0 0 0
        └─┴─┴─┴─┴── Timing data.
      └──────────── Duty cycle control command.
  └──────────────── Control data byte identifier.
```

## 4.2    WRITING CHARACTER DATA BYTES

| 8-BIT DATA BYTE | FUNCTION |
|---|---|
| 0 X Z Z Z Z Z | Character Data Byte |

NOTES: 1.    "X"-            don't care
          2.    "ZZZZZZ"-    6 bit character address from the character table

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, 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 <u>after</u> power up, a 100μs 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).

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## 5.0    INTERFACE CONNECTIONS

The US16SY11A version of this module has a 10 pin dual row unshrouded header (DuPont P/N 67996-110).  The US16SY11B version has no connector.

| Pin | Function | Pin | Function |
|-----|----------|-----|----------|
| 1 | Vcc | 2 | GND |
| 3 | SCLK | 4 | GND |
| 5 | DATA | 6 | GND |
| 7 | Reset\ | 8 | GND |
| 9 | NC | 10 | GND |

**Figure 6. Character Codes**

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