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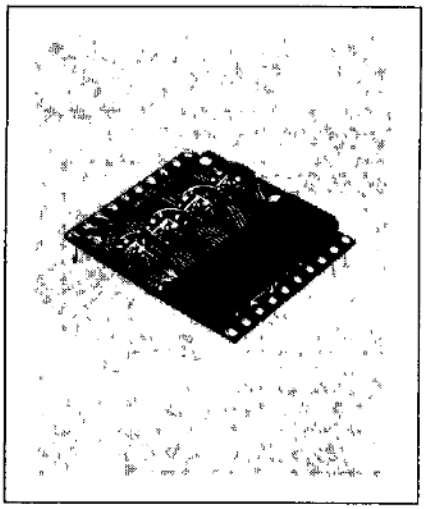
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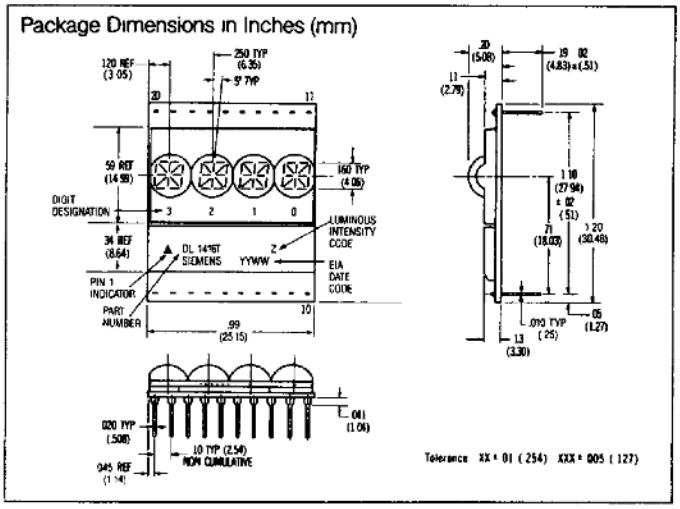
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SIEMENS

DL 1416T

.160″ RED, 4-DIGIT 16-SEGMENT ALPHANUMERIC Intelligent Display® WITH MEMORY/DECODER/DRIVER





NOT FOR NEW DESIGNS

(Refer to the Improved Extended Performance of DL 1416B for Similar Applications.)

FEATURES

- **End-stackable, 4-Character Package**
- **High Contrast, 160 mil High, Magnified Monolithic Characters**
- **Viewing Angle ± 20°**
- **64-Character ASCII Format**
- **Built-in Memory, Decoder, Multiplexer and Drivers**
- **Direct Access to Each Digit Independently and Asynchronously**
- **5 Volt Logic, TTL Compatible**
- **5 Volt Power Supply Only**
- **Independent Cursor Function**
- **Intensity Coded For Display Uniformity**

DESCRIPTION

The DL 1416T Intelligent Display is a four-digit LED display module having a 16-segment font and an on-board CMOS integrated circuit driver.

The CMOS chip includes memory for four digits and cursor, 64 ASCII character generator ROM, and segment/digit drivers with associated multiplexing circuitry. Inputs are TTL compatible as is the power supply requirement. Data entry is asynchronous and random access. A display system can be built using any number of DL 1416Ts since each digit of each DL 1416T can be addressed independently. Each digit will continue to display the character last "written" until replaced by another.

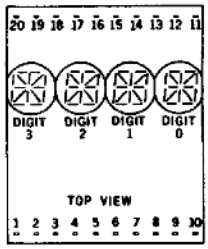
A cursor is defined as all segments of a digit position to be lit. The cursor is *not* a character, however, and upon removal leaves the previously displayed character unchanged. Normally, the cursor would be loaded and unloaded (flash) under software control. This can be used as a pointer in a line of DL 1416T displays or a "lamp test" function is realized by simply storing a cursor in all four digit positions of a display.

System interconnection is very straight forward. The least significant two address bits (A_0, A_1) are connected to the like inputs of all DL 1416Ts in a system. In small systems having 16 digits (4-DL 1416Ts), the enable ($\overline{CE}$) inputs of the four devices could simply be used directly to select each DL 1416T. In larger displays, the $\overline{CE}$ inputs would come from A 1-of-N decoder integrated circuit. In this case, address lines $A_2 \ldots A_n$ would go to the decoder inputs. Data lines (D_0-D_6) would be connected to all DL 1416Ts directly and in parallel. The cursor ($\overline{CU}$) and write ($\overline{W}$) lines would also be connected directly directly and in parallel. The display will then behave as a "write-only memory."

All products are 100% burned-in and tested, then subjected to out-going AQL's of .25% for brightness matching, visual alignment and dimensions, .065% for electrical and functional.

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

Pin		Function	Pin		Function
1	D5	Data Input	11	A1	Digit Select
2	D4	Data Input	12	Unused	
3	DØ	Data Input	13	Unused	
4	D1	Data Input	14	Unused	
5	D2	Data Input	15	Unused	
6	D3	Data Input	16	Unused	
7	$\overline{CE}$	Chip Enable	17	Unused	
8	$\overline{W}$	Write	18	V+	
9	$\overline{CU}$	Cursor Input	19	V–	
10	AØ	Digit Select	20	D6	Data Input



OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

MAXIMUM RATINGS

V_{CC}	–0.5 V to 6.0 V
Voltage, Any Pin Respect to GND (V-)	–0.5 to Vcc +0.5 VDC
Operating Temperature	–20 to +65°C
Storage Temperautre	–20 to +70°C
Relative Humidity (non condensing) @ 65°C	85%

OPTICAL CHARACTERISTICS (TYPICAL)

Luminous Intensity per digit/8 segments @5V,	.8 mcd
Viewing Angle	± 20°
Digit Size	0.16" ×0.125"
Spectral Peak Wavelength	660 nm
LED to LED intensity matching	1.8:1.0 max.
Display to Display intensity matching	1.5:1.0 max.
Bin to bin intensity matching	1.9:1.0 max.

DC CHARACTERISTICS

Parameter	–20°C Typ	+25°C[4]	+65°C Typ	Conditions
I_{CC} 4 digits on (10 seg/digit)		80 mA max[1]		V_{CC} = 5.0 V
I_{CC} Cursor[2]		105 mA max[1]		V_{CC} = 5.0 V
I_{CC} Blank		7 mA max	2.0 mA	V_{IN} = 0 V_{CC} = 5.0 V $\overline{W}$ = 5.0 V
I_{IL}	20 μA	160 μA max	10 μA	V_{IN} = .8 V V_{CC} = 5.0 V
V_{IL}		.8 V Max		V_{CC} = 4.5 V
V_{IH}[3]		2.7 V Min		V_{CC} = 4.5 V
		3.3 V Min		V_{CC} = 5.5 V

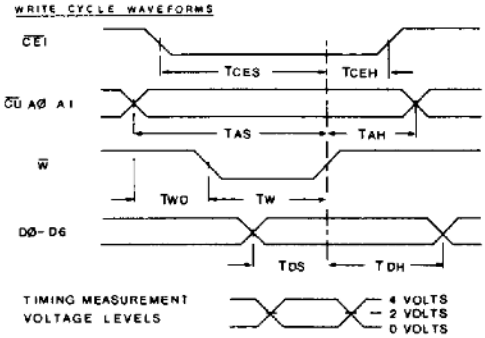
1. Measured at 5 seconds.
2. 60 sec. max. duration.
3. $V_{CC} \geq V_{IH} \geq 0.6\ V_{CC}$
4. V_{cc} = +5.0 VDC ±10%

AC CHARACTERISTICS @ 25°C

MINIMUM TIMING PARAMETERS @ 4.5 V (nanoseconds)

T_{AS}	1000
T_{WD}	500
T_W	500
T_{DS}	1000
T_{DH}	400
T_{AH}	400
T_{CEH}	400
T_{CES}	1000
T_{ACC}[4]	1400

TIMING CHARACTERISTICS



Note 1: This display contains a CMOS integrated circuit. Normal CMOS handling precautions should be taken to avoid damage due to high static voltages or electric fields.

Note 2: Unused inputs must be tied to an appropriate logic voltage level (eigher V+ or V–).

Note 3: **Warning** – Do not use solvents containing alcohol.

Note 4: Access time is defined as $T_{AS} + T_{DH}$ (sum of address set up and data hold times).

DL 1416T

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 for which the respective first four data lines (D_0, D_1, D_2, D_3) individually or together are held high. If previously stored, the cursors can only be removed if their respective data lines are held low while $\overline{CE}$, $\overline{CU}$ are low and write ($\overline{W}$) occurs.

The cursor ($\overline{CU}$) should *not* be hardwired high (off). During the power-up of DL 1416s the cursor memory will be in a random state. Therefore, it is recommended for the processor-based system to initialize or write out possible cursors during the system initializing portion of the software.

The cursor display will be over ridden by a blank from an undefined code in that digit position.

TYPICAL LOADING DATA STATE TABLE

$\overline{CE}$	$\overline{CU}$	$\overline{W}$	ADDRESS A_1	ADDRESS A_0	DATA INPUT 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

$\overline{CE}$	$\overline{CU}$	$\overline{W}$	ADDRESS A_1	ADDRESS A_0	DATA INPUT 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	D	K	B	E
L	L	L	X	X	X	X	X	X	L	L	L	D	K	B	☒
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E
L	L	L	X	X	X	X	X	L	L	H	L	D	K	☒	E
L	L	L	X	X	X	X	X	L	H	L	L	D	☒	B	E
L	L	L	X	X	X	X	X	H	L	L	L	☒	K	B	E
L	L	L	X	X	X	X	X	H	H	H	H	☒	☒	☒	☒
L	L	L	X	X	X	X	X	L	L	L	L	D	K	B	E

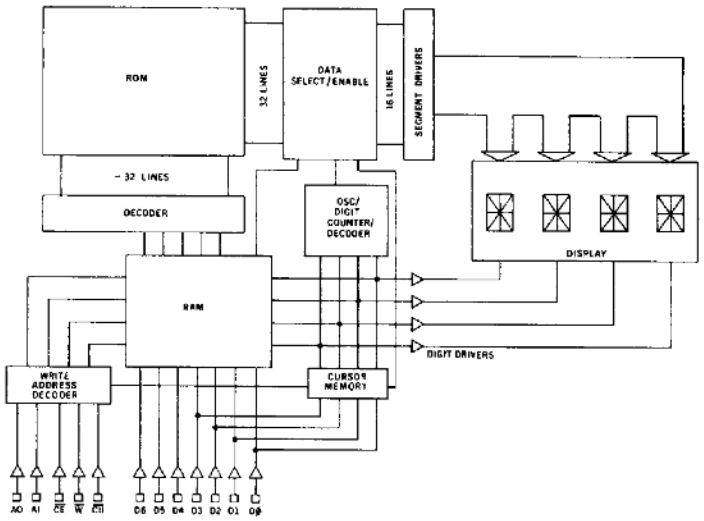
X = DON T CARE

CHARACTER SET

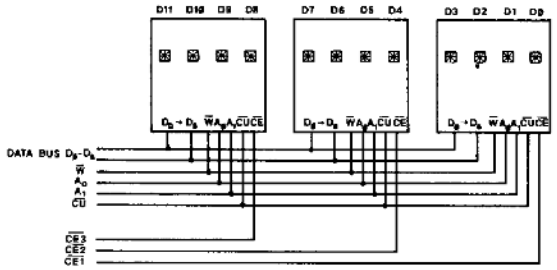
D6 D5 D4 D3	D0 L, D1 L, D2 L	D0 H, D1 L, D2 L	D0 L, D1 H, D2 L	D0 H, D1 H, D2 L	D0 L, D1 L, D2 H	D0 H, D1 L, D2 H	D0 L, D1 H, D2 H	D0 H, D1 H, D2 H
L H L L			"					'
L H L H	(	)	*	+	,	-	.	/
L H H L	0	1	2	3	4	5	6	7
L H H H	8	9	:	;	<	=	>	?
H L L L	@	A	B	C	D	E	F	G
H L L H	H	I	J	K	L	M	N	O
H L H L	P	Q	R	S	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

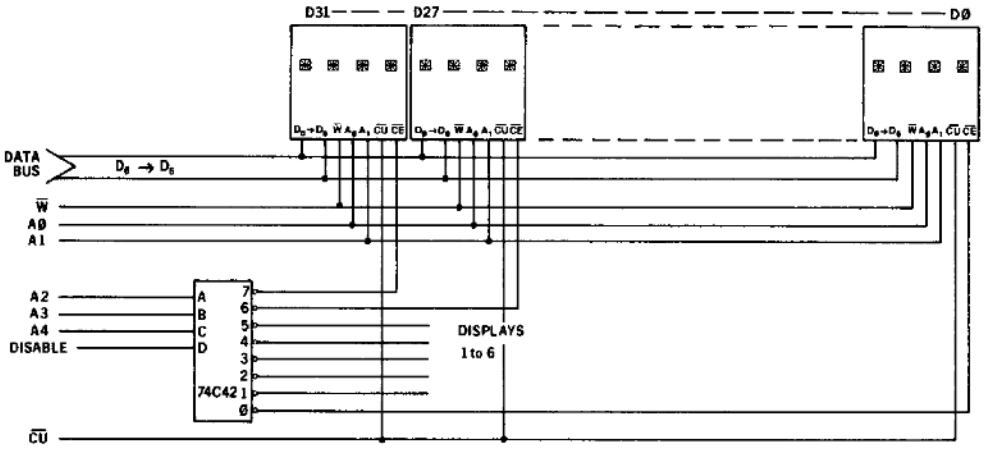
DL 1416T



INTERNAL SCHEMATIC



Typical interconnect
for small systems. 12digits



Typical schematic
for 32 digit systems

DL 1416T

DESIGN CONSIDERATIONS

For details on design and applications of the DL 1416T 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, 6800, or non-micro processor based systems, please refer to Appnote 9A and 13 in the current Siemens 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. The 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 1416T 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 unshielded 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 1416T 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 70°C. Water soluble organic acid flux or (except carboxylic acid) 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 preferred 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.

For further information refer to Appnotes 18 and 19 in the current Siemens 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.

For further information refer to Appnote 22 in the current Siemens Optoelectronic Data Book.

OPTICAL CONSIDERATIONS

The 0.16" high characters of the DL 1416T allow readability up to six 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 to the user's benefit 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 1416T 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. 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.

Refer to Siemens Appnote 23 for further information.

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