

APPLICATION		REVISIONS			
NEXT ASSY	FINAL ASSY	LTR	DESCRIPTION	DATE	APPROVED
		A	PRODUCTION RELEASE /E.O. 39960	11/9/06	B. Lo
		B	E.O. 40029	8/15/07	<i>[Signature]</i>

REV	B	A	A	A	B	A	A	A	A	B	B	B	B	A										
SHEET	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
REV	B	A	B	B	A	A	A	A	A	A	B	A	A	A	B	B	B	A	B	A	A	A	B	A
SHEET	CVR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

REVISION STATUS

PROJ. NO. 346		CONTRACT		 INDUSTRIAL ELECTRONIC ENGINEERS, INC. VAN NUYS, CALIFORNIA		
NOTICE IS HEREBY GIVEN THAT THIS DRAWING IS PART OF A PROPRIETARY ITEM OWNED BY INDUSTRIAL ELECTRONIC ENGINEERS, INC. AND SHALL NOT BE REPRODUCED, OR COPIED OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION OF IEE, INC.		DRAWN R. Rabb 10/26/06		Specification, VFD, Century Series, Dot Matrix Modules RoHS Compliant		
		CHECK B. Lo 11/9/06				
		APPROVED Billy Lo 11/9/06		SIZE A	CODE IDENT NO. 05464	S036X3
		APPROVED		SCALE	None	



PRODUCT SPECIFICATION

Century Series Flip

Dot Matrix ASCII VFD Modules

REV. B

TABLE OF CONTENTS

<u>LIST OF ILLUSTRATIONS</u>	3
<u>LIST OF TABLES</u>	4
<u>DEFINITIONS AND CONVENTIONS</u>	5
1.0 SCOPE	6
2.0 <u>APPLICABLE DOCUMENTS</u>	6
3.0 <u>CHARACTERISTICS</u>	6
3.1 <u>GENERAL</u>	6
3.1.1 Environment	6
3.1.2 Useful Life.....	6
3.1.3 Display Functions	6
3.1.4 Size and Weight	9
3.1.5 Character Cell Features	9
3.1.6 Character Font Data	10
3.2 <u>INTERFACES</u>	14
3.2.1 Power Interface	14
3.2.2 Data Interface	15
3.2.2.1 Serial.....	15
3.2.2.2 Parallel.....	15
3.2.3 Personality Interface	15
3.2.4 Power/Data Connector	16
3.2.5 Self-Test	16
3.3 <u>PERFORMANCE CHARACTERISTICS</u>	18
4.0 <u>PROGRAMMING CODES</u>	21
4.1 <u>NUMERIC ORDER CONTROL CODES</u>	21
4.2 <u>CURSOR CONTROL CODES</u>	23
4.2 <u>CURSOR CONTROL CODES (CONT.)</u>	24
4.3 <u>DATA DISPLAY MODE CODES</u>	25
4.3 <u>DATA DISPLAY MODE CODES(CONT'D)</u>	26
4.4 <u>PREPARE TO READ CODES</u>	26
4.5 <u>SCREEN CONTROL CODES</u>	27
4.6 <u>MISCELLANEOUS CODES</u>	29
5.0 <u>OPTIONS AND ACCESSORIES</u>	31
5.1 <u>PERFORMANCE OPTIONS</u>	31
5.2 <u>ACCESSORIES</u>	31
6.0 <u>OUTLINE DRAWINGS</u>	32

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 2

01/25/07

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Description</u>	<u>Page</u>
3-1	Functional Block Diagram, Intel Mode	7
3-2	Functional Block Diagram, Motorola Mode	8
3-4	ASCII Character Set	11
3-5	Cyrillic Character Set	12
3-6	European Character Set.....	12
3-7	Hebrew Character Set	13
3-8	Katakana Character Set.....	13
3-11	J1 Contact Arrangement	16
3-12	Timing Characteristics, Intel Mode	19
3-13	Timing Characteristics, Motorola Mode	20
6-1	Outline Drawing, 036X3-100-05420	33
6-2	Outline Drawing, 036X3-105-05220	34
6-6	Outline Drawing, 036X3-122-09220	35
6-7	Outline Drawing, 036X3-124-09420	36
6-10	Outline Drawing, 036X3-151-05240	37

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE N/A	REV B	SHEET 3

01/25/07

LIST OF TABLES

<u>Table</u>	<u>Description</u>	<u>Page</u>
3-1	Physical Dimensions	9
3-2	Display Character Fonts	10
3-3	Display Supply Current	14
3-4	Connector Pin Assignments	17
3-5	Execution Times	18
4-1	Dot Data for User Defined Characters	25

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE N/A	REV A	SHEET 4

01/25/07

DEFINITIONS AND CONVENTIONS

Conventions:

- ⇒ First Line, Column, Bit or Position is 0 or 00h.
- ⇒ Control Code names are *italicized*.
- ⇒ Upper case A with subscript from 0 to 7 indicates an address bit from LSB to MSB.
- ⇒ Upper case D with subscript from 0 to 7 indicates a data bit from LSB to MSB.
- ⇒ Counting order is left-to-right, top-to-bottom.
- ⇒ Hexadecimal notation is represented as XXh, where X is a numeric 0 – 9, or alpha A – F.
- ⇒ X = "Don't Care" or Variable Data

Definitions:

- Attributes Blink or Brightness Level.
- Field A display screen area consisting of one or more characters having attributes set.
- Home First line, first column; display screen position 00h.
- Reset Return display or function to its baseline (default condition).
- Restore Return display or function to a previously established state.

Abbreviations:

A	Amperes	LSB	Least Significant Bit
A _n	Address 'n'	mA	Milliamperes
AC or ac	Alternating Current	max	Maximum
ASCII	American Standard Code for Information Interchange	min	Minimum
°C	Degrees Centigrade (Celsius)	mm	Millimeters
CG	Character Generator	Mot	Motorola
CG RAM	Character Generator RAM	MSB	Most Significant Bit
CR	Carriage Return	msec	Milliseconds
CS	Chip Select	nsec	Nanoseconds
D _n	Data Bit 'n'	oz	Ounces
DC or dc	Direct Current	RAM	Random Access Memory
DD RAM	Data Display RAM	RD	Read
E	Enable	RS	Register Select
EIA	Electronic Industries Association	RST	Reset
ft-L	Foot-Lamberts	μA	Microamps
g	Gravitational Units	μF	Microfarads
Hz	Hertz (Cycles per Second)	μsec	Microseconds
ID	Identity or Identification	UDC	User Defined Character
I/O	Input/Output	V	Volts
LF	Line Feed	VFD	Vacuum Fluorescent Display
		WR	Write

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE N/A	REV A	SHEET 5

01/25/07

1.0 SCOPE

This document describes the complete performance and interface characteristics of the dot matrix family of Century Series Vacuum Fluorescent Displays (VFD). For the remainder of this document, the Century Series VFDs are referred to as the display.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

EIA-232 Interface Between Data Terminal Equipment and Data Communication
Equipment Employing Serial Binary Data Interchange

3.0 CHARACTERISTICS

3.1 General

The following sections describe the basic or "Standard" Century Series Dot Matrix VFD. For a complete list of options and accessories, see Paragraph 5.0.

3.1.1 Environment

The display will operate properly following exposure to any combination of the listed environmental conditions:

Storage Temperature	-50°C to +85°C	
Operating Temperature	-20°C to +70°C (Normal)	-40°C to +85°C (Wide)
Relative Humidity	0 to 90% (Non-condensing)	
Vibration	10 to 500 Hz, 2 mm Peak-to-Peak (any axis)	
Shock	20 g (any axis)	

3.1.2 Useful Life

The useful life of the displays ranges from 40,000 to 100,000 hours.

NOTE

Useful life for a vacuum fluorescent tube is defined as the period over which the light output decreases to half of its specified initial minimum brightness. Maximum useful life is achieved by display of random text messages. Users are encouraged to avoid fixed messages wherever possible, and to clear or blank the display when not in use. A screen saver mode is provided.

3.1.3 Display Functions

The dot matrix family of Century Series VFDs is able to simulate Intel 8041/42 series and Motorola 6821 interface characteristics as specified herein.

Critical interface lines are shown in the functional block diagrams, Figures 3-1 and 3-2.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 6

01/25/07

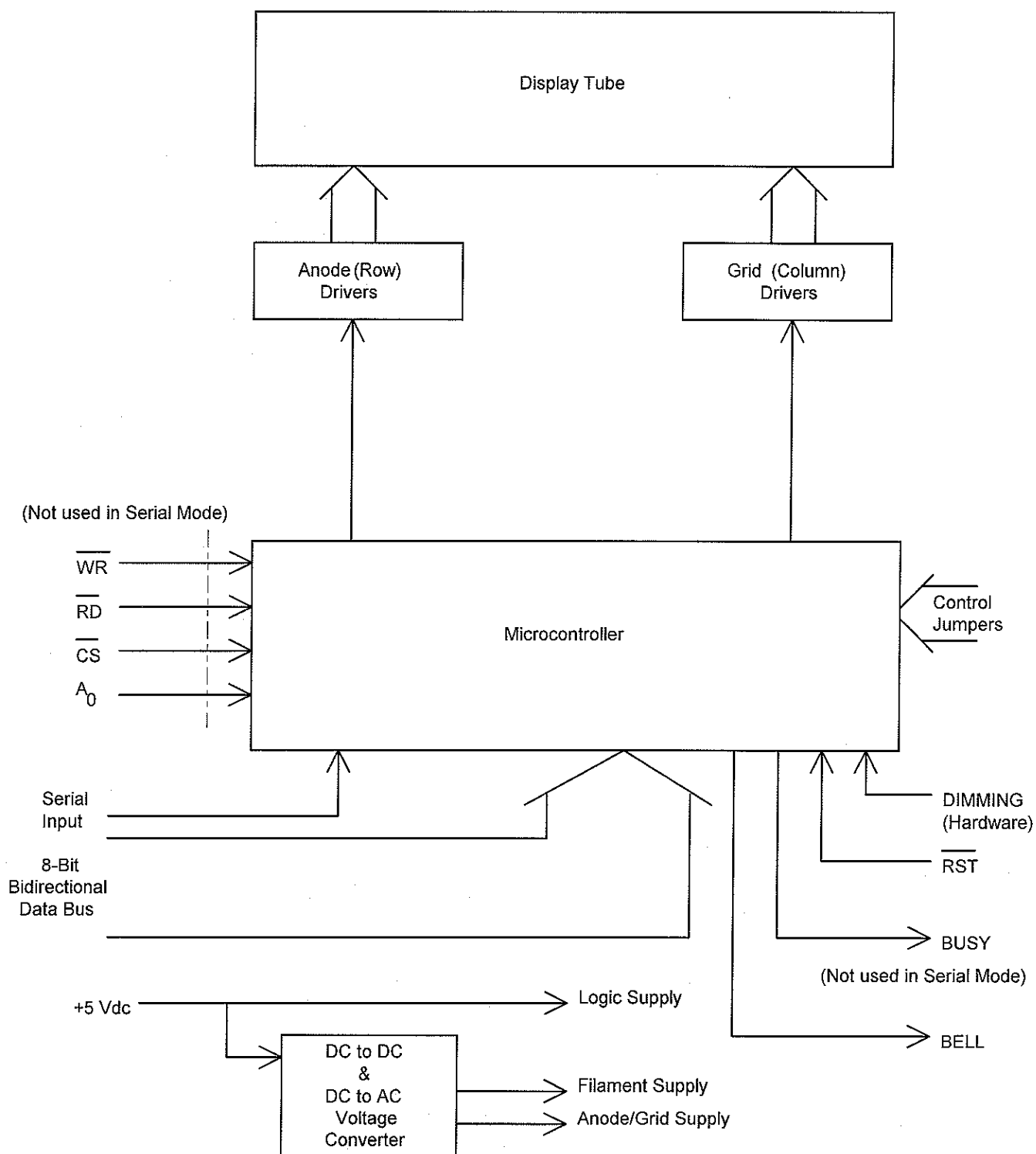


Figure 3-1
Functional Block Diagram, Intel Mode

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464		S036X3-XXX-XXXXX
	SCALE	N/A	REV A	SHEET 7

01/25/07

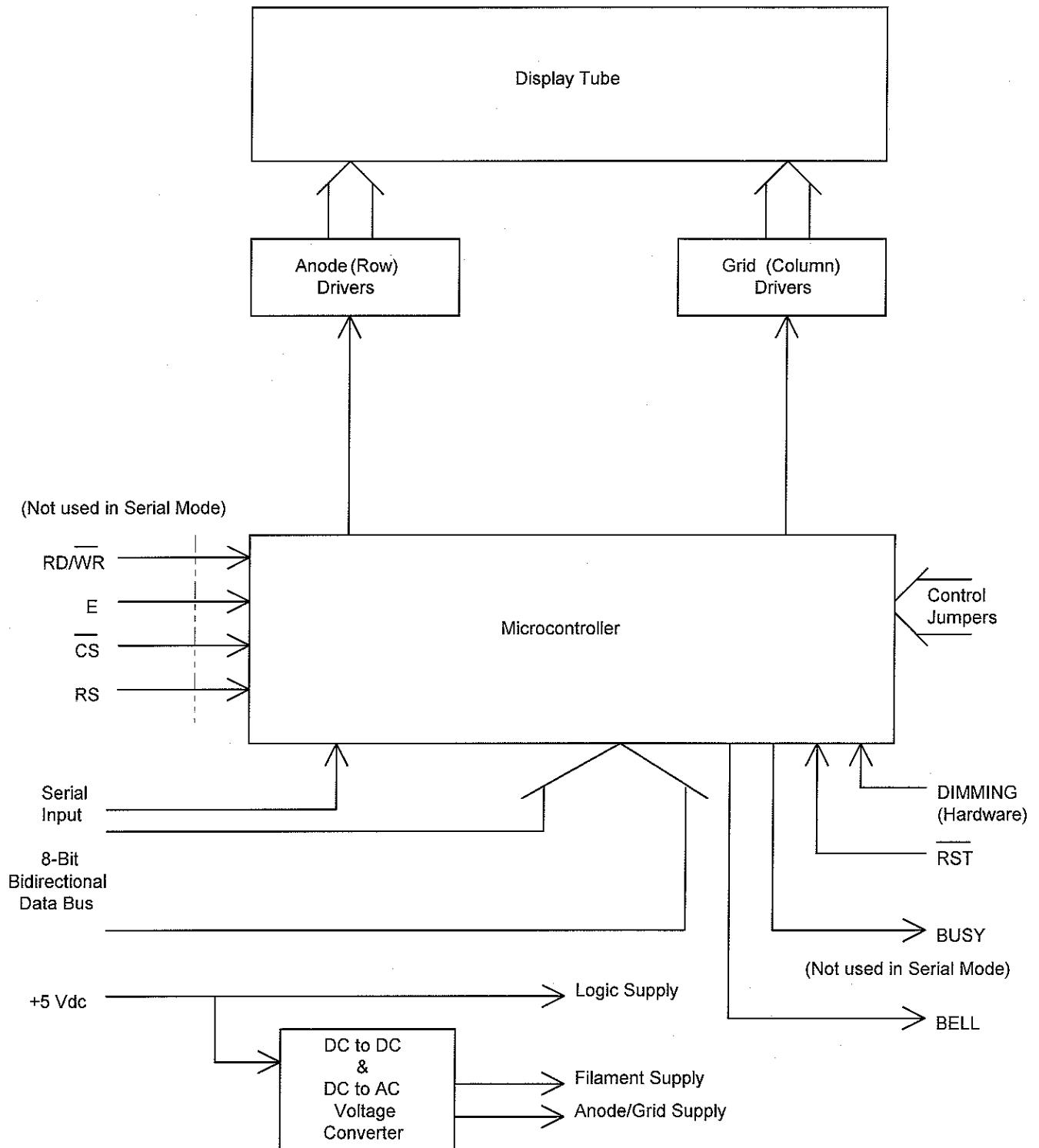


Figure 3-2
Functional Block Diagram, Motorola Mode

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464		S036X3-XXX-XXXXX
	SCALE	N/A	REV A	SHEET 8

01/25/07

3.1.4 Size and Weight

The physical dimensions of the displays vary with the size of the tube. The characteristics shown are for standard configuration display products, some options will affect these data.

Model	Tube Format	Length	Width	Depth	Weight (oz.)
036X3-100-05420	4 X 20	5.00 in.	2.78 in.	0.92 in.	6.5
036X3-105-05220	2 X 20	5.00 in.	2.25 in.	0.88 in.	4.0
036X3-122-09220	2 X 20	7.75 in.	2.58 in.	1.00 in.	7.0
036X3-124-09420	4 X 20	7.75 in.	3.40 in.	1.00 in.	12.5
036X3-151-05240	2 X 40	9.50 in.	2.05 in.	1.00 in.	8.0

Table 3-1
Physical Dimensions

3.1.5 Character Cell Features

Format The display character cells utilize a 5 x 7 dot matrix to produce the available character sets.

Character Sets The displays employ 4 built-in character tables with the Motorola and Intel modes.

Motorola/Intel Modes:

Each of the four Motorola/Intel character tables is comprised of the 96 character U.S. ASCII set, a 32 character scientific set, a 19 character set of special characters, a 10 character location for user definable characters and an embedded language specific character set. The embedded character sets occupy the address area between A0h and DFh and include a 64 character European set, a 33 character Cyrillic set, a 63 character Katakana set and a 27 character Hebrew set. The Motorola/Intel character tables are shown in Figures 3-4 through 3-8. Cells shown are exact representations of available characters and their hexadecimal locations. Locations are also shown for UDC's.

Always Present:

20h - 7Fh	ASCII Character Set.
80h - 9Fh	Scientific Character Set.
E0h - F2h	Special Character Set
F6h - FFh	User Defined Character Locations.

Activated by Control Code:

A0h - DFh	European Character Set.
A0h - C0h	Cyrillic Character Set.
A0h - DFh	Katakana Character Set.
A0h - BAh	Hebrew Character Set.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 9

01/25/07

3.1.5 Character Cell Features (Cont.)

Cursor Type	The displays include a block format cursor indicator.		
Color	Blue-green, 5000 Angstroms peak.		
Brightness	Minimum	100 ft-L	
	Typical	175 ft-L	

3.1.6 Character Font Data

The character font for each model of the dot matrix family of Century Series VFDs is described in the table below.

<u>Model</u>	<u>Tube</u> <u>Format</u>	<u>Character</u> <u>Height</u>	<u>Character</u> <u>Width</u>	<u>Character</u> <u>Pitch</u>
036X3-100-05420	4 X 20	5.00 mm	3.30 mm	4.75 mm
036X3-105-05220	2 X 20	5.05 mm	3.55 mm	4.75 mm
036X3-122-09220	2 X 20	9.20 mm	6.40 mm	5.10 mm
036X3-124-09420	4 X 20	9.10 mm	6.40 mm	8.30 mm
036X3-151-05240	2 X 40	5.00 mm	3.55 mm	4.75 mm

Table 3-2
Display Character Fonts

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 10

01/25/07

N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
FO	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Figure 3-4

ASCII Character Set
(with Scientific, Specials & UDC's)

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV	A
			SHEET	11

01/25/07

A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF

Figure 3-5
Cyrillic Character Set

A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF

Figure 3-6
European Character Set

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX		
	SCALE	N/A	REV	A	SHEET 12

01/25/07

A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF

Figure 3-7
Hebrew Character Set

80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC	UDC
F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Figure 3-8
Katakana Character Set

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE	N/A	REV A SHEET 13

01/25/07

3.2 Interfaces

3.2.1 Power Interface

The display power converter is a Constant Power configuration.

Supply Voltage 5 Volts dc $\pm$ 5%.

WARNING

Damage may occur if the supply voltage exceeds 5.5 Volts dc or if data or control signals are applied prior to application of dc power.

Supply Rise Time 100 msec maximum.

Supply Current: Minimum = all dots OFF, 5.25 Vdc; Maximum = all dots ON, 4.75 Vdc

<u>Model</u>	<u>Minimum</u>	<u>Typical</u>	<u>Maximum</u>
036X3-100-05420	650 mA.	770 mA	890 mA.
036X3-105-05220	350 mA	385 mA	510 mA
036X3-122-09220	600 mA	660 mA	720 mA
036X3-124-09420	1000 mA	1200 mA	1300 mA
036X3-151-05240	820 mA	870 mA	920 mA

Table 3-3

Display Supply Current

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE	N/A	REV B
		SHEET	14

01/25/07

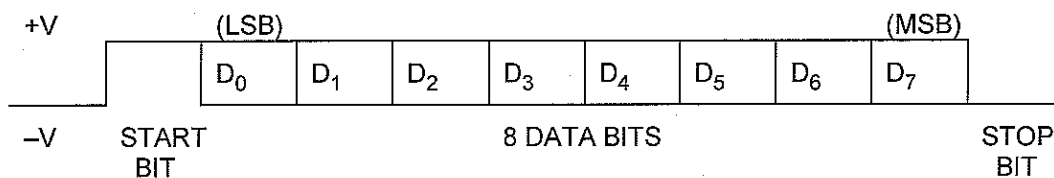
3.2.2 Data Interface

The displays accept either serial or parallel input data and control codes. Internal logic can interface to either Intel and Motorola processors.

3.2.2.1 Serial

Input Levels	High (space/logic 0)	+3 Volts to +15 Volts	(Conforms to EIA-232 specification).
	Low (mark/logic 1)	-3 Volts to -15 Volts.	
Baud Rate	Selectable—1200, 9600 or 19200. Maximum available baud rate depends on execution times. (See Table 3-5)		
Data Word	10 Bits. Eight Data Bits with start bit and 1 stop bit.		
Parity	None		
Error Indicator	If the operating software detects either speed or framing errors during data transmission, each error character received is replaced on the display screen with the symbol # (ASCII 23h).		

Format:

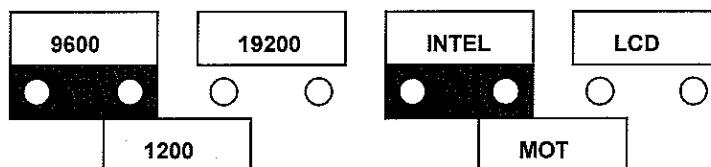


3.2.2.2 Parallel

Input Levels	High	$\geq 3.5 \text{ Vdc @ } 5.0 \mu\text{A maximum}$
	Low	$\leq 1.5 \text{ Vdc @ } 0.5 \text{ mA maximum}$
Output Levels	High	$\geq 4.6 \text{ Vdc @ } 5 \text{ mA maximum}$
	Low	$\leq 0.4 \text{ Vdc @ } 5 \text{ mA maximum}$
Pull-ups	Parallel I/O lines are pulled up to +5 Vdc by internal 10 k Ω resistors.	

3.2.3 Personality Interface

A 8 pin strip connector on the circuit card allows user selection of Baud Rate, Interface Mode and Start-up Mode. The illustration below matches the appearance of the jumper strip on the circuit card.



Jumpers positions are shown above for the default position. If not installed, the default setting is automatically selected.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 15

3.2.4 Power/Data Connector

The Power/Data connector (J1) contact arrangement is shown in the illustration below. See Table 3-4 for pin assignments.

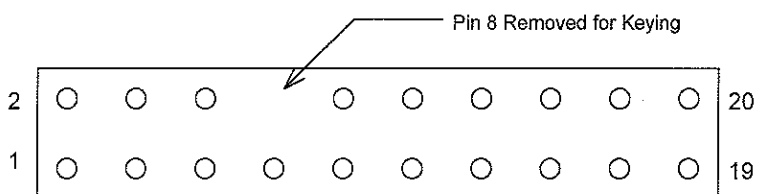


Figure 3-11
J1 Contact Arrangement

NOTE

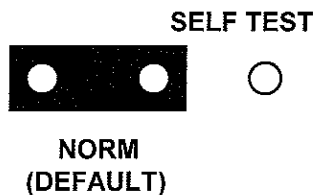
IEE recommends that the user install a keying plug in the mating connector at the Pin 8 location. This will assure that the mating connector is always installed correctly and will avoid damage to the display.

IEE supplied accessory connectors are properly keyed.

3.2.5 Self-Test

A 3 pin strip connector labeled (JPMR1) on the circuit card allows user to perform a display self-test with only power applied. To perform self-test, move jumper from left side position (default) to right side position and then apply or cycle display power. To return display to normal operation, remove jumper or move jumper back to default position and cycle power.

For expected data sequence, see section 4.6 (Miscellaneous Codes) and refer to code **3Eh Execute Self-test** section on sheet 30.



Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 16

01/25/07

Intel Mode

PIN NO.	FUNCTION	MNEM
J1-1	DATA BIT 7 (MSB)	D ₇
J1-2	+5 VDC	
J1-3	DATA BIT 6	D ₆
J1-4	+5 VDC	
J1-5	DATA BIT 5	D ₅
J1-6	COMMON	
J1-7	DATA BIT 4	D ₄
J1-8	REMOVED FOR KEYING	
J1-9	DATA BIT 3	D ₃
J1-10	COMMON	
J1-11	DATA BIT 2	D ₂
J1-12	BUSY	
J1-13	DATA BIT 1	D ₁
J1-14	SERIAL INPUT	
J1-15	DATA BIT 0 (LSB)	D ₀
J1-16	RESET	RST
J1-17	WRITE	WR
J1-18	CHIP SELECT	CS
J1-19	ADDRESS BIT 0	A ₀
J1-20	READ	RD

Motorola Mode

PIN NO.	FUNCTION	MNEM
J1-1	DATA BIT 7 (MSB)	D ₇
J1-2	+5 VDC	
J1-3	DATA BIT 6	D ₆
J1-4	+5 VDC	
J1-5	DATA BIT 5	D ₅
J1-6	COMMON	
J1-7	DATA BIT 4	D ₄
J1-8	REMOVED FOR KEYING	
J1-9	DATA BIT 3	D ₃
J1-10	COMMON	
J1-11	DATA BIT 2	D ₂
J1-12	BUSY	
J1-13	DATA BIT 1	D ₁
J1-14	SERIAL INPUT	
J1-15	DATA BIT 0 (LSB)	D ₀
J1-16	RESET	RST
J1-17	READ/WRITE	RD/WR
J1-18	CHIP SELECT	CS
J1-19	REGISTER SELECT	RS
J1-20	ENABLE	E

Table 3-4
Connector Pin Assignments

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 17

01/25/07

3.3 Performance Characteristics

Processor Power-up Cycle 500 msec minimum

Part Number	4 X 20 036X3 -100	2 X 20 036X3 -105	2 X 20 036X3 -122	4 X 20 036X3 -124	2 X 40 036X3 -151
Blink	150	100	100	150	100
Brightness	150	100	100	150	100
Send Character	150	100	100	150	100
Clear	1000	400	400	1000	850
Cursor Locate	150	100	400	150	850
Home	150	100	100	150	100
Horizontal Scroll	1000	500	500	1000	1000
Reset	900	800	800	1000	850
Vertical Scroll	1000	400	400	1000	400

Table 3-5
Execution Times (in μ sec)

Brightness Control Software or Hardware. Varies display brightness level in 8 discrete steps.
The Hardware brightness level control sets the upper brightness level limit.
Software control cannot advance brightness level above the hardware set limit.

Viewing Angle The displays are readable within a cone of 150° .

Dedicated Interface Lines:

RESET 15 msec (minimum) negative going pulse clears display and initializes processor power-up sequence.
(Requires current sink capable of discharging a 1.0μ F internal capacitor and a $10 \text{ k}\Omega$ resistor to V_{CC} .)

BUSY High during write or hardware reset. Low when ready for data.

DIMMING $10 \text{ k}\Omega$ internal pull-up provides hardware brightness level control.
(A $100 \text{ k}\Omega$ potentiometer is recommended.)

BELL Drive output for audible signalling device. A 160 msec wide output that can sink 0.2 A from a 5.0 Vdc source.

Dimming J2



Bell/Alarm J3



Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 18

01/25/07

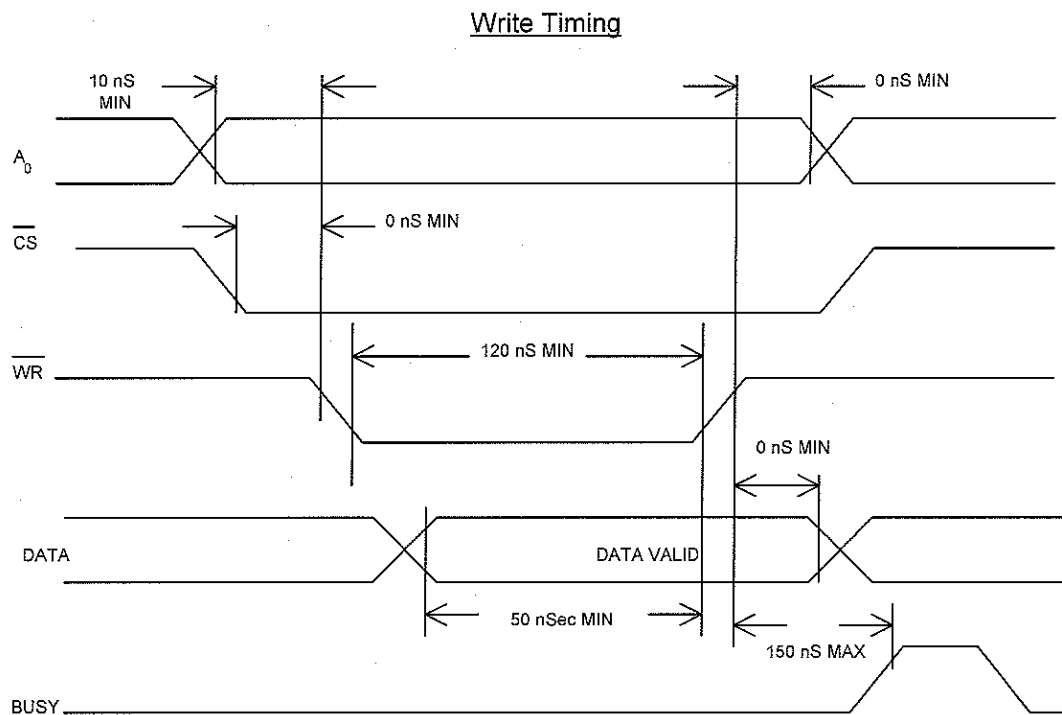
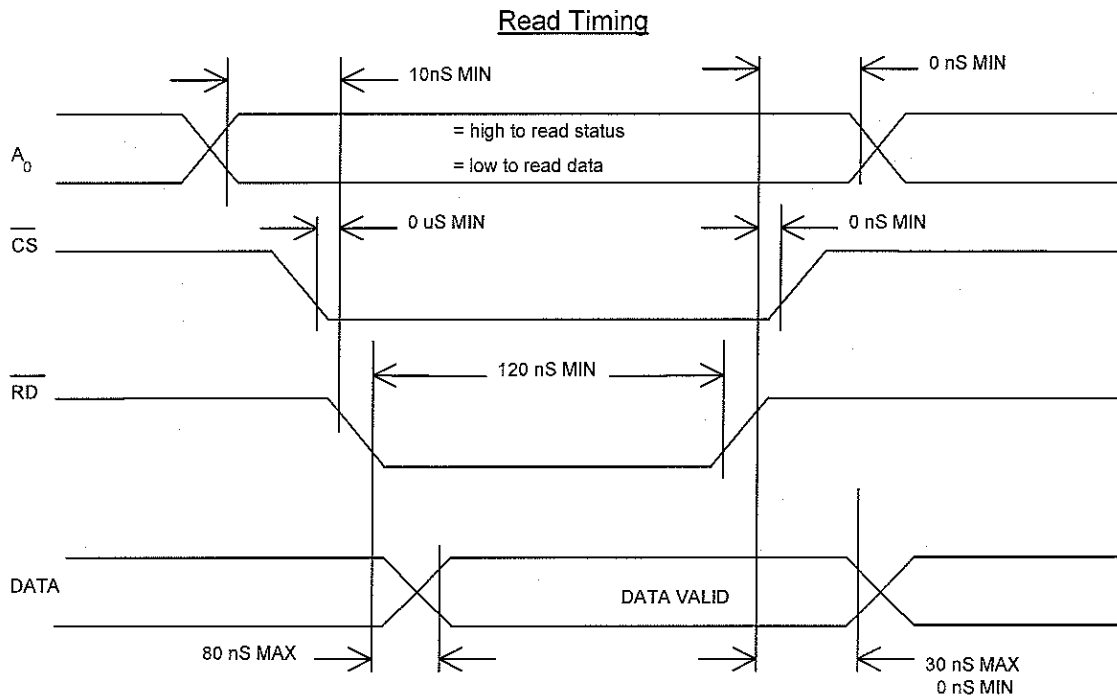


Figure 3-12
Timing Characteristics, Intel Mode

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 19

01/25/07

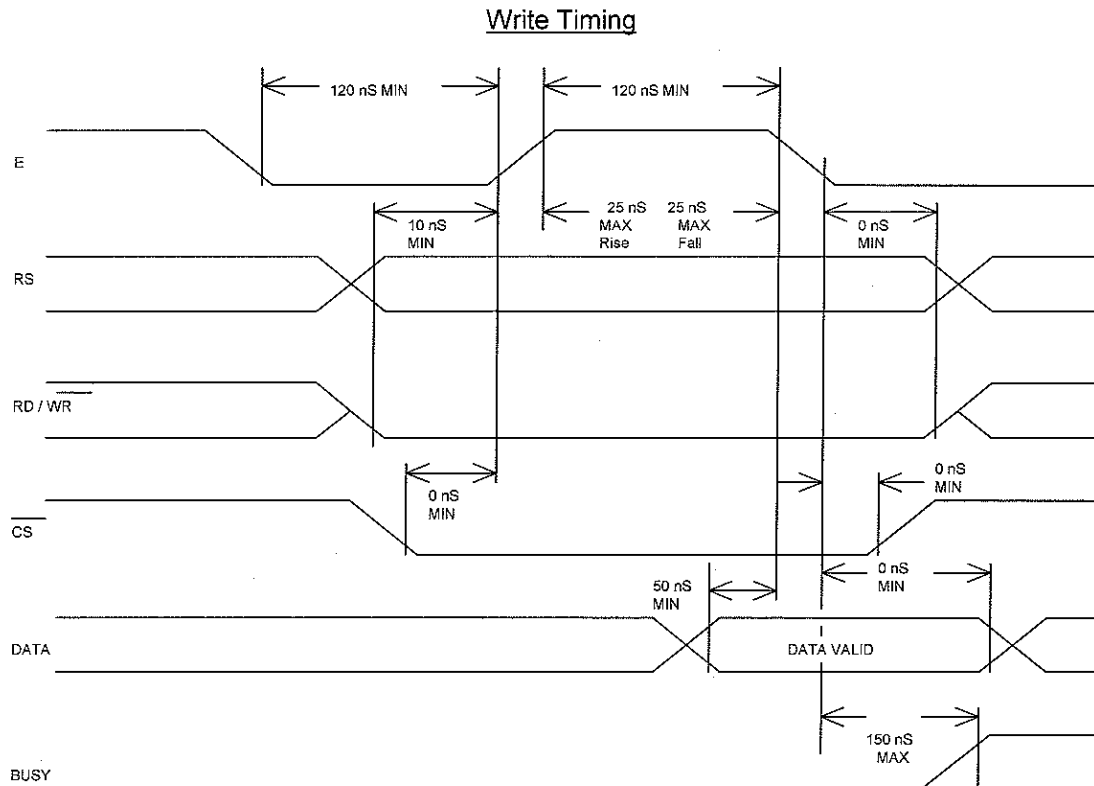
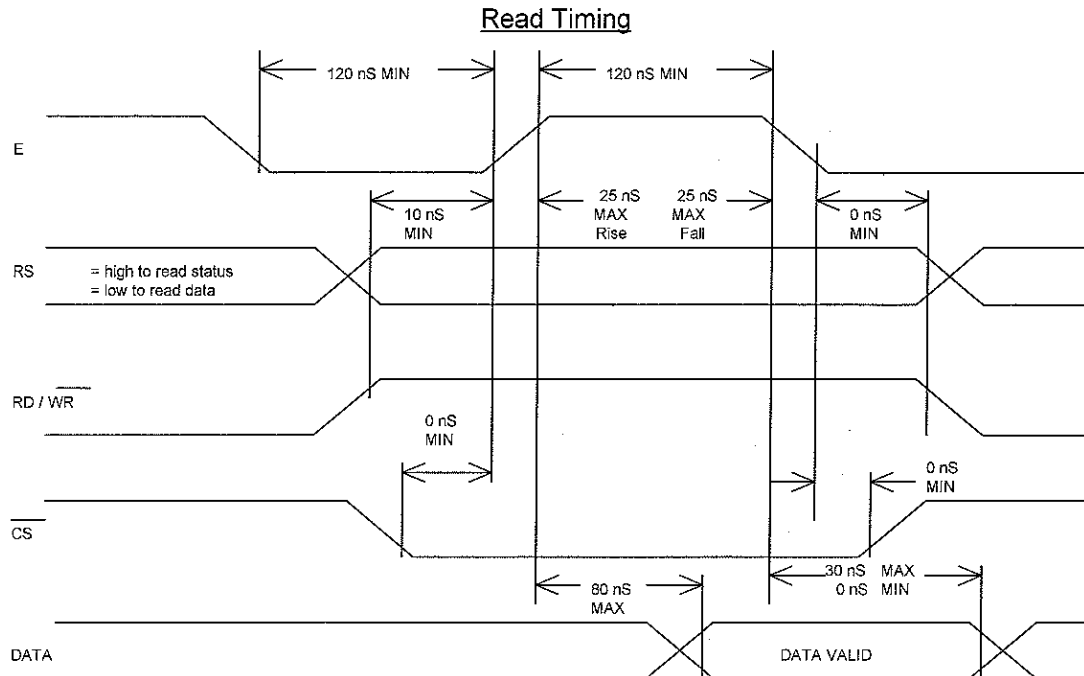


Figure 3-13
Timing Characteristics, Motorola Mode

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 20

01/25/07

4.0 PROGRAMMING CODES

The Century Series control codes occupy two hexadecimal address blocks. The first block is comprised of 00h–1Fh, while the second overlays part of the character table at 30h–3Fh. Control codes shown in **Bold** typeface are power-on defaults.

4.1 Numeric Order Control Codes

[A₀ (RS) = Low for the following Control Codes]

<u>Code</u>	<u>Name</u>	<u>Described in Section</u>	
00h	<i>Null</i>	4.6	Miscellaneous Codes
01h	<i>Prepare to Read Display Identification</i>	4.4	Prepare to Read Codes
02h	<i>Prepare to Read Software Check sum</i>	4.4	Prepare to Read Codes
03h	<i>Prepare to Read Cursor Location</i>	4.4	Prepare to Read Codes
04h	<i>Prepare to Read Data at Cursor Location</i>	4.4	Prepare to Read Codes
05h	<i>Prepare to Read Data at Cursor Location and Increment</i>	4.4	Prepare to Read Codes
06h	<i>Unassigned</i>		
07h	<i>Bell/Alarm Output</i>	4.6	Miscellaneous Codes
08h	<i>Backspace Cursor</i>	4.2	Cursor Control Codes
09h	<i>Advance Cursor</i>	4.2	Cursor Control Codes
0Ah	<i>Line Feed</i>	4.2	Cursor Control Codes
0Bh	<i>Blink Block Cursor</i>	4.2	Cursor Control Codes *
0Ch	<i>Underbar Cursor</i>	4.2	Cursor Control Codes *
0Dh	<i>Carriage Return</i>	4.2	Cursor Control Codes
0Eh	<i>Cursor Off</i>	4.2	Cursor Control Codes
0Fh	Cursor On	4.2	Cursor Control Codes
10h	<i>Scroll Line Lock</i>	4.6	Miscellaneous Codes
11h	Set Vertical Scroll Mode	4.3	Data Display Codes
12h	<i>Unassigned</i>		
13h	<i>Set Horizontal Scroll Mode</i>	4.3	Data Display Codes
14h	<i>Software Reset</i>	4.6	Miscellaneous Codes
15h	<i>Clear Display and Home Cursor</i>	4.2	Cursor Control Codes
16h	<i>Home Cursor</i>	4.2	Cursor Control Codes
17h	<i>Set Data Bit 7 High</i>	4.6	Miscellaneous Codes
18h	<i>Begin User Defined Character</i>	4.3	Data Display Codes
19h	<i>Set Address Bit 0 High</i>	4.6	Miscellaneous Codes
1Ah	<i>Cursor up One Line</i>	4.2	Cursor Control Codes
1Bh	<i>Move Cursor to Designated Location</i>	4.2	Cursor Control Codes
1Ch	Select European Character Set	4.3	Data Display Codes
1Dh	<i>Select Katakana Character Set</i>	4.3	Data Display Codes
1Eh	<i>Select Cyrillic</i>	4.3	Data Display Codes
1Fh	<i>Select Hebrew Character Set</i>	4.3	Data Display Codes

* Applies to 036X3–151–05240 only. Unassigned for all other models.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464		S036X3–XXX–XXXXX	
	SCALE	N/A	REV A	SHEET	21

01/25/07

4.1 Numeric Order Control Codes (Cont.)

[A₀ (RS) = High for the following Control Codes]

<u>Code</u>	<u>Name</u>	<u>Described in Section</u>	
30h	<i>Set Display Screen or Column Brightness Level</i>	4.5	Screen Control Codes
31h	<i>Begin Blinking Character(s)</i>	4.5	Screen Control Codes
32h	<i>End Blinking Character(s)</i>	4.5	Screen Control Codes
33h	<i>Blank Display Screen</i>	4.5	Screen Control Codes
34h	<i>Unblank Display Screen</i>	4.5	Screen Control Codes
36h	<i>Erase Line data With End Blink</i>	4.5	Screen Control Codes
37h	<i>Set Carriage Return and Line Feed Definitions</i>	4.5	Screen Control Codes
38h	<i>Underbar On</i>	4.2	Cursor Control Codes *
39h	<i>Underbar Off</i>	4.2	Cursor Control Codes *
3Ah	<i>Select Right to Left Data Entry</i>	4.5	Screen Control Codes
3Bh	Select Left to Right Data Entry	4.5	Screen Control Codes
3Ch	<i>Screen Saver On</i>	4.5	Screen Control Codes
3Dh	Screen Saver Off	4.5	Screen Control Codes
3Eh	<i>Execute Self-test</i>	4.6	Miscellaneous Codes
3Fh	<i>Terminate Self-test</i>	4.6	Miscellaneous Codes

* Applies to 036X3-151-05240 only. Unassigned for all other models.

While unassigned Control Codes have no function, they are viewed as activity if received by the display and will cause the Screen Saver function to reset.

CAUTION

While the display software will ignore erroneous single byte control codes, errors in multibyte commands will cause the software to "jump" out of the control mode.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 22

01/25/07

4.2 Cursor Control Codes

[A₀ (RS) = Low for the following Control Codes]

- 08h *Backspace Cursor*
Moves the cursor one position left. (Right if 3Ah is selected.)
Functions only on current line, does not move cursor to previous line.
- 09h *Advance Cursor*
Moves the cursor one position right. (Left if 3Ah is selected.)

If the cursor is in the last position on a line (other than the last line of the display screen), it will move to the first position of the next line.

If the cursor is in the last position of the last line, it will be blanked and remain in the same location.
- 0Ah *Line Feed*
On single line displays, clears data from the display screen. Cursor remains in same column.

On multi-line displays, moves the cursor down one line with no change in horizontal position unless on the last line.

If on the last line, cursor unblanked, executes a vertical scroll with no change in horizontal position.

If on the last line, last position, cursor blanked, executes a vertical scroll with no change in horizontal position and cursor becomes visible.

The function of this command is described for the default setting and can be modified by using control code 37h.
- 0Bh *Blinking Block Cursor* *
Sets the cursor style to a blinking block cursor.
- 0Ch *Underbar Cursor* *
Sets the cursor style to an underbar cursor.
- 0Dh *Carriage Return*
Returns the cursor to the left most position on the current line. (Rightmost if 3Ah is selected.)

The function of this command can be modified by using control code 37h.
- 15h *Clear Display and Home Cursor*
Clears the display screen and sets the cursor to the home position.
- 16h *Home Cursor*
Sets the cursor to the home position.
- 1Ah *Cursor Up One Line*
Moves the cursor up 1 line on multi-line displays. No function on single line displays or on the top line of multi-line displays.
- 1Bh *Move Cursor to Designated Location*
Moves the cursor to a specific display screen location using a 2 byte command consisting of control code 1Bh and a position ID. Screen positions are numbered from left to right, top to bottom starting with 00h.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 23

01/25/07

4.2 Cursor Control Codes (Cont.)

[A₀ (RS) = Low for the following Control Codes]

0Eh *Cursor Off*

Makes cursor invisible. Other cursor functions are not affected.

0Fh *Cursor On*

Makes cursor visible at 4 Hz blink rate. (Default)

* **Applies to 036X3-151-05240 only. Unassigned for all other models.**

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 24

01/25/07

4.3 Data Display Mode Codes

The following control codes define the way the display behaves after the last character has been written to the screen.

[A₀ (RS) = Low for the following Control Codes]

- 11h *Set Vertical Scroll Mode*
Causes data to scroll up one line, upon receipt of a displayable character, after the last character is written to the last line of the display screen.
Generates automatic *Carriage Return + Line Feed*. (Default)
- 13h *Set Horizontal Scroll Mode*
Causes the last line of the display screen to scroll from right to left after the last character is written to the last line as successive characters are written.
- 18h *User Defined Character*
A 7 byte command which may be used to define up to 10 custom characters. Each character must be separately defined and stored in locations F6h – FFh. The command consists of the control code 18h, a location code and 5 bytes of character dot data.

18 XX PP PP PP PP PPXX = F6 – FF

PP = Dot data from tables below

0 = Dot Off

1 = Dot On

BYTE	DATA BIT (036X3-100,-105,-122,-124)							
	7	6	5	4	3	2	1	0
3	33	15	34	16	35	17	0	18
4	29	11	30	12	31	13	32	14
5	25	07	26	08	27	09	28	10
6	21	03	22	04	23	05	24	06
7	0	0	0	0	19	01	20	02

CHARACTER MATRIX				
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

BYTE	DATA BIT (036X3-151)							
	7	6	5	4	3	2	1	0
3	29	20	11	02	28	19	10	01
4	31	22	13	04	30	21	12	03
5	33	24	15	06	32	23	14	05
6	35	26	17	08	34	25	16	07
7	0	0	0	0	36	27	18	09

Table 4-1

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 25

01/25/07

4.3 Data Display Mode Codes(Cont'd)

Dot Data for User Defined Characters

- 1Ch *Select European Character Set*
Selects character set shown in Figure 3-6. (Default)
- 1Dh *Select Katakana Character Set*
Selects character set shown in Figure 3-8.
- 1Eh *Select Cyrillic Character Set*
Selects character set shown in Figure 3-5.
- 1Fh *Select Hebrew Character Set*
Selects character set shown in figure 3-7.

4.4 Prepare To Read Codes

The following control codes allow data to be read from the display. All *Prepare To Read* commands must be followed by a **READ DATA** operation for each byte of output.

[A₀ (RS) = Low for the following Control Codes]

(See timing diagrams in Figures 3-12, 3-13 and 3-14 for read operation details.)

- 01h *Prepare to Read Firmware Identification Number & Display Format*
Outputs a 19 byte string representing the firmware ID number and line/column format.
e.g., IEE,35062-01,LXXCXX (for model: 036X3-100, -105, -122, -124)
e.g., IEE,35440-01,LXXCXX (for model: 036X3-151)
- 02h *Prepare to Read Software Check Sum*
Outputs a 4 byte string representing the hexadecimal check sum.
- 03h *Prepare to Read Cursor Location*
Outputs a 1 byte string representing the cursor location.
- 04h *Prepare to Read Data at Cursor Location*
Outputs a 1 byte string representing character data at current cursor location.
- 05h *Prepare to Read Data at Cursor Location and Increment*
Outputs a 1 byte string representing character data at current cursor location and generates an *Advance Cursor* command.

NOTE

Data cannot be read in serial mode.

Status Read Operation

[A₀ (RS) = High for the following Read Operation]

Status Returned to the Host on the Data Lines

Data Lines
XXXX XXIO

O = 0 Output Buffer Empty (READY)
O = 1 Output Buffer Full (BUSY)
I = 0 Input Buffer Empty (READY)
I = 1 Input Buffer Full (BUSY)

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 26

4.5 Screen Control Codes

[A₀ (RS) = High for the following Control Codes]

30h *Set Display Screen or Column Brightness Level*

Sets the display brightness level using a 3 byte command consisting of control code 30h, column ID, and brightness level. Column ID code FFh sets all columns. Brightness levels range from 00h (brightest) through 07h (dimpest). (Default is 00h)

Note

Brightness levels must be set by columns rather than by characters because of the construction of the vacuum fluorescent tube.

31h *Begin Blinking Character(s)*

Sets the start of blinking character(s) or underbar(s) and the blink rate using a 2 byte command consisting of control code 31h and blink code. Subsequent characters will blink until Control Code 32h is sent. (If a character is written at the current cursor location, that character will blink).

The "Underbar" and "Both" code sets apply only to 36X3-151-05240.

<u>Character Code</u>	<u>Rate</u>	<u>Underbar Code</u>	<u>Rate</u>	<u>Both Code</u>	<u>Rate</u>
00h	OFF (Default)	60h	OFF	80h	OFF
01h	1 Hz	61h	1 Hz	81h	1 Hz
02h	2 Hz	62h	2 Hz	82	2 Hz
04h	4 Hz	64h	4 Hz	84h	4 Hz

32h *End Blinking Character(s)*

Sets the end of blinking character(s) at the current cursor location. Subsequent characters will not blink until Control Code 31h is sent. (A character written to the current cursor location will not blink).

If a blinking character is overwritten by a non-blinking character, or if the *Erase Line* command is executed, the blink attribute is turned off.

33h *Blank Display Screen*

Sets the display screen to OFF. Data and attribute settings are not affected.

34h *Unblank Display Screen*

Returns the display screen to ON after 33h.

35h *Comma/Period/Triangle Function*

- 35-01-n: display character with period
n = display character 20-FF
- 35-02-n: display character with comma
n = display character 20-FF
- 35-03-n: display character with comma & period
n = display character 20-FF
- 35-04-n: display character with triangle
n = display character 20-FF

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464		S036X3-XXX-XXXXX
	SCALE	N/A	REV A	SHEET 27

4.5 Screen Control Codes (Cont.)

[A₀ (RS) = High for the following Control Codes]

36h *Erase Line Data With End Blink*

Erases 1 or more lines of data (with blink) using a 2 byte command consisting of control code 36h and blink field/line data.

Bits 0 through 3 retain (0) or erase (1) lines 0 through 3 respectively.

For example:

Blink Field ON/OFF

D ₇	D ₆	D ₅	D ₄
X	X	X	X
X	X	X	X

Line Position

D ₃	D ₂	D ₁	D ₀
0	0	0	1
1	1	0	0

Erase line 0, retain lines 1, 2, 3.

Erase lines 2 & 3, retain lines 0 & 1.

38h *Underbar On* *

Sets the underbar to ON at the current character position.

39h *Underbar Off* *

Sets the underbar to OFF at the current character position.

3Ch *Screen Saver On*

Sets the display screen to brightness level 07h (dimkest) after a 10 minute idle time.

(Any new control or data input resets the Screen Saver function for another 10 minute cycle. The Screen Saver function remains active.)

3Dh *Screen Saver Off*

Restores the screen display to previously established brightness level(s) and deactivates the Screen Saver function. (Default)

37h *Set Carriage Return and Line Feed Definitions*

Sets the functions of the Line Feed (0Ah) and Carriage Return (0Dh) commands using a 2 byte command consisting of control code 37h and the function ID.

Function ID

Definition

00h	LF = LF	CR = CR (Default)
01h	LF = LF + CR	CR = CR
02h	LF = LF	CR = CR + LF
03h	LF = LF + CR	CR = CR + LF

3Ah *Set Right to Left Data Entry*

Reverses data entry mode for use with Hebrew Character Set.

3Bh *Set Left to Right Data Entry*

Restores data entry mode to normal ASCII. (Default)

* **Applies to 036X3-151-05240 only. Unassigned for all other models.**

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 28

01/25/07

4.6 Miscellaneous Codes

[A₀ (RS) = Low for the following Control Codes]

- 00h *Null*
No operation. Sending a 00h to the display is viewed by software as activity, and will reset a Screen Saver code (3Ch).
- 07h *Bell/Alarm Output*
Activates 160 msec drive signal for alarm tone.
- 10h *Scroll Line Lock*
Sets 1 or more lines to be locked out from the Vertical Scroll function using a 2 byte command consisting of the control code 10h and a line ID.

<u>Line ID</u>	<u>Function</u>
00h	Locks line 0
01h	Locks lines 0 and 1
02h	Locks lines 0, 1 and 2
FFh	Cancel Line Lock

- 14h *Software Reset*
Clears the display screen, homes the cursor and resets modes and attributes to their default settings.

Note

If Hardware Self-test is programmed, sending control code 14h restarts self-test.

If Self-test was called by sending control code 3Eh, sending control code 14h has no effect.

- 17h *Set Data Bit 7 High*
Sets data bit 7 high for the following data byte.
- 19h *Set Address Bit 0 High*
Sets address bit 0 (A₀) high for the following byte only. The following byte must be a control code.
(In Motorola Mode, replace A₀ with RS).

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE	N/A	REV A
		SHEET	29

01/25/07

4.6 Miscellaneous Codes (Cont.)

[A₀ (RS) = High for the following Control Codes]

3Eh *Execute Self-test*

Displays the following data in sequence:

1. Software version number.
S/W NUMBER :
XXXXX-XX
2. Baud Rate selected.
BAUD : NNNN
3. Interface Mode selected.
INTERFACE:
INTEL(MOTOROLA)
4. Present (hardware) display brightness level.
HARDWARE BRIGHTNESS
LEVEL: N
5. Displays 8 brightness levels in a numeric representation of brightness levels.
DIM LEVELS: 01234567
6. Displays the 3 blink rates in a numeric representation of blink rates.
BLINK RATES :
1Hz 2Hz 4Hz
7. Displays the entire character font with vertical scrolling.

(Single line displays scroll continuously in *Horizontal Scroll Mode*).

Self-test overrides the hardware brightness level control setting and displays information at the highest brightness level (level 0).

Self-test may be invoked by setting a jumper on the circuit card prior to power up.

Self-test runs continuously until terminated by 3Fh.

3Fh *Terminate Self-test*

Terminates either a hardware or software induced self-test and sets display screen to the highest brightness level.

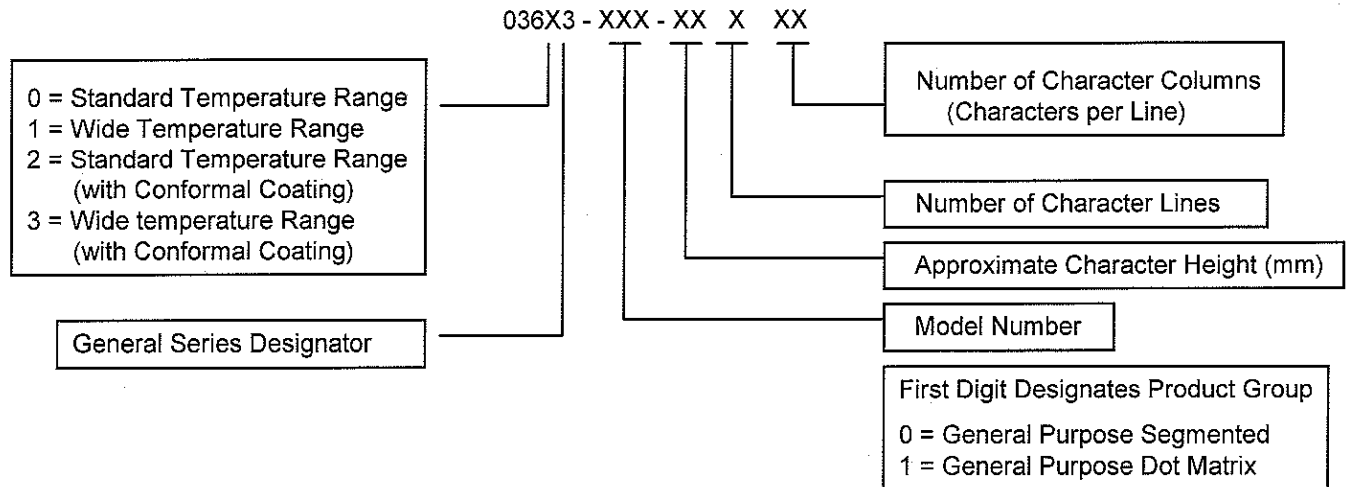
Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 30

01/25/07

5.0 OPTIONS AND ACCESSORIES

The following sections list commonly available options and accessories to the Century Series of Vacuum Fluorescent Displays which can enhance performance or utility for specific applications.

5.1 Performance Options



Note

Spaces shown in Part Number above are for clarity only.

5.2 Accessories

ITEM	Part Number
Connector Key	43866-03
Mating Connector, Power/Data	43866-05
Mating Connector, Dimming	48272-02
Cable Assembly, Single Ended	35406-XX*
Cable Assembly, Double Ended	35407-XX*
Filters	35064-XXX**-NN***

- * Dash number indicates cable length in whole inches.
 - ** 3 Digit dash number (XXX) indicates Display Model Number.
 - *** 2 digit dash number (NN) indicates filter color.
- | | |
|-----|--------------|
| -01 | Neutral Gray |
| -02 | Blue |
| -04 | Aqua |
| -05 | Neon |
| -07 | Green |
| -09 | Neutral(CP) |
| -10 | Yellow(CP) |

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV A	SHEET 31

01/25/07

6.0 OUTLINE DRAWINGS

The following pages contain Outline Drawings of the available Century Series Dot Matrix Vacuum Fluorescent Displays. Each outline drawing includes:

1. Mounting and elevation dimensions to assist the user in packaging design.
2. Interface connector location, contact arrangement and keying.
3. Location and arrangement of personality jumpers.
4. Recommended panel cutout.

Note

The outline drawings which follow are **NOT** to scale.
Refer to numeric dimensions for design data.

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE N/A	REV A	SHEET 32

01/25/07

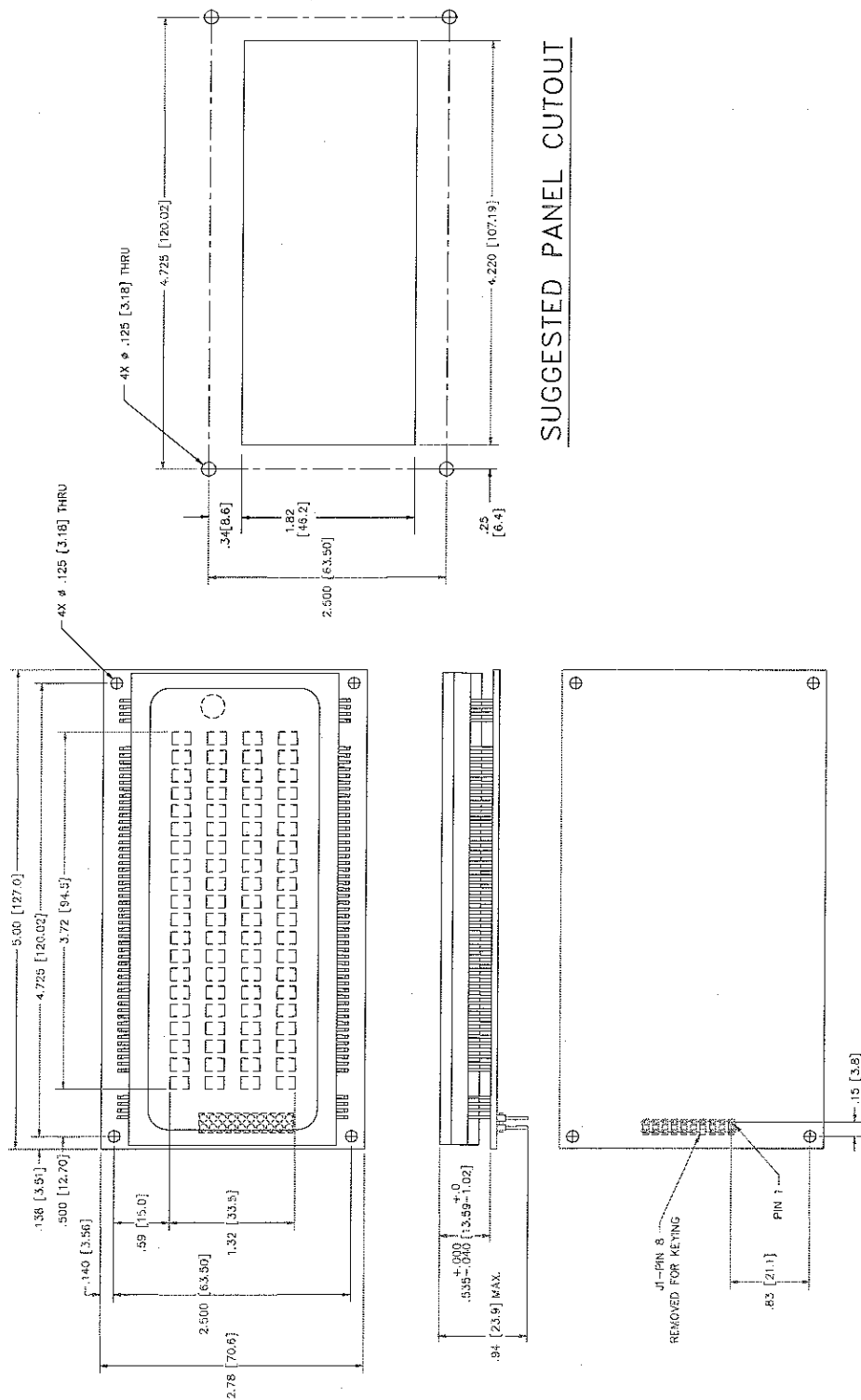


Figure 6-1

036X3-100-05420, 4X20 5mm

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE N/A	REV B	SHEET 33

01/25/07

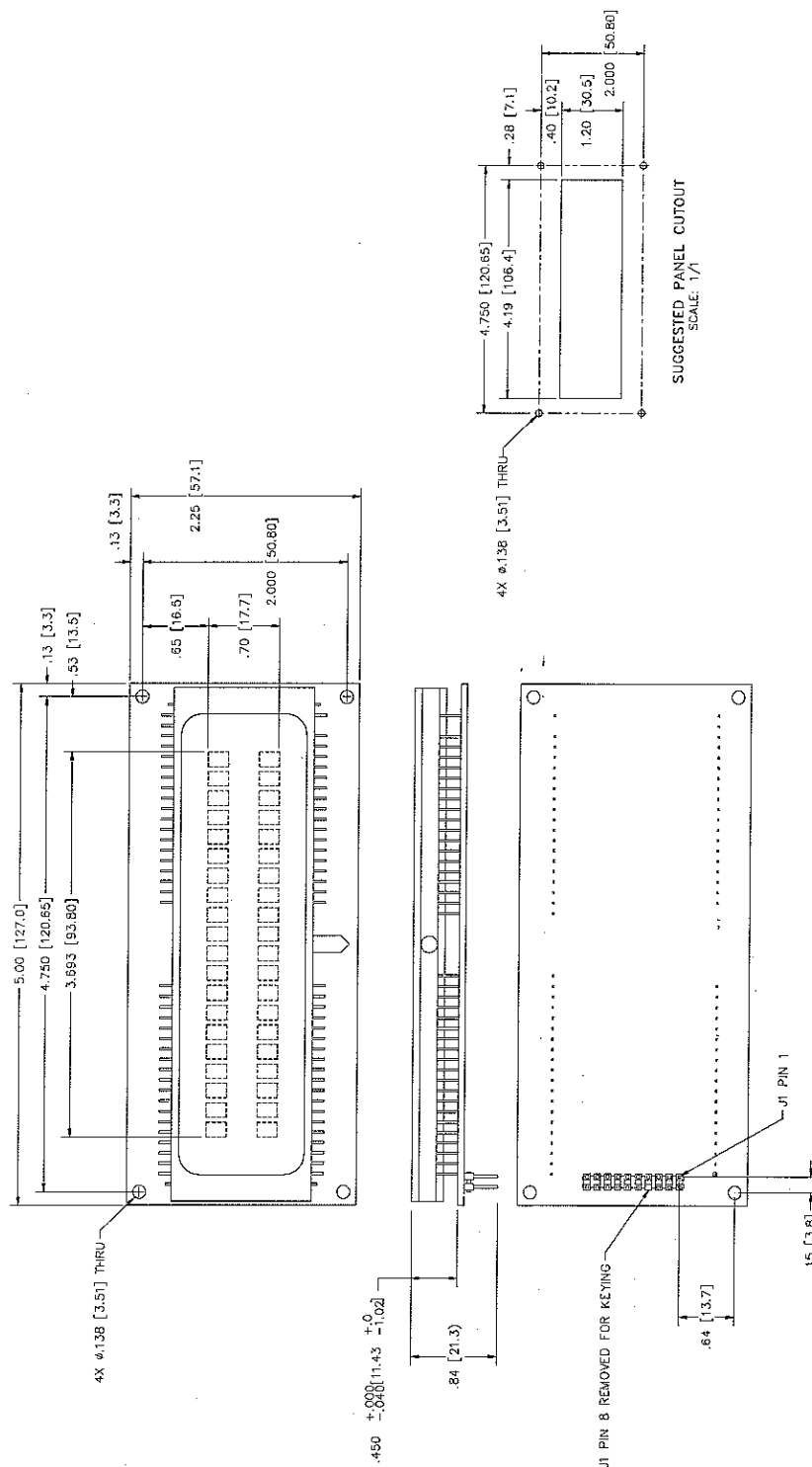


Figure 6-2

036X3-105-05220, 2X20 5mm

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE	N/A	REV B
			SHEET 34

01/25/07

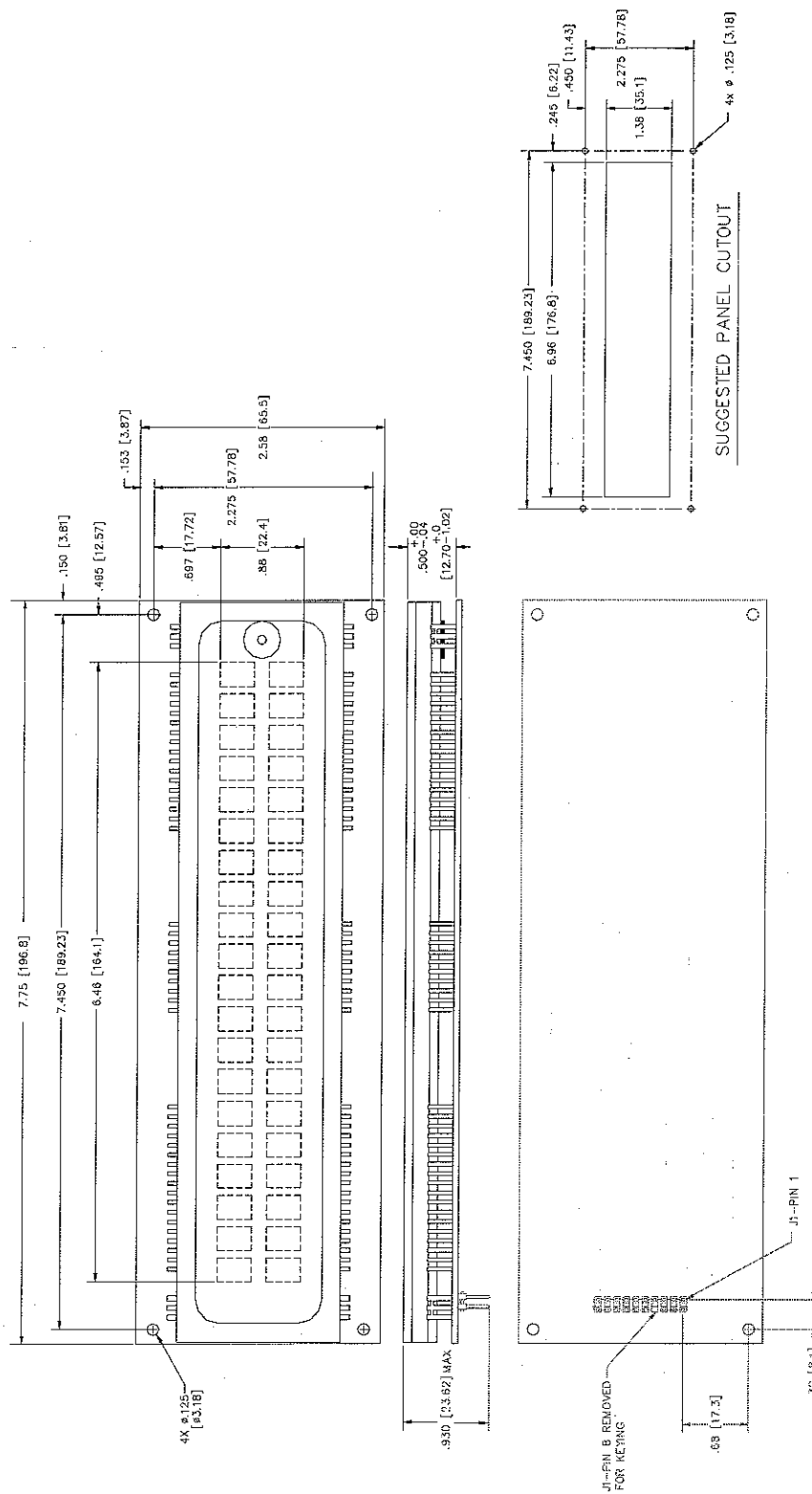


Figure 6-6

036X3-122-09220, 2X20 9mm

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX
	SCALE	N/A	REV B
			SHEET 35

01/25/07

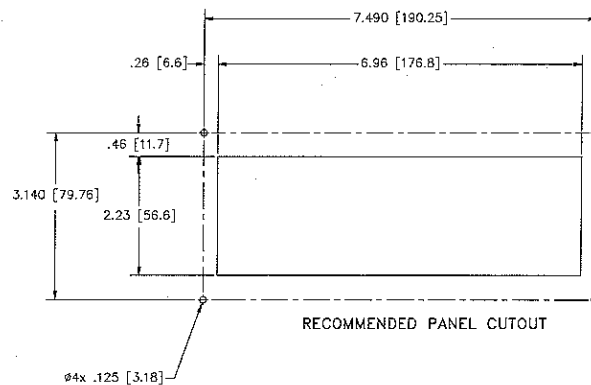
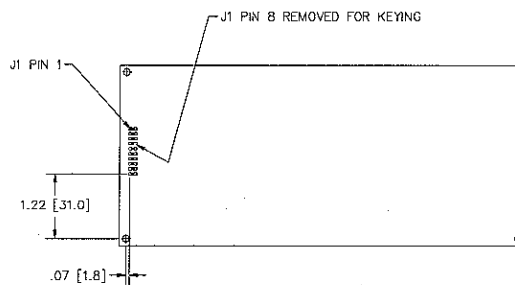
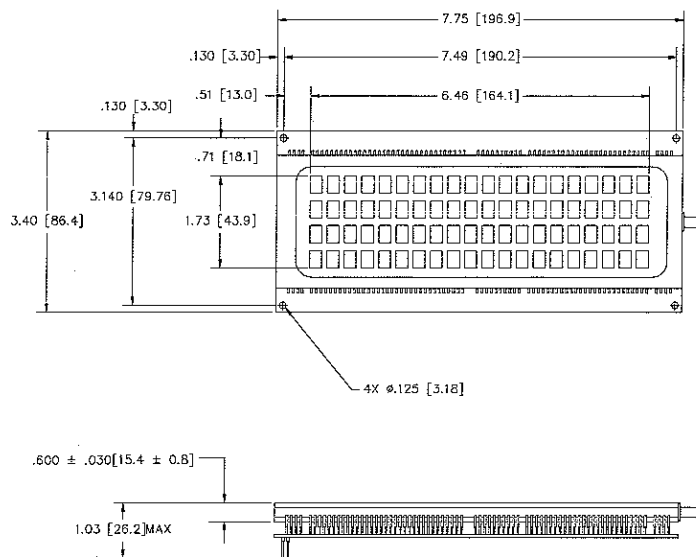


Figure 6-7
036X3-124-09420, 4X20 9mm

Industrial Electronic Engineers, Inc. Van Nuys, California	SIZE A	CODE IDENT NO. 05464	S036X3-XXX-XXXXX	
	SCALE	N/A	REV B	SHEET 36

01/25/07

