SIEMENS
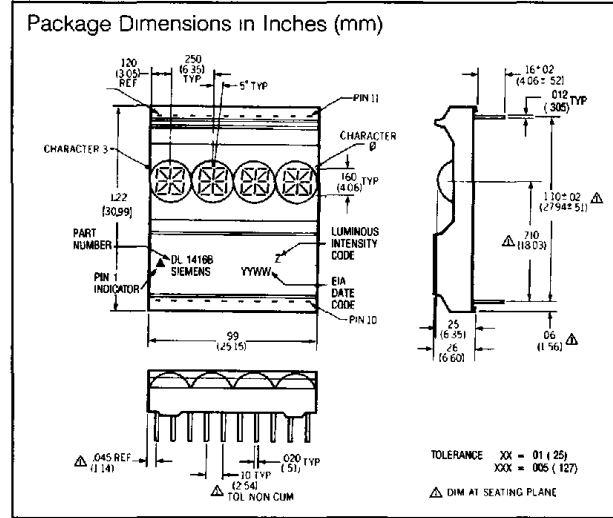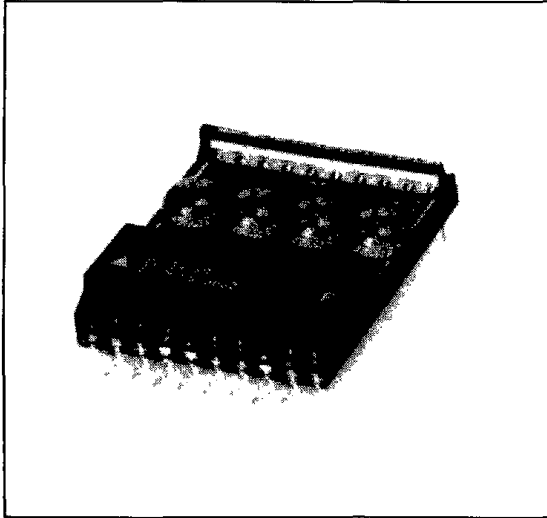
DL 1416B T-41-37

.160" Red, 4-Digit 16-Segment Plus Decimal ALPHANUMERIC Intelligent Display® With Memory/Decoder/Driver

Intelligent
Display Devices

Package Dimensions in Inches (mm)

FEATURES

- 0.16" x 0.125", Magnified Monolithic Character
- Viewing Angle, X Axis ±30°, Y Axis ±50°
- Rugged, Solid Plastic Encapsulated Package
- Top Lens Rail for Display Protection
- Fast Access Time, 350 ns
- Full Size Display for Stationary Equipment
- Built-In Memory
- Built-in Character Generator
- Built-in Multiplex and LED Drive Circuitry
- Direct Access to Each Digit Independently & Asynchronously
- TTL Compatible, 5 Volt Power
- 17th Segment (Decimal Point) for Improved Punctuation Marks
- Independent Cursor Function
- End Stackable, 4 Character Package
- Intensity Coded for Display Uniformity
- 100% Burned In and Tested
- Extended Operating Temperature Range: –40°C to +85°C

DESCRIPTION

The DL 1416B is a four digit display module having 16 segments plus decimal and a built in CMOS integrated circuit

The integrated circuit contains memory, ASCII ROM decoder, multiplexing circuitry, and drivers Data entry is asynchronous and can be random A display system can be built using any number of DL 1416Bs since each digit of each DL 1416B can be addressed independently. Each digit will continue to display the character last "written" until replaced by another

System interconnection is very straightforward. The least significant two address bits (A_0, A_1) are connected to the like inputs of all DL 1416Bs in a system. In small systems having 16 digits (four DL 1416Bs), the enable ($\overline{CE}$) inputs of the four devices could simply be used directly to select each DL 1416B. In larger display systems, the $\overline{CE}$ inputs would come from a 1 of N decoder integrated circuit In this case, address lines A_2 A_n would go to the decoder inputs. Data lines (D_0–D_6) would be connected to all DL 1416Bs directly and in parallel. The cursor ($\overline{CU}$) and write ($\overline{WR}$) lines would also be connected directly and in parallel. The display will then behave as a "write only memory"

The cursor function causes all segments of a digit position to illuminate The cursor is NOT a character, however, and upon removal, the previously displayed character will reappear

Important: Refer to Appnote 18, "Using and Handling Intelligent Displays" Since this is a CMOS device, normal precautions should be taken to avoid static damage

Specifications are subject to change without notice

Maximum Ratings

Supply Voltage V_{CC} .... -0.5 V to $+6.0$ Vdc
Voltage, Any Pin Respect to GND . -0.5 to (V_{CC} +0.5) Vdc
Operating Temperature .... $-40°C$ to $+85°C$
Storage Temperature .... $-40°C$ to $+100°C$
Maximum Solder Temperature, 1.59 mm (0.063″)
    below Seating Plane, t<5 sec... .... .260°C
Relative Humidity (non condensing) @85°C 85%

Optical Characteristics

Time Averaged Luminous Intensity
    per digit (8 segments) .... 0.25 mcd min.
    @25°C ... . 0.75 mcd typ.
Off Axis Viewing Angle.
    Horizontal . . . . ±30°
    Vertical . . . . ±50°
Digit size ...... 0.160″×0.125″
Spectral Peak Wavelength . . . . 660 nm
LED to LED Intensity Matching . . .. 1.8:1.0 max.
Average Display Intensity Matching (one bin) . 1.5:1.0 max.
Bin to Bin Intensity Matching (adjacent bins) . 1 9.1.0 max.

TIMING CHARACTERISTICS

WRITE CYCLE WAVEFORMS
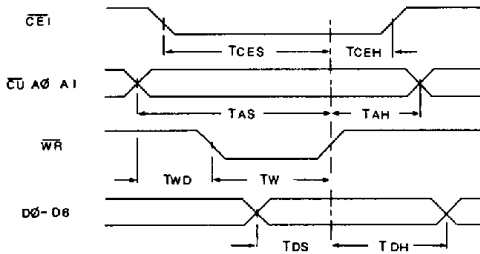
TIMING MEASUREMENT
VOLTAGE LEVELS
— 4 VOLTS
— 2 VOLTS
— 0 VOLTS

TOP VIEW
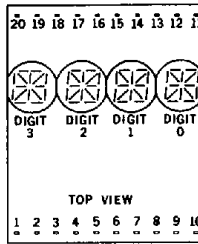
Pin		Function	Pin		Function
1	D5	Data Input	11	A1	Digit Select
2	D4	Data Input	12	Unused	
3	D0	Data Input	13	Unused	
4	D1	Data Input	14	Unused	
5	D2	Data Input	15	Unused	
6	D3	Data Input	16	Unused	
7	CE	Chip Enable	17	Unused	
8	WR	Write	18	V+	
9	CU	Cursor Input	19	V–	
10	A0	Digit Select	20	D6	Data Input

DC CHARACTERISTICS

Parameter	$-40°C$			$+25°C$			$+85°C$			Units	Conditions
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_{CC} 4 Digits on 10 segments/digit		115	140		80	125		65	100	mA	V_{CC} =5 V
I_{CC} Blank		2.5	4.0		2 0	3.5		1.5	2.5	mA	V_{CC} = $\overline{WR}$ = 5 V, BL = 0.8 V
I_{IL}		100	120		75	90		60	75	μA	V_{CC} =5 V, V_{IN} = 0.8 V
V_{IH}	2.0			2 0			2.0			V	V_{CC} =5 V±0.5 V
V_{IL}			0.8			0.8			0.8	V	V_{CC} =5 V±0.5 V

AC CHARACTERISTICS Minimum at V_{CC} =4.5 V in nanoseconds

Parameter	Symbol	$-40°C$	$+25°C$	$+85°C$
Address Set Up Time	T_{AS}	225	300	400
Cursor Set Up Time	T_{CUS}	225	300	400
Chip Enable Set Up Time	T_{CES}	225	300	400
Data Set Up Time	T_{DS}	100	175	300
Write Time	T_W	150	250	350
Address Hold Time	T_{AH}	30	50	80
Data Hold Time	T_{DH}	30	50	80
Write Delay Time	T_{WD}	30	50	80
Chip Enable Hold	T_{CEH}	30	50	80
Cursor Hold Time	T_{CUH}	30	50	80
Access Time	T_{ACC}	255	350	480

DL 1416B

LOADING DATA

The chip enable ($\overline{CE}$) held low and cursor ($\overline{CU}$) held high will enable data loading. The desired data code (D_0-D_6) and selected digit address (A_0-A_1) should be held stable while write ($\overline{W}$) is low for storing new data. The timing parameters in the AC characteristics table are minimum and should be observed. There are no maximum timing requirements. Data entry may be asynchronous and in random order. All undefined data codes (see character set) loaded as data will display a blank.

Digit 0 is defined as the right hand digit with $A_1 = A_0 = 0 =$(low).

LOADING CURSOR

The chip enable ($\overline{CE}$) and Cursor ($\overline{CU}$) are held low. A write ($\overline{W}$) signal will now load a cursor into any digit position addressed by (A_0 - A_1); as defined in data entry. A cursor will be stored if D0 = H and removed if D0 = L. The ($\overline{CU}$) pulse width should not be less than write ($\overline{WR}$) pulse or erroneous data may appear in the display.

TYPICAL LOADING DATA STATE TABLE

$\overline{CE}$	$\overline{CU}$	$\overline{W}$	ADDRESS A_1	A_0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
H	X	X	X	X	X	X	X	X	X	X	X	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE
L	H	L	L	L	H	L	L	L	L	L	H	NO CHANGE	NO CHANGE	NO CHANGE	A
L	H	L	L	H	H	L	L	L	L	H	L	NO CHANGE	NO CHANGE	B	A
L	H	L	H	L	H	L	L	L	L	H	H	NO CHANGE	C	B	A
L	H	L	H	H	H	L	L	L	H	L	L	D	C	B	A
L	H	L	L	L	H	L	L	L	H	L	H	D	C	B	E
L	H	L	H	L	H	L	L	H	L	H	H	D	K	B	E
L	H	L	–	–	–	–	–	–	–	–	–	SEE CHARACTER SET			

X = DON'T CARE

TYPICAL LOADING CURSOR STATE TABLE

CONTROL			ADDRESS		DATA								DISPLAY DIGIT			
$\overline{CE}$	$\overline{CU}$	$\overline{WR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0		3	2	1	0
X	X	H	PREVIOUSLY LOADED DISPLAY										B	E	A	R
X	X	H	DISPLAY PREVIOUSLY STORED CURSORS										B	E	A	R
L	L	L	L	L	X	X	X	X	X	X	H		B	E	A	▨
L	L	L	L	H	X	X	X	X	X	X	H		B	E	▨	▨
L	L	L	H	L	X	X	X	X	X	X	H		B	▨	▨	▨
L	L	L	H	H	X	X	X	X	X	X	H		▨	▨	▨	▨
L	L	L	H	L	X	X	X	X	X	X	L		▨	E	▨	▨

X = DON'T CARE

CHARACTER SET

D6 D5 D4 D3 \ D2 D1 D0	L L L	H L L	L H L	H H L	L L H	H L H	L H H	H H H
L H L L		!	"	#	%	%	&	/
L H L H	(	)	✳	+	,	--	.	/
L H H L	0	1	2	3	4	5	6	7
L H H H	8	9	:	;	∠	=	∖	?
H L L L	@	A	B	C	D	E	F	G
H L L H	H	I	J	K	L	M	N	O
H L H L	P	Q	R	S	T	U	V	W
H L H H	X	Y	Z	[	\	]	^	--

NOTE: All undefined data codes that are loaded or occur on power-up will cause a blank display state.

DL 1416B

INTERNAL SCHEMATIC

Typical Interconnect
for small systems. 12digits

Typical schematic
for 32 digit systems

DL 1416B

Intelligent Display Devices
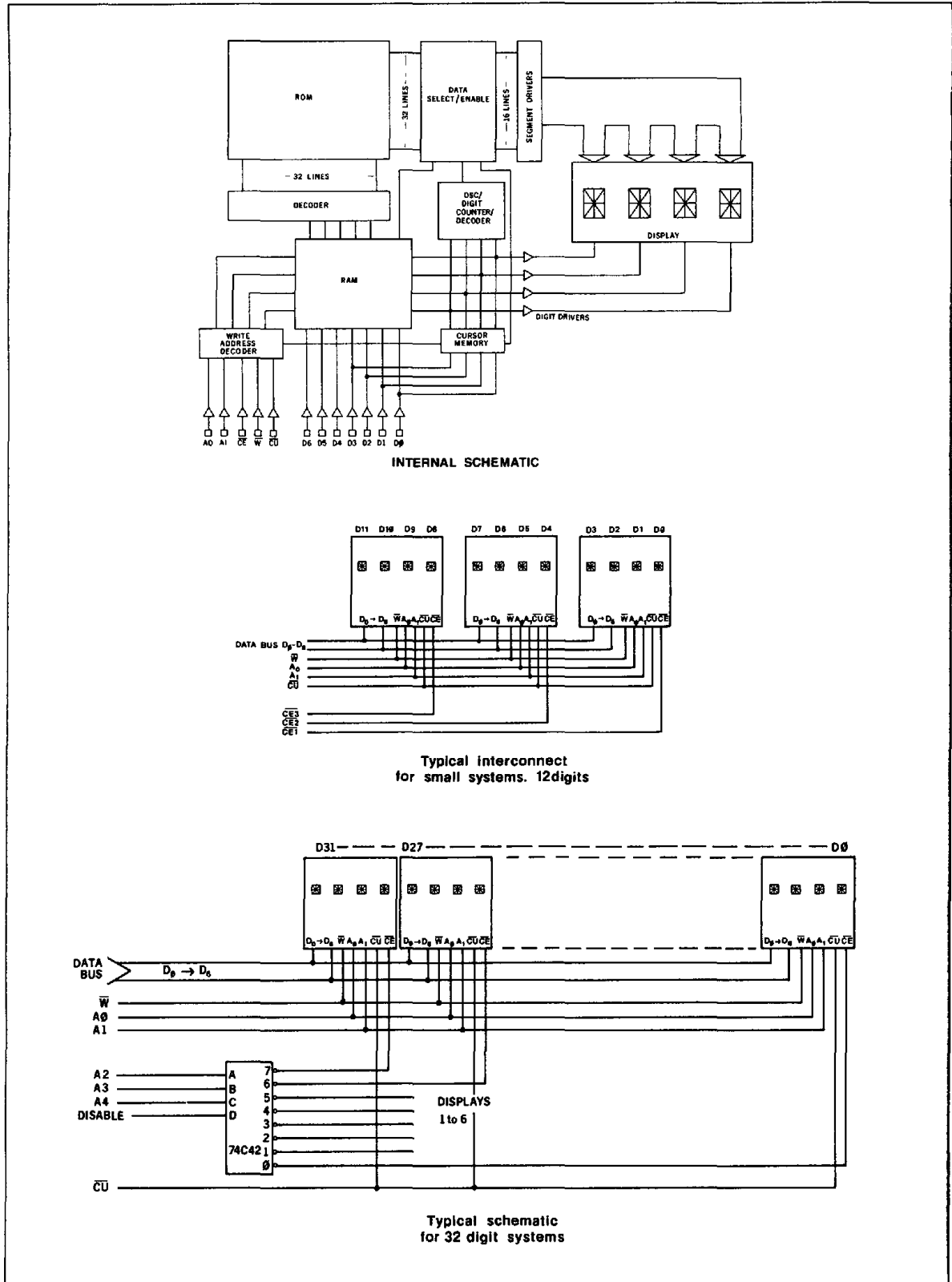
DESIGN CONSIDERATIONS

For details on design and applications of the DL 1416B utilizing standard bus configurations in multiple display systems, or Parallel I/O devices, such as the 8255 with an 8080 or memory mapped addressing on processors such as the 8080, Z80, or 6800, or non-microprocessor based systems, please refer to Appnote 9A and 13 in our current Optoelectronic Data Book.

ELECTRICAL AND MECHANICAL CONSIDERATIONS

VOLTAGE TRANSIENT SUPPRESSION

It is highly recommended that the display and the components that interface with the display be powered by the same supply to avoid logic inputs higher than V_{CC}. Additionally, the LEDs may cause transients on the power supply line while they change display states. Common practice is to place .01 μF capacitors close to the displays across V_{CC} and GND, one for each display, and one 10 μF capacitor for every second display

ESD PROTECTION

The metal gate CMOS IC of the DL 1416B is extremely immune to ESD damage. It is capable of withstanding discharges greater than 3KV. However, users of these devices are encouraged to take all the standard precautions, normal for CMOS components. These include properly grounding personnel, tools, tables, and transport carriers that come in contact with un-shielded parts. Where these conditions are not, or cannot be met, keep the leads of the device shorted together or the parts in anti-static packaging

SOLDERING CONSIDERATIONS

The DL 1416B can be hand soldered with SN63 solder using a grounded iron set to 260°C

Wave soldering is also possible following these conditions. Preheat that does not exceed 93°C on the solder side of the PC board or a package surface temperature of 85°C. Water soluble organic acid flux (except carboxylic acid) or resin-based RMA flux without alcohol can be used

Wave temperature of 245°C ±5°C with a dwell between 1.5 sec to 3.0 sec. Exposure to the wave should not exceed temperatures above 260°C, for 5 seconds at 0.063" below the seating plane. The packages should not be immersed in the wave.

POST SOLDER CLEANING PROCEDURES

The least offensive cleaning solution is hot D I water (60°C) for less than 15 minutes. Addition of mild saponifiers is acceptable. Do not use commercial dishwasher detergents

For faster cleaning, solvents may be used. Care should be exercised in choosing these as some may chemically attack the nylon package. Maximum exposure should not exceed two minutes at elevated temperatures. Acceptable solvents are TF (trichlorotrifluoroethane), TA, 111 Trichloroethane, and unheated acetone.

Unacceptable solvents contain alcohol, methanol, methylene chloride, ethanol, TP35, TCM, TMC, TMS+, TE, and TES. Since many commercial mixtures exist, you should contact your solvent vendor for chemical composition information. Some major solvent manufacturers are Allied Chemical Corporation, Specialty Chemical Division, Morristown, NJ;

Baron-Blakeslee, Chicago, IL; Dow Chemical, Midland, MI; E I DuPont de Nemours & Co., Wilmington, DE.

Further information is available in Siemens Appnotes 18 and 19 in our current Optoelectronic Data Book

An alternative to soldering and cleaning the display modules is to use sockets. Naturally, 20 pin DIP sockets 1 10" wide with 100" centers work well for single displays. Multiple display assemblies are best handled by longer SIP sockets or DIP sockets when available for uniform package alignment. Socket manufacturers are Aries Electronics, Inc., Frenchtown, NJ; Garry Manufacturing, New Brunswick, NJ; Robinson-Nugent, New Albany, IN; and Samtec Electronic Hardware, New Albany, IN

Further information is available in Siemens Appnote 22 in our current Optoelectronic Data Book.

OPTICAL CONSIDERATIONS

The .16" high characters of the DL 1416B allow readability up to 8 feet. Proper filter selection will allow the user to build a display that can be utilized over this distance

Filters allow the user to enhance the contrast ratio between a lit LED and the character background. This will maximize discrimination of different characters as perceived by the display user. The only limitation is cost. The cost/benefit ratio for filters can be maximized by first considering the ambient lighting environment.

Incandescent (with almost no green) or fluorescent (with almost no red) lights do not have the flat spectral response of sunlight. Plastic band-pass filters are inexpensive and effective in optimizing contrast ratios. The DL 1416B is a red display and should be matched with a long wavelength pass filter in the 600 nm to 620 nm range. For display systems of multiple colors (using other Siemens displays), neutral density grey filters offer the best compromise.

Additional contrast enhancement can be gained through shading the displays. Plastic band-pass filters with built-in louvers offer the "next step up" in contrast improvement. Plastic filters can be further improved with anti-reflective coatings to reduce glare. The trade-off is "fuzzy" characters, but mounting the filters close to the display reduces this effect. Care should be taken not to overheat the plastic filters by allowing for proper air flow

Optimal filter enhancements for any condition can be gained through the use of circular polarized, anti-reflective, band-pass filters. The circular polarizing further enhances contrast by reducing the light that travels through the filter and reflects back off the display to less than 1%.

Several filter manufacturers supply quality filter materials. Some of them are Panelgraphic Corporation, W. Caldwell, NJ, SGL Homalite, Wilmington, DE, 3M Company, Visual Products Division, St Paul, MN, Polaroid Corporation, Polarizer Division, Cambridge, MA, Marks Polarized Corporation, Deer Park, NY, Hoya Optics, Inc , Fremont, CA

One last note on mounting filters: recessing display and bezel assemblies is an inexpensive way to provide a shading effect in overhead lighting situations. Several Bezel manufacturers are R M F Products, Batavia, IL, Nobex Components, Griffith Plastic Corp , Burlingame, CA; Photo Chemical Products of California, Santa Monica, CA; I E E - Atlas, Van Nuys, CA

Please refer to Siemens Appnote 23 for further information

DL 1416B