

T-71-11-07



GigaBit Logic

16G071

## Transimpedance Amplifier 18 dB Gain / 700 MHz Bandwidth

### FEATURES

- High gain > 18 dB
- Broad Bandwidth: DC to 700 MHz typ.
- Low noise: 3 pA/√Hz typ. for 16G071-30L1
- -35.3 dBm input sensitivity for 10<sup>-9</sup> BER (@ 1.2 Gbit/s)
- Low output impedance
- Stable operation
- Four choices of integrated feedback resistance: 1.0, 1.5, 2.0, and 3.0 KΩ

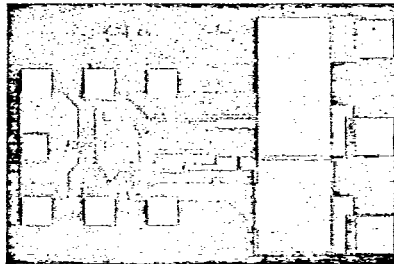
### APPLICATIONS

- Fiber optic systems
- Instrumentation and measurement systems

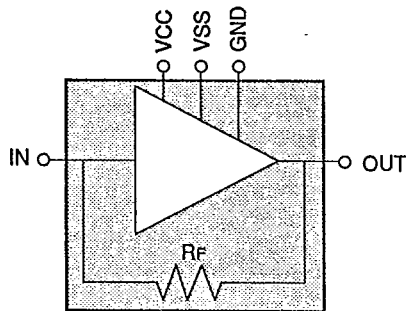
### FUNCTIONAL DESCRIPTION

The 16G071 is a stable GaAs IC transimpedance amplifier capable of 18 dB gain ( $R_s = R_L = 50\Omega$ ) at a 700 MHz -3 dB cutoff frequency. It operates from +5V and -2V supplies and dissipates just 165 mW typical making it ideally suited for high speed fiber optic, instrumentation, and measurement applications. The integrated feedback loop design provides high gain and stable operation. Four choices of integrated feedback resistance are available to match various photodiode load requirements: 1.0, 1.5, 2.0, and 3.0 KΩ.

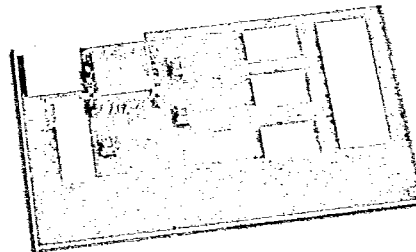
### CHIP PHOTOMICROGRAPH



### CIRCUIT DIAGRAM



### EVALUATION BOARD



### ORDERING INFORMATION

Nominal Feedback Resistance	18 pin leadless chip carrier	Die	Assembled & Tested Evaluation Board
1.0 KΩ	16G071-10L1	16G071-10X	16G071-10L1E
1.5 KΩ	16G071-15L1	16G071-15X	16G071-15L1E
2.0 KΩ	16G071-20L1	16G071-20X	16G071-20L1E
3.0 KΩ	16G071-30L1	16G071-30X	16G071-30L1E

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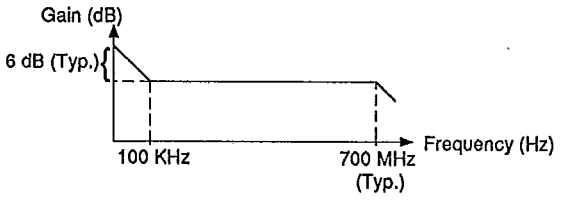
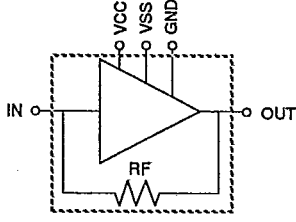
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ABSOLUTE MAXIMUM RATINGS							
SYMBOL	PARAMETER			ABSOLUTE MAXIMUM RATINGS			
I IN	Current into any input; continuous			1 mA			
I OUT	Current from any output; continuous			15 mA			
V IN	Voltage applied to any input; continuous VCC = +5V, VSS = -2V			-2 to +0.6V			
V OUT	Voltage applied to any output			-2 to +0.6V			
VCC	Supply Voltage			0V to +8V			
VSS	Supply Voltage			0V to -4V			
PD	Power Dissipation			1W			
TSTOR	Storage Temperature			-55 to +150°C			
TA	Ambient Operating Temperature			-55 to +120°C			
RECOMMENDED OPERATING CONDITIONS							
PARAMETER	SYMBOL	Min	Nom	Max	UNITS		
Supply Voltage	VCC	+4	+5	+6	V		
	VSS	-4	-2	-1.8	V		
Output Termination Load Resistance	Rload		50		Ω		
Ambient Operating Temperature	TA	0		70	°C		
ELECTRICAL CHARACTERISTICS							
VCC = +4V to +6V, VSS = -4V to -1.8V, TA = 0°C to 70°C							
PARAMETER	SYMBOL	TEST CONDITIONS	PART #	VALUE			UNITS
				Min	Typ	Max	
Supply Current	ICC	I IN = 0	All parts	10	25	40	mA
	ISS	I IN = 0	All parts	-8	-20	-32	mA
Feedback Resistance	RF	DC	16G071-10	0.9	1.0	1.1	KΩ
			16G071-15	1.35	1.5	1.65	KΩ
			16G071-20	1.8	2.0	2.2	KΩ
			16G071-30	2.7	3.0	3.3	KΩ
Gain (f = 10 MHz)  Typical open loop voltage gain is 9.5 (approximately 20 dB)	A	RS = RL = 50Ω	16G071-10	16.5			dB
			16G071-15	17.0			dB
			16G071-20	17.5			dB
			16G071-30	18.0			dB
High Frequency Cut-off (-3dB)	fc			600	700		MHz

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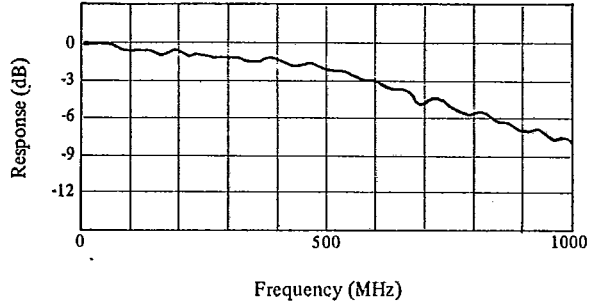


LOW FREQUENCY OPERATION	PIN DESCRIPTIONS
<p>The 16G071 is a DC-coupled amplifier. However, at low frequencies the gain characteristic changes as shown in the following diagram:</p> 	<p>VCC ... +5V supply voltage                  VSS ... -2V supply voltage                  GND ... Ground                  IN ... Input                  OUT ... Output                  RF ... Feedback Resistance</p> 



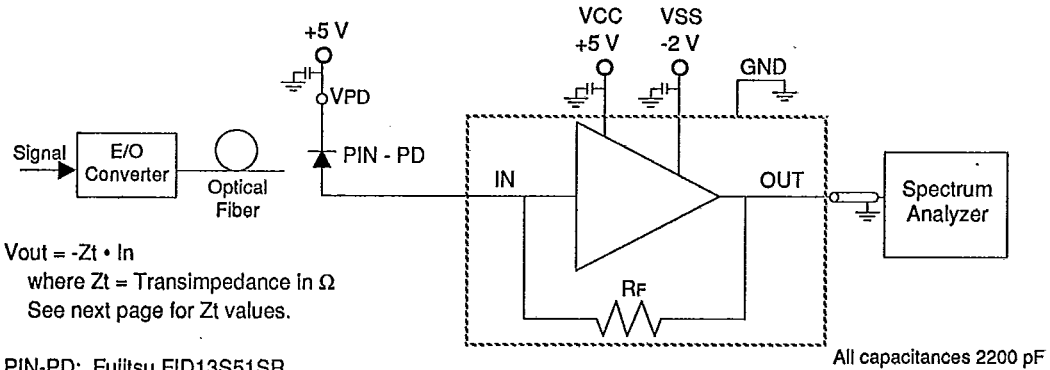
**EXAMPLE OF PIN-AMP SYSTEM MEASUREMENT**

1) Frequency Response



Conditions  
 VCC = +5V  
 VSS = -2V  
 VPD = +5V  
 RF = 900Ω

2) Measurement Block Diagram



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**INPUT NOISE CURRENT DENSITY & TRANSIMPEDANCE (Typical Values)**

Note: Zt is derived from S-Parameters and may change at high frequency because of photodiode capacitance in actual circuit implementation.

16G071-10L1 (Rf = 1 KΩ ± 10%)			16G071-15L1 (Rf = 1.5 KΩ ± 10%)		
Freq. (MHz)	Zt (Ω) (RF transimpedance)	Ini (pA / √Hz) (Equivalent input noise current density)	Freq. (MHz)	Zt (Ω) (RF transimpedance)	Ini (pA / √Hz) (Equivalent input noise current density)
10	829	5.8	10	1246	4.2
20	829	5.8	20	1247	4.1
50	826	5.7	50	1233	4.3
70	822	5.9	70	1239	4.6
100	826	6.3	100	1237	5.0
200	808	7.0	200	1218	5.4
300	812	6.7	300	1215	5.5
400	819	6.1	400	1213	5.2
500	821	5.6	500	1208	4.8
600	829	5.4	600	1194	4.5
700	826	5.2	700	1169	4.5
800	823	5.2	800	1148	4.5
900	835	4.7	900	1151	4.1
1000	834	3.9	1000	1111	3.5

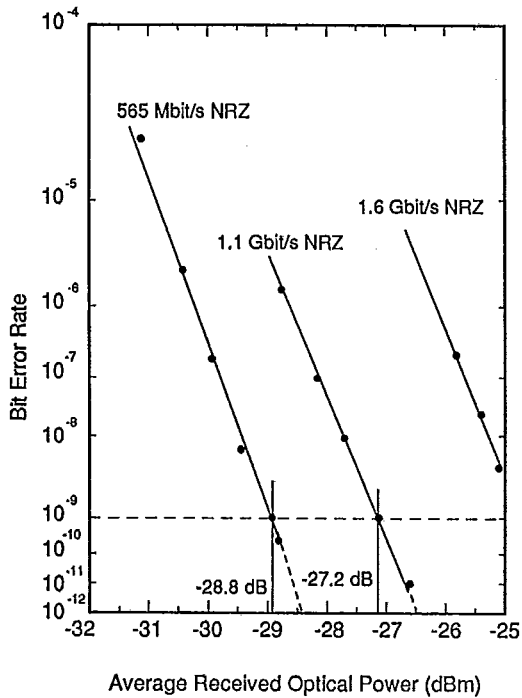
16G071-20L1 (Rf = 2 KΩ ± 10%)			16G071-30L1 (Rf = 3 KΩ ± 10%)		
Freq. (MHz)	Zt (Ω) (RF transimpedance)	Ini (pA / √Hz) (Equivalent input noise current density)	Freq. (MHz)	Zt (Ω) (RF transimpedance)	Ini (pA / √Hz) (Equivalent input noise current density)
10	1527	3.5	10	2342	2.6
20	1530	3.6	20	2394	2.6
50	1534	3.8	50	2375	2.6
70	1522	4.1	70	2381	2.6
100	1494	4.1	100	2269	2.7
200	1476	4.2	200	2227	2.9
300	1433	4.2	300	2084	3.1
400	1392	4.2	400	1969	3.1
500	1389	3.9	500	1967	2.9
600	1323	4.0	600	1777	3.1
700	1260	4.0	700	1675	3.2
800	1244	4.1	800	1687	3.3
900	1181	4.0	900	1519	3.4
1000	1111	3.8	1000	1382	3.3

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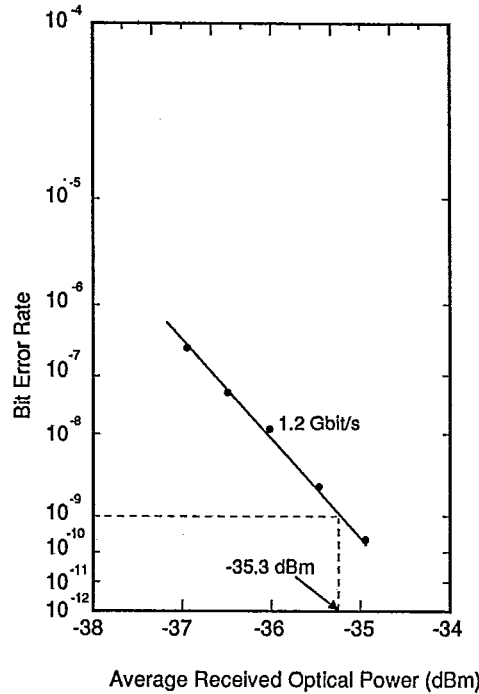
**SENSITIVITY CHARACTERISTICS**

**PIN PHOTODIODE DETECTOR**



- RF = 1 K $\Omega$ ; LCC package
- Fujitsu FID13S51SR photo diode
- 1.3  $\mu$ m wavelength
- $2^{15} - 1$  PRBS; Mark Ratio = 1/2

**APD DETECTOR**



- RF = 1 K $\Omega$ , unpackaged die mounted on ceramic board
- Fujitsu FPD13R31SR APD (M = 8.0)
- 1.3  $\mu$ m wavelength
- $2^{15} - 1$  PRBS; Mark Ratio = 1/2

**PRECAUTIONS**

Because of their small dimensions, the GaAs FETs from which the 16G071 is designed can be damaged or destroyed when subjected to large transient voltages. Such transients can be generated by power supplies when switched on if not properly decoupled. It is also possible to induce spikes from static electricity charged operators or ungrounded equipment. To prevent damage to devices from transient breakdown.

- DC ground all equipment and operators
- Avoid any voltage surges when turning on power supplies

**16G071-10X SENSITIVITY (PIN Photo Diode)**

BER	AVERAGE RECEIVED POWER (dBm)		
	565 Mbit/s	1.1 Gbit/s	1.6 Gbit/s
$10^{-9}$	-28.8	-27.2	-24.9
$10^{-11}$	-28.6	-26.5	-23.9
Overload Point		-3.2	-3.2

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EXAMPLE OF AC CHARACTERISTICS

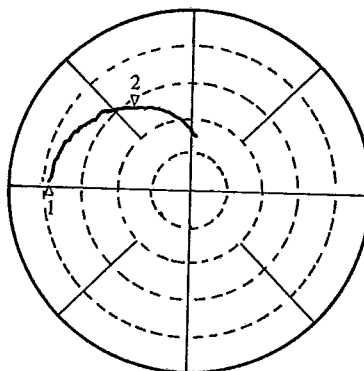
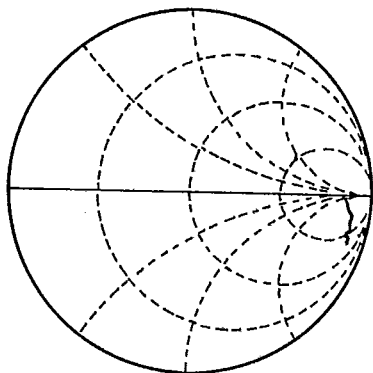
S-Parameters

S<sub>11</sub>

1 Unit Full Scale

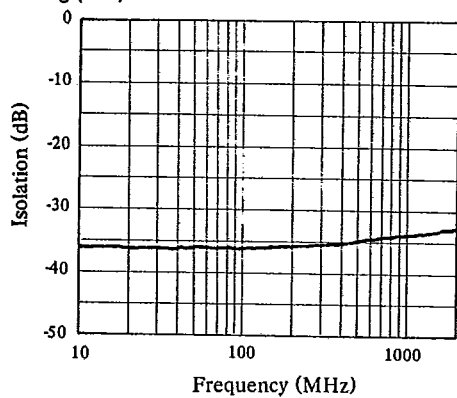
S<sub>21</sub>

10 Units Full Scale



Markers 1: 10 MHz  
2: 850 MHz

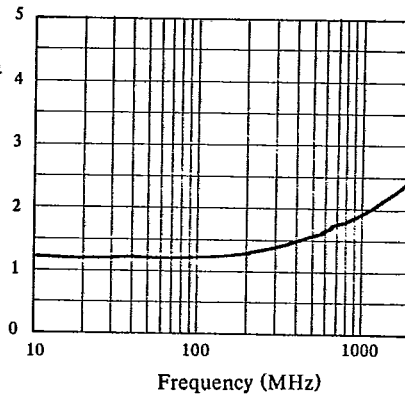
20 Log (S<sub>12</sub>)



S<sub>22</sub>

$$\frac{1+S_{22}}{1-S_{22}}$$

VSWR



Conditions: V<sub>DD</sub> = +5V V<sub>SS</sub> = -2V R<sub>F</sub> = 3kΩ

(Note: these data are measured by on-chip probing)

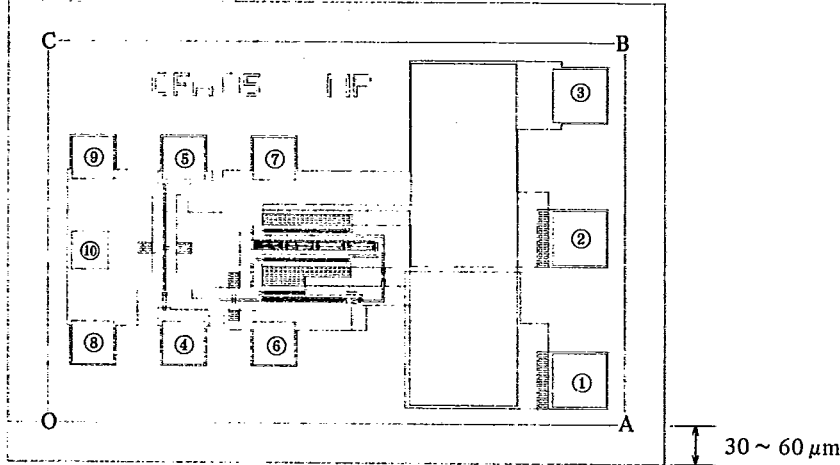
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**DIE PAD ASSIGNMENTS (16G071-NMX)**

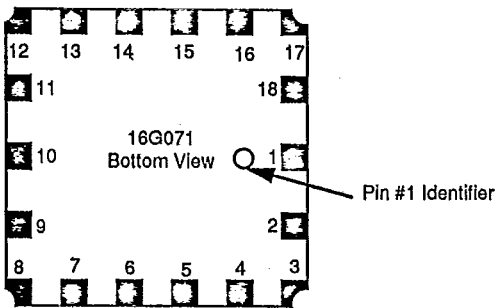


Thickness: 450 μm

The point O designates the origin of the drawing

PAD	PAD SIZE	CENTER POSITION (μm)	PAD	PAD SIZE	CENTER POSITION (μm)
1 ... VCC	95 μm sq.	940, 78	8 ... GND	75 μm sq.	80, 140
2 ... VSS	95 μm sq.	940, 328	9 ... GND	75 μm sq.	80, 464
3 ... GND	95 μm sq.	940, 578	10 ... GND	65 μm sq.	75, 302
4 ... IN	75 μm sq.	240, 140	A		1020, 0
5 ... OUT	75 μm sq.	240, 464	B		1020, 670
6 ... GND	75 μm sq.	400, 140	C		0, 670
7 ... GND	75 μm sq.	400, 464			

**PACKAGE PIN ASSIGNMENTS (BOTTOM VIEW)**



1 ... NC	10 ... NC
2 ... GND	11 ... VCC
3 ... NC	12 ... VCC
4 ... NC	13 ... VCC
5 ... OUT	14 ... NC
6 ... NC	15 ... NC
7 ... IN	16 ... VSS
8 ... NC	17 ... VSS
9 ... NC	18 ... VSS

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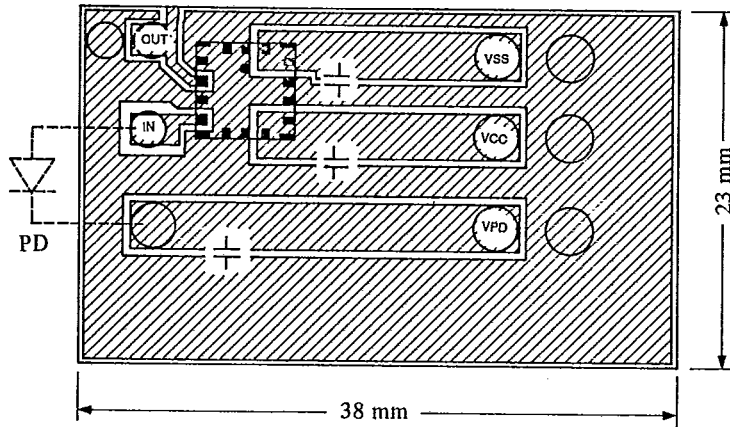


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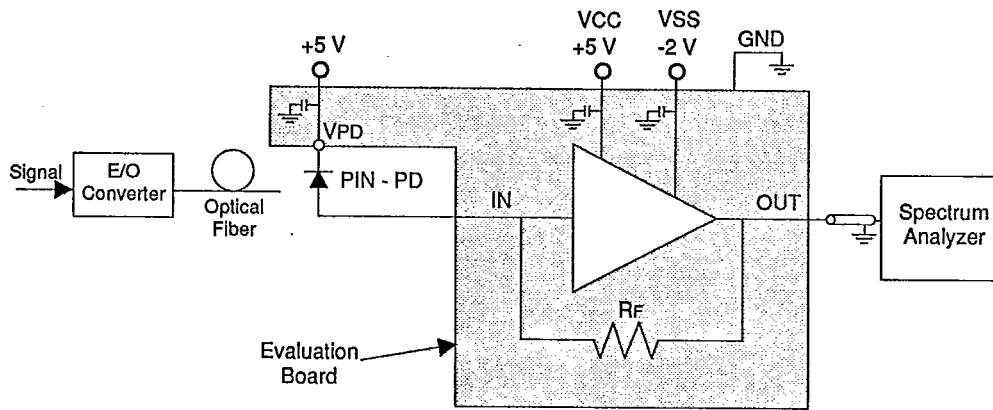
EVALUATION BOARD USER'S GUIDE

1) Board Layout



The open circles indicate the soldering position for coaxial cables and a photodiode (PD)

2) Measurement Block Diagram



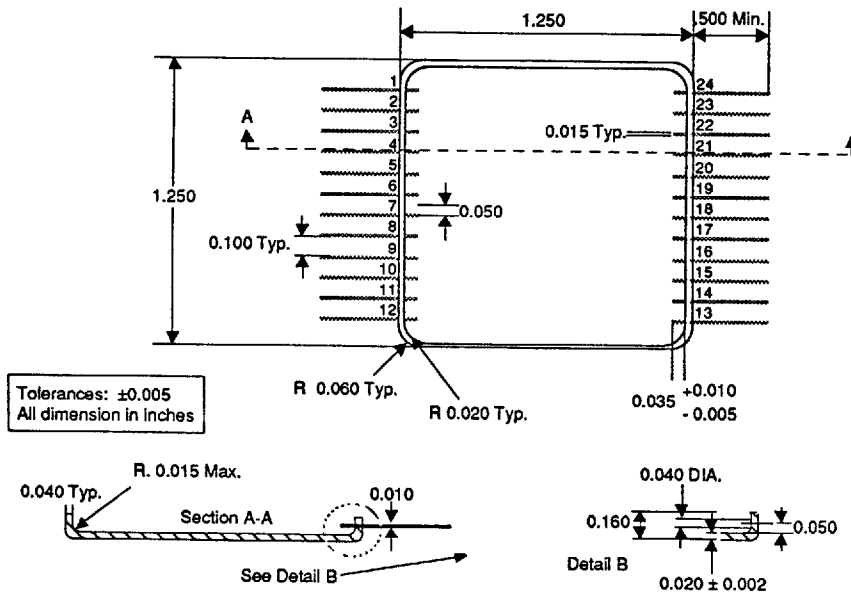
PIN-PD: Fujitsu FID13S51SR

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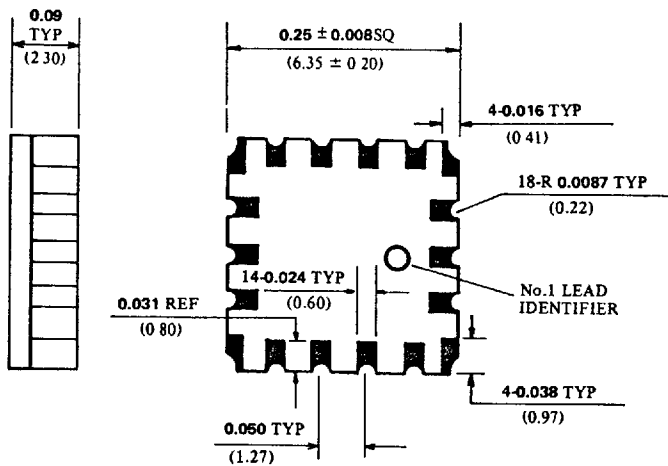


24 PIN METAL FLATPACK  
18 PIN PACKAGE

24 PIN METAL FLATPACK  
Type H



18 PIN LEADLESS CHIP CARRIER  
TYPE L1



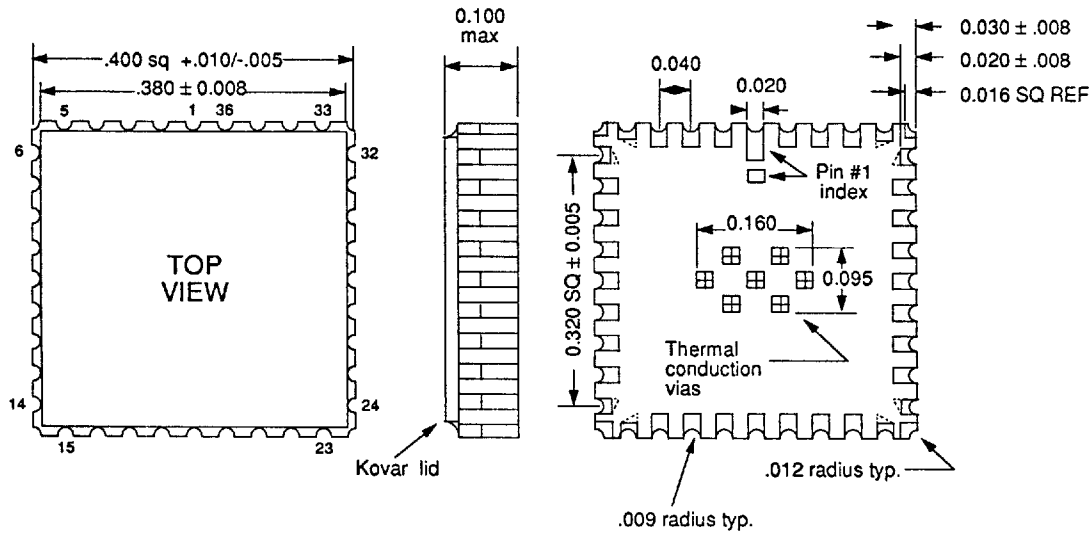
All dimensions shown in inches and (millimeters)

T-90-20



36 PIN PACKAGES

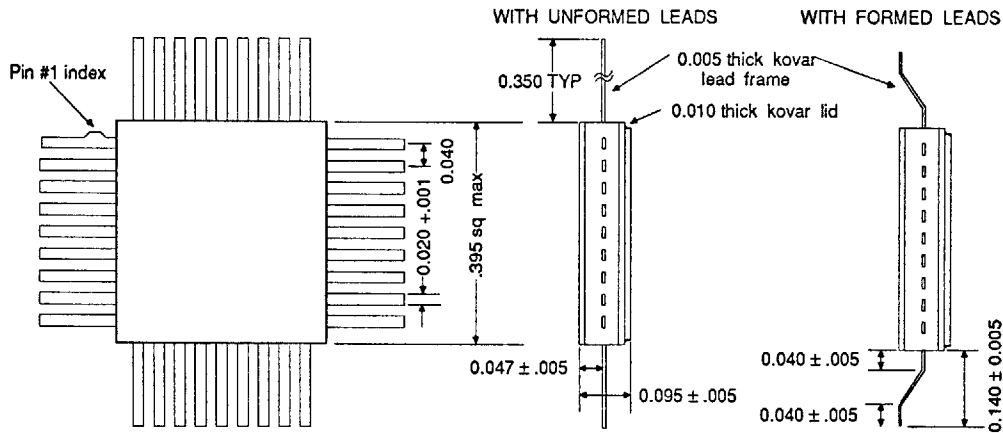
36 PIN LEADLESS CHIP CARRIER  
TYPE L36



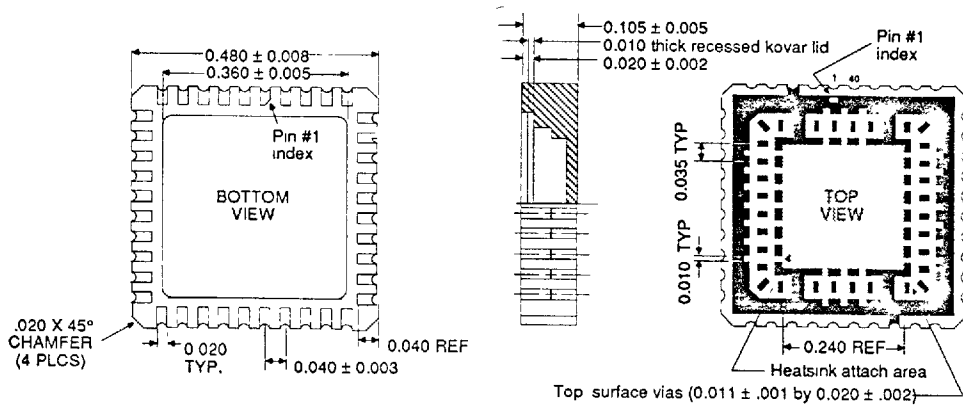
NOTES:

- 1) The package bottom thermal vias, top lid surface and 4 metallized corner castellations (when present) are all at Vss potential.
- 2) All dimensions in inches.
- 3) Pin #1 identifier may be an elongated pad or small, square gray marker.

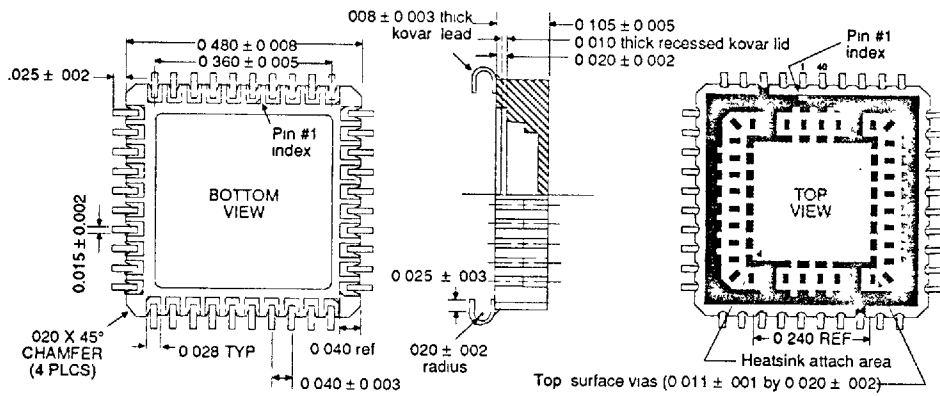
36 I/O LEAD FLATPACK  
TYPE F



**40 PIN LEADLESS CHIP CARRIER  
TYPE L**



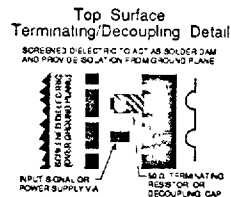
**40 PIN LEADED CHIP CARRIER  
TYPE C**



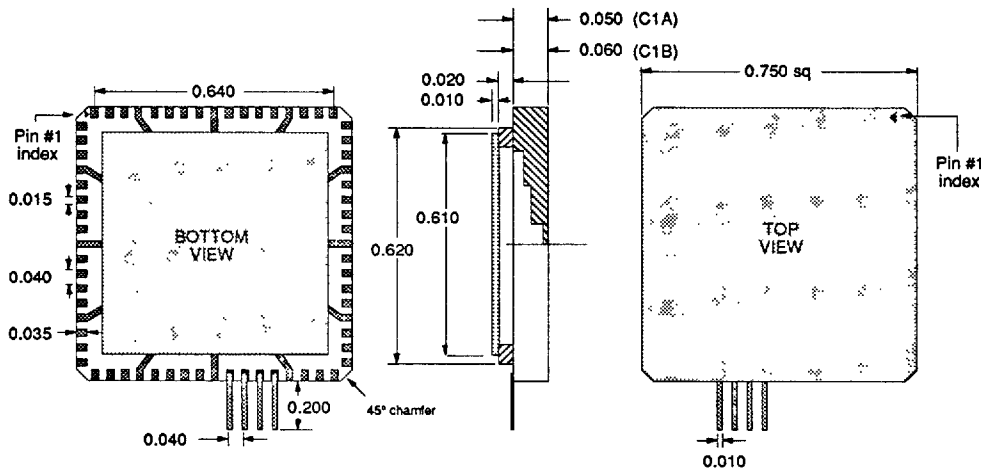
**NOTES**

- (1) Footprint is JEDEC standard outline
- (2) Top surface vias (for terminating resistors and decoupling capacitors) are not available on pins 3, 4, 17, 18, 23, 24, 37, and 38
- (3) Top surface metal (not including vias) and pins 3 and 23 are used at VTT potential
- (4) Recommended top surface chip resistors are 0.040 long by 0.020 wide by 0.010 thick typ. 100 mw min. nominal power rating (Mini-Systems MSR 21 or equivalent)
- (5) Recommended top surface chip capacitors are 0.040 long by 0.030 wide by 0.020 thick typ. 25V VCCW 1000 of min. (Johnson R09 caps or equivalent)
- (6) Recommended heat-sinks are GBL P/Ns 90GHS 40 A and 90GHS 40 B
- (7) Thermally conductive, electrically non-conductive epoxy is recommended for heatsink attachment (Ablestick 789 4 or 561K, or Thermalloy Therabond™ or equivalent)
- (8) L40 and C40 packages are dimensionally identical except for contact finger width

TOP SURFACE LEGEND	
Metalized Ceramic	
Screened Dielectric	
Bare Ceramic	

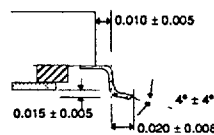


**68 PIN LEADED CHIP CARRIER  
TYPE C1**



1. All dimensions in inches.
2. C1A PACKAGE: Package lid, top, and pins 4, 9, 14, 21, 26, 31, 38, 43, 48, 55, 60, 65 are at common potential (system ground).
3. C1B PACKAGE: Package lid and pins 4, 9, 14, 21, 26, 31, 38, 43, 48, 55, 60, 65 are at common potential (system ground).
4. Tolerance on all dimensions is  $\pm 1\%$  but not larger than  $\pm 0.005$ . Tolerance on 0.640 end pad to end pad dimension is  $\pm 0.003$ .

**GULLWING LEADS**



**132 PIN LEADED CHIP CARRIER  
TYPE C3**

