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Industrial Electronic Engineers, Inc.
Van Nuys, California

SIZE A	CODE IDENT NO. 05464	S03601-96-080
SCALE	REV A	SHEET 2

1.0 GENERAL DESCRIPTION

1.1 Introduction

This specification describes the interface requirements and features of a two-line Vacuum Fluorescent Display, 40 characters wide. The characters are formed using a 5x7 dot matrix.

1.2 Application

This unit may be used as a console display which provides alphanumeric information that is easily readable in high ambient light. Its capability makes it ideal for point-of-sale terminals, office computers, and a wide range of business and industrial equipment.

1.3 Special Features

"Minimum depth"	Hardware reset
Low cost	Software dimming
Hardware interrupt	European character set
User defined characters	

1.4 Description

This Vacuum Fluorescent display is a self-contained multiplexed unit which provides a simple interface to a microprocessor system.

This unit consists of a Vacuum Fluorescent display tube and a minimal amount of electronic hardware. Primary complexity is contained within the microprocessor software, which controls all display functions.

A single +5VDC power supply (approximately 530mA typical) is required for operation. Total power is thus about (2.7) watts.

All display characters and standard control codes are in a 8-bit format. All inputs are TTL compatible. No unusual coding or critical timing is required to interface with and operate this display.

A wide spectrum of color filters is available to fit all applications. The characters are bright, but soft, providing comfortable short or long-term viewing.

An ASCII-coded English font employs a standard 96 character set.

A special font employs a 96 character set.

Figure 3 depicts the character sets as displayed by the 03601-96-080 module.

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2.0 BLOCK DIAGRAM

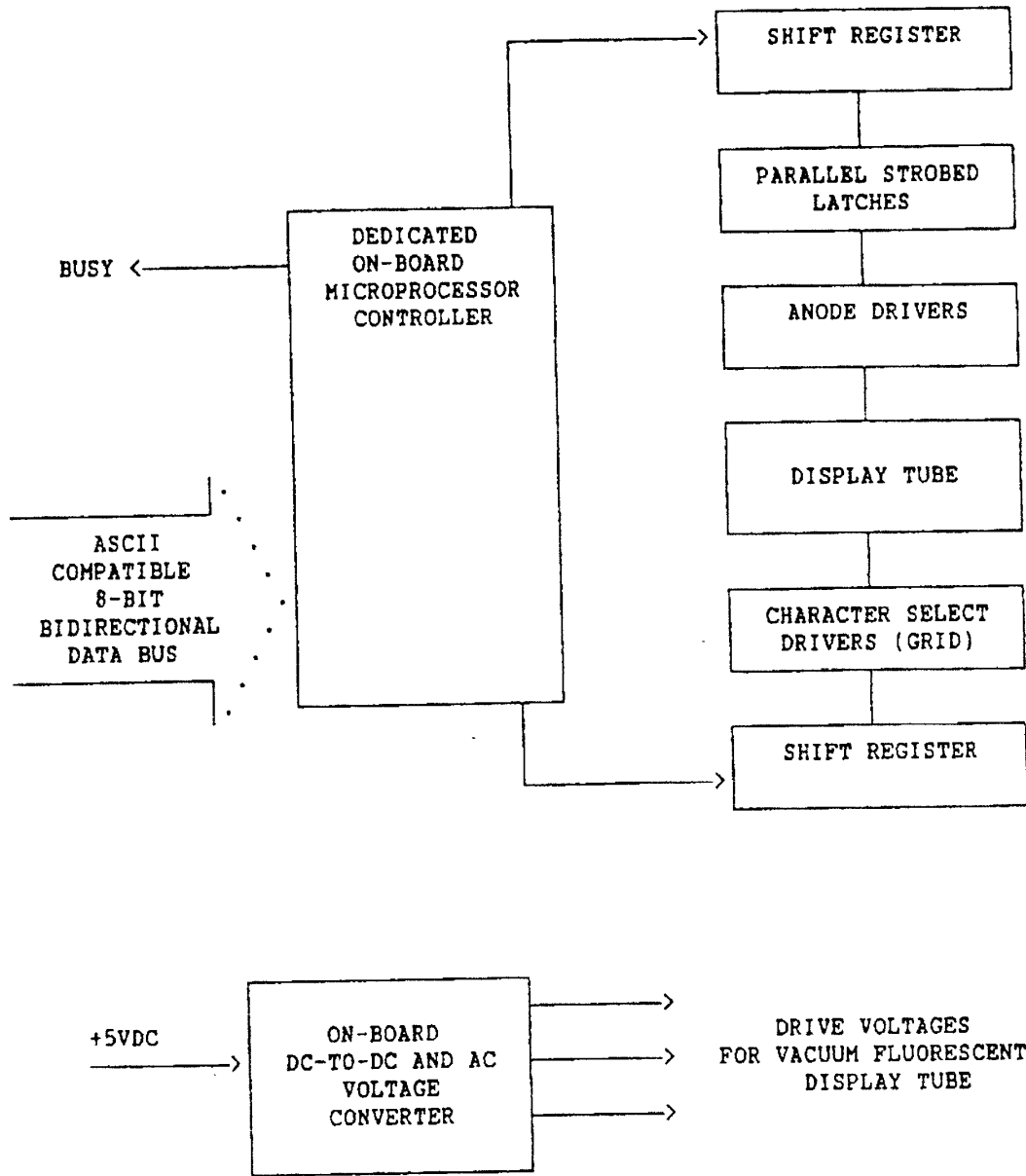


FIGURE 1

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3.0 THEORY OF OPERATION (Dot Matrix Displays)

The Vacuum Fluorescent Display array consists of three basic electrodes which are enclosed in an evacuated glass chamber. The first electrode is the filament, which spans the entire length of the display, and is made from a small diameter oxide coated tungsten wire. This element is common to all characters and supplies the electron emission needed for operation. Individual grid electrodes are provided, one for each character, to control current passing to the anodes. Each grid is a fine mesh metal screen which provides digit-select electrical control with no visual interference. When the grid is positive with respect to the filament, electrons are allowed to pass on to the third electrode, the anode dots, causing the fluorescent phosphor coating on each positively charged dot to glow. Selectively energizing these fluorescent dots causes the desired character to be displayed.

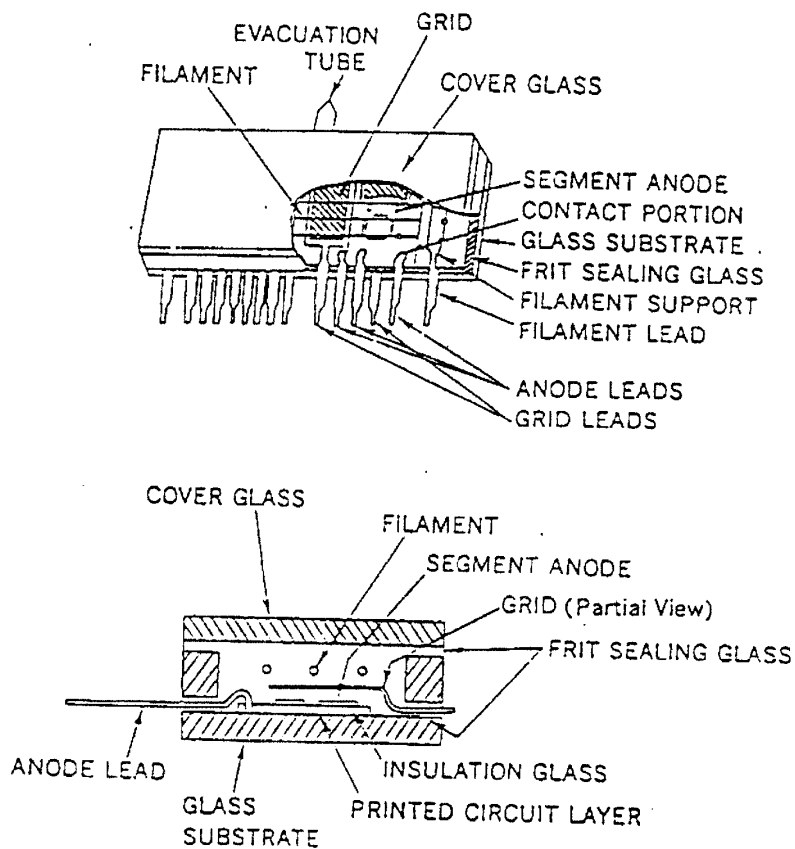


FIGURE 2

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4.0 OPERATION

4.1 Loading ASCII Character Data

All printing characters are in locations from 20 (HEX) to 7F (HEX) and from A0 (HEX) to FF (HEX). Control character assignments are as follows.

4.2 Control Codes

NOTE: CARE SHOULD BE TAKEN NOT TO SEND UNDEFINED CONTROL OR COMMAND CODES TO THE FLIP DISPLAY MODULE AS THIS MAY CAUSE A SOFTWARE MALFUNCTION OF THE MODULE.

DATA (HEX)	DESCRIPTION
08	BACK SPACE CURSOR LOCATION ONE POSITION
09	ADVANCE CURSOR LOCATION ONE POSITION
0A	LINE FEED (vertical scroll from bottom line; cursor positions to the left-most grid).
0D	CARRIAGE RETURN (returns cursor to left-most character position of the same line; does not clear display)
0E	+ MAKE CURSOR INDICATOR INVISIBLE (the cursor location counter continues to function but there is no visible indicator of next location)
0F	MAKE CURSOR INDICATOR VISIBLE (Flashing "reverse rubout character")
<11>	+ NORMAL DATA ENTRY WITH AUTOMATIC CARRIAGE RETURN AND LINE FEED (data entered beginning at the home position)
<12>	OVERWRITE OF RIGHT-MOST CHARACTER/AUTOMATIC CARRIAGE RETURN OFF
<13>	HORIZONTAL SCROLL MODE (from right to left on bottom line only, after line has been filled)
14	RESET
15	+ DISPLAY CLEAR (returns cursor to upper left-most position of multi-line displays).
16	+ CURSOR HOME (returns cursor to upper left-most position of multi-line displays).
18	BEGIN EXTERNAL FONT LOAD
19	BIT 7 HIGH FOR NEXT BYTE ONLY

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4.2 Control Codes (Continued)

DATA (HEX)	DESCRIPTION
1D	DIM (20%)
1E	BRIGHT (50%)
1F	BRIGHTEST (100%)

+ Display automatically defaults to these conditions after power-up.

4.2.1 Cursor Positioning Instruction

DATA (b7-b0)	DESCRIPTION
1B HEX (0001 1011)	MOVE CURSOR TO FOLLOWING POSITION (2 byte instruction to locate cursor.
XLXX XXXX	SECOND BYTE (Location in binary - upper left most location is zero, L=0 upper line, L=1 lower line, 0000 0000 "moves cursor to home position)*

*For numbers greater than 27 Hex for each line, cursor location will remain unchanged.

4.3 Reading Data and Status Information

Busy status is available on J1-1. This signal may be used as a hardware interrupt for the host processor when the display is busy. High busy signal indicates that the display is busy.

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4.4 Character Chart (5x7 Dot Matrix)

DATA BITS				b7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
b3	b2	b1	b0	b6	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	
				b5	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	
				b4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
				HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0	0			SP	0	0	P	>	P			Ä	Ö	ä	ö	□	
0	0	0	1	1			!	1	A	Q	a	q			Ä	Ö	ä	ö	□	
0	0	1	0	2			"	2	B	R	b	r			Ä	Ö	ä	ö	□	
0	0	1	1	3			#	3	C	S	c	s			Ä	Ö	ä	ö	□	
0	1	0	0	4			\$	4	D	T	d	t			Ä	Ö	ä	ö	□	
0	1	0	1	5			%	5	E	U	e	u			Ä	Ö	ä	ö	□	
0	1	1	0	6			&	6	F	V	f	v			Ä	Ö	ä	ö	□	
0	1	1	1	7			'	7	G	W	g	w			Ä	Ö	ä	ö	□	
1	0	0	0	8			(8	H	X	h	x			Ä	Ö	ä	ö	□	
1	0	0	1	9)	9	I	Y	i	y			Ä	Ö	ä	ö	□	
1	0	1	0	A			*	:	J	Z	j	z			Ä	Ö	ä	ö	SP	
1	0	1	1	B			+	;	K	E	k	e			Ä	Ö	ä	ö	SP	
1	1	0	0	C			,	<	L	Y	l	y			Ä	Ö	ä	ö	SP	
1	1	0	1	D			-	=	M	U	m	u			Ä	Ö	ä	ö	SP UDC	
1	1	1	0	E			.	>	N	^	n	^			Ä	Ö	ä	ö	SP UDC	
1	1	1	1	F			/	?	O	_	o	_	⊗		Ä	Ö	ä	ö	UDC	

FIGURE 3

Note: 30H and AFH are the same character
 SP = Space
 UDC = User defined character

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4.5 Alternate Character Codes

Not available at this time.

4.6 User Defined Character Loading (5 X 7 Dot Matrix)

One or more characters may be replaced temporarily (until power-off or reset) by user-defined character patterns. To do so, enter the following sequence of commands and data:

BYTE	DESCRIPTION	A0
1	Start load 18 (HEX)	0
2	Location	0
3-7	Character dot data	0
8	Last byte with end bit	0
End bit E:	0 = end of external font load	0
End bit E:	1 = continue to next ASCII character location	0

Location byte: 00 --> FD (Hex) location
 01 --> FE (Hex) location
 02 --> FF (Hex) location

CHARACTER DOT DATA

		DATA BIT								CHARACTER MATRIX																																						
		7	6	5	4	3	2	1	0																																							
3	X	17	08	X	26	X	07	X	<table border="1" style="width: 100%; text-align: center;"> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr> <tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr> <tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr> <tr><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td></tr> </table>					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1	2	3	4	5																																												
6	7	8	9	10																																												
11	12	13	14	15																																												
16	17	18	19	20																																												
21	22	23	24	25																																												
26	27	28	29	30																																												
31	32	33	34	35																																												
4	X	19	10	X	28	18	09	X																																								
5	X	21	12	02	30	20	11	01																																								
6	X	23	14	04	32	22	13	03																																								
7	X	25	16	06	34	24	15	05																																								
8	X	E	X	35	33	31	29	27																																								

NOTE 1: ADDRESSING EVERY DOT FOR EVERY GRID IS NOT RECOMMENDED.

4.7 Execution Times (Maximum)

Character rate	430µS
Line feed	440µS
Control codes	440µS
Display clear	1.7µS
Horizontal scroll	4.8mS
Software reset	2.2mS
Hardware reset	500mS

4.8 Dedicated Hardware Lines

See Section 4.3.

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4.9 Self-Test

The display will go into self-test mode, if test point E2 is connected to ground. In the self-test mode, the display will display every printable character from 20 Hex to FF Hex until E2 has been disconnected from ground.

4.10 Connector Pin Assignments

J1 (POWER/DATA)

PIN NO.	FUNCTION
J1-1	BUSY
J1-2	WRITE STROBE
J1-3	D7 (MSB)
J1-4	D6
J1-5	D5
J1-6	D4
J1-7	D3
J1-8	D2
J1-9	D1
J1-10	D0 (LSB)
J1-11	+5V @ 530mA (TYP.)
J1-12	GROUND (COMMON)
J1-13	NOT USED
J1-14	RESET

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1.0 ELECTRICAL CHARACTERISTICS

5.1 Power ON / OFF Sequence

There are no deleterious effects associated with power ON and OFF of this display, however, rapid ON/OFF sequencing is not recommended. The power/data connector should not be connected/disconnected while power is applied.

CAUTION: Do not apply data or strobe signals unless logic power is also applied; otherwise, the input circuits may be damaged.

Because of the power-up cycle within the microprocessor, rise time of the power supply should be less than 100ms. The display module is not ready to accept data for 500ms.

5.2 Interface Signals

All logic signals abide by the following convention: logic "1" is a high, logic "0" is a low.

Input Levels:

Logic 1 > 2.4VDC @ 1uA.
Logic 0 < 0.5VDC @ 1.6mA.

Output Levels:

Logic 1 > 3.5VDC @ 150uA.
Logic 0 < 0.5VDC @ 4mA.

All parallel interface lines are internally pulled up using 10K resistors connected to the +5V supply.

5.3 Absolute Maximum Ratings

Primary voltage +5.5VDC
Logic range -0.5VDC thru +5.5VDC

5.4 Normal Operating Ratings

Primary Voltage: +5.0 +/- 0.25VDC

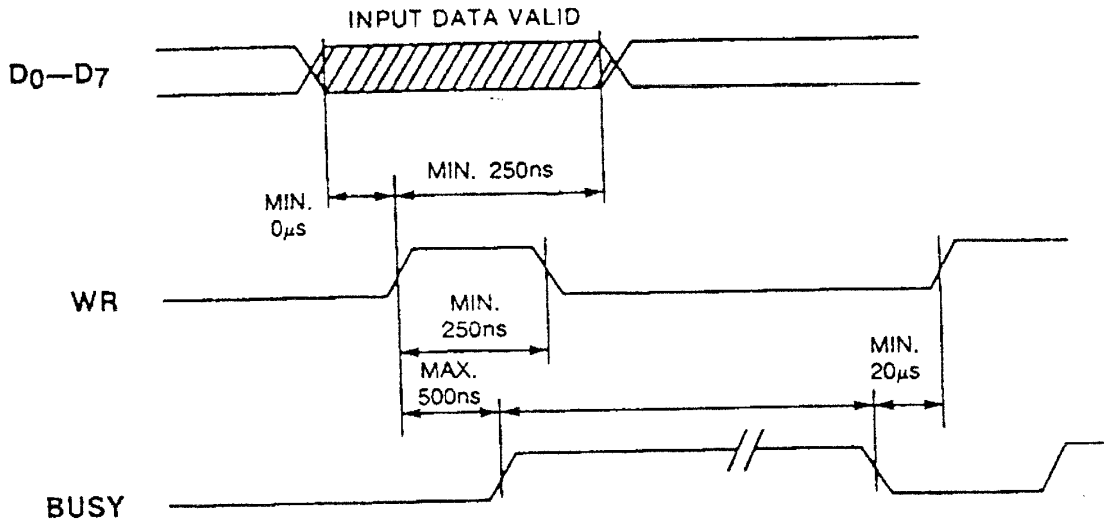
Brightest (Default) Setting - Current Required (at 5.0VDC):

Pre-Production	Production	
(Brightest)		
670mA Max.	580mA Max.	(Screen filled with "EF (HEX)" character)
530mA Typ.	440mA Typ.	(Screen filled with "H" character)
410mA Min.	320mA Min.	(Screen clear)

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5.5 Timing Characteristics And Timing Diagram

DATA WRITE TIMING



6.0 OPTICAL CHARACTERISTICS

Format:	2 lines of 40 characters
Character height:	0.183 (4.65 mm)
Character width:	0.10 (2.55 mm)
Character spacing:	0.167 in. (4.25 mm) center-to-center
Character design:	5 x 7 dot matrix
Type of cursor indicator:	Block
Character sets:	96-character U.S. ASCII-7, 96-character European
Color:	Blue-green, peak at 5000 Angstroms
Viewing angle:	150 degrees
Brightness: (22°C)	100fl (min), 200fl (typ)
Projected life at rated operating conditions:	40,000 to 100,000 hours*

*Note: End of useful life is defined as the point when the display tube light output has decreased to half its initial minimum rated brightness. This life rating is based on use with random text messages. To obtain maximum life, users are encouraged to avoid fixed messages and to blank or clear the display when it is not in use.

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7.0 ENVIRONMENTAL CHARACTERISTICS

Operating temperature: 0 to +55 (°C) +32 to 131 (°F)
 Storage temperature: -20 to +70 (°C) -4 to +158 (°F)
 Relative humidity: 0 to 95% (noncondensing)
 Vibration: 10 to 50 Hz 2mm peak-to-peak (3 axis)
 Shock: 20 G (3 axis)
 Weight: 6.3 ounces (177 grams)

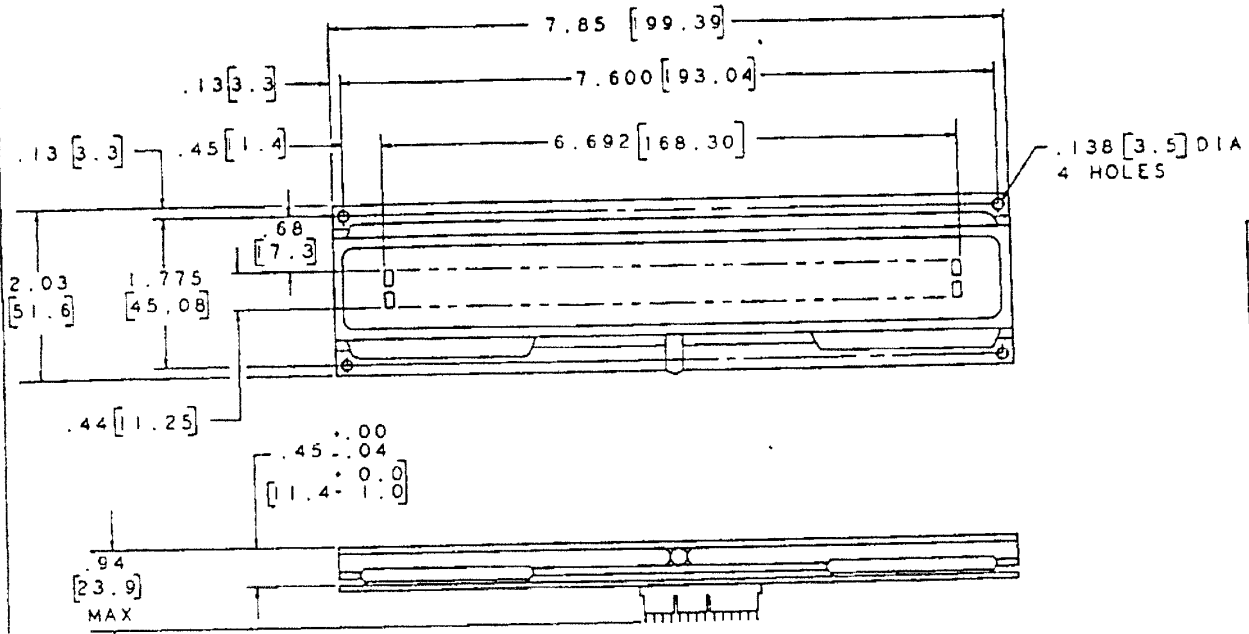
8.0 ACCESSORIES

Cables	Part Number		Qty Required
Data and Power	32770-XX	Single-ended	1
	32771-XX	Double-ended	1
Filters	33096-XX		
Gray	-01		
Blue	-02		
Aqua	-04		
Neon Yellow-Orange	-05		
Green	-07		
Neutral Gray CP	-09		
Yellow CP	-10		
Connectors	Mates With:		
Data	Molex 6373-14		
Power	Molex 2695-14		

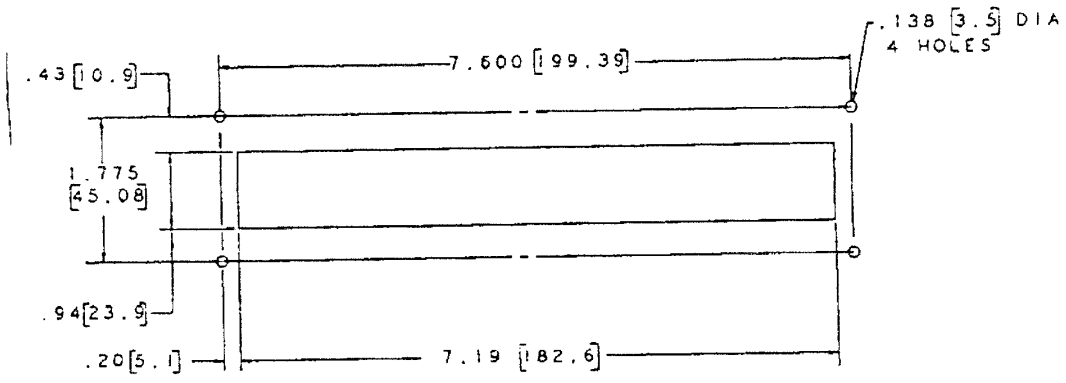
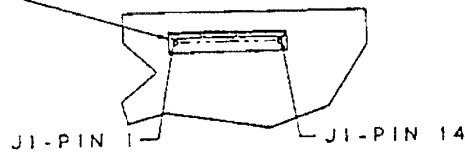
*XX = Length in inches: -99 omits cables

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9.0 OUTLINE AND INSTALLATION DRAWING



J1 CONNECTOR
MATES WITH
MOLEX 5051-14



SUGGESTED PANEL CUTOUT

FIGURE 4

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