Semiconductor Corporation

CS8127

Light Emitting /Detecting Diode T-75-11-37

Features

- Supports bi-direction communication when used with the CS8123 and CS8124 OPTIMODEM™
- Compatible with the CS8125 T1 Optical Driver
- Couples efficiently into 50/125 µm, 62.5/125 µm, 100/140 µm and 200 µm PCS cables
- Power coupled to 50/125 µm cable is typically 40 µW.
- Responsivity as receiver is typically 0.20A/W with 50/125 µm fiber
- ST-Connector

General Description

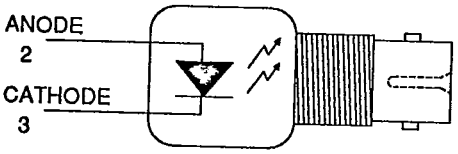
The CS8127 light emitting and detecting diode is designed to support bi-directional, ping-pong communication over a single optical cable. In bi-directional applications, the CS8127 acts alternately as a transmitter and as a receiver. Transmitter output is typically 40µW @ I_F = 100mA. Receiver responsivity is typically 0.20 A/W. At these performance levels, the CS8127 can support CS8123/4 transmission distances of up to 1km using 50/125 fiber with 3dB of headroom.

The CS8127 is offered in a Plastic Fiber DIP package compatible with ST type connectors. The CS8127 is intended to operate with graded index multimode fibers with diameters ranging from 50/125 to 200µm.

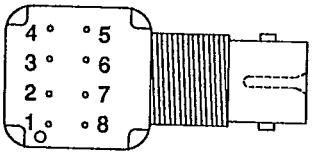
ORDERING INFORMATION:

CS8127- IP1

I - -40° to +85°C Temperature Range
P - Plastic Fiber DIP package ST type connector
1 - Performance grade (fiber coupled power and responsivity)



Pin	Function
1	NC
2	ANODE
3	CATHODE
4	NC
5	NC
6	NC
7	NC
8	NC



BOTTOM VIEW

8

Preliminary Product Information | This document contains information for a new product. Crystal Semiconductor reserves the right to modify this product without notice.

Crystal Semiconductor Corporation
P.O. Box 17847, Austin, TX 78760
(512) 445-7222 FAX: (512) 445-7581

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Units
Continuous Forward Current	I_F	-	100	mA
Reverse Breakdown Voltage I_R = 10µA		2.0	-	V
Case to Cathode (Anode) Voltage		-	110	V
Storage Temperature	T_{STG}	-65	150	°C
Case Operating Temperature	T_C	-40	85	°C

ELECTRO-OPTICAL CHARACTERISTICS (T_C = 25 °C)

Parameter		Symbol	Min	Typ	Max	Units
Emitter						
Forward Voltage	I_F = 100mA	V_F	-	1.7	2.0	V
Fiber Coupled Power I_F = 100mA (Note 1)	50µm fiber 62.5µm fiber 100µm fiber 200µm fiber	P_{OC}	20 44 116 640	40 88 232 1280	- - - -	µW
Peak Wavelength	I_F = 100mAdc	λ_E	840	850	860	nm
Spectral Bandwidth (-3dB points)	I_F = 100mAdc	$\Delta\lambda$	-	50	-	nm
Response Time 10-90%	1V prebias, I_F = 100mA$_{peak}$	t_R t_F	- -	12 15	20 20	ns
Power Output Temperature Coefficient	50µm fiber I_F = 100mA	$\Delta P_O/\Delta T$	-	-0.01	-	dB/°C
Peak Wavelength Temperature Coefficient	50µm fiber, I_F = 100mA	$\Delta\lambda p/\Delta T$	-	+0.25	-	nm/°C
Detector						
Dark Leakage Current	V_R = 1V	I_D	-	0.5	20	nA
Responsivity λ_D = 850nm (Note 1)	50 µm fiber 62.5µm fiber 100µm fiber 200µm fiber	R	0.10 0.09 0.08 0.05	0.20 0.18 0.16 0.10	- - - -	A/W
Package Capacitance	V_R = 0V, f = 1MHz	C	30	55	80	pF
Response Time, 10-90%	V_R = 0V, λ_D = 850nm	t_R t_F	- -	7 4	20 20	ns ns
Responsivity Temperature Coefficient	50µm fiber λ_D = 850nm	$\Delta R/\Delta T$	-	+0.93	-	%/°C
Responsivity Wavelength Coefficient	50µm fiber λ_D = 850nm	$\Delta R/\Delta\lambda$	-	-3.7	-	%/nm

Note: 1. Parameter tested for 1 m of 50 µm fiber. Values for larger diameter are based on calculations relative to 50 µm fiber.

Specifications are subject to change without notice.

Typical Emitter Performance

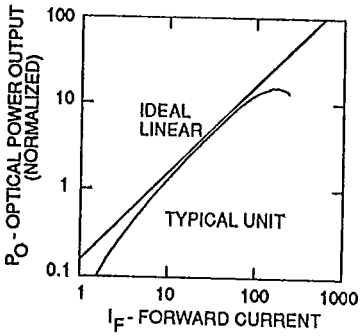


Figure 1. Relative Power Out vs Forward Current

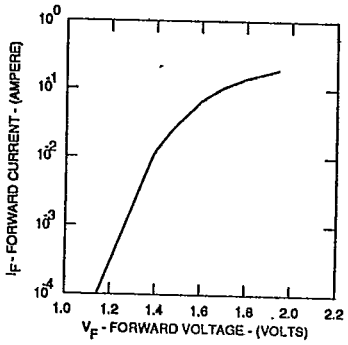


Figure 2. Forward Current vs Forward Voltage

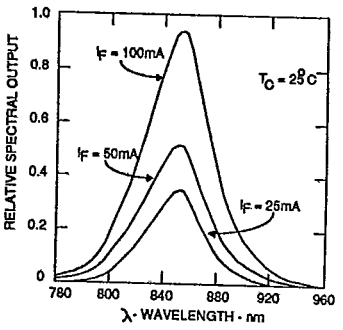


Figure 3. Relative Spectral Output vs Wavelength

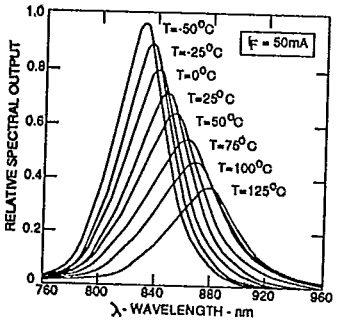


Figure 4. Spectral Output vs Temperature

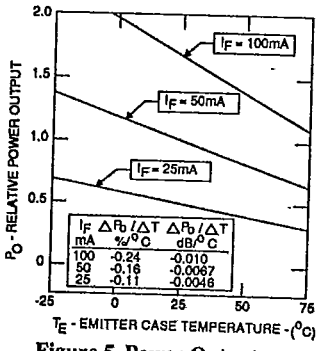


Figure 5. Power Output vs Temperature

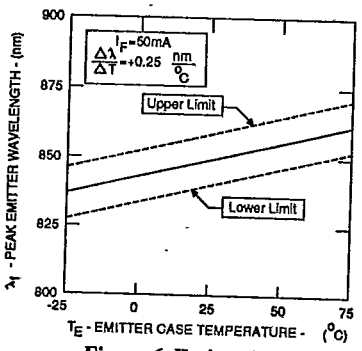


Figure 6. Emitter Peak Wavelength vs Temperature

Emitter/Detector Performance

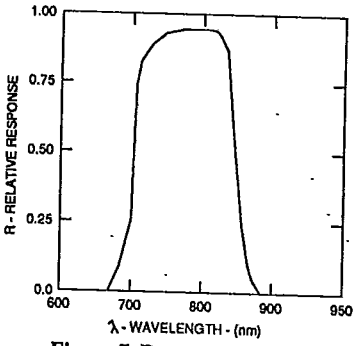


Figure 7. Detector Spectral Response vs Wavelength

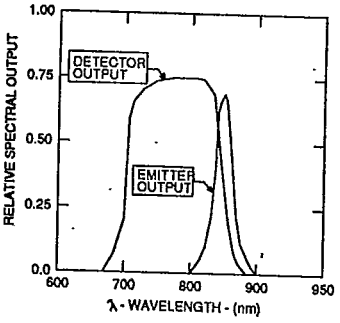


Figure 8. Emitter/Detector Spectral Output vs Wavelength

Typical Detector Performance

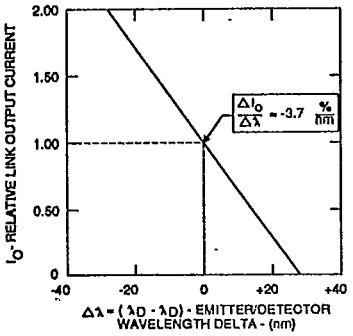


Figure 9. Relative Link Output Current vs Emitter/Detector Wavelength Delta

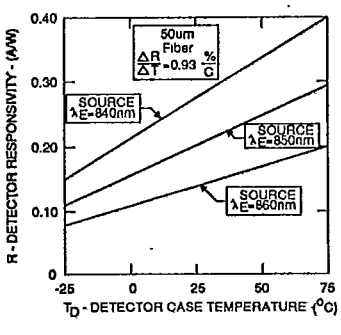


Figure 10. Detector Responsivity vs Detector Temperature

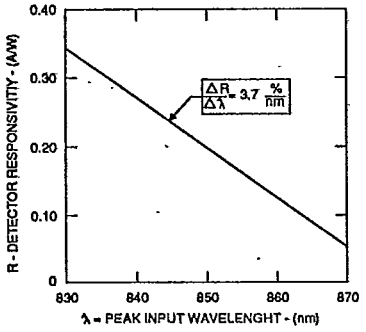


Figure 11. Detector Responsivity vs Wavelength

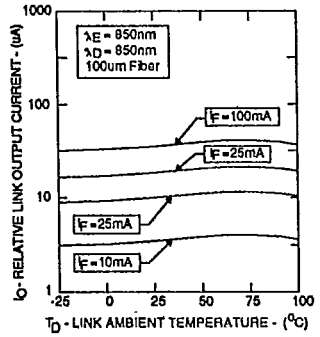


Figure 12. Link Output Currrent vs Link Temperature

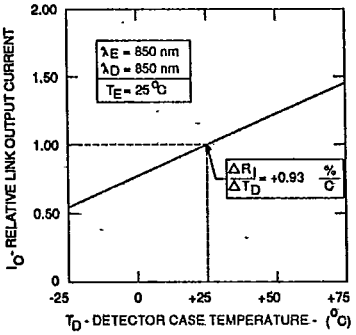


Figure 13. Relative Link Output vs Detector Temperature

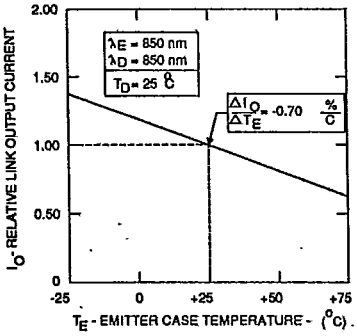


Figure 14. Relative Link Output vs Emitter Temperature

The CS8127 is intended to be used with Crystal's CS8123 and CS8124 OPTIMODEM products. The CS8127 can also be used with the CS8125 PCM transmitter and CS8126 PCM receiver. Excellent light power output and responsivity characteristics distinguish the CS8127 from transmit only LEDs and receive only PIN diodes. The CS8127 is capable of supporting transmission distances of 1 km over 62.5/125 µm fiber with nearly 3 dB of operating margin.

Calculating a Link Budget

A link budget should be calculated to ensure that the current generated by the LED in receive mode is between 1 µA and 30 µA (the limits of the CS8123/4 LDN/LDP inputs). Power coupled to the fiber, the attenuation characteristics of the fiber, loss due to splices or interconnects, the responsivity of the LED, and variations due to temperature must all be considered when calculating a link budget.

The following is an example of a link budget for transmission over 1 km of 62.5/125 µm fiber with both ends at 25°C.

Fiber coupled power for 62.5/125 µm fiber = 44 µW, min
Loss (Fiber attenuation): 3.75 dB/km
Light power at end of fiber: $44 \times 10^{(-3.75/10)}$ = 18.55 µW
Responsivity for 62.5/125 µm fiber: 0.09 A/W, min
Current out of LED (receiving): 18.5 µW x 0.09 A/W = 1.67 µA

Since output power and responsivity are based on minimum performance values for the CS8127, 1.67 µA of output current represents the minimum, worst case output current. The minimum light power needed to generate 1 µA of current is 11.11 µW, so the operating margin is at least 2.25 dB.

Now consider temperature which affects wavelength, transmit power and responsivity. If the temperature increases at both ends of the link by 50°C, calculate the resulting change in performance.

Change in transmitted wavelength:
$\Delta\lambda_E$ = +0.25 nm/°C
850 nm + (0.25 nm/°C)(50°C)
= 862.5 nm
Change in responsivity due to wavelength:
ΔR_λ = -3.7 %/nm
0.09 A/W + (-3.7 %/nm)(12.5 nm)
= 0.09 A/W - 46.2 %
= 0.048 A/W
Change in output power due to temperature:
$\Delta P_{OC(temp)}$ = -0.01 dB/°C
44 µW + (-0.01 dB/°C)(50°C)
= 44 µW - 0.5 dB
= 39.2 µW
Change in responsivity due to temperature:
ΔR_{temp} = +0.93 %/°C
44 µW + (0.93 %/°C)(50°C)
= 0.09 A/W + 46.5 %
= 0.132 A/W
Totals: Transmission change:
44 µW - 11%
= 39.2 µW
Receiver change:
0.09 A/W - 46.2 % + 46.5 %
= 0.09 A/W

The change in performance is minimal as long as both ends are at the same temperature.

Now consider the case where the transmitter is at 50°C and the receiver is at 0°C. Following the same calculations for +25°C delta on the transmitter and -25°C delta for the receiver:

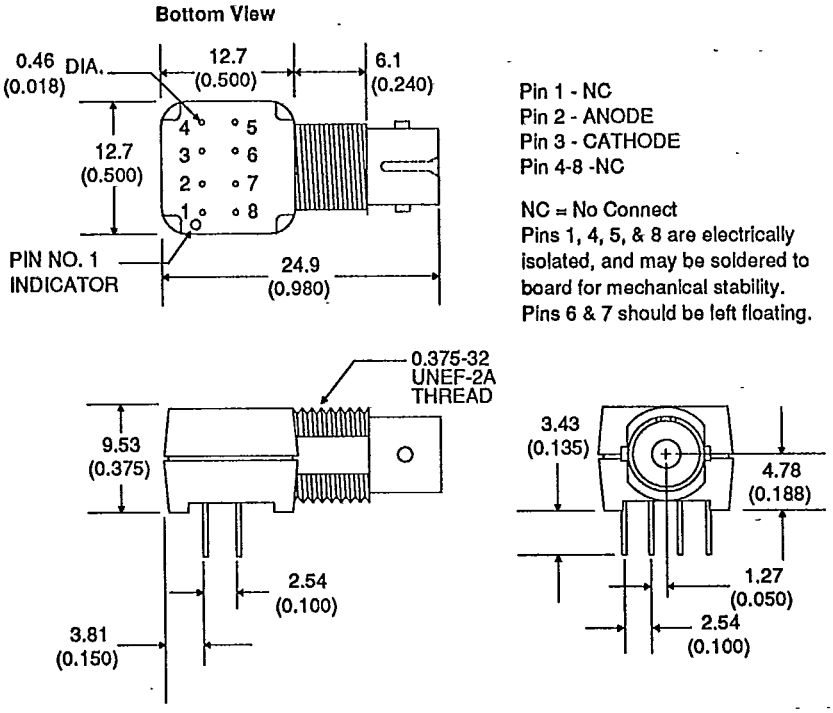
$\Delta\lambda_E$ = +6.25 nm
$\Delta P_{OC(temp)}$ = -0.25 dB or -5.6 %
ΔR_λ = -23.1 %
ΔR_{temp} = -23.3 %

This shows that 5.6 % of the output power, and 46.4 % of the receiver performance is lost which translates to 3.55 dB. The loss of 3.55 dB due to temperature difference between the ends of the link exceeds the 2.25 dB margin calculated for 1 km of 62.5/125 µm fiber. To be assured of reliable operation when the ends of the link will differ by 50°C either the length of 62.5/125 µm fiber must be reduced, or larger diameter fiber is required.

When using large diameter fiber for short distances, take care not to exceed the 30 µA max input current of the CS8123 or CS8124. The TCL pin can be used to limit the output drive current thereby reducing the power coupled to the fiber.

The CS8127 is specified to withstand up to 100 mA of continuous current while the CS8123/4 specifications indicate that their maximum output current is 115 mA. In normal operation, the OPTIMODEM is driving the LED a fifth of the time. In this case, the 115 mA of output currrent is not continuous and will not damage the CS8127.

Mechanical Specifications



Pin 1 - NC
Pin 2 - ANODE
Pin 3 - CATHODE
Pin 4-8 -NC

NC = No Connect
Pins 1, 4, 5, & 8 are electrically isolated, and may be soldered to board for mechanical stability. Pins 6 & 7 should be left floating.

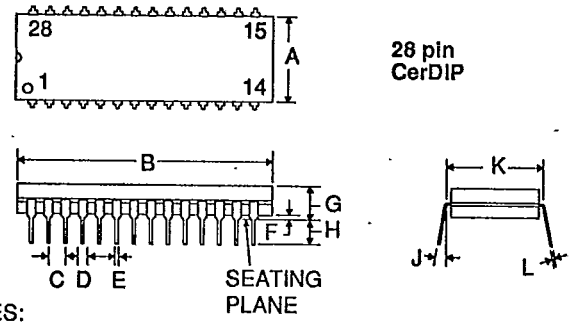
All dimensions in millimeters and (inches).

CRYSTAL

MECHANICAL DATA

T-90-20

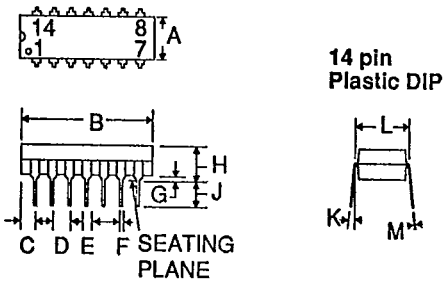
MECHANICAL DATA



28 pin CerDIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	12.70	15.37	0.500	0.605
B	36.45	37.85	1.435	1.490
C	2.54 BSC		0.100 BSC	
D	1.27	1.65	0.050	0.065
E	0.38	0.56	0.015	0.022
F	0.51	1.27	0.020	0.050
G	4.06	5.84	0.160	0.230
H	2.92	4.06	0.115	0.160
J	5°	15°	5°	15°
K	15.24 BSC		0.600 BSC	
L	0.20	0.30	0.008	0.012

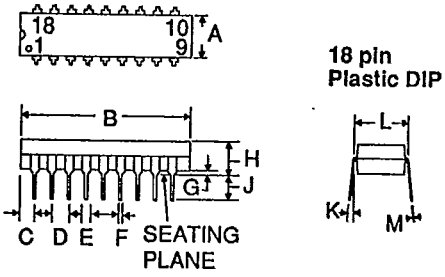
NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.13MM (0.005") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION K TO CENTER OF LEADS WHEN FORMED PARALLEL.



14 pin Plastic DIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.10	6.60	0.240	0.260
B	18.54	19.56	0.730	0.770
C	1.65	2.16	0.065	0.085
D	2.54 BSC		0.100 BSC	
E	1.02	1.78	0.040	0.070
F	0.38	0.53	0.015	0.021
G	0.51	1.02	0.020	0.040
H	3.81	5.08	0.150	0.200
J	2.92	3.43	0.115	0.135
K	0°	10°	0°	10°
L	7.62BSC		0.300BSC	
M	0.20	0.38	0.008	0.015

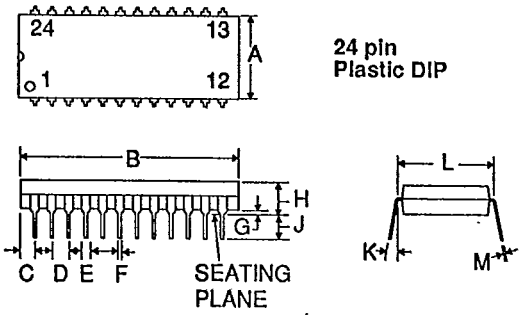
NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.13MM (0.005") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



18 pin Plastic DIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.10	6.60	0.240	0.260
B	22.22	23.24	0.875	0.915
C	1.02	1.52	0.040	0.060
D	2.54 BSC		0.100 BSC	
E	1.27	1.78	0.050	0.070
F	0.36	0.56	0.014	0.022
G	0.51	1.02	0.020	0.040
H	3.56	4.57	0.140	0.180
J	2.92	3.43	0.115	0.135
K	0°	15°	0°	15°
L	7.62BSC		0.300BSC	
M	0.20	0.38	0.008	0.015

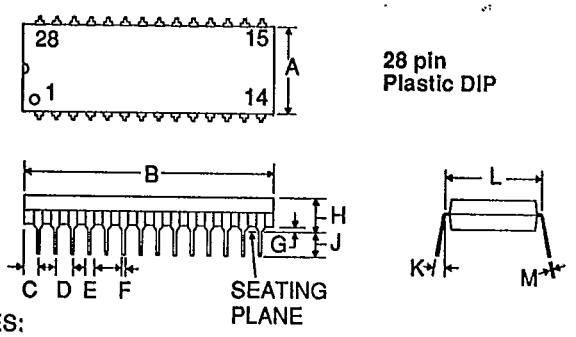
NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



24 pin Plastic DIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	13.72	14.22	0.540	0.560
B	31.37	32.13	1.235	1.265
C	1.65	2.16	0.065	0.085
D	2.54 BSC		0.100 BSC	
E	1.02	1.52	0.040	0.060
F	0.36	0.56	0.014	0.022
G	0.51	1.02	0.020	0.040
H	3.94	5.08	0.155	0.200
J	2.92	3.43	0.115	0.135
K	0°	15°	0°	15°
L	15.24 BSC		0.600 BSC	
M	0.20	0.38	0.008	0.015

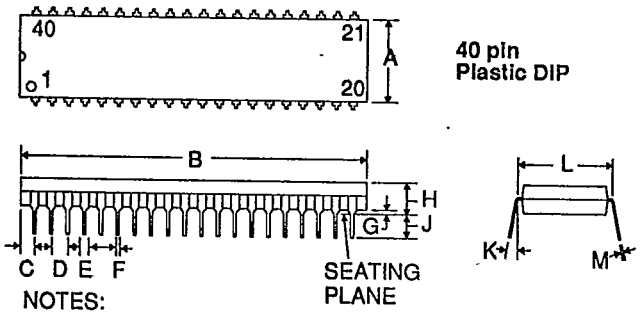
NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



28 pin Plastic DIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	13.72	14.22	0.540	0.560
B	36.45	37.21	1.435	1.465
C	1.65	2.16	0.065	0.085
D	2.54 BSC		0.100 BSC	
E	1.02	1.52	0.040	0.060
F	0.36	0.56	0.014	0.022
G	0.51	1.02	0.020	0.040
H	3.94	5.08	0.155	0.200
J	2.92	3.43	0.115	0.135
K	0°	15°	0°	15°
L	15.24 BSC		0.600 BSC	
M	0.20	0.38	0.008	0.015

NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



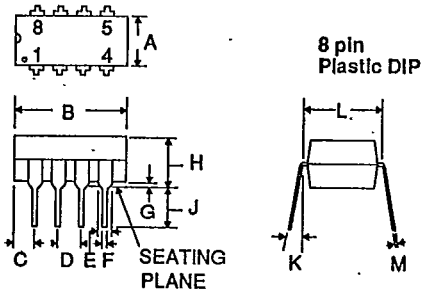
40 pin Plastic DIP

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	13.72	14.22	0.540	0.560
B	51.69	52.45	2.035	2.065
C	1.65	2.16	0.065	0.085
D	2.54 BSC		0.100 BSC	
E	1.02	1.52	0.040	0.060
F	0.36	0.56	0.014	0.022
G	0.51	1.02	0.020	0.040
H	3.94	5.08	0.155	0.200
J	2.92	3.43	0.115	0.135
K	0°	15°	0°	15°
L	15.24 BSC		0.600 BSC	
M	0.20	0.38	0.008	0.015

NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.

12

T-90-20



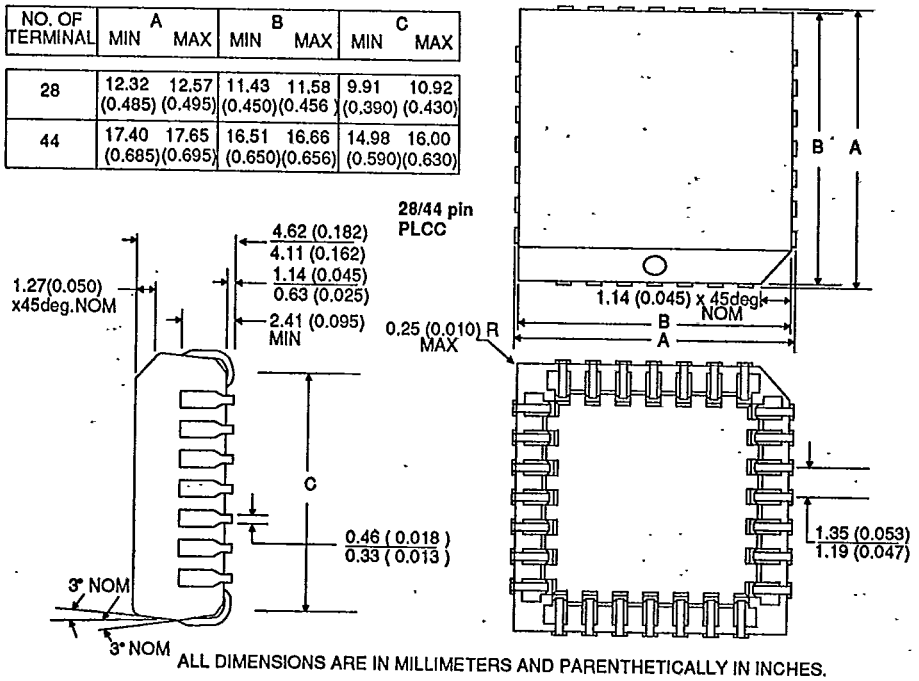
8 pin
Plastic DIP

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	6.10	6.60	0.240	0.260
B	9.14	10.2	0.360	0.400
C	0.38	1.52	0.015	0.060
D	2.54 BSC		0.100 BSC	
E	1.02	1.78	0.040	0.070
F	0.38	0.53	0.015	0.021
G	0.51	1.02	0.020	0.040
H	3.81	5.08	0.150	0.200
J	2.92	3.43	0.115	0.135
K	0°	10°	0°	10°
L	7.62BSC		0.300BSC	
M	0.20	0.38	0.008	0.015

NOTES:
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.13MM (0.005") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.

NO. OF TERMINAL	A MIN	A MAX	B MIN	B MAX	C MIN	C MAX
28	12.32 (0.485)	12.57 (0.495)	11.43 (0.450)	11.58 (0.456)	9.91 (0.390)	10.92 (0.430)
44	17.40 (0.685)	17.65 (0.695)	16.51 (0.650)	16.66 (0.656)	14.98 (0.590)	16.00 (0.630)

28/44 pin
PLCC



ALL DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES.